Proposal on a sustainable strategy to avoir point source pollution of water with plant protection products

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PROPOSAL ON A SUSTAINABLE STRATEGY TO AVOID POINT SOURCE POLLUTION OF WATER WITH PLANT PROTECTION PRODUCTS

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Cemagref and TOPPS –partners
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* TOPPS is a 3-year, multi-stakeholder project covering 15 European Countries - it stands for Training the Operators to prevent Pollution from Point Sources which began 1st November 2005, and ends 30th October 2008. TOPPS is funded under the European Commission's Life program and by ECPA, the European Crop Protection Association. TOPPS is aimed at identifying Best Management Practices and disseminating them through advice, training and demonstrations at a larger co-ordinated scale in Europe with the intention of reducing losses of plant protection products to water.

CONTENT

PROPOSAL ON A SUSTAINABLE STRATEGY TO AVOID POINT SOURCE POLLUTION OF WATER WITH PLANT PROTECTION PRODUCTS (PPPs)

0 EXECUTIVE SUMMARY AND CONCLUSION

This proposal is based on results and lessons learned from the TOPPS project.

Aim of this proposal is to suggest a strategy, considering the difference between countries, which can be implemented on Member state level in order to avoid PPPs pollution of water through point sources.

Two main entry routes of PPPs into water can be distinguished:

a) Point sources: this mainly concerns aspects of the handling of PPPs before and after the spraying operation.
b) Diffuse sources: this concerns aspect related to the application in the field influenced to a large degree by the weather.

Some studies have shown that the point source pollution could be the main entry source of PPPs (>50%) into water.

TOPPS developed common Best Management Practices (BMPs) in a multistakeholder approach, benefiting from various expertise already existing in the countries. (BMPs are published in 12 languages and can be downloaded from the website www. TOPPS-life.org

0.1. A sustainable strategy is based on common BMPs and the necessary efficient BMPs implementation structures and tools

0.1.1 BMPs.(What to do and how to do it)

The BMPs address three strategic perspectives: correct behaviour, improved infrastructures and equipment (risk mitigation enablers). These perspectives were applied to the working processes (from start to end –Figure 1).

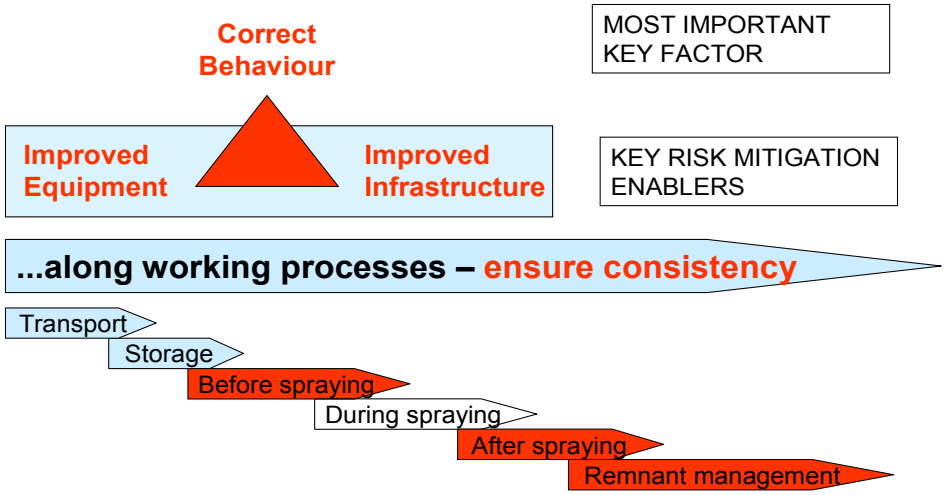


Figure 1 : Correct behaviour, improved infrastructures and equipment applied to the processes

0.1.2 BMPs implementation structures and tools

BMPs implementation also needs to address three key strategic perspectives. These consist of:

- a defined process to develop and update the BMPs
- the transfer of the BMPs to the advisers in the field
- the implementation measures and tools to reach the operators

Implementation is mainly a question of the creation of awareness and to support behaviour change. The risk mitigation enablers (equipment/infrastructure) are relatively easy to implement, because it is more related to the level of support given or to the regulatory measures. Technical and infrastructure requirements are easy to control (e.g. sprayer testing). Control processes for correct behaviour would be difficult and expensive to establish. The identified risky processes are more related to behaviour than to infrastructure and equipment (Figure 2)

People do not behave on the level of rational facts but on perceptions.

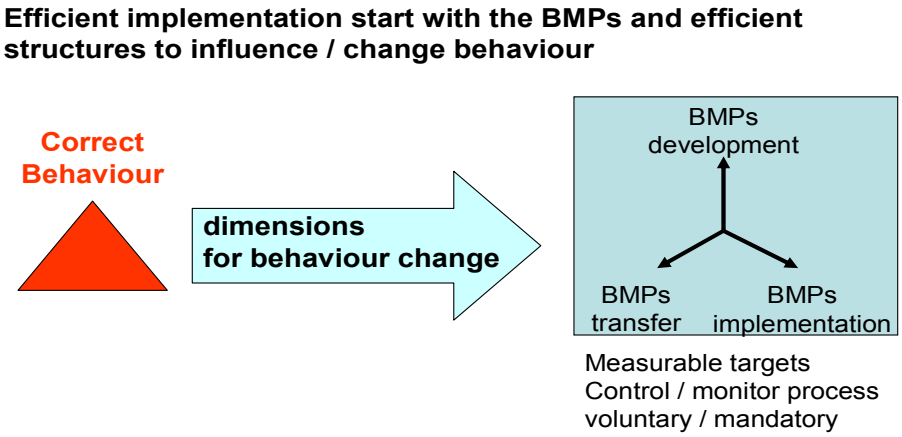


Figure 2: Strategic perspectives for the implementation of a sustainable strategy

0.2 Methodology for the Up- Scaling proposal

0.2.1 Analysis of current situation

Concerning stakeholders, awareness and significance of the point source problem as well as opinions on the best implementation measures were analysed based on a survey (n=600).

The operator's awareness, opinions and current practices were investigated by two telephone surveys in 6 pilot catchment areas at the beginning 2007 and June 2008. Additionally the status on equipment and infrastructure was evaluated by audits on farm. Results achieved are representative for the catchments not for a specific country. It represents some of the puzzle pieces of a bigger picture. It shows the diversity one needs to consider if implementation measures are being discussed on member state level. Structural elements of the catchment areas are described and can be extrapolated considering comparable structures to make estimates for a wider geography.

0.2.2 Gap analysis

The gaps between the current situation and the BMPs were defined. In this document focus is given to the key risk areas for point source pollution, which is the filling, cleaning and the management of contaminated liquids (remnant management)

0.2.3 Consistency analysis

BMPs are generally used as a tool to help implementation and behaviour changes. The consistency of currently given recommendations were compared with the BMPs developed in TOPPS.

0.2.4 Organisational structures for implementation

The implementation structures in the pilot catchments areas were described by the TOPPS partners. Descriptions are based more on qualitative rather than on a quantitative level. Case studies from DK, DE and FR show examples of how implementation was performed and what lessons could be gained.

0.3 Up-Scaling proposal

0.3.1 Implementation structures to support correct behaviour

a). BMPs development and update

Clear development structures where BMPs are developed in a multi stakeholder approach are identified only in few countries. (i.e.; UK, FR). BMPs available are often very general and describe "what to do" but not sufficiently "how to do things". This is often not specific enough especially when we consider the complexity of PPP and water protection.

As the CAP is setting the frame for the farmers in the European community, it would be consistent to develop common Best Management Practices as a core for all member states, especially as the BMPs are mentioned as part of the regulatory frame of the PPP use.

Depending on the member state policy the implementation of BMPs may need to follow different timelines taking into account the existing country diversities. Result of disseminating common BMPs will be consistent messages given to the operators and the credibility of recommendations would increase.

Currently it is not clear how the BMPs are disseminated in the member states into the advisory and education system. TOPPS did not identified established special BMPs training schemes for advisers and school teachers.

Proposal:

- The development and update of BMPs requires an organisational structure, which includes stakeholders and the clear understanding of respective responsibilities for the development process, implementation and dissemination.
- Core BMPs should be developed at member state level and tailored according to the sensitivities in catchments (consistent messages results in improved credibility)
- BMPs development should adopt a process view. (from the transport of PPP to the remnant management)
- TOPPS-BMPs development to prevent point sources was successfully performed as a project at European level and may serve as example for other common BMPs developments .
- Developed BMPs should be diddeminated based on using a clear communication plan. This should offer accessible print materials, education materials and training courses.
- Developed BMPs should be disseminated to all advisers and other relevant professionals.
- Feedback mechanisms should be established in order to understand how BMPs work and to make them better in an updating process.
- BMPs should be updated at regular intervals or based on defined criteria because as new technologies and methods are developed.

b). BMPs transfer

Advisers need to be considered a key success factor for BMPs implementation (see case study DK). The advice structures existing in the countries are very different. This can take the form of public advisory services, semi public services (farmer unions) and private advice mainly through retail and distribution networks.

Public advice when it exists is the main instrument for the BMPs transfer. For the implementation of BMPs it is necessary to utilize the complete advice potential in an area. This includes all advisers from public services to the private companies. The objective must be to reach as many operators as possible. Estimates from catchments partners indicate that current advice structures may reach and disseminate the BMPs to between to 25 - 60% of the farmers.

We have not found specific training courses offered to advisers (e.g. on PPP and water protection). In the UK all advisers are obliged to show that they update their knowledge regularly on different aspects of PPP. Their training activity is documented and part of an certification process, which is required for every adviser (BASIS scheme). In most other countries advisers need to attend training courses once to be enabled to give advice to operators. TOPPS could not investigate in detail all the aspects of the adviser training and the content delivered but the question need to be raised: Who trains the advisers on BMPs, who has been trained and how is the knowledge updated?

Advice on BMPs is mostly unrelated to short term economic aspects of farming and may not receive the same level of interest from operators and advisers. Therefore incentive schemes for advisers should be considered (see case study Bretagne).

Proposal:

- Distribution of local agreed BMPs documents to all advisers.
- Deliver training courses to advisers to enable them to disseminate the BMPs to operators (Modules).
- Advisers should be trained on BMPs and the participation should be documented (voluntary vs. mandatory).
- Consider certification schemes for advisers (see UK "BASIS" scheme).
- Create a market for BMPs advice (see case study Bretagne).
- Incentives schemes for advisers attending trainings and giving BMPs advice should be developed.
- Methodes for most effective advice should be studied.

c) BMPs implementation

Basically the implementation can be organised in a voluntary or as a mandatory concept. In the surveys carried out we can see that operators and stakeholders in countries have different attitudes (probably culturally determined) towards such approaches. Case studies on BMPs implementation suggest that information and advice approaches alone are not sufficient for a broad implementation. Either incentives to support changes are necessary or regulations need to enforce implementation.

Compliance with BMPs should be monitored. Those related to the equipment or the infrastructures are the easiest to be implemented. Monitoring / checking the correct behaviour (e.g. on the correct cleaning of a sprayer) is very difficult to carry out and unlikely to be cost effective. Changing behaviour needs repeated information, training and research based explanations. Trainings should be structured and offered in modules with transparent and consistent content (e.g. Training on water protection). Participation of operators in trainings events should be monitored and actively managed to ensure that all operators are trained. Point source reduction is a relevant topic for every operator. BMPs advice today is mainly given in farmer meetings, where among other topics only general information may be transferred on BMPs.

Currently there appears to be no clear targets set for the advisers and for the operators or at least any targets are not clearly communicated.

Quality of advice as mentioned in the stakeholder survey is the most important aspect for BMPs implementation, but currently this is not measured in the pilot catchments. The efficiency of the advice according to information from the UK is measure there by farmer surveys.

Audits carried out with an adviser in partnership with the operator could be a good tool to refer to the situation of a specific farm. The audit would provide training and advice at the same time and sets a standard for the contents discussed. Repeated audits can provide the basis to measure progress.

Proposal:

- Specific BMPs operator trainings should be offered.
- Training offers should address the different needs of the operators (e.g.; special course or an audit, mistblowers, fieldsprayers etc.).
- Participation of operators in courses or audits should be documented and a certificate should be delivered to the operator.
- Implementation targets for a catchment area should be established. These should be communicated among stakeholders including the measures and the monitoring process.
- Advice quality should be evaluated.
- Concepts to attract the interest of operators for trainings or audits (incentives) should be developed.

0.3.2 Improved equipment

The current regulatory framework is focussed on the Plant Protection Product (PPP - active ingredient and formulated product). Regulation for the mitigation techniques on spray equipment is weak, which results in big variations in the equipment attached to sprayers. Efficient risk mitigation needs to focus not only on the PPP, but also needs to take the application into account.

Today standards (ISO and / or EN) define requirements for PPP application technique. These standards serve as a recommendation but are not legally enforced. If risk mitigation equipment were regulated, established and new sprayer testing schemes in countries could organise a control process and new organisational structures would not be required. Technical improvements of equipment just by the replacement of old sprayers will take about 7 to 13 years (average age of sprayers). Additional upgrading of old sprayers could have a faster effect, but this could be only achieved if attractive incentives are offered.

Proposal:

- Lack of regulation for mitigation equipment on sprayers does not realize full risk mitigation potential. Technical improvements to mitigate risk of point source pollution can be significant. Potential point source reduction potential is estimated at 35 to 50%.
- We propose that some key technical mitigation measures are made mandatory at least for new sprayers. Sprayers should only be sold on the market with: Lowest possible residual volumes (current standard should be more demanding), rinse water tank, internal and external cleaning devices, induction bowls and better measuring techniques for filling spray tanks.
- Upgrading of equipment is proposed according to BMPs. Implementation examples suggest that clear regulation for sprayers should be set for manufacturers (new sprayers) and incentives given to farmers would accelerate the improvement of older sprayers with mitigation equipment.

0.3.3 Improved infrastructure

Key risk processes for point source pollution are the sprayer's filling and cleaning executed on farm. If farmers do not use the alternative of filling and cleaning the sprayers in the field additional precautionary measures are necessary (Collection of spills and washing water). This includes measures to correctly manage and store empty packages. Collection services are established in many countries but the efficiency in some countries could be improved. Guidelines should be given on how contaminated liquids (Remnant management) need to be decontaminated (Bio-purification systems). Areas like transport and storage have already received regulatory attention in most countries. These areas are important but we estimate that their significance for point sources is more related to accidents.

Proposal:

- Detailed and consistent advice should be given to farmers on possible options for the filling, cleaning and remnant management and on the consequences for the farm's infrastructure.
- Farm audits are recommended to reach all farmers and to provide at the same time training and a report on suggested infrastructure improvements. The audits should be repeated to monitor the progress.
- Empty container management schemes need to be established and optimized.
- Infrastructures should comply with BMPs and implementation needs targets adapted to specific country / catchment.
- Audit reports could be used as a basis to grant incentives for improvements.

1. INTRODUCTION

1.1.1 Environmental challenges

In recent years there has been increasing attention paid to the fate of pesticides in the environment and their impact on both ground and surface water quality. Much research has been done in this area and the adoption of the Water Framework Directive in 2000 has brought the issue into sharper focus than ever before.

In particular, the new water quality monitoring requirements introduced by the Water Framework Directive and the gathering of existing monitoring data from the EU Member States and other data-holders such as the water industry, have identified findings of pesticides in water bodies across the EU. Ensuring good drinking water quality and that there is no unacceptable effects on the aquatic environment are the fundamental issues of concern.

Pesticides are already subject to rigorous testing and evaluation, including potential effects to the aquatic environment, before authorisation for use in the EU can be granted. This traditional regulatory approach is essentially aimed at ensuring that products can be used safely, and at encouraging the development of new and improved products.

However, it is becoming increasingly clear that in order to comply with the stringent water quality objectives defined in the Water Framework Directive, the traditional product-based approach must be complemented by the recognition of the fact that the way that products are used in real life on the farm is also absolutely critical.

The TOPPS project has identified, demonstrated and disseminated information and techniques regarding how the real life use of pesticides on the farm can be improved to avoid point source losses to water. Up-scaling of these concepts and activities to an EU scale will be a critical element to help ensure that the EU's water is of high quality, and complies with the objectives established in the Water Framework Directive.

1.1.2 TOPPS goals

TOPPS project (Train Operators to Prevent Pollution from Point Sources) has the following four main Goals:

- The development of EU wide accepted baseline on Best Management Practices (BMPs) for dedicated stewardship and risk mitigation of PPP pollution of water from point sources in a multi-stakeholder approach.
- The development of training and information materials for farmers and advisers based on defined BMPs.
- The Dissemination of BMPs through information, training, demonstrations and publications.
- The Proposal of a sustainable approach to avoid point sources through an up-scaling process.

TOPPS project started in November 2005 and is funded until October 2008; 12 partners and 9 subcontractors are working for the project in 15 EU member states. It is supported by the European Community through their financial instrument Life and the ECPA the European Crop Protection Association (Figure3)

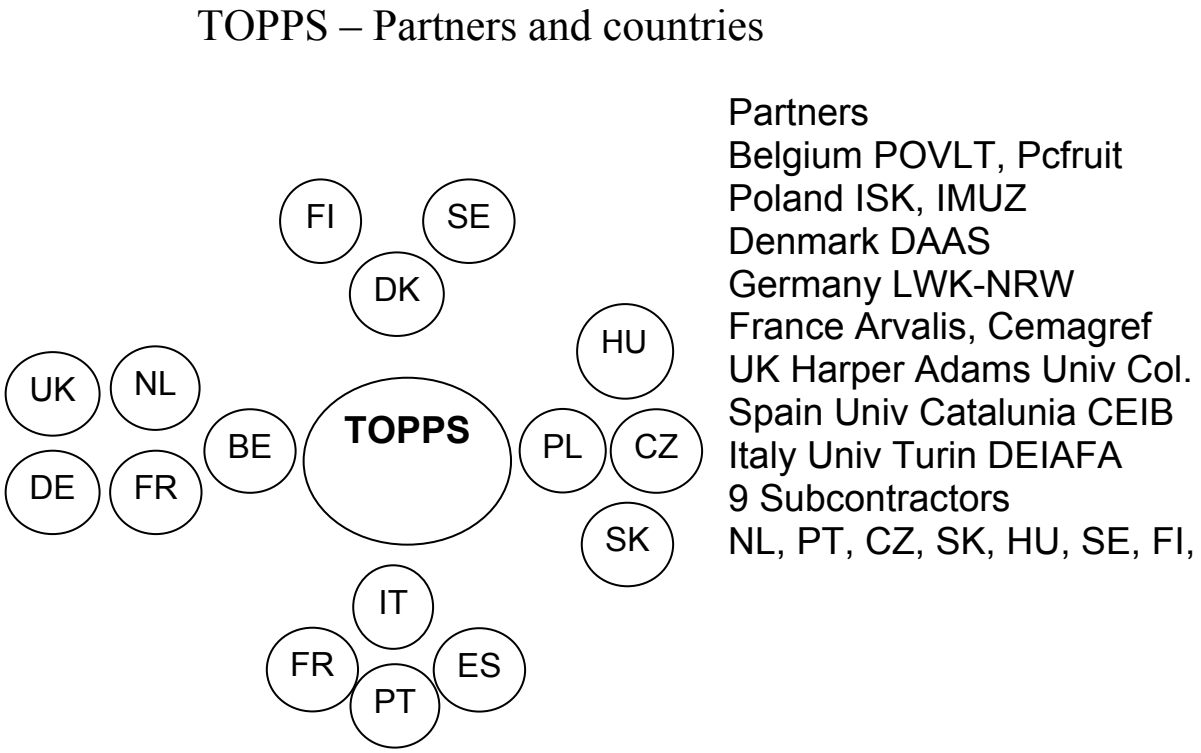


Figure 3 TOPPS – Partners and countries

Crop protection associations in various countries gave supports to ensure local involvement of stakeholders. In the pilot catchments in France and Italy local advisory services were contracted to support TOPPS implementation.
France: Chambre Agriculture Nord pas de Calais, Fredon, Lille, Vaeskens and LaFlandre (privat PPP distributors)
Italy : Coldiretti, Cuneo and Agriimpressa, Cuneo

1.1.3 TOPPS point sources definition and significance

The point sources pollution mainly relates the handling aspects of PPPs (filling, cleaning, remnants management) while the diffuse pollution sources are more related to the application of PPPs often resulting from natural environmental factors (runoff, drift etc). Few studies are available on the subject, where point and diffuse sources are clearly separated (DE, BE, UK). It is estimated in the studies that point sources contribute > 50% to the PPP pollution of surface water (Bach et al, 2000, 2005; Franck et al, 1982; Muller et al, 2002; Leu et al, 2004; Aubertot et al, 2005).

1.1.4 TOPPS regulatory background and the fit with the EU legislative framework (Stuart Rutherford ECPA)

The aims and objectives of the TOPPS project fit closely with a wide variety of EU environmental legislation and programmes. These EU measures are intended to set the framework for future actions at the EU level (Figure 4).

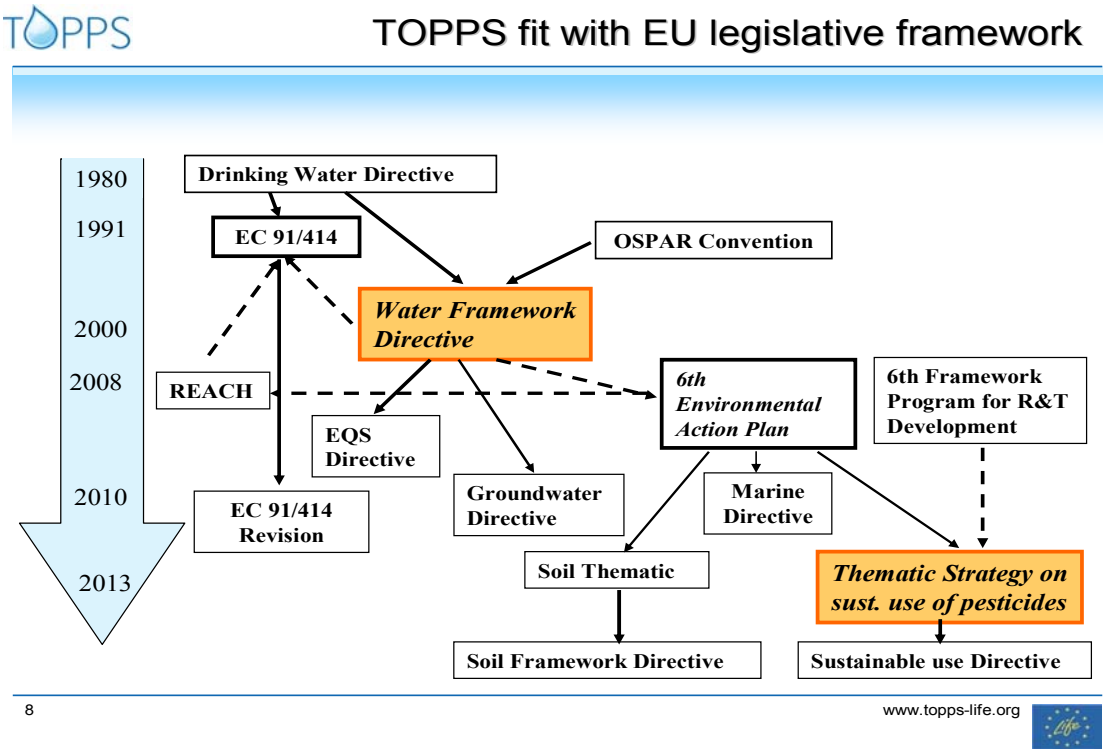


Figure 4: The EU legislative framework

However, there are two specific areas with which TOPPS is most closely associated:

- The Water Framework Directive
- The Thematic Strategy on Sustainable Use of Pesticides, and the related envisaged Directive on the Sustainable Use of Pesticides

Below is a short summary of the key links between the objectives of TOPPS, and the objectives of the main EU measures which are in place and which are of direct relevance for the TOPPS project.

The Water Framework Directive - WFD (Directive 2000/60/EC, OJ L327 22.12.2000)
The WFD seeks to establish a "framework" which draws together all EU water legislation (surface water, groundwater, coastal waters), and introduces the concept of managing all water issues according to "River Basin Management Plans" (RBMPs). The objective, *inter alia*, is the achievement of "good status" in all waters by 31/12/15.

Key aspects of the WFD include:

- Article 4 establishing the environmental objectives
- Article 7 on waters used for the abstraction of drinking water
- Article 11 on the "Programme of Measures" (PoMs) which Member States are required to establish for each river basin district
- Article 13 on the "River Basin Management Plans" (RBMPs) which will provide the framework for actions at Member State level
- Article 16 on strategies against pollution of water by "priority substances" identified at the EU level, and compliance with related Environmental Quality Standards (EQSs) – *see Proposal/ Directive....2008/(when available)*
- Article 17 on strategies to prevent and control pollution of groundwater

TOPPS seeks to identify and disseminate simple and practical measures which can be taken at the farm level to greatly reduce or completely eliminate so-called "point source" losses of pesticides to water, thereby contributing to improved water quality. In this way, TOPPS will contribute to the achievement of the medium/ long term objectives of the WFD.

The WFD Common Implementation Strategy (WFD-CIS)

Of note is the fact that the WFD and its related legislation establishes the objectives to be obtained, but that it contains little or no information regarding how this is to be done in practice. Due to the challenging and complex nature of the legislation, a specific strategy has been put in place by the Commission to facilitate implementation by the Member States, known as the WFD "Common Implementation Strategy" (WFD-CIS). Web address:**http://circa.europa.eu/Public/irc/env/wfd/home**

The WFD-CIS consists of a series of Working Groups and consultative bodies, comprising representatives from the Commission and its related bodies, stakeholders, and Member State representatives. The WFD-CIS seeks to establish common understanding and interpretation of the legislation, and also to provide practical guidance to assist Member State authorities and any other entities involved with the implementation of the WFD – i.e. it seeks to provide some of the answers as to "how" to implement the WFD, primarily in the form of non-legally binding guidance documents.

Of particular relevance for the TOPPS project is the Strategic Steering Group on WFD and Agriculture (SSG WFD & Agri) which has been established as part of the WFD-CIS. The SSG WFD & Agri is tasked with establishing how best to meet the considerable challenges posed by the need to achieve the stringent objectives and timetable set by the WFD, while at the same time ensuring that the needs of agriculture are met.

Two initiatives launched in the SSG WFD & Agri are especially relevant for the TOPPS project:

- The establishment of a "catalogue of measures" which Member States may, *inter alia*, use as a basis for the agriculture related elements of their river basin "Programmes of Measures" as required by the WFD. The TOPPS Best Management Practices (BMPs) form a very useful input for those aspects of the catalogue of measures dealing with reducing pesticide losses to water.
- There is an ongoing effort to identify how CAP and Rural Development Regulation (RDR) funds could be made available to support the implementation of measures relevant to the achievement of the agriculture related objectives of the WFD.

The TOPPS project has been presented at SSG WFD & Agri meetings, and the TOPPS BMPs have been provided as source material.

The Drinking Water Directive (Directive 98/83/EC, OJ L330 5.12.98)

The original drinking water directive 80/778/EEC was for the most part repealed and replaced from end-2003 by Directive 98/83/EC on the quality of water intended for human consumption. This legislation governs the quality of water "at the tap" in the consumer's home.

There is a link between 98/83/EC and Article 7 of the WFD as noted above, in that WFD Art 7.3 requires that Member States shall ensure the necessary protection for raw bodies of water used for the abstraction of drinking water with the aim, *inter alia*, ... "to reduce the level of purification treatment required in the production of drinking water".

With its aim of improving water quality, TOPPS will contribute to the objective of reducing required purification treatment.

The Groundwater Directive (Directive 2006/118/EC, OJ L372 27.12.06)

Directive 2006/118/EC on the protection of groundwater against pollution and deterioration significantly amended the prior groundwater Directive 80/68 EC (OJ L 20 26.1.80) in order to integrate its requirements into the WFD management scheme. As noted above, Directive 2006/118/EC was put forward in accordance with WFD Art 17.

It should be noted that TOPPS is primarily aimed at reducing losses of pesticides from point sources into surface water (due to the fact that by their nature most point source losses, e.g. overspray, washing down drains, spillage etc. go into surface water). However, the general good practices which TOPPS seeks to promote will also contribute to the objective of protecting groundwater (e.g. through avoiding over-spraying wells, and by better remnant management). Furthermore, due to the possible movement of water across the Groundwater/Surface water interface, by either natural or human activities, actions aimed at Surface water can benefit Groundwater and vice versa.

The Thematic Strategy on the Sustainable Use of Pesticides –TS (COM(2006) 372 final, Commission proposal for a Directive COM(2006) 373 final)
The TS and its associated envisaged Directive seek to achieve more sustainable use of pesticides as well as a significant reduction in risks, consistent with the necessary level of protection against pests. It is focussed on the use phase of plant protection products.
The major part of the measures contained in the Thematic Strategy should be integrated as far as possible into existing instruments and policies. Those measures, that were deemed necessary, but could not be integrated into existing legislation is intended to be covered by an envisaged future framework directive.

The key aspects of the TS/ future Directive are:

- National Action Plans (NAPs) to reduce risks and dependence on pesticides which Member States are required to establish. Stakeholders will be involved in the establishment and implementation of NAPs (envisaged in article 4 of proposal for a framework Directive)
- Creation of appropriate trainings and certificate systems for professional users, distributors and advisers (envisaged in article 5)
- Regular and compulsory inspection of application equipment (envisaged in article 8)
- Specific measures to enhance protection of the aquatic environment: notably creation of buffer zones where there can be no application or storage (envisaged in article 10)
- Reduction of pesticides in sensitive areas, such as special conservation areas. (envisaged in article 11)
- Handling and storage of packaging and remnants of pesticides (envisaged in article 12)
- Article 13 on the promotion by Member States of Integrated Pest Management (IPM) schemes (envisaged in article 13)

There is a clear link between the practical measures related to training and education regarding the sustainable use of pesticides which the TS seeks to promote at Member State level, and the agriculture-related elements of the WFD Programmes of Measures that the Member States are obliged to prepare.

The TOPPS project has delivered information and demonstration tools aimed at increasing awareness of the need to protect water, and provides for suitable training tools and best management practices that can be implemented in practice (by farmers) at a European scale. The exercise of establishing,

promoting, and disseminating the TOPPS point-source related Best Management Practices has already begun under the TOPPS project within the bounds of what was possible given the project's resources.

It remains an open question to what extent the new opportunities presented by the implementation phase of the TS/ envisaged framework Directive, and the WFD can be exploited in terms of:

- Integrating TOPPS messaging and BMPs into Member State WFD Programmes of Measures, and TS education, initial training and additional training programmes
- Finding new resources, both human and financial, to push forward appropriate demonstration, education and training programmes

Directive on placing plant protection products on the market (Directive 91/414/EEC, OJ L 230 19.8.91)

Directive 91/414/EEC is the framework legislation governing authorisation and placing of plant protection products (PPPs, also known as "pesticides") on the market. This legislation is concerned with the evaluation of pesticides to ensure that they can be used safely in the EU from the perspective of the environment, operator safety, and residues on food.
The legislation is essentially concerned with the pre-use phase, while TOPPS is essentially concerned with actual use in practice. Nevertheless, there are some links between the two in that PPP authorisations under Directive 91/414/EEC or at Member State level contain specific restrictions or requirements related to the use phase aimed at mitigating risk to water e.g. by mandating buffer strips between sprayed crops and any water body.

The legislation is currently undergoing amendment, which will result in replacement of the existing Directive with a new Regulation. The new regulation is likely to be published in 2009.

1.2 Up-Scaling procedure

1.2.1 TOPPS working steps

The Up Scaling approach at the end of the project has the goal to integrate all relevant aspects found during the project to propose a strategy to avoid point sources. The following figure (5) shows the different working steps performed in the project.

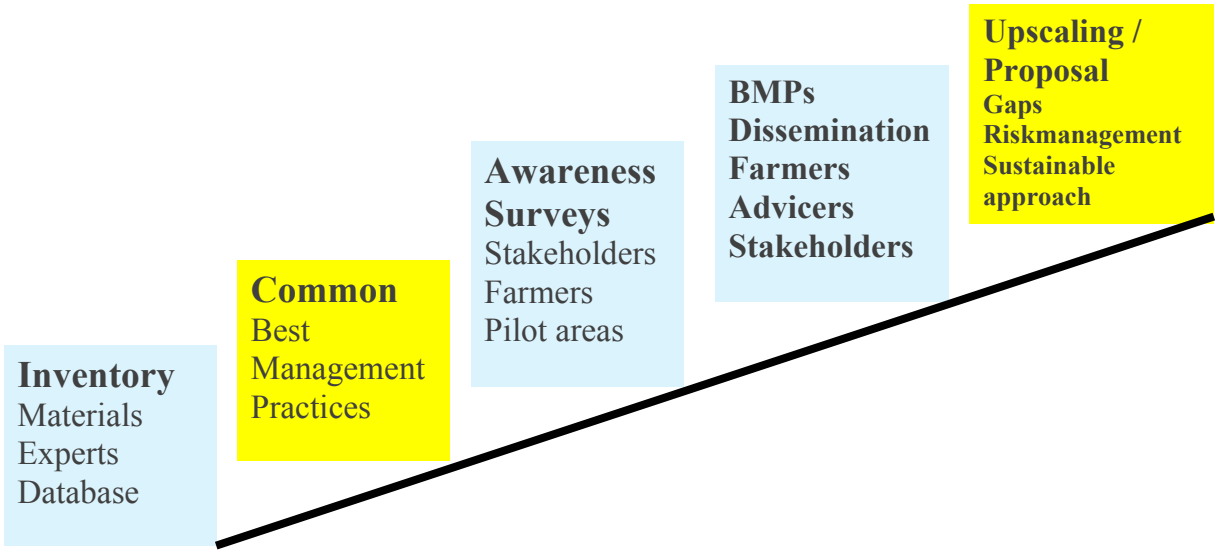


Figure 5 : Work packages of TOPPS Project

One basis for the Up-Scaling proposal is the guideline on Best Management Practices (BMPs) and field information from pilot catchment areas (farmer surveys and Farm audit) and a stakeholder survey. The BMPs are the benchmark to measure the gap that exists in practise today related to operator behaviour, status of equipment and infrastructure.

1.2.2 BMPs development

A structured procedure was used to develop the BMPs. Three main perspectives (behaviour, technique, and infrastructure) were applied to evaluate each of the relevant working processes (Figure 6) to avoid point sources.

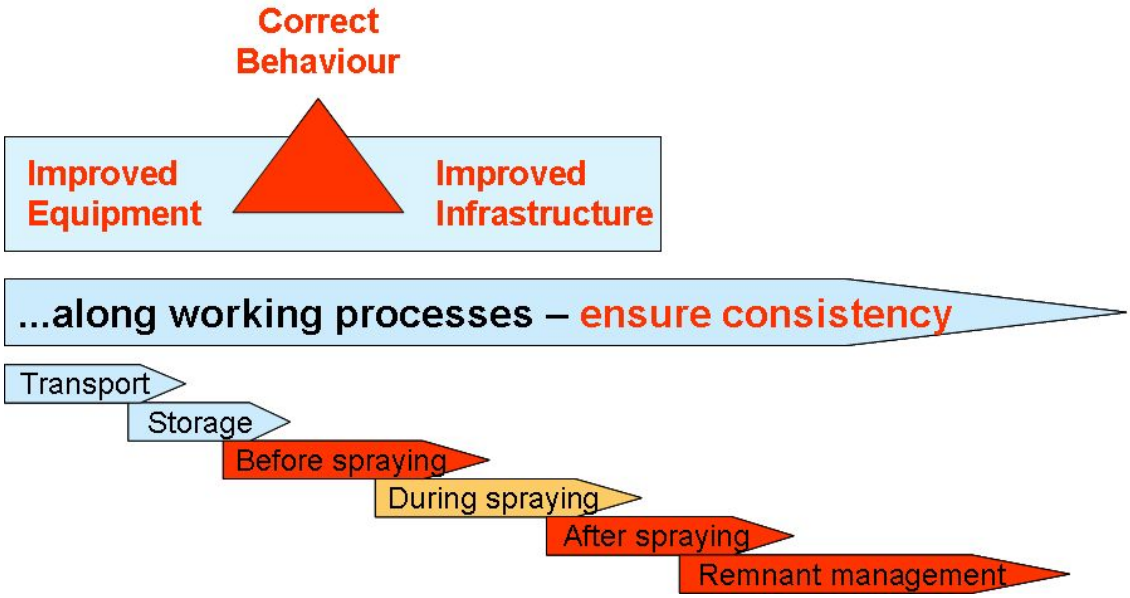


Figure 6: BMPs development concept

1.2.3 Structure of BMPs

BMPs have been systematically developed by working process and sub-processes. The details were composed by two main types of information: statements and specifications. (Statements: what to do; Specifications: how to do it). They were developed in an iterative approach by the TOPPS teams and validated at national and EU levels through stakeholders' consultation between October 2006 and February 2007.

The following figure 7 presents an example how BMPs were developed on the process level. (BMPs can be downloaded from the TOPPS website: www.TOPPS-life.org)

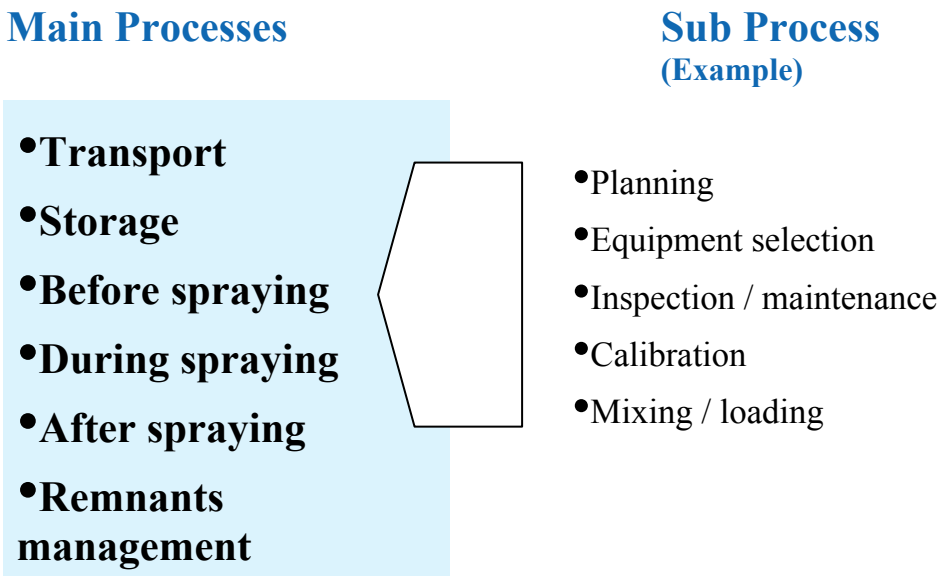


Figure 7: Details of processes and sub processes identified

1.2.4 Up-scaling methodology

The Up-scaling proposal is based on the following data and information and on suggestions and experiences from TOPPS partners:

- TOPPS Best Management Practise (BMPs).
- Perception and opinion survey with stakeholders in 9 countries (n = 600).
- Analysis and research in 6 pilot catchment areas (BE, FR, DE, DK, PL, IT).
- Perception and opinion surveys with operators in pilot areas (beginning 2007) to understand the perception of farmers on PPPs related to water pollution and their handling of PPPs.
- Audits in pilot areas focussed on technical and infrastructure status (to evaluate the availability and use of risk mitigation measures in practice.
- Repeated survey on operators' perception and opinion (June 2008) to measure changes resulting from TOPPS activities.
- Definition of good and bad practises based on BMPs (Risk analysis).

Up-scaling proposal development:

- Gap analysis of technical requirements defined in BMPs with status found in practice.
- Cost estimates for technical and infrastructure upgrades to comply with BMPs.
- Analysis of organisational structures in pilot area on the development, transfer and implementation of BMPs.
- Case studies to benchmark organisational requirements.

2. STATUS AT CATCHMENT LEVEL

2.1 Pilot catchments description

The characteristics of the six catchments are presented in the following table (Table1). The climate is temperate with moderate temperatures and rainfalls. The size of the catchments varies from 138 km² (IT) to 723 km² (BE).

Drinking water is extracted in all the catchments except in the French and Italian ones. Surface water is exploited for drinking only in the Belgium and German catchments..

In all the catchments the main activity (in term of land use) is agriculture. The agricultural areas vary from 42% (IT) to 86% (FR) of the catchments surface. The main crops are cereals, except in the Italian catchment where nearly ¾ of the cropping pattern is vineyards. The number of farmers vary from 100 (DK) to 7000 (PL). This variation can be linked with the size of the catchments and the size of farms (an average of 79 ha in DK and 7.6 ha in PL).

The Danish catchment is the only one that has a majority of part-time farmers (2/3). This characteristic is important in term of spraying practices and equipments. For example, the Danish part-time farmers in general have older sprayers without equipments for cleaning the sprayer.

		BE - Yser	DE - Stever&Haltern	DK - Bygholm	FR - Yser	IT - Alba	PL - Utrata
Catchment area	Size	723 km²	800 km²	180 km²	381 km²	138 km²	792 km²
Land use & Farmers	Main activity	Other	Agriculture	Agriculture	Agriculture	Agriculture	Agriculture
	Agricultural surface	75%	64%	60%	86%	42%	69%
	Average surface of farms	22 ha	?	79 ha	40 ha	4,22 ha	7,6 ha
	Cropping pattern	34% cereals 27% feed 15% patatoes 13% industry crops 11% vegetables	50% cereals 30% maize 10% grassland 10% oil seed rape	winter-wheat/barley oil seed rape maize spring barley grass	37% cereals 20% patatoes 12% vegetables 12% pastures 5% sugar beets 5% feed 9% others	70% vineyards 15% nut orchards 15% others	76% arable lands 10% meadows 7% orchards 7% pastures
	Farmers number	4732	3000	274 with a legal status as farms but only 100 with an actual agricultural activity	~ 800	1367	7000
	Place of farming in the activity	80% full-time 20% part-time	67% full-time 33% part-time	1/3 full-time 2/3 part-time (based on the more realistic estimation: 100 farmers)	>95% full-time <5% part-time	68% full-time 32% part-time	80% full-time 20% part-time

Table1 : Pilot catchments area characteristics

2.2 Perception of the significance of entry sources and chances to avoid them

2.2.1 Stakeholders

The results presented in the following part are based on a mail survey with stakeholders on their perception of point source pollution (n=600) in 10 countries in 2006 (Figure 8).

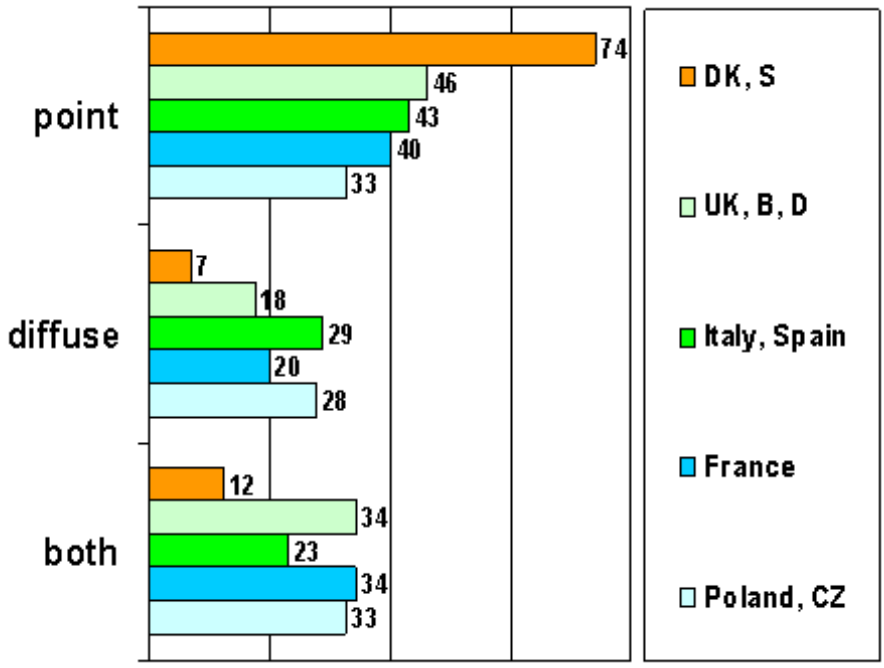


Figure 8: Perception of the most important entry source of PPP into water (Stakeholder survey 2006)

- On average point sources are perceived as the most important entry source.

- In North Europe 74% of the stakeholders see point sources as most important.
- Significant part of the experts cannot give a priority to a specific entry source.

A majority of the respondents (61%) think they could be confronted more and more with PPP water contamination concerns in the coming years. Most of the reasons put forward are an increase of environmental issues and the implementation of water legislation. They think that the information given through the media will as a consequence have an increase in the awareness of people on this topic.

Two thirds of respondents think that all areas of PPP use (agriculture, forestry, and urban use) are concerned by PPP pollution.
On average 46% of the respondents consider pollution from point source as the most important source of water contamination (but this perception varies strongly by country / cluster) while 20% of them think pollution from diffuse source is most important. About 30% think that pollution from point or diffuse sources have the same importance for water contamination. (Figure 8)

Clusters	Point	Diffuse	Both	No opinion
Mid West (Belgium, United Kingdom, The Netherlands, France and Germany)	**85**	**3**	**10**	**3**
East (Poland, Czech Republic, Slovakia and Hungary)	**81**	**2**	**5**	**12**
Nordic (Denmark, Sweden and Finland)	**88**	**3**	**4**	**5**
South (France, Italy, Spain, Portugal)	**70**	**6**	**16**	**8**
France	**86**	**1**	**10**	**3**

Table 2 : Entry source easiest to be reduced as seen by stakeholders

There is a large consensus among stakeholders that point sources (82%) could be the easiest entry route of PPP to be reduced. This offers good opportunities to realise fast wins if the focus is set correctly in education, advice and training (Table 2)

2.2.2 Operators (Farmers)

The farmers in the different catchments areas have been interviewed by phone on point sources. (Surveys carried out in 2007 and repeated in 2008), the following paragraph presents some of the results of these surveys (Figure 9).

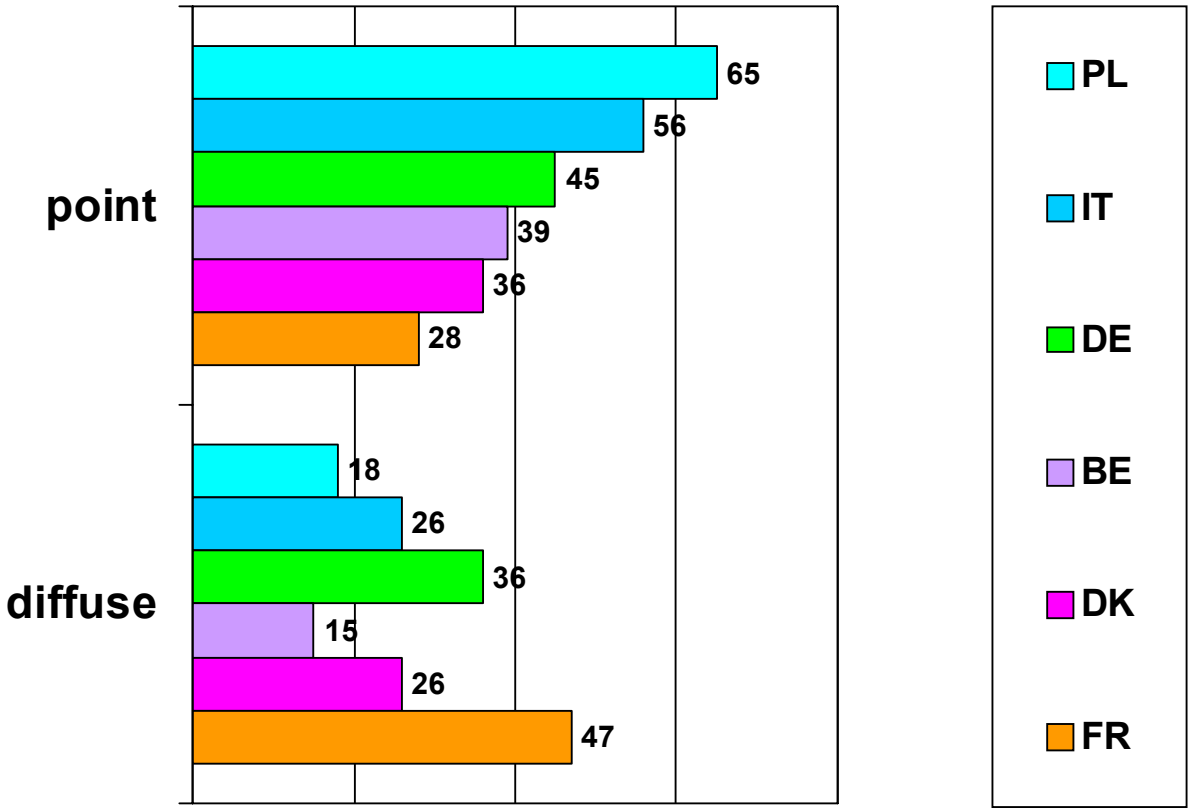


Figure 9: Point of views about the most important entry source of PPP into water (Surveys 2007 n = 847)

The majority of farmers think that point source pollution is the most important source but there are big differences in the perception of entry source significance by country. French farmers are the only ones to think diffuse source is the most important source of water contamination. Awareness of farmers is a reflection of advice, information, education and regulations. The knowledge of farmers on the subject is not broadly established which indicates the need for more information and advice. (Figure 9)

The majority of Danish and Belgium farmers (46% resp. 51%) in the catchment area say that they cannot judge the significance of various entry sources of PPP into water in the 2007 survey (figure 10). In 2008 surveys we see a general reduction of the farmers that say they cannot judge the significance of entry sources; this can be seen as a direct effect of the TOPPS activities. (Table 3) The success of the information campaign depended heavily on the level of personal interaction between advisers and farmers, which was very high in Italy, Poland and France. In Germany the information was mainly transferred by meetings and written information resulting in little change in the perception of farmers. In Denmark the information was mainly transferred to farmers through the local advisory service.

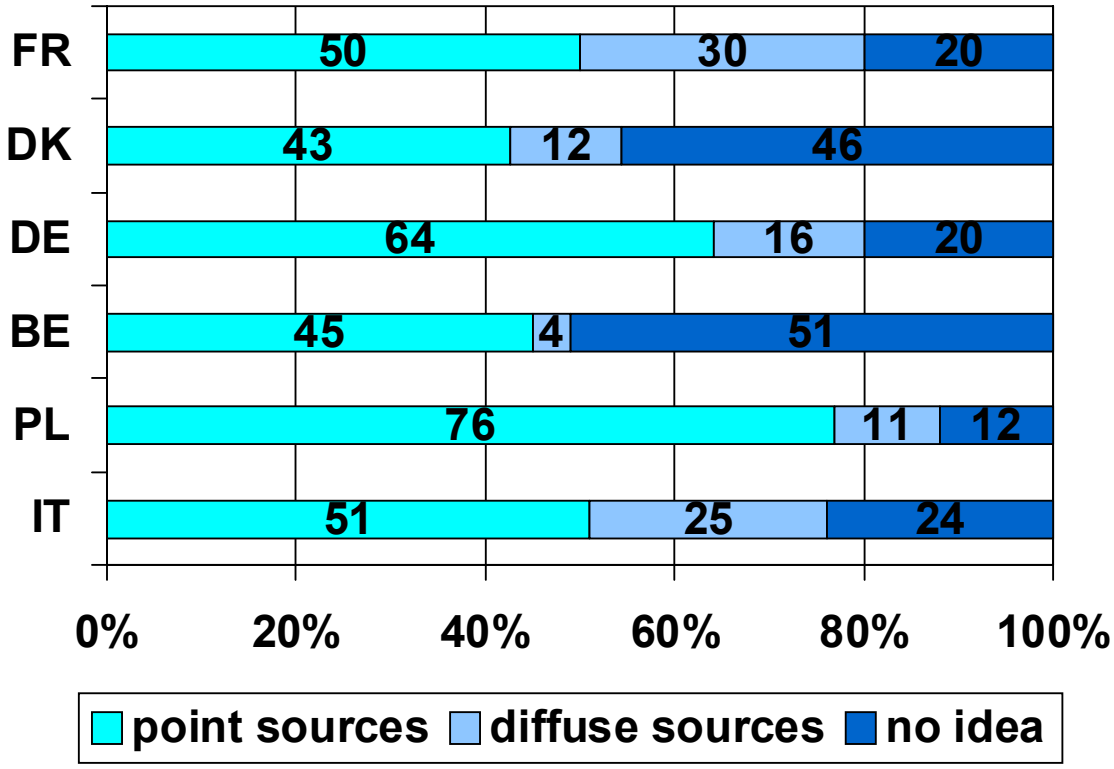


Figure 10: Which entry source of PPP into water can be easiest avoided ? (Farmer surveys 2007)

The results of the farmer surveys represent only the situation in the catchments, it is a reflection of the local situation and structures and not representative for a whole country. A majority of farmers see point sources as the easiest to be reduced, but variations between countries are very high, much higher than those seen with stakeholders. Focus of advice and training on point sources could realize rapid results because increasing awareness will help to change behaviour. Regular surveys may be helpful to measure the effectiveness of advice and learning on best methods to transfer BMPs to operators.

Operators perception on significance of entry sources (% of respondents)						
Comparision of the surveys in catchments beginning 2007 and June 2008						
Question: Which is the most important entry source of PPP into water ?						
	Belgium		France		Germany	
	2007	2008	2007	2008	2007	2008
Point sources	39	48	28	36	44	39
Diffuse sources	16	45	47	53	35	40
No idea	44	6	25	12	20	21
	Italy		Denmark		Poland	
	2007	2008	2007	2008	2007	2008
Point sources	56	55	36	65	65	72
Diffuse sources	26	33	26	25	18	19
No idea	22	12	41	10	15	8

Table 3: Most important entry routes as seen by operators (Farmer surveys 2007 and 2008)

2.3 Risk perception of point sources by working processes

2.3.1 Stakeholders

The stakeholders have been interviewed to rank the risks of the main working processes relevant to avoid point sources: transport, storage, filling, cleaning and remnant management. Results showed high consensus on the identified key risk areas: filling, cleaning and remnant management. The variation among stakeholders is small across countries. (Figure 11)

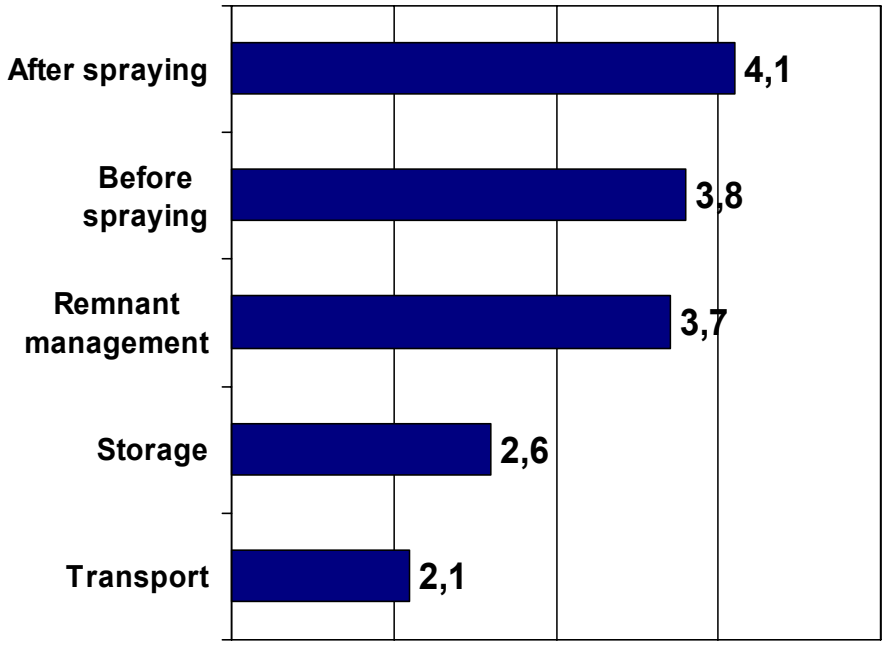


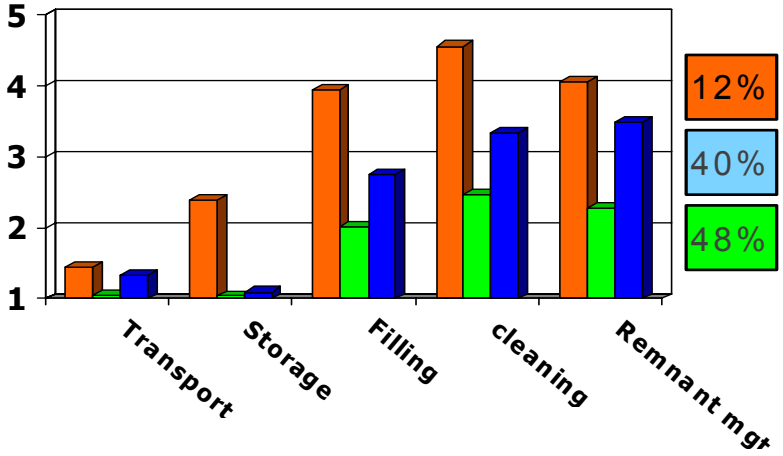
Figure 11: Rating of stakeholders on the point source risks by working process (5 = high risk, 1= low risk – stakeholder survey)

2.3.2 Operators (Farmers)

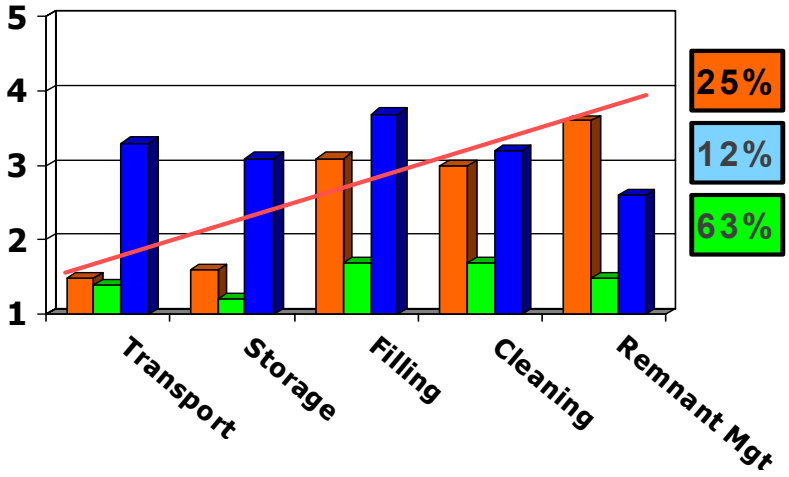
On average farmers gave the same ranking on working processes relevant to avoid point sources as the stakeholders did (Surveys 2007). If the farmer responses are further analysed (Cluster analysis) we can distinguish groups, differing to a large extend in their ratings. (Figure 12). The groups differ in their ability to differentiate the risks related to working processes.

Three models were identified.

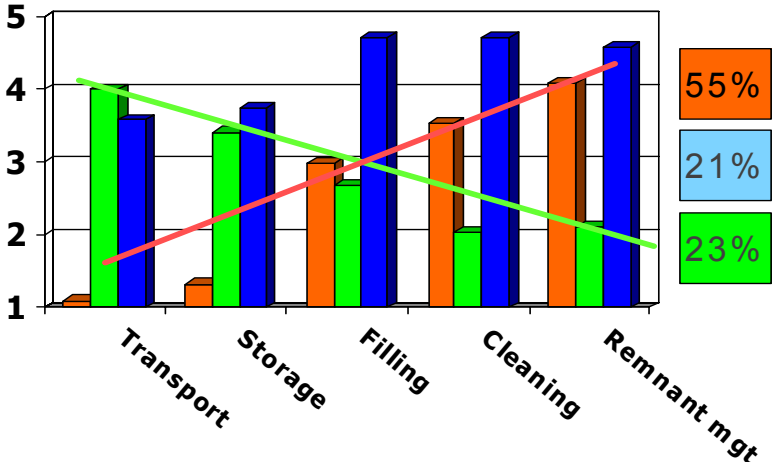
1. All farmers were able to differentiate risks (BE).
2. 25 to 35% differentiate risks and the rest rate risks rather unspecific and either low or high (DE, DK, IT, FR).
3. Farmers differentiate the risks but partly completely contrary to others (PL).



a) Results catchment Belgium



b) Results catchment France



c) Results catchment Poland

Figure 12: Risk perception of working processes differ by groups of farmers (% respondents) (Example catchment: Belgium, France, Poland - Ratings : High risk =5 , low risk = 1)

The differences in the risk perception highlight the need for advice and information. It also shows that only 25 to 50 % of the farmers are likely to be reached by the current structures of advice.
Farmers and stakeholders rate on average the risks by working process similar. The variation among farmers is much higher also variations between catchments areas are large.

2.3.3 Stakeholders evaluation of risk mitigation measures

Stakeholders evaluated different risk mitigation measures on their risk reducing potential concerning equipment and infrastructure. The analysis of the survey is shown for the equipment in figure 13 and for the infrastructure in figure 14. Measures are mapped according to a statistical analysis which links their effects with the efficiency they can provide to mitigate point source risks.

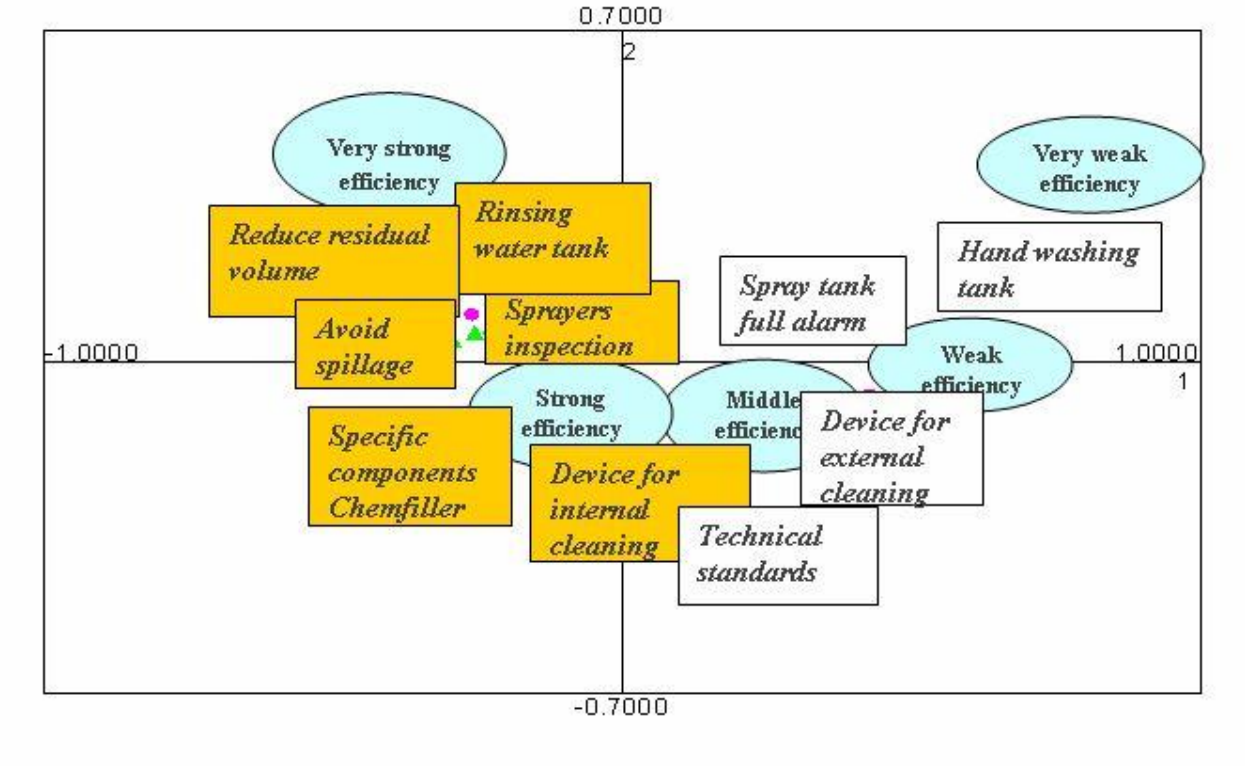


Figure 13: Mapping of equipment / measures according to their point source risk mitigation potential (stakeholder survey 2006)

The three main technical points important for the reduction of possible point sources risks are: reduction of residual volumes, need for a rinse water tank and techniques to avoid spills.

Stakeholders see the strongest measures to reduce point sources pollution risks related to the infrastructure in well organised container recovery systems, dedicated handling and washing areas where washing waters can be collected and in the establishment of bio-purification systems.

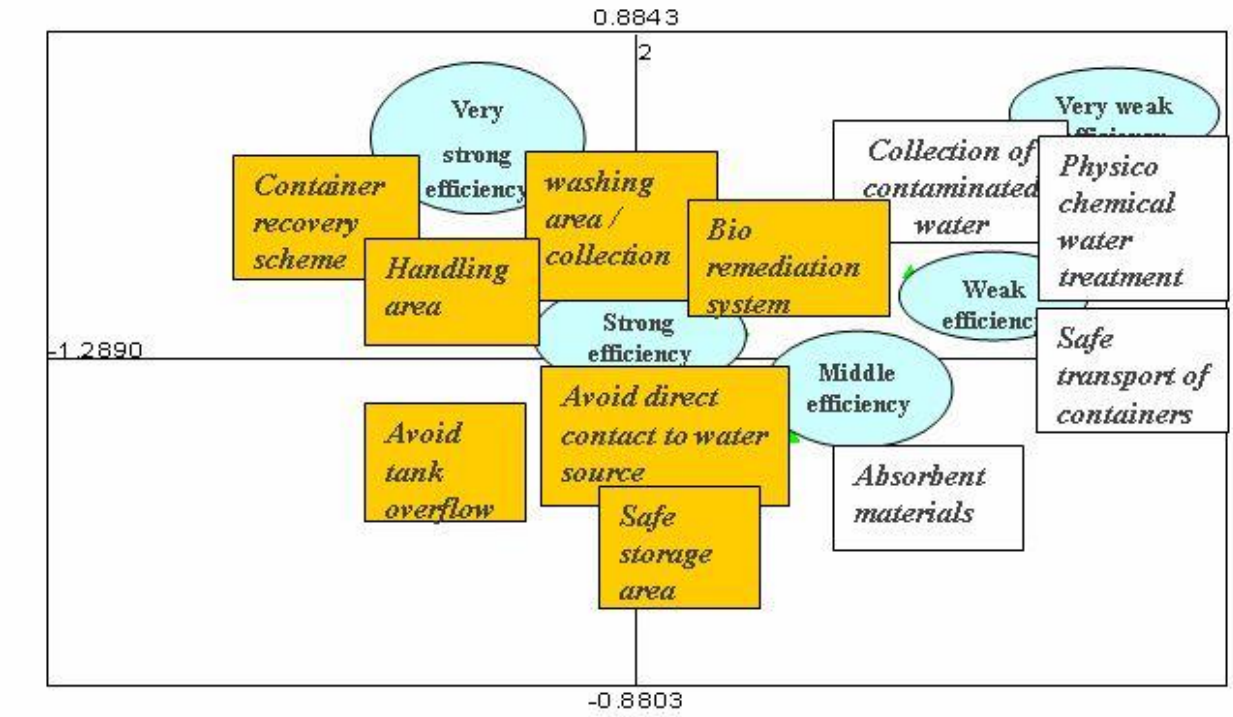


Figure 14: Mapping of measures related to infrastructure according to their point source risk mitigation potential (stakeholder survey 2006)

2.3 Status concerning infrastructure and equipment

2.3.1 Status on practices and infrastructure

In spring 2007 farm audits were conducted by local advisory services in the catchments to focus on the current status of infrastructure and equipment. In the French and Belgium catchment the audit tool Aquasit® of Arvalis Institut du Vegetal was used. In the other catchments comparable structured questionnaires were utilized to conduct personalised audits through interviews. In the German catchment the audits were done by questionnaire completed in farmer meetings.
The variations found in practises and status of infrastructure among the catchments is shown in table 4. Variations are shown for the minimum and the maximum of the findings in %. This information reflects the efforts needed to develop a common approach to reduce risk and to avoid point sources.

Table 4: Status on infrastructure and practises based on farm audits in catchments (Variations found min / max %)			
Processes	**Infrastructure / Practises**	**Min %**	**Max %**
Transport	PPP delivered directly from retailer	**PL - 0**	**BE- 98**
	Transport by car	**FR - 2**	**IT - 99**
Storage	Storage < 20m from surface water	**DE - 10**	**FR - 32**
	Storage < 20m from filling place	**IT - 38**	**DE - 90**
	Specific PPP storage available	**DK - 59**	**BE - 91**
	Storage is locked	**IT - 58**	**DK - 88**
	Storage clearly marked	**IT - 8**	**BE - 77**
	Storage with safety instructions	**IT - 6**	**BE - 74**
	Storage with ventilation	**PL - 43**	**DE - 100**
	Storage can retain spills	**IT - 3**	**DE - 100**
	Storage has water resistent flour	**PL - 70**	**DE - 100**
	Store has shelves	**DK - 52**	**BE - 87**
	Fire extingusher outside PPP store	**IT - 24**	**DK - 88**
	Absorbent material in store available	**DK - 20**	**DE - 90**
	PPP stored according to a classification system (alphabetic or other)	**DE - 0**	**BE - 86**
	Yearly PPP inventory executed	**DE - 10**	**FR - 94**
Filling	Filling sprayer on farm	**IT - 81**	**DK - 100**
	Filling from a pond	**DK - 0**	**FR - 35**
	Filling from a well	**DE - 0**	**BE - 62**
	Filling from a river/ditch	**PL - 0**	**BE - 29**
	Filling from the water network	**BE - 2**	**DE - 95**
	Equipped with Antiback flow device	**PL - 20**	**BE - 68**
	Filling from intermediary tank	**PL - 5**	**DE - 73**
	Filling on water prove platform on farm	**FR - 18**	**DE - 94**
	Filling on platform where overflow/spills can be collected	**FR - 0**	**DE - 72**
Cleaning	Internal cleaning in the field	**DE - 36**	**IT - 98**
	External cleaning on farm	**IT - 89**	**FR - 96**
	Cleaning water can reach surface water	**PL - 5**	**FR - 81**
	Empty containers are rinsed	**PL - 81**	**DK - 100**
	Special collection service for empty containers	**IT - 48**	**BE - 100**

Filling places in the German catchment have been supported in cooperation with Farmers, Advisory service and Water industry for the past 15 years. These are filling and washing places which drain contaminated water into the slurry tank.

2.3.2 Status on spray equipment

The availability of key risk mitigation equipment based on audit results are presented in table 5. Looking at the figures it is necessary to note that in the case of the Italian catchment it is mainly referring to vineyard sprayers while in the other catchments results are referring to boom / field crop sprayers. In the case of Denmark please note that in this area 2/3 of farmers are part-time farmers. This is reflected in rather old sprayers with a low level of mitigation equipment.

Table 5: Risk mitigation equippment on sprayers (availability in % respondents) (TOPPS farm audit 2007)						
Country	**BE**	**DE**	**DK****	**FR**	**IT***	**PL**
Induction hopper	80	73	**30**	**86**	**4**	37
Container rinse nozzle	60	70	26	**81**	**2**	**6**
Antidrift nozzle	64	**95**	**45**	58	**1**	46
Hand clean water tank	23	**85**	30	83	59	**29**
Inside cleaning nozzle	35	55	44	**56**	**8**	**22**
External cleaning device	**84**	74	15	**11**	**1**	15
Rinse water tank	66	80	37	**89**	**25**	**15**
Questionaires (n)	100	233	45	100	100	120
Average age of sprayers	12,1	8,9	**12,7**	9,3	**7,4**	9,5
*	Italy mainly vine sprayers					
**	2/3 part time farmers					

As a general trend we can conclude that older sprayers are mainly found on smaller farms and those which have higher shares of their business in animal production.
Counting on the sprayer replacements process means that any technical improvements will have an average time lag of about 10 years. Clear guidance and enforced standards are required to achieve this.

2.3.3 Farmers practices classified in risky or safe practice

A criteria list to define save and risky practices was developed based on the BMPs. This criteria list was used to classify and estimate save and risky practices in a qualitative approach interpreting the survey and audit results from the catchments (Annexes 1, 2).

3. KEY RISK AREAS AND GAP ANALYSIS

In the following chapter focus will be given to the key risk areas for point sources.

- Filling (before spraying)
- Cleaning (after spraying)
- Remnant management

Based on the farm audits and surveys the current status on the availability of risk mitigation tools and aspects of the correct behaviour handling PPPs are described. Potential risks are estimated and the appropriate risk mitigation measures are proposed.
The gap will be defined as difference between the situations found in practise and the BMPs requirements (benchmark)

Investments necessary to upgrade infrastructure and equipment to comply with the proposed BMPs are estimated. The costs don't take into account farmer's contributions they usually provide especially if infrastructure investments are concerned (Annexe 4).

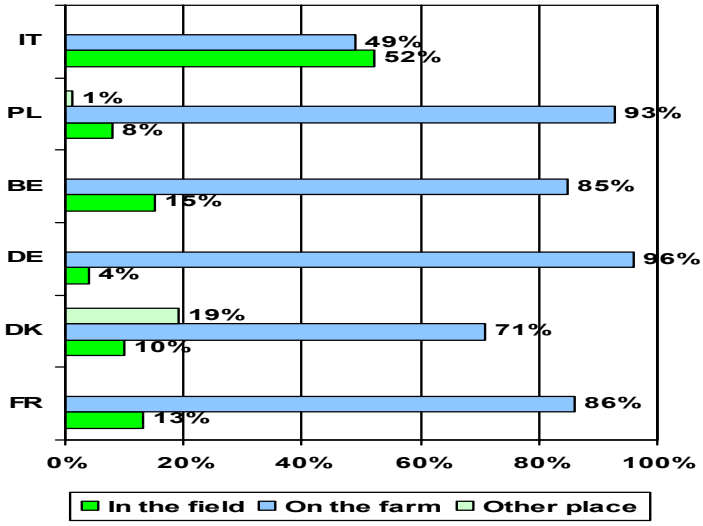
3.1 Filling process

The BMPs recommend two options for the filling

- filling in field of application
- filling on farmyard or at homestead

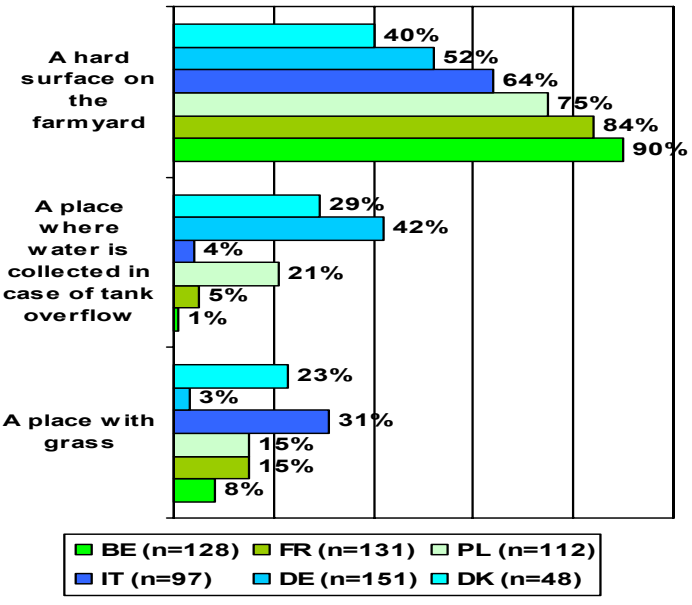
Precautionary measures to avoid any contamination of surface water are necessary if filling is done on farmyard. The risk to spill PPP concentrate or spray solution is related to the number of products being used and the number of sprayer fills per season.

3.1.1. Filling on farm / filling place



Most farmers fill their sprayers on farm (Figure 15) Italy represents an area which is growing mainly vine. They operate filling stations in the different vineyards.
From the surveys we can assume that farmers see filling on farm more practical than filling in the field. It is therefore unlikely that many farmers will transfer filling to the fields.

Figure 15: Sprayers filling (Farmer survey 2007)



Filling on hard surfaces can pose point source risks if PPP spills or tank overflow cannot be collected. (Figure 16)
In areas where animal production is common filling places drain spills to the slurry tank. Collection tanks , Bio-purification systems or physical / chemical cleaning systems are additional alternatives to mitigate the point source risk. Currently such systems are not very wide spread. (For further details see Bio-purification brochure on TOPPS website)

Figure 16: Characteristics of filling places (Farmer surveys 2007)

3.1.2 Water source protection

As seen in the surveys the water sources used to fill the sprayers vary a lot by country (Figure 17). It is recommended to use special equipment to avoid any PPP pollution of the water sources when filling the sprayers.
These equipments are backflow checkvalve or intermediary tanks, which avoid any direct contamination of the water source during filling. A high risk is the sourcing of water directly from a well where any contamination would be directly to the ground water.

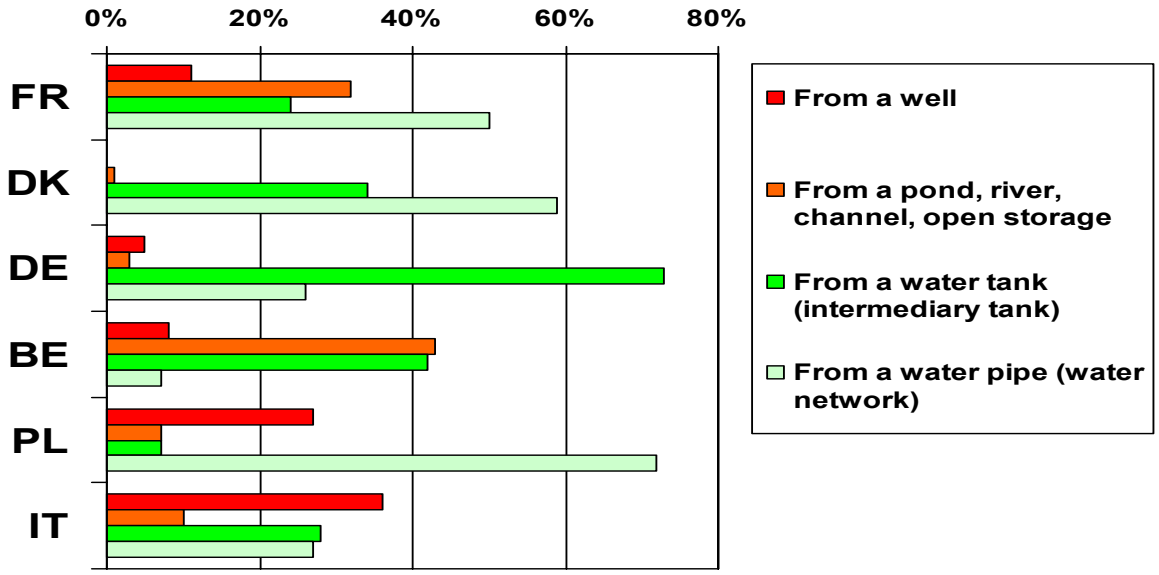
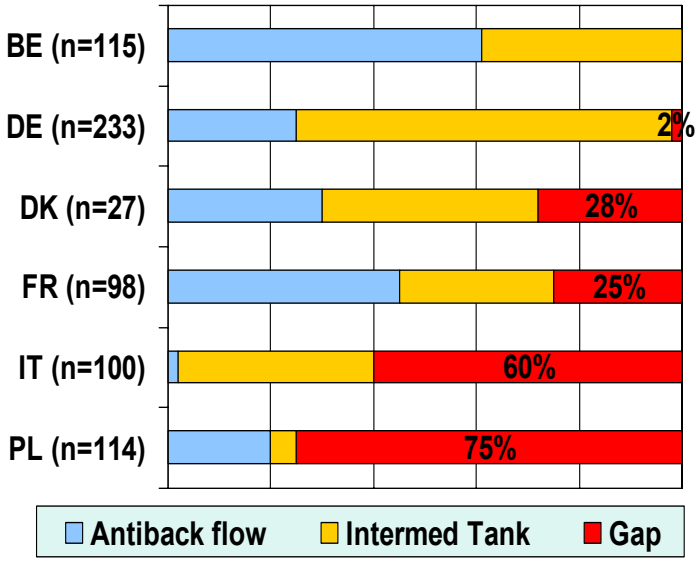


Figure 17: Water sources to prepare spray liquid (Farmer survey 2007)



Antiback flow devices and intermediary tanks are effective risk mitigation measures to protect the water sources when filling the sprayer. The red bars indicate the risk mitigation gap based on the audit results and the BMPs. (Figure 18)

Figure 18: Filling places equipped with devices to protect the water source (Farm audits 2007)

3.1.3 Correct filling and avoidance of overflow

Flow meters with automatic shutter (BMP recommended).

Most farmers are filling their sprayers with water by using the scales (marks) attached to the tank (Figure19). Research has shown that these scales are often not very precise and often not sufficiently readable (low tech).

The correct amount of water is crucial to ensure on one hand that the amount of spray liquid needed is sufficient to spray the crops on the other hand any unused left over spray will increase the point source risk at the cleaning process after spraying.

An automatic shutter with the flow meter is a useful mitigation tool to avoid overflow of spray liquid from the tank during the filling and to ensure that the exact amount of water needed is filled in the tank.

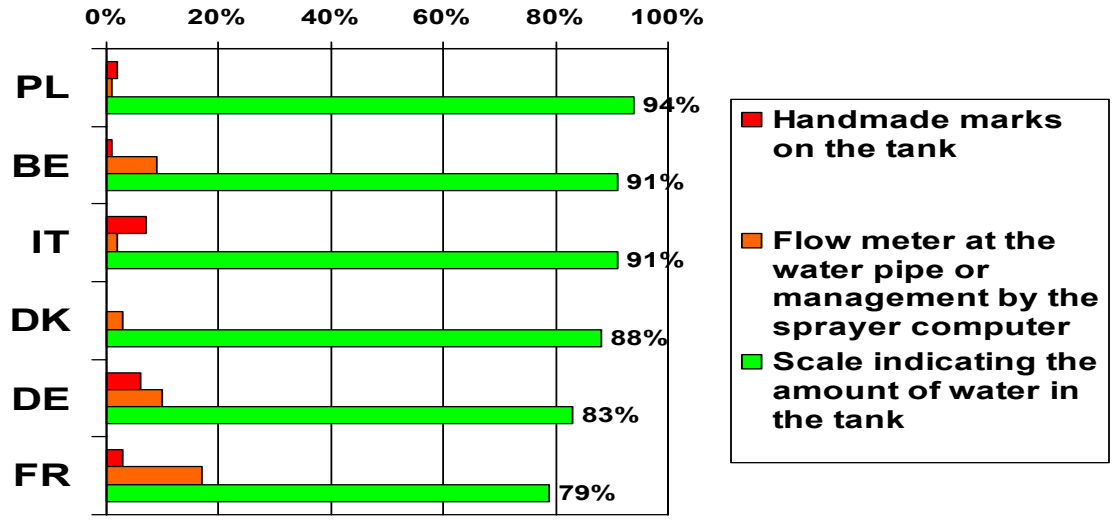
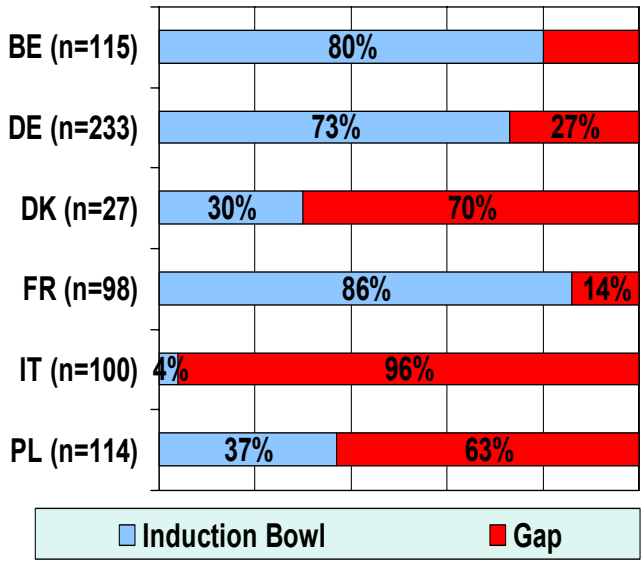


Figure 19: Method used to measure the amount of water filled in the spray tank

3.1.4 Risk mitigation filling PPP using Induction bowls (BMP recommended)



Induction bowls are devices attached to the sprayers to avoid climbing up the sprayer to fill the PPP concentrate in the tank. Climbing up the sprayer causes an additional risk to spill product. PPP is pumped from the induction bowl into the spray tank (Figure 20)

Most modern field sprayers are equipped with induction bowls. Orchard and vineyard sprayers are seldom equipped with induction bowls but technical solutions to be used at the farm are available (stand alone devices)

Figure 20: Sprayers equipped with an Induction bowl

3.1.5 Empty container management

BMPs recommend that empty containers are rinsed three times if no rinsing tool (f.e. rinse nozzle attached to a induction bowl) is used. Most farmers indicate that they rinse the empty containers but sometimes the rinsing is not done frequently or thoroughly enough.

Induction bowls should be equipped with a rinse nozzle able to clean empty PPP containers. Such rinsing devices have the advantage that the rinsing can be done with pressure and the rinse water is directly pumped back into the sprayer tank.

Insufficiently rinsed containers present a big point source risk, because the remaining material in the containers is often undiluted PPP. The graph (Figure 21) below shows the status based on the audits how many sprayers are equipped with container rinsing nozzles, respectively show the % need for upgrading.

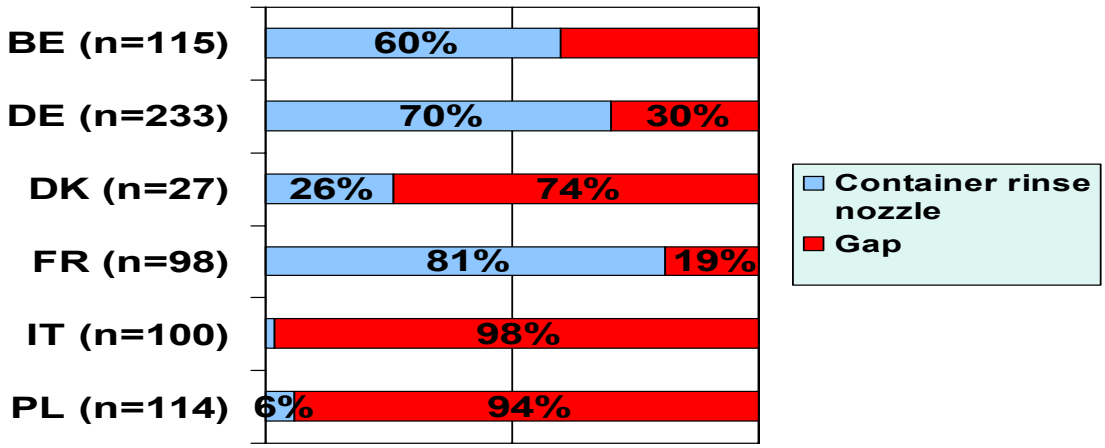


Figure 21: Sprayers equipped with container rinsing nozzles (Farm audit 2007 Italy vine sprayers / other field-sprayers)

In some countries special services exist which collect empty PPP containers for further management. The survey shows that the adoption of the collection system in some countries can be improved (Figure 22). In Belgium the system is able to collect 100% of the containers.

An important risk mitigation practice for empty container management is the storage in a safe and dry place. Collection services take the empty containers only at certain times and therefore an intermediate storage of empty containers is necessary (Figure 23).

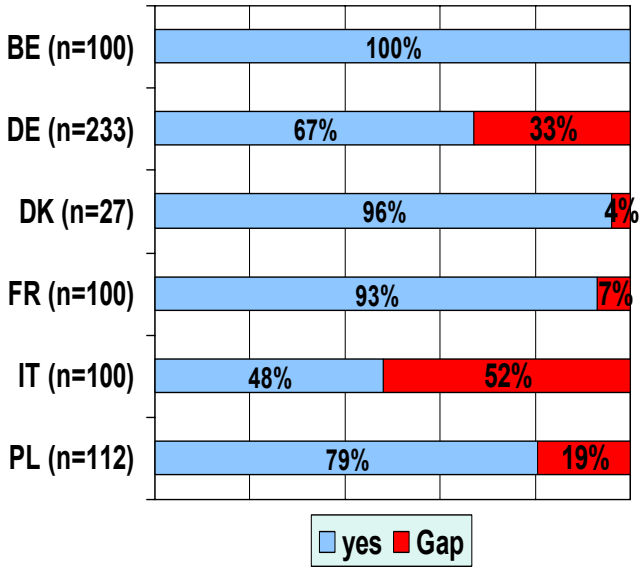


Figure 22: Farmers using special services for empty container collection

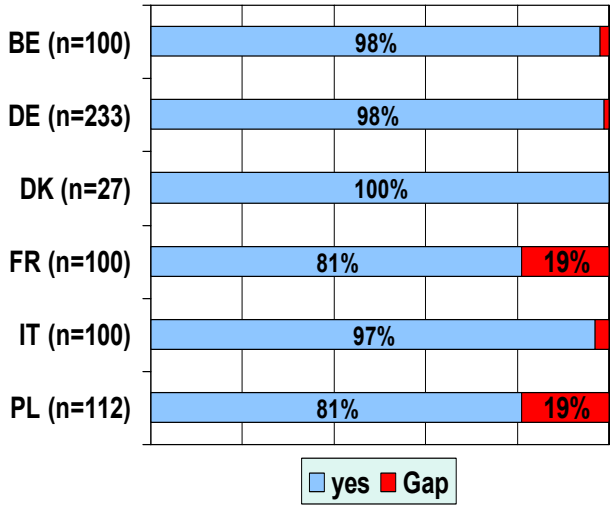


Figure 23: Empty containers stored in a save and dry place

3.1.6 Cost estimate for proposed risk mitigation measures

a) Filling place (Secured mixing and loading area):

Option 1: ~65m² filling place connected to the slurry tank (local regulations need to be consulted): 1500-3000 € or ~30 € per m² (NB: The filling place on the Danish demo-farm was about 10.000 € - done by a contractor).

Option 2: filling place waterproof, bounded and spills collected (separate tank) –: 1500-5000 €

Option 3: collectively used filling place (for 10 farmers, gallows-filling, bio purification system: 10 000 € to 50 000 € (System for small farm structures, specialty crop situations)

Option 4: collecting tray (saucer principle) 500-5000 € (according to the sprayer size, material (Prototype German Demofarm)

b) Water sourcing / Devices to protect water supply

Non return valve (Antiback flow): 15-100 €; with automatic shutter to avoid overflow 300-600 €

Intermediary water tank: 150-450 € (second hand, from 1000 to 3000L) or 600-1500 € (first hand, from 1000 to 3000 L), gallows: 150-450 €

c) Precise filling (exact measurement and avoidance of tank overflow)

Quarter turn gate: 15-35€, simple filling device: 250-500€, with automatic shutter to avoid overflow 300-600 €, electronically filling device: 800-1200€

d) Induction hopper

Induction hopper with rinse nozzle to clean empty containers: 450-1000€ ; 800-1500€ Stand alone 500 €, prices depend on size of induction hopper. Lower prices for smaller sprayers

e) Empty container storage / management

Empty container storage can be installed in a special place in the PPP storage or in a separate area that can be protected from unauthorised access and that is kept dry. Any connections with surface water must be avoided. The costs depend on the specific farm situation.

3.2 Cleaning (after spraying)

In field studies carried out by the Univ. Giessen Hessen (Germany), where intensive operator training was provided and sprayer cleaning was transferred from the farmyard to the field, contamination of water coming from farmyards showed average reductions of the PPP - pollution by about 70%.

These results show the significance of the cleaning process to reduce the risk of point source pollution.

3.2.1 Inside cleaning of the sprayer

Due to inherent machine design some spray liquid cannot be sprayed out completely (Total residual volume[1]). For risk mitigation purposes the volume which remains in the sprayer therefore should be minimized. Focus on optimized tank design, positioning of pumps and other devices or optimized dimensioning of pipes and booms can reduce the residual volume. The residual volumes are especially of concern for field sprayers, as they have more volume (pipes and boom) compared to orchard sprayers.
The EN standard 12761 defines requirements for the total residual volumes. Figure 24 shows tests (ENTAM) of new field and orchard sprayers on their compliance with the standards. All tested sprayers were complying with the standards (Debear 2008)

[1] Spray mixture which remains in the sprayer and which cannot be delivered with the intended application rate; Indicator: 25% drop of pressure shown at manometer

The variations found between sprayers' on the residual volumes are huge. The best sprayers tested are already 50% better than the standard.

It is therefore proposed to review the standard requirements for residual volumes. If we assume that the inside cleaning of field sprayers has a potential point source risk of about 70% (indicated by studies in Hessen Germany) a reduction of the residual volumes by 50% could reduce the total point source risk theoretically by 35% (just by improvements of the sprayer designs).

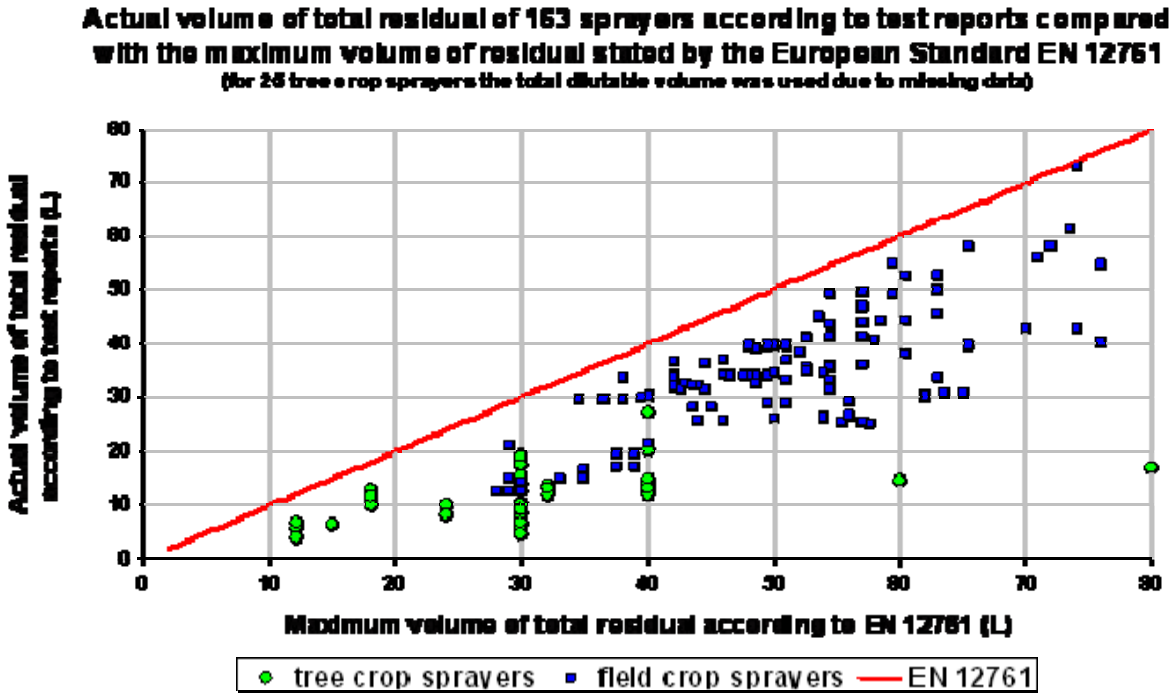


Figure 24 Residual volume of new sprayer compared to EN 12761 (Debaer 2008)

3.2.2 Inside cleaning procedure

BMPs recommend that the residual volume which remains in the sprayer after spraying is diluted three times and sprayed out in the field after each rinsing (multiple rinsing).
Continuous cleaning: An alternative method for the cleaning was tested under TOPPS, which offers additional benefits (see TOPPS Cleaning Brochure on TOPPS website and H.Kramer 2008) with some technical modification. The remaining spray solution can be diluted more efficient and faster compared to multiple rinse procedures.

Most countries recommend to dilute remaining spray liquid and to spray it out in the field, but this is not often specified in detail. French and Danish (being published) regulation allow farmers to leave all remaining liquid in the field if dilutioned to 1% and 2% respectively of the original spray solution is achieved. This means from a risk mitigation aspect that no contaminated liquid will be carried back to the farm and therefore can be considered as a very effective risk mitigation measure.
These procedures require that the sprayers are equipped with an extra tank to carry sufficient rinse water. In ENTAM tests about 40% of the tested field sprayers did not have the capacity to achieve a 1% dilution of residual volumes in a triple rinse procedure (Debear 2008)

The current practice of the management of residual spray liquid after spraying based on the surveys is shown in Figure 25. The variation among different catchments areas is huge.
Farmers that say they dilute the remaining spray and spray it out in the field as recommended varies between 16 and 91% for the catchments. In some countries the share of farmers that are not responding may show that there is high insecurity on the correct procedures required.

In the Italian catchment we are dealing mainly with vineyard sprayers. The majority of the farmers say that they spray the remaining liquid out in the field. To clarify what this really means will need further investigation. The awareness of the residual spray and the associated volumes is very variable and in general not well developed. We also saw that some definitions are not clear and therefore some final conclusions are difficult to make from the conducted surveys.

Model calculation field sprayer (worst case).
Assumption all residual volume in the sprayer will contaminate surface water if cleaning is done on farm without prior dilution and no precautions.
Residual volume based on standard EN 12761; Water volume 250 l/ha; Dose 1000 g ai/ha.

Tank-volume Fieldsprayer	Residual volume	g / active ingredient	If 10 cleanings per season performed
800 l	34 l	136 g	1360 g
3000 l	57 l	228 g	2280 g
4000 l	93 l	372 g	3720 g

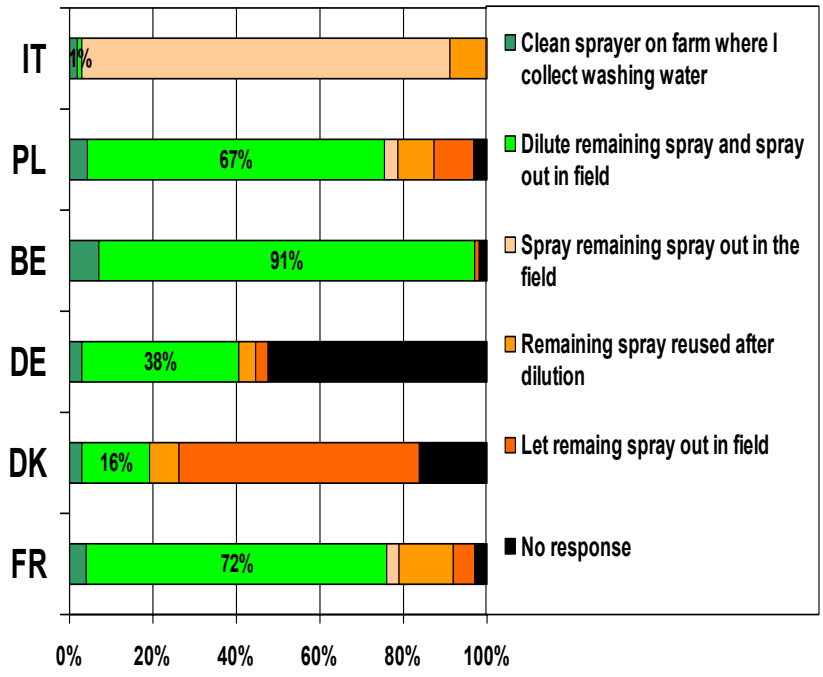


Figure 25 Management of liquid remaining in the tank after spraying

3.2.3 Rinse water tank

As explained above the availability of rinse water and the correct cleaning / rinsing procedure is a key risk mitigation measure.

Generally new sprayers are equipped with rinse tanks, but there are a lot of old sprayers in use, which are not equipped. In the farm audits (Figure 26) the current status of the availability of rinse water tanks for field-sprayers is shown.
In Denmark the low level of equipment corresponds with the farm structure in the catchment, which has mainly part time farmers and also relatively old sprayers.

Most sprayers in France, Belgium and Germany carry rinse water tanks. Audits in France and Belgium where also the rinse tank capacity was specifically investigated showed that in the majority of the cases the rinse tank capacity was less than 10 % of the spray tank volume.
Availability of rinse water is an absolute requirement to reduce point source risks. Possibilities to help farmers upgrade their sprayers should be investigated.

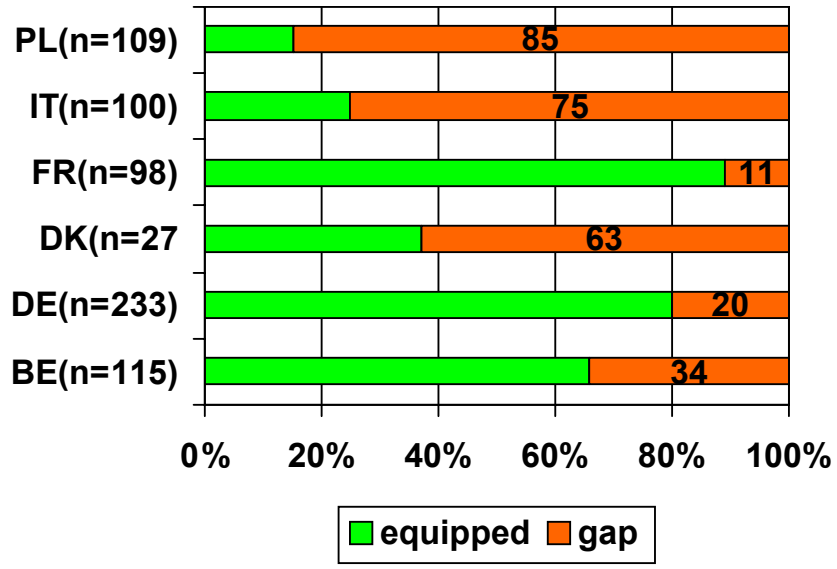
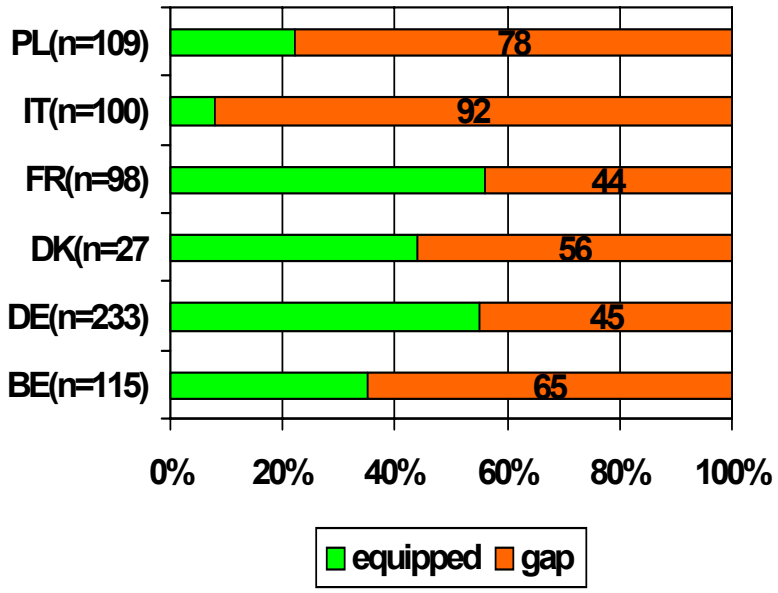


Figure 26: Rinse water tank equipment of sprayers (Farm audit 2007, Italy vine sprayers)

3.2.4 Inside (internal) cleaning



Cleaning nozzles help to improve the efficiency of the cleaning process inside the sprayer tank. Rinse water is distributed via the rinsing nozzle, which rotates and cleans deposits of spray liquid off the tank walls.
Cleaning nozzles are recommended as risk mitigation measures for the inside cleaning. Currently not very many sprayers are equipped with internal cleaning devices (Figure 27)

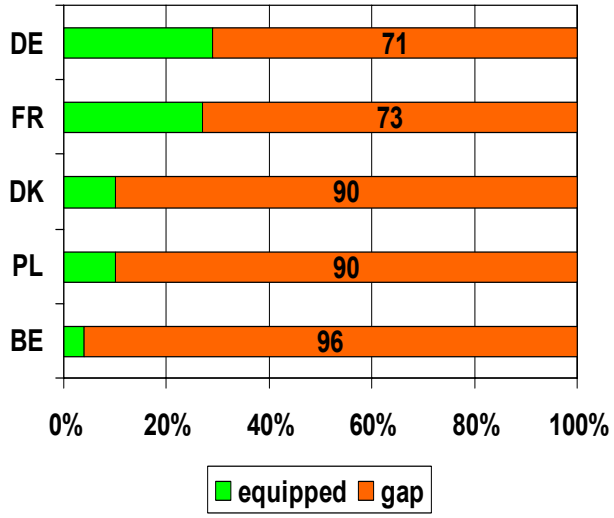
Figure 27: Sprayers equipped with inside cleaning nozzles (Farm audit 2007)

3.2.5 Outside (external) cleaning

The outside cleaning aspect is especially relevant for air assisted vine and orchard sprayers. Research showed that deposits of PPP to the outside can be significant. It was also shown that PPP deposits are easier to be cleaned off if the deposits are still wet. This means that outside cleaning is recommended to be performed in the field after spraying.
This requires cleaning devices attached to the sprayer.
The available rinse water must be sufficient such that inside and the outside cleaning can be performed. This requires efficient cleaning procedures. Best cleaning results with low amounts of water were achieved with high pressure lances. This procedure could wash off most of the deposits.

Model calculation for orchards/vine sprayers (C.Debaer et al 2006)
Outside contamination 0,33 to 0,83% of applied amount (Balsari et al 2006 – ISO test)
Assumption: 25 kg ai / ha and year applied.
82,5 to 207 g ai (C.Debaer et al.2006) deposit on the sprayer per ha.
(20 ha 1650 g ai to 4140 g ai)

3.2.6 Outside cleaning devices



To date outside cleaning devices are not very common for field sprayers.
Vine and orchard sprayers in the Italian catchment show 1% of the sprayers equipped with outside cleaning devices. We cannot judge the vine and orchard sprayer situation in other areas but we assume that these sprayers are hardly equipped. Results shown are from the farmer survey 2007 as seem to fit better with information we received from spray manufacturers.

Figure 28: Sprayers equipped with outside cleaning devices (Farm survey 2007)

3.2.7 Current cleaning practices

Technical and infrastructural tools are only enablers to help mitigate the risk of point sources. Therefore it is essential to advice and convinces operators to follow Best Management Practices.
Cleaning of sprayers on farm has probably a lot of practical advantages e.g. availability of equipment, sufficient washing water, but if washing water is not collected this practise can be a relevant point source risk.
Farmers indicated that they basically clean the outside of their sprayers on the farmyard (43 to 95%) (Figure 29)

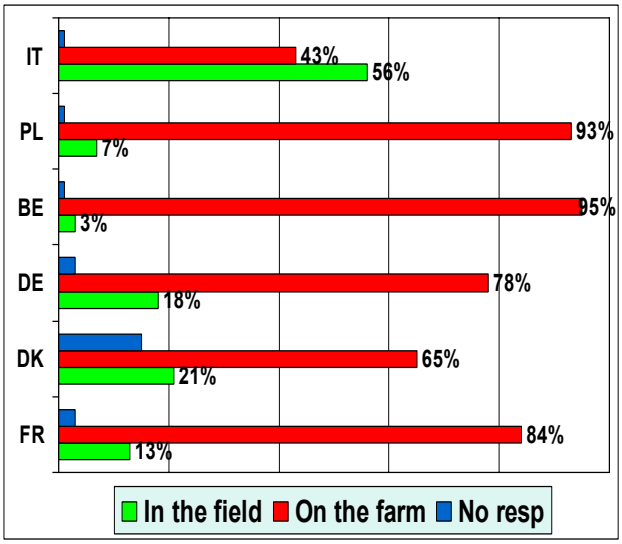


Figure 29: Places where sprayers are cleaned from the outside

Another aspect of risk mitigation is the distance from the washing place to surface water.
From the survey result we can see that in Italy and France a significant part of farmers clean their sprayers not far from surface water. (Figure 30).

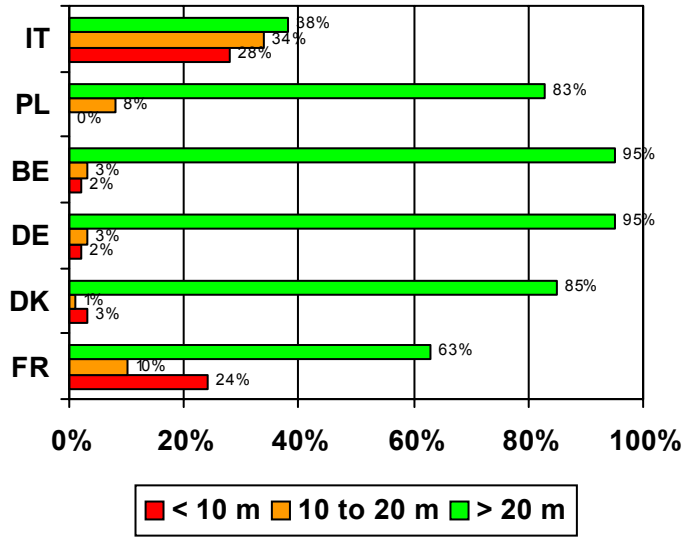


Figure 30: Distance of the cleaning place to surface water

3.2.8 Cost estimate for proposed risk mitigation measures

New sprayers should be equipped with internal and external cleaning devices. Old sprayers should be upgraded with respective cleaning kits (rinse water tank and devices for inside and external cleaning).

Costs per sprayer depend on the size of the sprayer and will range from 600 to 1200 € per sprayer for a complete cleaning kit (small sprayers):

a) Cost for rinse water tanks range depending on sizes needed between 100 to 1000 €

b) Cleaning nozzle system 200 to 500 €.
c) External cleaning device attached to sprayer - spray lance low pressure 100 to 400 €
d) External high pressure cleaning lance, low water use device 1200 to 3000 €)

3.3 Remnant management

Remnants management refers to the management of any PPP contaminated liquids accrued on farm. These are originating mainly from the cleaning, filling and maintenance processes. Risks depend to a large extend on how the cleaning process is done in the field / or on the farmyard.
Regulations in countries are not yet consistent. DK and FR allow farmers to leave all contaminated liquid in the field if certain dilution factors of the residual spray volumes are achieved (Factors 100 in FR, 50 in DK). In some other countries there are no clear regulations existing or such practices are not permitted.
In cases where farmers cannot leave diluted contaminated liquids in the field, they necessarily bring contaminated liquids back to the farm, where they can cause a significant point source risk if not treated correctly. Such situations require additional risk management measures that need a special infrastructure on farm (Figure 31)

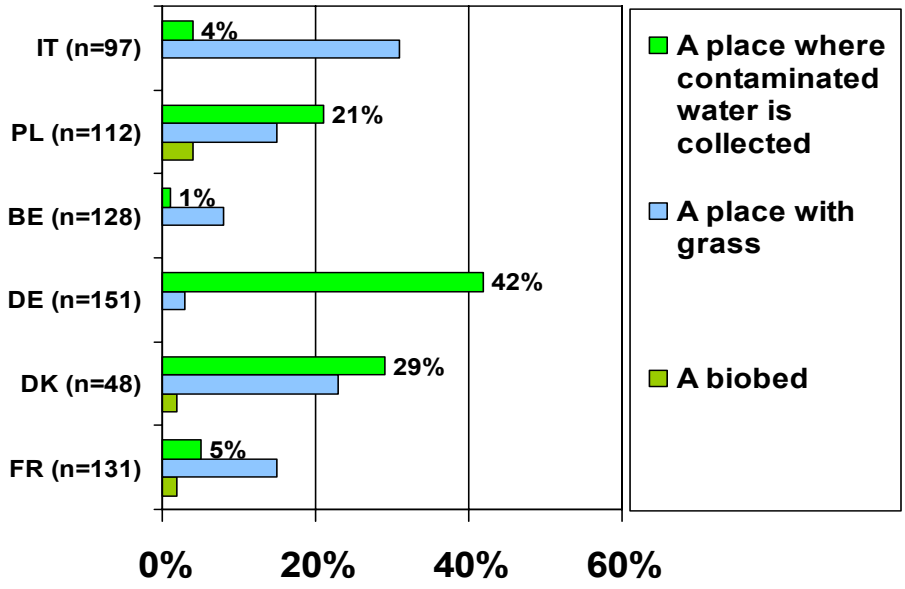


Figure 31: Remnant treatment place (Farmer survey 2007)

Three different concepts, that are pursued in various countries can be identified.

a) Collection of remnants in slurry tank

This system is only feasible on farms where animal production is done.
It requires that the cleaning process is performed as described in the cleaning section (only diluted spray liquid) as degradation processes in the slurry are limited.

b) Biopurification systems (Biobeds, Biofilters), Figures 32, 33);

Such systems have been researched in few countries and they are officially approved in the UK, FR, BE (part). In Sweden biobeds are recommended mitigation tools.

Such systems are recommended to be combined with collection tanks which allow a continuous delivery of contaminated liquid to be treated. Biopurification systems have shown to be efficient and offer farmers a possibility to mitigate the point sources risks at reasonable cost.
Degradation rates for most products investigated vary between 95 and 99% (Further details see TOPPS bio purification brochure / **www.TOPPS-life.org**).
The bioactive matrix is normally used for 6 to 8 years. It is recommended to spread this utilized matrix in the field. In some countries this recommendation is not given or regulation do not allow such procedure.

c) Physical / Chemical systems

Approved methods in some countries are systems using charcoal which filters PPP out of the contaminated liquids, systems which evaporate the water and treat the remaining solid as a special waste or systems which try to separate the liquid and the solid phases through membranes.

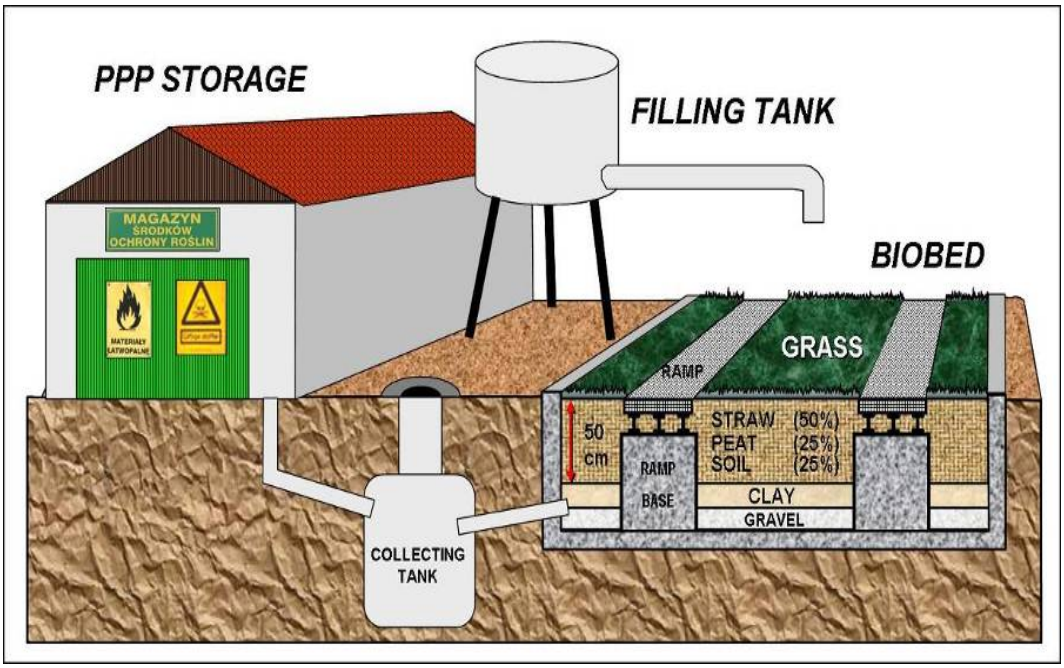


Figure 32: Bio-bed infrastructure for sprayer filling / cleaning (picture ISK)

3.3.1 Cost estimation of the infrastructure for treatment of the remnant

a) Washing place, water proof which drains to the slurry tank
Depending on size: cost about 30 €/ m² (Farmer contribution not considered)

b) Biopurification systems
Biobed / Phytobac / Biobac: 5000 -10000 €
Cost could be higher for larger biobeds (high volumes to be treated and if biobed is built completely by a special company)
Biofilter: 1000 -2000€ (built by farmer)

c) Physical / chemical systems
Sentinel, Phytomax / Phytocat (physico-chemical water treatment, active coal): ~25 000 € to 35 000 € (system)

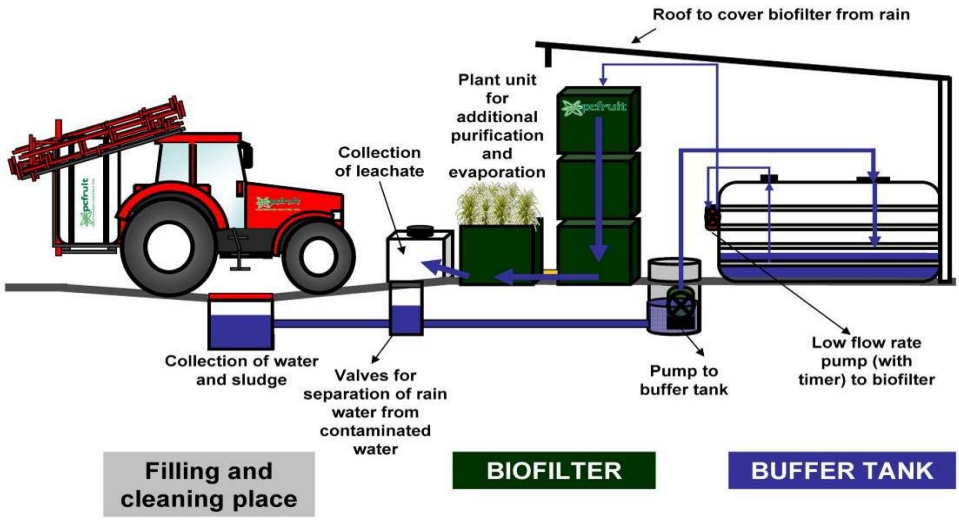


Figure 33: Bio-filter infrastructure for sprayer filling (Picture pcfruit)

4. ORGANISATIONAL STATUS

Avoidance of point source pollution starts with the BMPs. Key factor is the correct use of PPP, which is mostly related to aspects of behaviour.

The equipment and infrastructure are important tools to mitigate risks in case of mistakes or accidents. Therefore it is essential to understand which organisational structures are in place to develop, update, transfer and to implement BMPs as this is relevant to change behaviour.

The analysis provided describes the status on a qualitative rather than on quantitative level. It is based on information received from the pilot catchments areas from our partners. Results may not be representative for a certain country, because advice structures and also BMPs can vary a lot in the countries and by regions.

4.1 BMPs development and updating

4.1.1 General

If we compare the situations in the 6 different catchments we see large variations concerning the development the use and the updating of BMPs. The concept of BMPs is generally known as a tool to transfer information to farmers. Specific BMPs on water protection do not existing in all catchments (BE, FR, DK, DE).

The contents of the BMPs vary strongly in the level of detail. On many occasions the recommendations are not very specific. PPP use and water protection is complex and general recommendations do not address this complexity for example: Threshold values are set by regulators but these are not explained to operators in detail as to what it means for their practise.

The TOPPS BMPs therefore were developed not only on the basis of what to do but also on the level of how to do things.

4.1.2 Development of BMPs (Water protection)

Currently there is not a common process established to develop BMPs across the catchments related to water protection.

Some countries develop BMPs on a national level others on federal or regional levels. This sometimes results in different BMPs even in the same country. This creates inconsistencies in the recommendations given and may lead to confusion by operators. (Example: Approval of bio-purification systems, differences in distance regulations to surface water). Broad involvement of stakeholders is often missing, which may results in not sufficient support of BMPs.

BMPs are often very general and unspecific. Sometimes they focus on selected work processes and do not consider the work processes relevant from start to the end. (Details on the compliance of local recommendations/ regulations with TOPPS-BMPs see in Annex 4). If the BMPs are too general operators do not get clear guidance for their practice.

4.1.3 Updating of BMPs

BMPs are generally not updated on a regular schedule.
Updating is done mainly when new regulations need to be considered.

General objectives and targets are expressed in the BMPs but these are not specified i.e. for a specific area. Therefore it is often not clear which targets should be achieved and how progress is monitored.

4.1.4 Accessibility of BMPs for advisers and operators

The term BMP in agriculture is used very general and often a simple web search would not lead the operator directly to the information he is searching for.

A good example found is the “Green Code” of the PSD (Pesticide Safety Directorate, an agency of the Department of environment, food and rural affairs in the UK) They publish the “Code of Practice for Using Plant Protection Products” where farmers and advisers get all information for legal compliance from one place. For further information see web site: **http://www.pesticides.gov.uk/safe use**).

Similar systems are in place in France (CORPEN). A dedicated term for the safe use of PPP in countries could help to find respective materials and guidelines better. BMPs information sometimes seem to be buried on advisory services or ministry websites (visibility and accessibility of BMPs should be improved). (See description CORPEN)

During the TOPPS project it also appeared obvious that no European structure exists, that represents organisations delivering advice and education to farmers. This makes it difficult to develop common consistent content relevant for the BMPs, which also act as a legal reference and requirement for supports given by the CAP to farmers. (Table 6)

Table 6: Description of BMPs development as reported from the catchment areas			
Country	Belgium	France	Germany
Catchment	Yser	Yser	Stever/Haltern
General BMPs	yes	yes Technical info on PPPs application and handling guidelines (TAM)	yes
Specific BMPs related to PPPs and water protection	yes	yes	yes
Who developes guidelines	Flemish Dept. Agriculture & Fisheries	National committee of stakeholders (CORPEN)	Advisory service, Water industry, Companies, Farmers (Regional)
Who approves guidelines	Flemish Authotity Dept. Agriculture & Fisheries	National committee of stakeholders (CORPEN)	Advisory service, Water industry, Companies, Farmers (Regional)
How old are the current guidelines	2006	2006	2007
How often are guidelines updated	if new regulations	if new regulations	if new regulations
General or specific guidelines	general with some specifications	specific recommendations	general recommendations
Target group	Adviser&Farmers	Farmers	mainly Advisers
BMPs obligatory or just recommendations	recommended	recommended with incentives	obligatory and recommended
Other information	update planned 2009	BMPs are usually updated based on specific crop aspects supported by technical institutes. They are diffused by local experts to farmers	
Country	Denmark	Italy	Poland
Catchment	Bygholm	Tanaro	Utrata
General BMPs	yes	yes Regional Rural Development Plans - Guidelines (PSR)	yes
Specific BMPs related to PPPs and water protection	yes	No	No
Who developes guidelines	National committee of stakeholders National consensus	Regional Administration Plant Protection Dept. Regional consensus	
Who approves guidelines	National committee of stakeholders National consensus	Europe (PSR.Plans)& Regions approve	
How old are the current guidelines	1999	2007	
How often are guidelines updated	if new regulations	every year	
General or specific guidelines	most general with some specifications	most general with some specifications	
Target group	Farmers	Farmers&Advisers	
BMPs obligatory or just recommendations	obligatory and recommended	obligatory and recommended	
Other information	New regulation will be published soon and BMPs will be updated	if mandatory guidelines are not respected penalties by reducing subsidies	

Case study CORPEN: Structure to develop and transfer BMPs

In France the Ministry of Ecology and Sustainable Development and the Ministry of Agriculture and Fisheries are in charge of the CORPEN (Orientation Committee for agricultural practices that respect the Environment)

Created in 1984, the CORPEN (www.ecologie.gouv.fr/-CORPEN-.html) is a forum for analysis, expertise and definition of proposals. In the field of agricultural practices, it develops and disseminates recommendations contributing to the reduction of pollution and to take greater account of environmental issues.

Since 1992 the CORPEN have enlarge its field activity to the pesticides. In 1996 CORPEN edited a Brochure concerning pesticides (Application techniques and handling of pesticides used in agriculture - elements to prevent the risk of water pollution.

By the end of 2006 a Brochure was edited "Techniques d'application et de manipulation des produits phytosanitaires, Application techniques and handling of pesticides". This document is available online at the following address (www.ecologie.gouv.fr/Techniques-d-application-et-de.html).

This brochure that the French Government has established is in fact a BMPs brochure. But the CORPEN is not very engage (limited numbers of persons and not its first mission) in training of the advisers.

The CORPEN is diffusing its brochure and documents to the public on its internet site and by the past was sending for free its brochure to the people in charge of pesticides management in the Agricultural Chambers.

CORPEN is now well known in France for pollution prevention and people dealing with the pesticides use.

4.2 BMPs transfer (analysis based on 6 pilot areas- BE, FR, IT, PL, DK, DE)

4.2.1 Transfer of the BMPs from the development to the advisers

Advisers translate and transmit knowledge from research and administration to the operators.
We have not found very structured and transparent approaches in the catchments, where advisers are trained on BMPs. (Table 7).
Public advisers are mainly informed on voluntary basis in meetings, where training is often provided by their central organisation of the advisory service. Advisers from industry and the distribution network are not included in a general or systematic information and training scheme and an overview of who has been trained on what subject seems not to be available.
The only structured system to ensure training and updating of all advisers in the field is the BASIS system in the UK. This concept includes all potential advisers and has the theoretical potential to reach a maximum number of farmers for the advice.

Example: BASIS®
BASIS® is a certification system, which requests that all persons giving advice to farmers need to accumulate points in a certain time and on defined subjects, showing they have updated their knowledge in order to renew their license as an adviser.
Points are collected by attending information meetings, conferences, trainings, etc. which have been certified by BASIS. The curriculum of BASIS courses has about 30% on water protection.
Stakeholders define the subject areas in which points need to be collected. (**http://www.basis-reg.co.uk/**.).
BASIS® is an independent organisation set up at the suggestion of the UK Government in 1978 to establish and assess standards in the pesticide industry relating to storage, transport and competence of staff. It is an industry self-regulated scheme, in line with Government deregulation policy, giving balanced and independent advice to registered distributors. It does not seek to emulate the role of any Government enforcement agency. BASIS became a registered charity in 1999.
The BASIS Registration Board consists of representatives of all trade associations with pesticide interests such as the Crop Protection Association (CPA), National Association of Agricultural Contractors (NAAC), National Farmers Union (NFU), Agricultural Industries Confederation (AIC), Association of Independent Crop Consultants (AICC), and County Council representatives. The Board also has members elected by distributors as well as representatives of both Defra and HSE as observers. It is headed by an independent Chairman.

4.2.2 Transfer of BMPs from advisers to operators

Two main aspects of advice can be distinguished: advice that is focussed mainly on commercial aspects, and advice on non commercial aspects.
Commercial advice may be defined as that likely to directly influence the income of a farm. This advice is given by all sources of advice, independent advisers (public, private) and by industry and distributors. This advice is mainly based on cost / benefit aspects important for the farmer.

Non commercial advice concerns practices to protect environment or the transfer of legal regulations. This advice is normally not relevant for the farm income in a short term if not coupled to incentives, subsidies or fines. This advice (BMPs, Regulations) is mainly a domain of public or semi public advisers. If a "market" for such advice could be developed for the advisers and the operators the interest to give or receive such advice could be increased.

In the farmer survey 2008 (Table 8) we can see that the main source of information for BMPs is printed information (Farm press, brochures). The second most important source of information is the direct interaction with an adviser.

Table 7: Transfer of BMPs to advisers as reported from the catchments			
Country	Belgium	France	Germany
Catchment	Yser	Yser	Stever/Haltern
Obligation to update knowledge ?	no	no	no
Trainings implemented in the catchment ?	yes	yes	yes
How much of trainings focus on water protection?	2007 -3 (2 TOPPS, 1 Phytophar) 2008 - 2 (1 TOPPS, 1 Phytophar)	1 to 2 (1 TOPPS) depends on "news" too	1 to 2 per year
Who provides trainings	Public agriculture research centre (e.g.POVLT) Flemish govern-ment, Farmers organisations, Phytophar	1) Arvalis 2) Own initiatives of the local advising structures (f.e Chambre Agriculture)	Landwirtschaftsd Kammer NRW
Frequency ?	It depends on "what is hot news" but annually in the calm periode	1) Once per year 2) ?	3 to 4 per year
How many advisers per session?	Depends very much on subject	1) 15 2) depend on subject	from 10 to 30
Duration of training ?	hours to one day	1) 3 days + 1 day for updating 2) hours to some days ?	1 day (6 hours)
Do trainings provide a sort of certification?	no	1) yes 2) no	no
What sort of certification is provided ?	Attendance certified		
Are there specific trainings for advisers who opewrate in sensitive areas ?	no	Not "officially" but in their job advisers need to be aware on specific regulations, subsidies	yes (nitrates & pesticides issues on water ect.
Is quality of advice evaluated?	yes	no	no
How is advice evaluated ?	Controls by nat. Centre for Agr.Trainings-NCBL&Agr.Training Center West Flanders; they follow courses and check teachers (National Agr. Centre)	no	only trough improving of water quality
Country	Denmark	Italy	Poland
Catchment	Bygholm	Tanaro	Utrata
Obligation to update knowledge ?	no	no	no
Trainings implemented in the catchment ?	yes	yes	yes
How much of trainings focus on water protection?	2	only those of TOPPS	about 5 (majority on PL&EU regulations; 1 for TOPPS
Who provides trainings	Tarinings organised by DAAS 1 national, 2 regional trainings (TOPPS)	expert from farmers unions, Representatives of regionalor provincial administration, occationally privat companies	Advisory centres, Institutes of plant protection, Institutes for agricultural subsidies, Ministry of Agriculture, Research Inst.,Universities
Frequency ?	Once	2 to 3 per year	From TOPPS 1 Training , 30 persons
How many advisers per session?	1) about 120 2)20 to 30	from 20 to 200	From 10 to 30
Duration of training ?	1 day (6 hours)	1 day	1 day
Do trainings provide a sort of certification?	no	no	?
What sort of certification is provided ?		attendance	?
Are there specific trainings for advisers who opewrate in sensitive areas ?	no	no	No
Is quality of advice evaluated?	no	no	yes
How is advice evaluated ?	surveys in past on 30 farms conducted by DAAS		MODR makes controls on basis of surveys on farms

How have you received information / advice on the correct practice to reduce the risk of water pollution related to PPP ? (Framer survey 2008)						
	FR	IT	DK	BE	DE	All
Farm press ?	84	11	55	84	43	60
Information materials (newsletter, brochure, guidelines, flyers, etc.)?	76	68	59	78	55	69
personal advice ?	49	58	17	24	40	38
farmer fielddays ?	45	24	7	27	53	32
participation in trainings with other farmers?	44	33	3	21	36	29
agricultural meeting events ?	44	36	10	25	46	33
farm audit ? (personal advice + report)	40	11	14	11	15	21
visit of demofarm ?	30	28	0	3	16	17
internet ?	30	4	12	28	13	19
Other?	12	0	7	0	8	6
Catchment survey 2008						

Table 8: Information source of farmers to reduce the risk of pollution from PPP (survey 2008)

It could be valuable to specially investigate the best methods to transfer BMPs to farmers and to measure changes in awareness or behaviour in order to optimize learning outcomes and advice efficiency.
Information received from catchment partners indicated that about 30% (PL) rising to more than 80% (DK) of the farmers have access to the internet. The use of the Internet as an information source for BMPs is not really strongly used except in FR and BE.
It should be investigated if the BMPs messages on the internet are presented in an easily understandable form and if they could be readily accessed by operators.

In the catchments survey farmers were asked from whom they get information related to PPP use and water protection (Table 9). If we compare across catchments we can conclude that the distribution system of PPP and the public/private advisory services are regularly mentioned. Farmers unions in Italy represent 70% of the source providing advice to farmers.

The results also need to take into account the roles of organisations which are not always comparable in the countries.

Which organisations have informed / adviced you on how to optimize your practices related to pesticide handling to protect water? (Farmer survey 2008)					
	FR	IT	DK	BE	DE
farmers union	47	70	6	28	30
wholesale/ retailer of pesticides	63	12	-	35	45
public advisory service	59	10	-	13	40
private advisory service	43	34	50	9	18
Cooperative	56	0	31	3	43
Pesticides manufacturers	30	6	12	25	30
water agency	29	1	9	1	26
food industry	36	0	4	7	0
technical institutes	18	2	9	14	11
municipality	10	6	18	13	6
farmer colleagues	41	7	31	28	34
other	16	1	11	3	5

Table 9: Organisation informing the farmers on how to optimize their practices

We notice large variations in the answers referring to PPP manufacturers and the water industry. Obviously farmers mention many sources of information, but we cannot judge the quality, completeness and reliability of the information they receive.

4.3 BMPs implementation

4.3.1 Status on Training and Education (farmers)

The education systems to become a farmer are reflected by different levels of qualification in all countries. Comparison of the level of education could not be evaluated in TOPPS. Farmers surveys showed that more than 80% (DE, FR, PL > 90%) of the farmers have a formal education in agriculture. Two exceptions in farmer's education levels are evident in DK with 74% and 49% in Italy, having a formal education. These are areas where a high share of part time farmers operate.
There is no obligation to update the knowledge regularly except for Denmark and Poland where sprayer licenses need to be renewed. Some certification and crop assurance schemes require farmers to update their knowledge if they wish to remain certificated or to sell into certified markets (Special certification schemes).
Currently the update of farmer's knowledge is mostly voluntary and is normally achieved by participation of the farmers in meetings and demonstrations. The content of the presentation given in the meetings varies depending on specific topics relevant in an area or broader context. It is not known if there is documentation available on the contents delivered or if records are made as to who has attended such meetings.

Detailed analysis of the farmer survey in FR shows that the awareness of the importance of point sources compared to diffuse sources shows a positive correlation to formal education (the higher level the higher the significance of point sources) (Figure 34) and by the activity of the farm (arable crop producers see point sources more important than animal producers) (Figure 35)

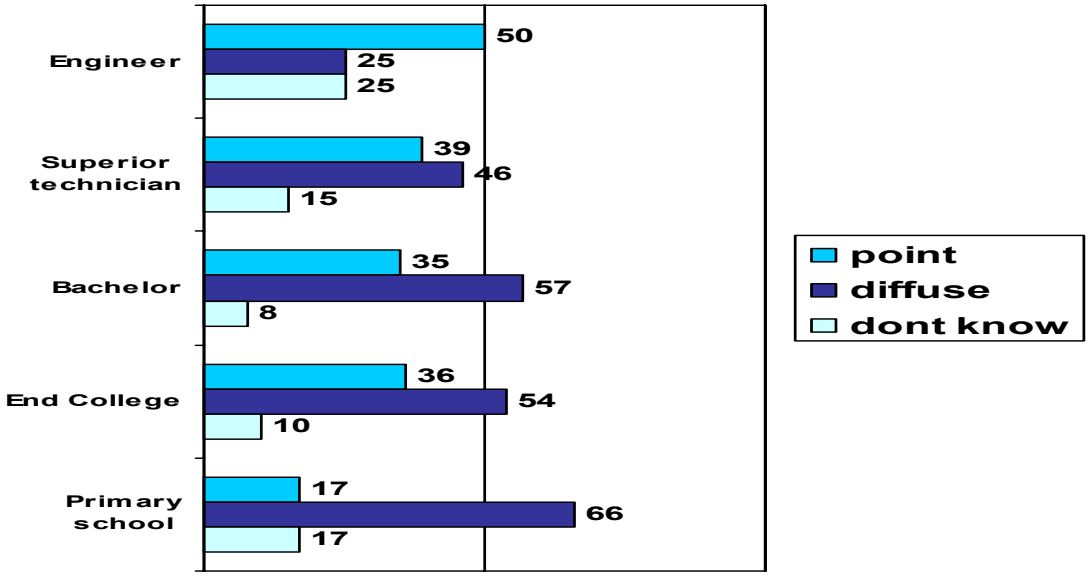


Figure 34: French farmers formal education on pollution source perception (2008 survey)
(What is the most important entry route for PPP into water?)

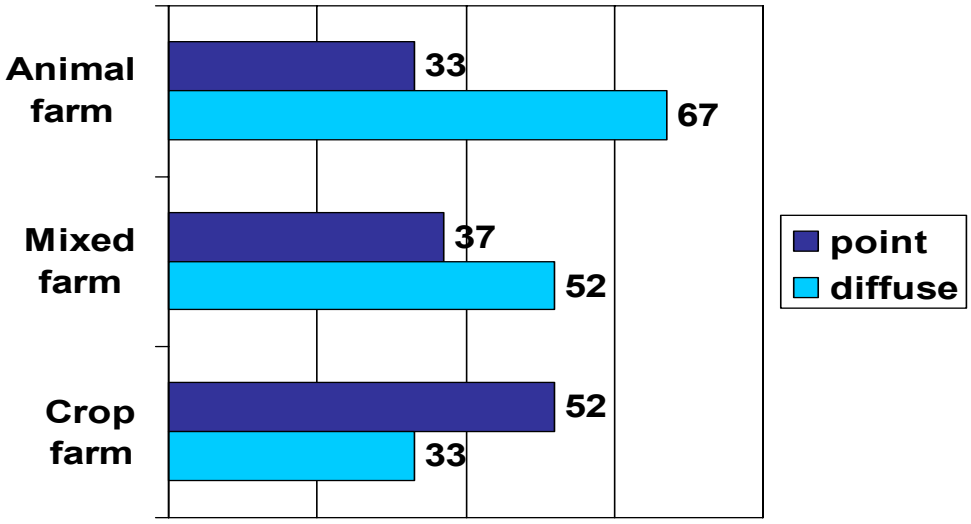


Figure 35: Perception of pollution source related to farm type (Farmer survey France 2008) (What is the most important entry route for PPP into water?)

4.3.2 Access to farmers with BMPs advice

Farmers participating in meetings and trainings are not registered except in DK. This means that there is no information which farmer has received training on a certain subject.
Reports from partners in the catchments areas estimate that about 25% to 30% of the farmers are reached by the current advice and training schemes with BMPs advice. (Report from Italy estimated 50% to 60%).
BMPs on the correct use of PPPs are relevant for each operator; therefore the accessibility of all operators by the current advice structures is considered a big challenge.
In the farmer survey 2007 between 40% (BE) and 97% (PL) said that they intend to participate in a training related to PPP and water protection (Figure 36).
It seems that farmers prefer different approaches to being informed about BMPs and probably needs work more to target specific groups to meet their different preferences.

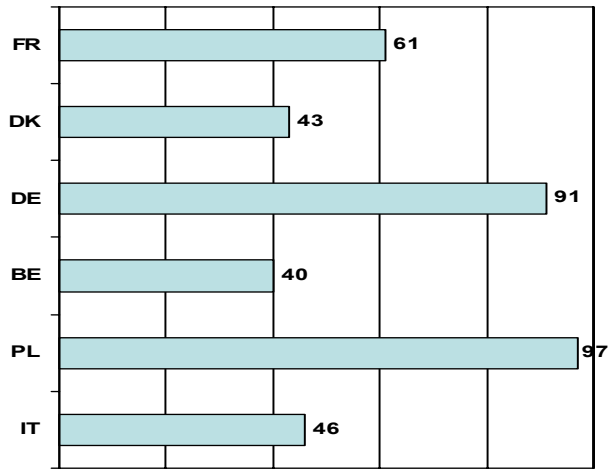


Figure 36: Intended participation in an information meeting in the next 5 years on PPP and water protection (Farmer survey 2007)

4.3.3 Practical experiences on implementing BMPs (Case studies)

a) Case study DK (Poul Henning Petersen DAAS)
Information and advice as an instrument in the Danish Pesticide Action Plan (PAP).

Project period was 2000-2002: The activity has been continued in a less intensive way in the PAP 2004-2009.
In the project different instruments were used to reduce the risk of contamination of pesticides in the environment:

- Education of advisors
- Checklist with BMPs developed by Danish Agricultural Advisory Service
- Farm audits by independent advisors in the Danish Agricultural Advisory Service

Education of advisors
A collection of training and information materials was developed. The materials described the problems concerning point sources and how to avoid contamination of the environment. In the year 2000, six "one day courses" for advisors and agricultural teachers were held with 116 participants (mainly advisors). About 25 percent of advisors of the advisory service participated in these courses.

Checklist:

A checklist describing all processes involved in handling the pesticides was used in farm audits. The audit normally took place as a separate visit of about 2 hours on the farm. Farm infrastructure and practices were discussed. Improvements for better practices were identified and proposed.

Results:

Reports from the 2008 audits have been analyzed and the findings are:

- About one third of farmers are cleaning the sprayer on farmyard area with gravel or concrete, where spills and cleaning water is not collected.
- About 50 percent of farmers are filling the sprayer on a farmyard area with gravel.
- About 22 percent of the farmers did not use the remaining spray solution on the last sprayed crop.
- About 80 percent of farmers did not adequately dilute the remaining spray solution.

Experiences from the project:

- According to the advisors the audits has increased the awareness of the farmers regarding point sources.
- Almost all farms have a potential for a better practice
- Farmers are willing to make changes, but much more focused advice need to be delivered.
- The motivation of the farmers to participate in the project (audits) was dependent on the enthusiasm of the adviser

PAP 2004-2009

Concerning information and advice on the handling of pesticides, the activities have continued as an instrument in PAP 2004-2009. Advisers have reported the data shown in figure 37

From 2004 to 2007 the number of farms has been 227, 284, 240 and 563. In 2007 the average area of the farms has been more than 200 ha. In 2007 about 80 percent of the sprayers had rinse water tanks indicating that these bigger farms have relatively new sprayers. In the period 2004-2006 the average area has been considerably smaller and the percent of sprayers with rinse water tank was only about 50 percent.
The case study shows that information and advice alone had not been able in four years to change the behaviour of filling the sprayers.
Neither the mitigation measures have significantly increased (Filling place able to collect spill and washing water) nor has the filling process been shifted to the field or areas with vegetation.

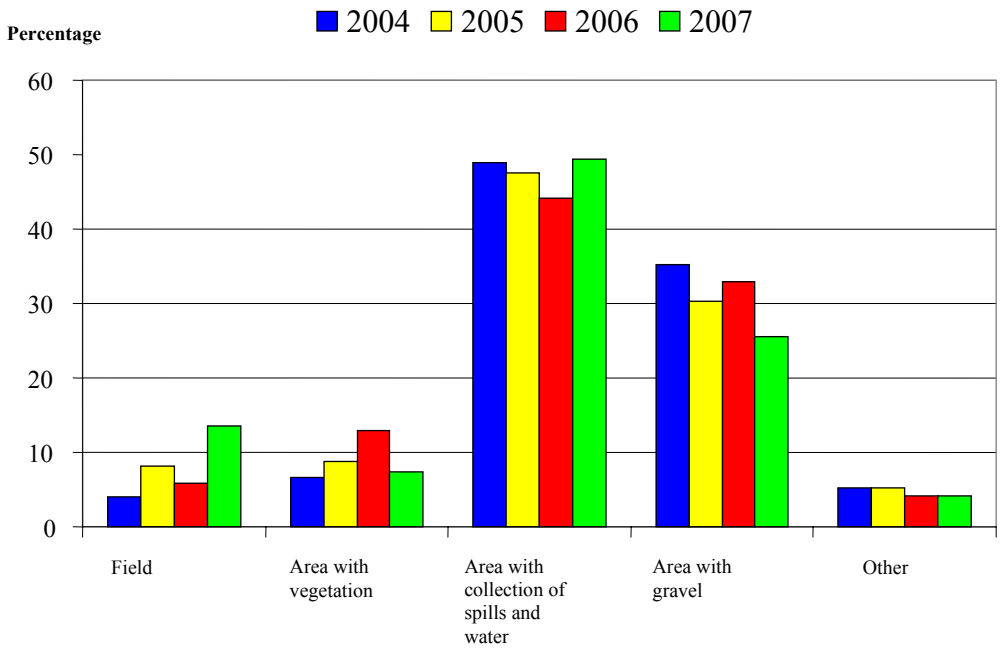


Figure 37: Area on the farm where the sprayer is filled (DK 2004-2007)

b) Case study DE
Measures and strategies in the Stever catchment to deal with PPPs in water: Learning for the TOPPS Up - scaling proposal. (Harald Kramer LWK-NRW).

General description of the area:

The catchment is situated in the northern part of North Rhine Westphalia – Münsterland. The median temperature is 9.5 °C and the precipitation about 730 mm/a. The Stever catchment has a total area of approx. 880 km², with two different catchment sub areas Stever and Halterner Mühlenbach. About 70 % of the area is covered by drainage.

The Stever area has a lot of heavy clay soils, with cracking after dry periods presenting and a high risk of pesticide leaching to drains and ditches. In parts with dense subsoils, interflow is important and has to be considered too.

The area used in agriculture is approx. 52.000 ha with about 1.600 farms. 800 farms participate in the water cooperation "Stever". (*Cooperation: Joint effort of Farmers, Waterindustry and Landwirtschaftskammer (regional advisory service) and other stakeholders to reduce PPP pollution of surface water.* Farmers voluntarily participate in the cooperation and cover about 60% of the catchment area.
The water is collected in the artificial lake "Halterner Stausee". After filtration through sand basins (about 80 m thick) this water is used with enriched ground water for drinking purposes for more than one million people.

Problems:

After the introduction of the Drinking Water Regulation in 1986 and continuous monitoring for pesticides it became clear that for certain pesticides – Isoproturon in cereals and Atrazin used in maize – the requirements of less than 0,1 µg/l per pesticide - could not be met without changes.

Measurements in the river Stever showed that in the first weeks after application peaks of several µg/l of Atrazin or Isoproturon could be found in certain years associated with heavy rains short after the main application periods.

Important steps and activities in the "Stever cooperation":

Members of the cooperation are: the chamber of agriculture (LWK NRW after 2004), local authorities, water suppliers, ministry of agriculture, the farmers union and local farmers.

- 1994: Isoproturon substitution programme
- 1997: Isoproturon optimization programme
- 1999: Withdrawal of Isoproturon and Chlortoluron on light sandy soils and clay soils with drainage. Further substitution of active ingredients: Bentazon, Terbutylazin and Metolachlor

- 2006: changes in weed populations created new challenges, requiring permanent adaptation of necessary control methods (management with herbicides of different mode of action).

- During all these years financial support was given for technical improvements and for advice on crop growing practices by the water suppliers.

Cooperation Strategy

The four key elements

- Free advice on BMPs to operators supported by water industry)
- Incentives (support) for technical improvements
- Management of active ingredients (change or substitution)
- Methods of last resort (charcoal for purification)

Implementation - Supportive measures:

- Additional advisors at the chamber of agriculture (LWK NRW) in the catchment area (free of charge advise on BMP's and crop husbandry through field days, lectures, faxes and farm visits)
- Financial support for:
  - Anti drift nozzles
  - Induction hoppers and clean water tanks (sprayer cleaning in the field).
  - Filling and washing places mostly connected to slurry tanks (avoidance of Point Sources).
  - Buffer strips (reduction of interflow and run off).
  - Management of active ingredients (Atrazin, Simazin, Isoproturon, Chlortoluron, Terbutylazin, Metolachlor, Bentazon).
  - Advice and tools for reducing the nitrogen concentration in surface water (N_{min} surveys, fertilizer adjustment and nitrogen efficiency).

Results / Successes

- Reduction of pesticide concentrations in surface water below the threshold of 0.1µg/l for drinking water.(Figure 38).

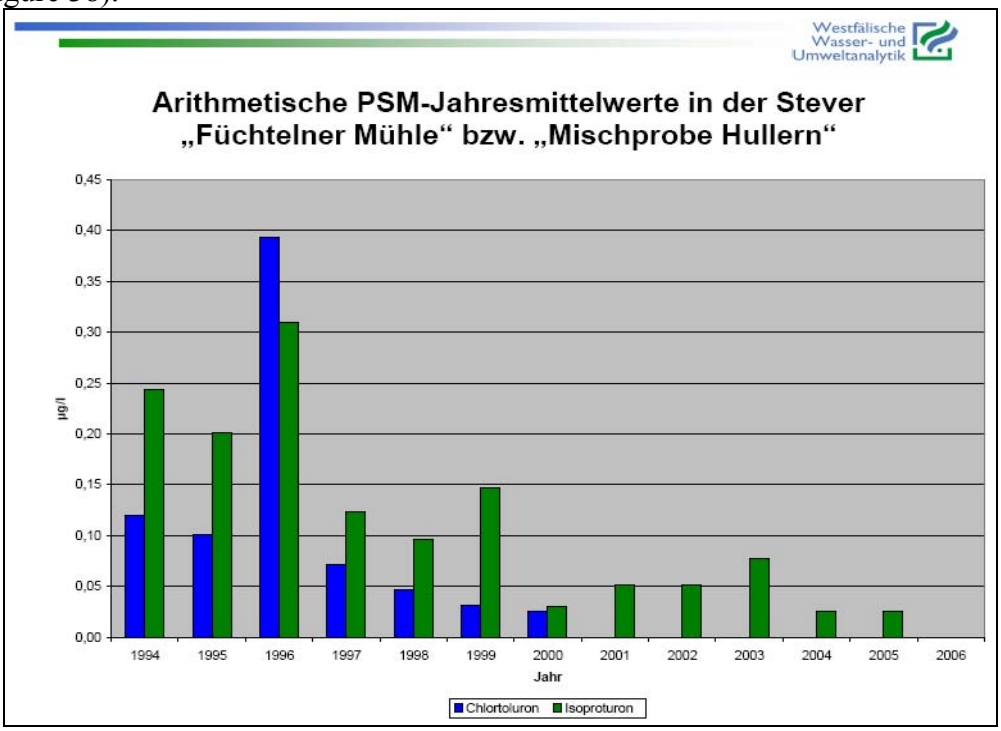


Figure 38: Means of annual averages of PPP'S in the Stever "Füchtelner Mühle" and "mixed sample Hullern" respectively (Wirth, M., Stever yearbook, 2006)

- Charcoal filtering of water was only necessary under worst case situations – after heavy rainfalls in the main spraying season(s). There have been cost savings of more than 1 Mill.€ in the last years compared to the early 90th on charcoal (Figure 39).

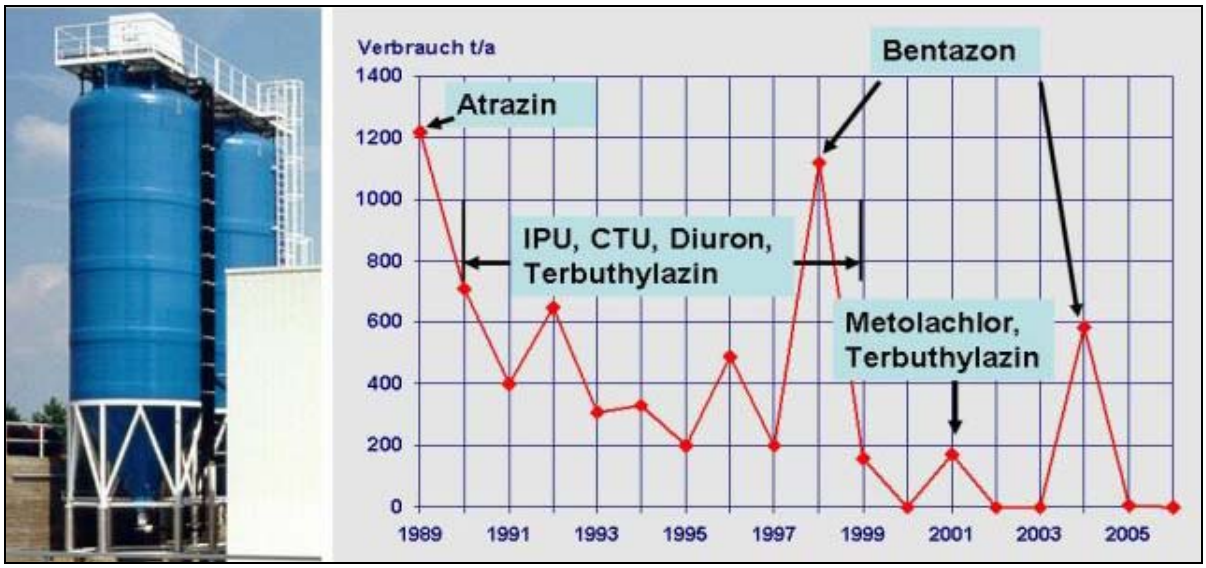


Figure 39: Use of charcoal in the waterworks Haltern due to active ingredients (Wirth, M., Stever yearbook, 2006)

- Technical improvements and their effect to reduce point sources

The measures suggested are almost the same as identified and proposed in the TOPPS-project to avoid point sources.(Table 10, 11)

Description	2001 - 2006	% of farms (water cooperation)
Clearing places	117	> 10 %
Induction hoppers	96	
Multi nozzle holder	42	< 10 %
Spray lance - external cleaning	4	
Cleaning brush	8	
Rinsing nozzle	28	
Clean water tank	24	
Spray computer	14	
Driving guidance	7	
Foam marking	3	
Circulation systems	5	
Electronical field book	12	
Removal of old PPP's	34	
financial support in total	Approx. 250.000 €	

Table 10: Financial support for technical improvements (number of farms)

Description	Importance
Filling and cleaning places	XXX
Induction hoppers	XXX
Multi nozzle holder	X
Spray lance - external cleaning	XXX
Rinsing nozzle	XX
Clean water tank	XXX
Separate pump for continuous cleaning	XXX
Spray computer	XX
Driving guidance	—
Foam marking	—
Circulation systems	X
Electronical field book	X
Taking back of old PPP's	XX

XXX = very important, XX = important, X = useful, — = further improvements

Table 11: Suggestions for technical improvements

- Support on advice
  Participants in field days: **500/a**
  Participants in lectures with main focus on water protection: **300/a**
  Recipients of faxes: **700/a**

Lessons learned:

Several cooperations in North Rhine Westphalia were established in catchment areas the majority of which now manage the surface water quality with no serious problems concerning thresholds for PPP's. Under very special and difficult conditions, like those in the Stever area, improvements of the advisory system and financial support for technical upgrading have resulted in improvements in the water quality.

In certain river subsystems (heavy clays with drainage systems, high percentage of certain crops and therefore high inputs of certain a.i.'s) additional problems may arise, which can be solved by a higher input in advice and technical improvements.

Under very adverse conditions there has to be an active management of the active ingredients used.

Summary:

For most active ingredients and river subsystems the cooperative approach is sufficient. In a few river areas with heavy clay soils or silty soils prone to erosion and high percentages of winter cereals or maize a substitution of some active ingredients was / is proposed with additional advice and incentives paid by the water companies – Isoproturon, Atrazin, Bentazon and to a certain degree Terbutylazin.

Since something changes all the time - withdrawal or introduction of new active ingredients, changes of cultivation practises - a continuous monitoring programme accompanied by adjustments in management practises and use of chemicals is necessary.

The main threat is the rising importance of resistant weeds. This has occured because only a few modes of actions can be used and the prospect of new active ingredients looks less promising. It is therefore very important to maintain a large "toolbox".

The Stever cooperation case shows that advice and incentives to promote changes in behaviour and in the mitigation measures (technique/infrastructure) are effective to manage the surface water quality. In the Stever cooperation farmers who participate represent 60% of the area. As the results show this was sufficient to stay below the threshold for drinking water, in even more difficult situations mandatory cooperations might be necessary.

Nevertheless a comment needs to be made that the Stever catchment is a highly vulnerable area as outlined in the introduction of this case study.
Other German locations with shallow groundwater table, low adsorption capacity of the top-soil layers and high infiltration rate to groundwater (e.g. on carstic soils) are considered to be potentially vulnerable as well. In these areas joint recommendations are to be developed **proactively** and combined with the cited adjustments in management practice and use of chemicals early enough.
Today, solid principles are adapted proactively in vulnerable areas - and these step by step (which is done for certain compounds (e.g. terbuthylazine). First of all, reliable data from geoclimatic and agronomic conditions are to be linked with the elucidation on existing findings. Driven by the vulnerability of an area and the customer-/grower-needs, individual management practices are to be fine-tuned. Here product-profiles and their use are advised in the direction of rate-justification and use-optimization. This includes new or further risk-mitigation options as well. It´s logical that for the successful adaptation of adequate management practice all relevant stakeholders are to be involved.
Regions with high parts of monoculture and regions need to be assessed very carefully as well
At the end the feasibility of specific management systems in a region can be proven by monitoring data.

c) Case study FR (Julie Maillet Mezeray, Arvalis): "Common approach to improve water quality"

Certain regions in Bretagne have been identified as having problems with PPP pollution in water. The project described has been running since 2005 and shows an approach to implement BMPs in order to improve water quality.

The project is based on three major elements:

1. Multi-stakeholder involvement
2. Advice / Audits (transparency, documentation)
3. Incentives

Stakeholders involved:
Arvalis: Institut du vegetal (technical institute)

Arvalis has developed computer based audit tools which are able to identify risk areas for water pollution depending on the perspectives applied. The tool which focuses on the farm is Aqusite®, it helps to identify potential point source risks. This tool is used to conduct a systematic audit, which involves an adviser and the farmer. The audit take ½ day and delivers advice to the farmer during the audit and a report which proposes investments or practices for improvements. This report is the basis for the investments needed and for the application for financial incentives at the Conseil Regional de Bretagne.

Arvalis trains the advisers (public and private) to use the Aquasite® tool and to conduct the audit. The training takes two days and costs per person 1500.-€. With the Aquasite® training the adviser also receives a certificate which enables him to carry out an audit (Quality control)

CRODIP - Network of stakeholders in the region: Farmers Union, Chambre Agriculture, PPP-Distributors and Farmers

CRODIP started as a network in 1996 to organise audits on sprayers (sprayer testing). With the current project they have expanded their activity to include audits on farms.
CRODIP organises the basic work for the adviser trainings and organises the audits for the farmers. The audit reports are documented by CRODIP. For the services provided they receive 150 € per adviser training.

A certified adviser can offer audits to farmers. The cost of an audit is 500 € for the farmer. (250 € are paid by the farmer, 250 € are paid by the Conseil Regional de Bretagne).

Conseil Regional Bretagne (regional administration)

The regional administration (Conseil Regional de Bretagne) supports the activities. They sponsor each audit with 250 € and based on the audit report investments can be supported with 40% of the cost or maximum 1000 €. If incentives are given there is a control after one year to check if the investments supported were realized.

Results:

1450 audits conducted 2005 to 2007
1200 audits planned 2008
95 advisors trained and certified
About 300 investments were supported in 2006 with an average investment of 2700 €.

This project is an interesting BMPs implementation approach, because it uses a systematic tool, which helps to standardise the training given (consistent messages and content) and the results proposed.
The trained advisers will deliver the same analysis irrespective if they are working in the public or private sector. This increases the potential advice capacity available in an area and therefore can reach more farmers.
At the same time as the audit training is provided for the farmer and the documentation as to which farmers in the area have received training on the subject of water protection is transparent.

The audit approach would also allow progress to be measured over time if audits are repeated. They could be linked to set targets and would also be an indicator to measure the effectiveness of the advice. With such a concept a market for BMPs advice can be developed.

4.3.4. Implementation targets

We could not find any information in the catchment where concrete targets to implement the BMPs are set. This includes the analysis of the current situation, definition of measurable targets to be achieved after a certain time, criteria on which progress is monitored and its communication to all stakeholders.
In areas where there are incentives schemes or obligatory requirements (i.e. sprayer tests), statistics exist on what has been supported or tested over time, but it is not possible to relate this to the situation for the whole area. This information would be necessary to set targets (i.e. for upgrading techniques or infrastructure).

Without concrete targets the efficiency of the advice cannot be linked to incentives or measured. Motivated and engaged advisers are a key success factor for implementation.

4.4 How is the implementation controlled

We can distinguish two types of controls that are usually implemented through farm visits:

- One is managed by authorities to check if national and European regulations are followed (BE, DE, DK, FR and IT). The penalties may be fines and /or suppression of subsidies.

- The second is related to the crop assurance / certification schemes and industrial contracts. In case of non conformity, the certification or label can be suspended (BE, FR, IT and UK).

Three main processes are implemented in the catchments to enforce the implementation of BMPs relating to point source pollution by PPPs:
Sprayer inspection, licence for spraying and farm audits. In catchments, the degree of control varied and the implementation procedure are also very different.

4.4.1 Sprayer inspection

Inspection of sprayers is mandatory in Belgium, Germany and Poland and will start in France 2009.

The situation is different in the Piemont catchment (IT) since the inspection of sprayers is mandatory only for the farms that join PSR plans (Plans of rural development - EU subsides farming programs). The frequency of inspections varies from every 2 years (DE) to every 3 years (BE, PL) or every 5 years (FR, IT). The controls are managed in all the catchments by the authorities.
The TOPPS surveys results have shown that there are very few, if any sprayers that have never been inspected in the BE, DE, FR and PL catchments whereas the rate amounts to 51% and 37% in the IT and DK catchments. These results can be linked to local regulations (BE, DE, PL) but also with processing industry requirements (FR) (Figure 40).

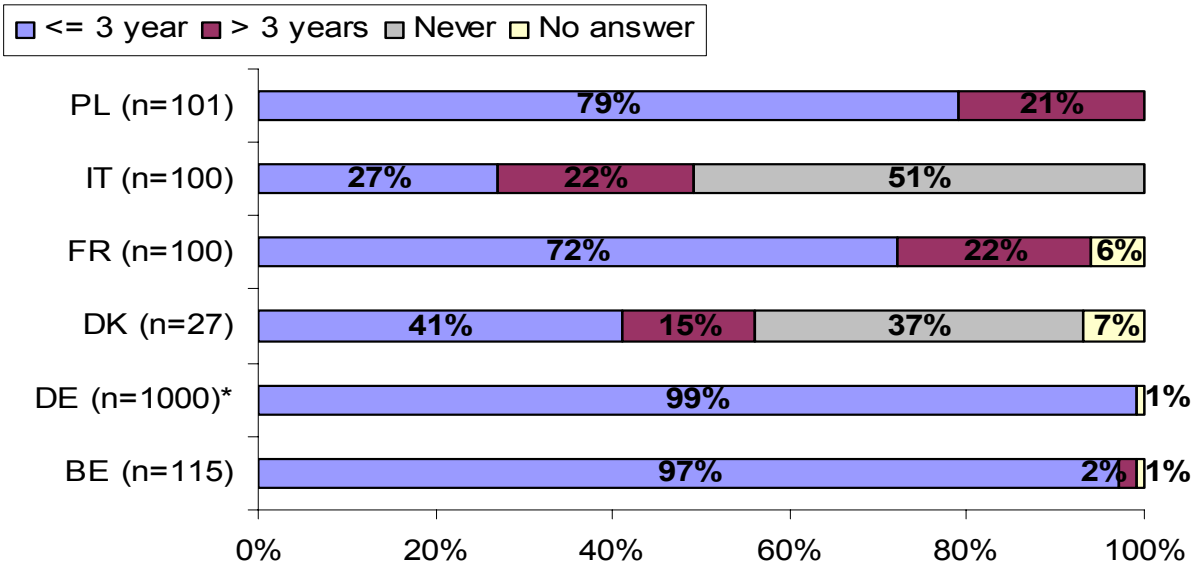


Figure 40: Date of the last inspection of your sprayer by a specialist company (TOPPS farmer audit in catchments - *Information comes from Cooperation report – Farm audit 2007)

In the French catchment most of the farmers are involved in industrial contracts which require the sprayer to be tested (e.g. GIQF, Agriculture contrôlée Mc Cain).
The situation is similar in UK: there is no mandatory inspection of sprayers but many crop assurance schemes require the sprayer to be tested annually (e.g. ACCS - assured combinable crops scheme).
In the Piemont farms that have joined PSR plans (EU – sponsored plan) require sprayer testing, but they do not cover all the sprayers. That is why 51% of the sprayers have never been inspected.

4.4.3 Spraying licence

A licence is required for spraying in several countries like DK, DE, PL and UK. Farmers can get such licence through public agricultural services, schools or universities. Farmers have to attend special courses to validate their knowledge partly in theoretical and / or practical tests. There are no directly comparable situations between the countries.

In Italy, the PPP license is necessary to purchase pesticides but not specifically for apply them. The courses for achieving the licence are mainly focussed on the biological and chemical aspects related to PPP and there is very little information about sprayers and PPP application conditions.

In Belgium, there is no mandatory spraying licence at the moment (planned for 2010) nevertheless farmers need to be an "authorised user" to use PPP's and this status is received with an agricultural education or after 15 years experience in farming.

The licence is usually valid for a lifetime (DE, DK, UK) except in Italy and Poland where the farmers have to renew it every 5 years (e.g. in Italy the courses for renewal of licenses are 8 hours long). Obligation to renew licences is likely to be more frequent in the future (e.g. DK, UK). Many crop assurance schemes in the UK require farmers to be members of the National Register of Sprayer Operators (NRoSO). This requires the accruing of 30 points over a 3 years period by attending training and knowledge transfer events (Points document participation and content of the training).

Table 12 :Licence for spraying (status catchments)							
	BE - Yser	DE - Stever& Haltern	DK - Bygholm	FR - Yser	IT - Alba	PL - Utrata	UK
Mandatory ?	No	Yes	Yes	No	Yes	Yes	Yes
Duration ?		Lifetime	Lifetime		5 years	5 years	Lifetime
Which organism issue the licence ?		Plant protection service Schools & university	The Danish EPA (Environment Protection Agency) regulates education programs for operators		The provincial Administration	Agricultural advisory service	National proficiency test council (NPTC)
Which requirements ?		Special courses & examination	Theoretical & practical tests		20 hours courses mainly focussed on the biological and chemical aspects related to PPP + 1 exam (multiple answers test)	16 hours of training courses + final test	1 written test on legislation/PPPs safe use&storage 1 verbal test 1 practical demo
Other information	Will be implemented within 2 or 3 years		Renewing of licence will probably become mandatory in the future		In Italy a licence is mandatory for purchasing pesticides but not specifically for spraying PPPs Courses for renewal of licenses (every 5 years) are 8 hours long		The duration of the licence will probably become 5 or 10 years in the future + Many crop assurance schemes require the farmers to be member-ship of the National Register of Sprayer Operators (NRoSO) which requires to accrue 30 points over a 3 years period

5. MOTIVATIONS TO CHANGE AND MEASURES TO SUPPORT CHANGE

5.1 Motivation for change

In the 2008 farmer survey, farmers were asked what they considered the major drivers to change their practices to reduce point sources. Variations among countries were considerable but a general pattern shows that strong motivation would be to comply with regulations and to accept a personal responsibility and commitment to protect health and environment (Figure 41).
Also the role of the adviser as a key influencer and the acceptance of audit results received high levels of agreements. The aspect of subsidies was ranked as the least significant aspect on average. (Variation: 15% to 50%).)

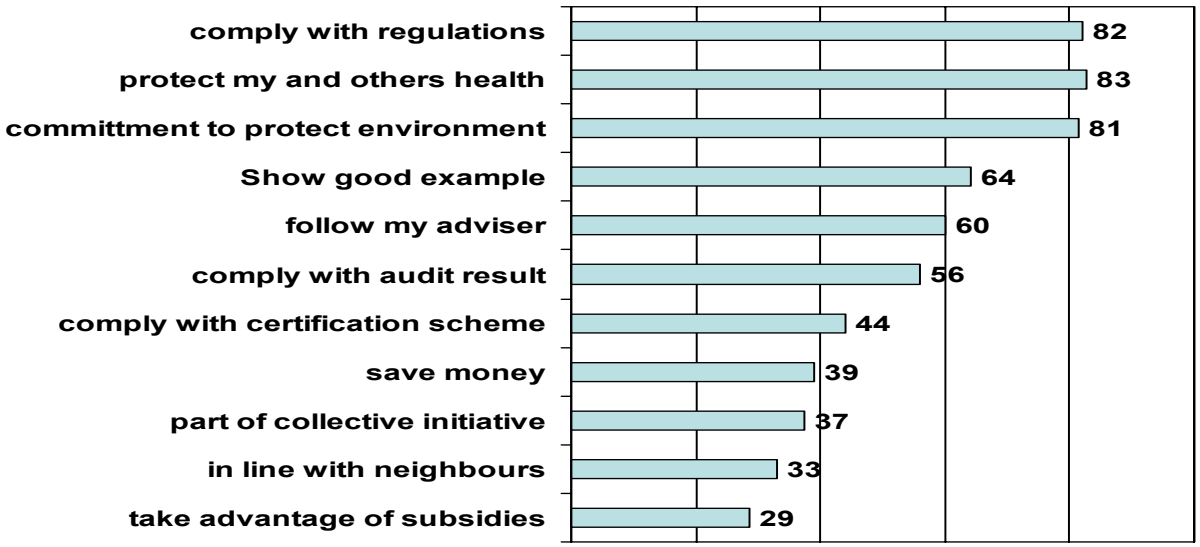


Figure 41: Farmers agreement in % on aspects relevant to change their behaviour to avoid point sources (Framer survey 2008)

5.2 Evaluation of measures on their effectiveness to reduce point sources by farmers (Farmer survey 2008) and stakeholders (stakeholder survey 2006)

Farmers see subsidies and voluntary training as effective measures to reduce point sources. Regular farm audits received the highest ranking among measures which suggest a stronger mandatory approach. Audits could be developed as an effective tool combining advice and clear monitoring. Lowest ranking was to have mandatory trainings and renewable sprayer licences (Figure 42). Variations on opinion in this aspect among countries is huge (0 to 55% acceptance). To pursue a strong mandatory approaches may develop considerable resistance among farmers and may not deliver the effects expected.

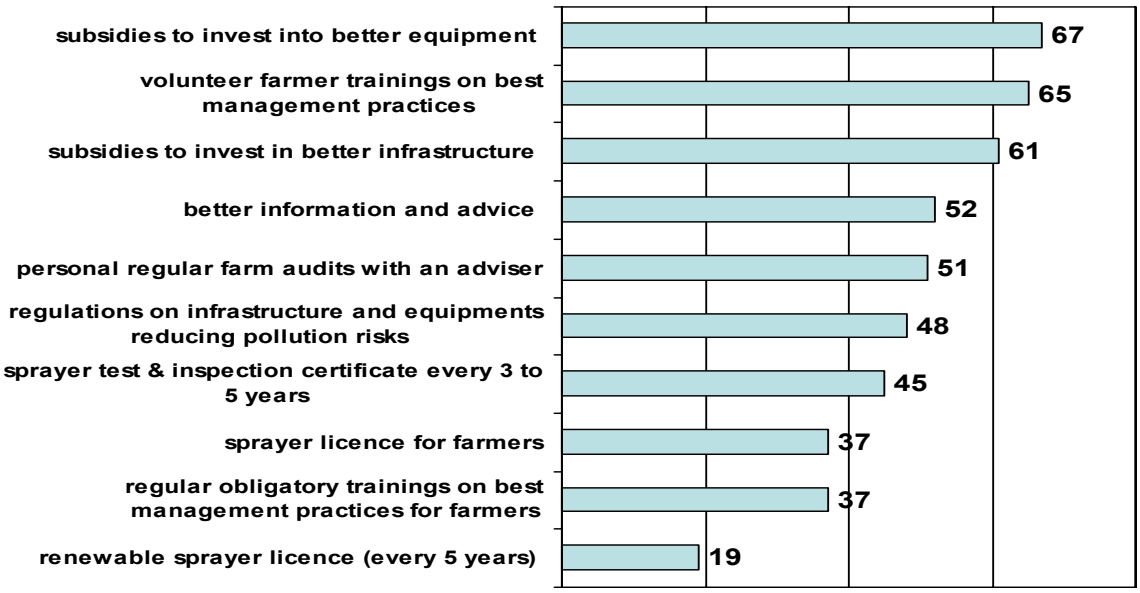


Figure 42: Farmer evaluation of measures to reduce point sources (Farmer survey 2008 agreement in %)

5.3 Evaluation of measures on their effectiveness to reduce point sources by stakeholders (stakeholder survey 2006)

In the stakeholder survey three main elements in order to change operator behaviour were analysed (Figure 43).

- Training and Demonstration
- Support of change through incentives
- Stronger regulation and controls

The respondents identified training and demonstration as the top priority. Regular operator training and mandatory training were seen more important than an increase in advisor support.
The most important overall criteria was "Quality of advice". At the moment we cannot define from the information received what "Quality of advice" means in detail. We therefore suggest that this aspect is further investigated.
We could differentiate two distinct groups of stakeholders.

a) Believers in regulation:

30% of the respondents saw stronger regulation and controls together with fines as the most important measures to change behaviour. This position was strongly expressed in the North and the East. We certainly can assume cultural differences in the attitudes towards controls.

b) Believers in training and advice:
The remaining (70%) are favouring activities based on trainings and more advice (16 % in this group see mandatory trainings important).

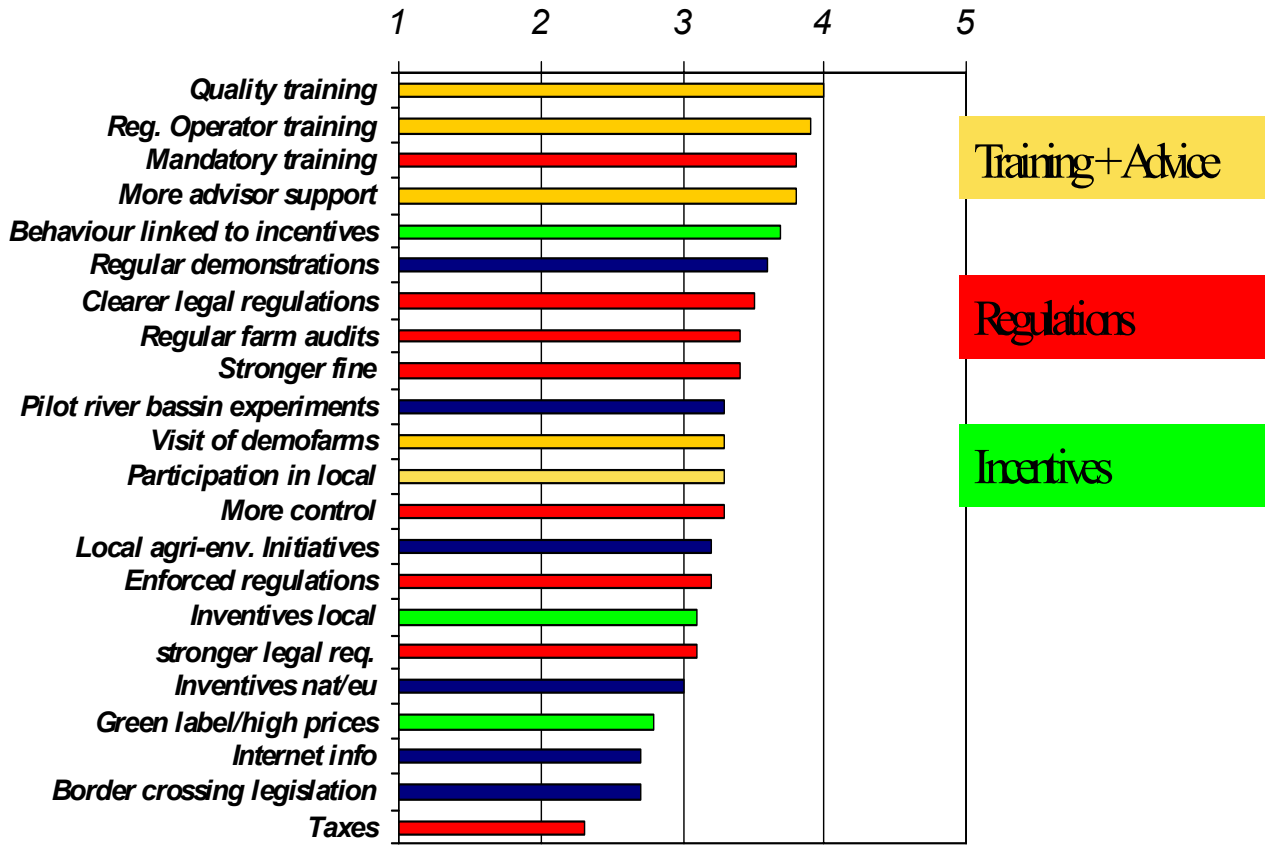


Figure 43: Stakeholder evaluation of measures to reduce point sources (Stakeholder survey 2006 ; rating 5= high effectiveness, 1 low effectiveness)

6. SUSTAINABLE STRATEGY TO AVOID POINT SOURCES

6.1 General

The TOPPS project has delivered information and demonstration tools aimed at increasing awareness of the need to protect water, and provides suitable training tools and best management practices that can be used and implemented in practice (by farmers and advisers) at a European scale.

The exercise of establishing, promoting, and disseminating the TOPPS point-source related Best Management Practices (BMPs) has already begun under the TOPPS project.
It is expected that these BMPs will be helpful in the implementation phase of the Thematic Strategy on sustainable use of pesticides, the envisaged framework Directive and the WFD in terms of:

- Integrating TOPPS - BMPs into Member State WFD Programmes of Measures, and TS education and training programmes.

- Finding new resources, both human and financial, to push forward appropriate demonstration, education and training programmes.

Research suggested, where point and diffuse routes of PPP into water had been investigated, that point sources are the major entry route of PPP into water (> 50%). If we take research activities and

publications as supporting indicators, the focus given to point sources is not reflected in its significance, compared with diffuse sources.

Point sources can be avoided if the appropriate measures are taken, wheras diffuse sources can only be reduced because they are much more dependent on conditions, that are out of our direct control. These include adverse weather conditions (rainfalls, wind and temperature), soil type and topography. If we successfully implement a sustainable strategy to prevent point sources, the potential risk of PPP water contamination can be reduced by 50% to 70%.

The following proposal on a sustainable strategy is based on findings and expertise collected during the TOPPS project.

6.2 Key elements of a sustainable strategy to prevent point sources

A sustainable strategy needs to focus on three key elements: Correct behaviour, improved equipment and improved infrastructure (Figure 44).

Most important aspect is the correct behaviour of the operators in handling PPPs.

Potential risks can be mitigated by the enablers improved technology and equipment. These elements need to be consistently analysed along with the working processes: Transport, Storage, before Spraying, during Spraying, after Spraying and Remnant management.

The most critical work processes are, cleaning the sprayer after use, filling of the sprayer and the management of remaining diluted contaminated liquids (Remnants).

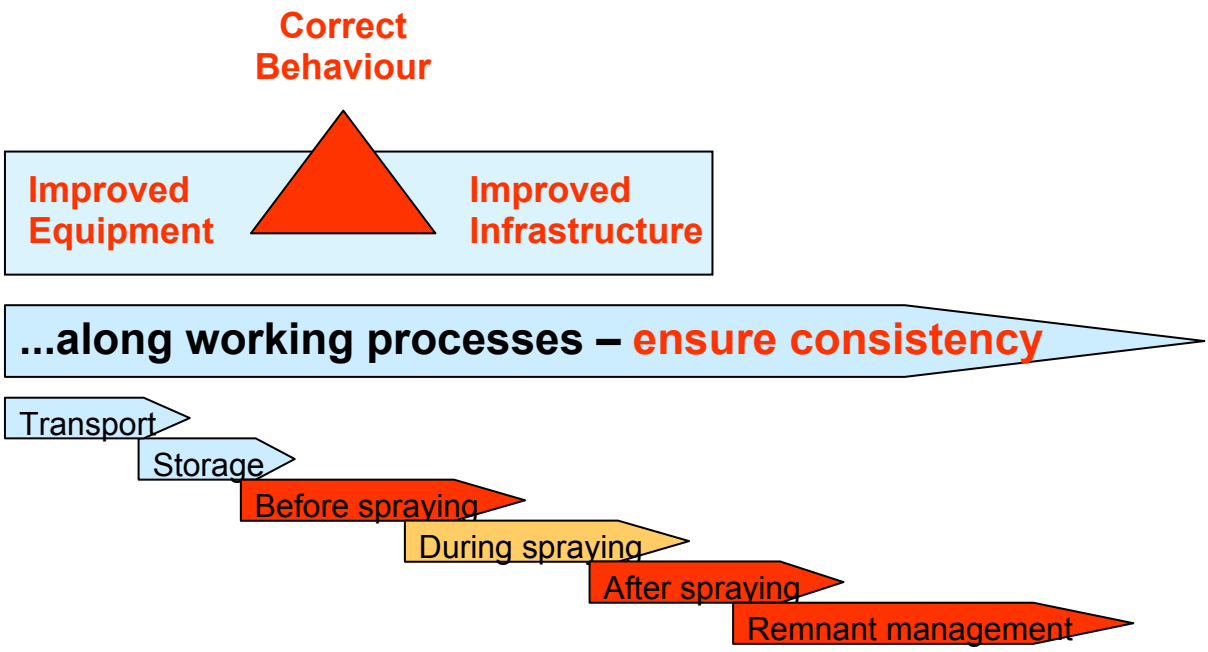


Figure 44: Key elements of a sustainable strategy to reduce point sources

6.3 Correct behaviour

As identified in the TOPPS project the correct handling of PPPs is the key success factor to avoid point sources. Behaviour change starts with consistent BMPs and the organisational requirements for their implementation. These are clear structures on BMPs development, transfer and implementation (figure 45).

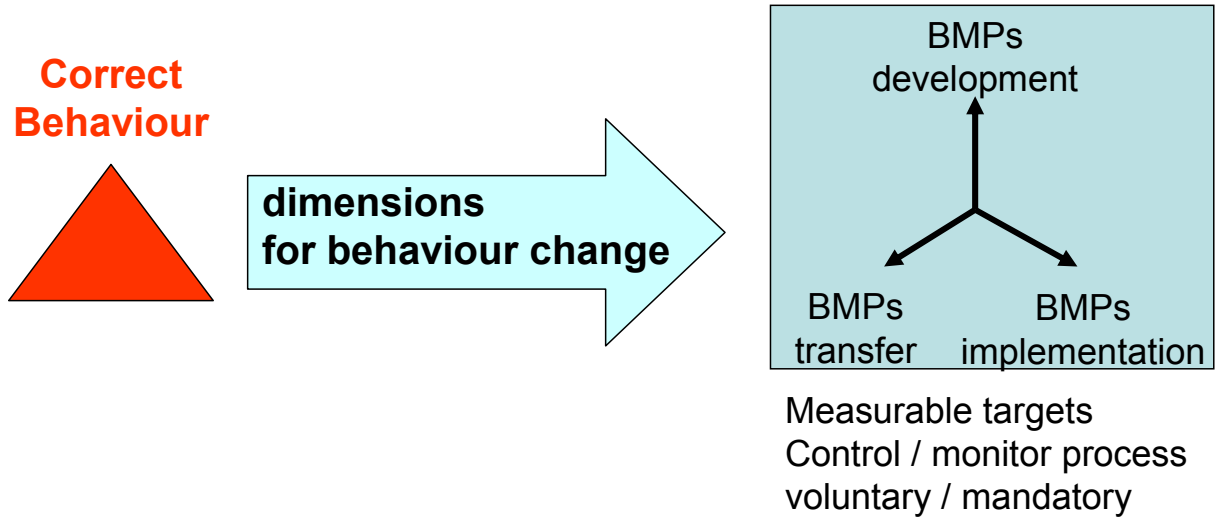


Figure 45: Dimensions to implement correct behaviour and organisational requirements

6.3.1. BMP development

TOPPS - BMPs as far as we know are the first BMPs related to PPP and water protection on a European scale. With the involvement of about 250 European experts and stakeholders a European core of BMPs to prevent point sources has been developed.
This could serve as a frame for member countries to adopt proposed specifications (how to do things) and adapt them to their local requirements.

As the CAP is applicable to all member states as well as other legal frameworks (WFD etc.) these BMPs should be part of a frame of guidelines relevant for all member states.
As TOPPS has shown a European core could be the basis for further detailed specification on country or regional levels.

Today there are no structures available at a European level that could help to develop core BMPs in specific areas. As BMPs are mentioned as part of the regulatory framework a European concept would help to develop consistent approaches for BMPs. Current BMPs across Europe and even regions are often not consistent and as a result they are often not considered credible by operators. This creates the opinion among operators that some are at a disadvantage compared to others.

Clear and transparent development structures for BMPs development are not established in all countries. BMPs previously available in countries are mostly general in nature. For a complex area like PPP and water protection it is often not sufficient to simply recommend what to do, it is also necessary to explain how to do it.

Proposal:

- Develop a structure on EU basis for the development of BMPs (core guidelines).
- Learning from TOPPS: Project based development of BMPs allows specific focus and appropriate selection of experts and involved stakeholders on EU level. (Flexible approach)
- BMPs should be developed under a process view (holistic approach). This ensures that the focus is not lost and the BMPs are not missing important aspects.
- BMPs need to be specific (how to do things)
- Feedback on implementation is necessary for updates and adaptations.

6.3.2. BMP transfer

BMPs transfer needs to be addressed initially to the advisors in an area. How the training of advisers is organised in countries is not fully understood. Generally the advisory services train their advisers that are working in their respective organisation. The content of the training programme depends very much on actualities. How advisers are trained and how their knowledge is updated is not fully understood and should be investigated in more detail.

Partners in catchments assume that advice on BMPs is mainly given by public or semi public advisers.

We only found an advisers training scheme in the UK, where all persons giving advice to farmers (public, private) need to acquire a license which needs regular updating (BASIS system)

Proposal:

- The current training scheme for advisers should be investigated in more detail.
- Specific trainings for advisers on BMPs should be offered and certified. These offers should involve all advisors (private and public) in order to maximize the capacity of advice available in an area.
- Advisers should update their knowledge on BMPs at regular intervals.
- BMPs training participation should be documented

6.3.3. BMP Implementation

a) Behaviour change
Behaviour change starts with creating awareness through advice and information provided to the operators. Information on BMPs is mainly delivered in meetings with farmers and in the respective media. Accessibility of farmers in meetings can be a problem.
Catchment partners estimated that between 25 and 60% of farmers are reached by the advice offered. Key success factor for the efficiency of the advice are enthusiastic advisers and a monitoring of advice efficiency.

Proposal:

- Specific trainings on BMPs should be offered to operators
  (group trainings or specific audits).
- Training contents need to be defined on the basis of transparent curricula.
- Trainers and trainings need to be certified (Define rules and roles for certifiers).

- Training schemes should be open for all advisers (public, private)
  (create competition to get best trainings).
- Level of obligation for training need to be defined: Mandatory / voluntary (define incentives).
- Participants in training need to get a certificate (possible element for control process).
- Participation of operators to the trainings should be documented.
- BMPs training should be refreshed and updated (time interval).
- Incentive schemes for advisers should be developed.
- Advice quality / efficiency should be measured (Evaluation/Surveys UK).
- Clear, measurable targets for an area / catchment should be developed and monitored. Measures and targets need to be communicated (Voluntary - Incentives / Mandatory – regulations).
- Control and monitoring processes need to be established and communicated to operators.

b) Improved equipment

The current regulatory framework is focussed on the Plant Protection Product (PPP - active ingredient and formulated product). Proven biological efficacy and favourable risk analysis on the behaviour of the product for health and the environment are prerequisites to get approval to bring and to keep a PPP on the market. (Directive 91/414/EEC, OJ L 230 19.8.91)

Comparable regulation for the spray equipment does not exist. Risk mitigation needs to focus on the entire crop protection process. The elements of this are the PPP, the equipment for the application and the infrastructure.
Today standards (ISO and / or EN) define the requirements for PPP sprayers. These standards serve as a recommendation but are not legally enforced. (Only in Germany do new sprayers need to be declared at a national authority (JKI - Braunschweig). They issue a label which is attached to the sprayer if the standards are met).

Proposal:

- Lack of regulation does not realize the full risk mitigation potential.
  Technical improvements to mitigate risk of point source could be huge
  (the reduction of the total residual volume alone has the potential to reduce point sources risk by estimated 35%) .
- Regulations are currently mainly focussed on the PPP (functional view) but the Plant protection process includes also the application technique and the infrastructure. (Apply consistent process view for risk mitigation).
- Upgrading of equipment is proposed according to BMPs. Implementation examples suggest that incentives given to farmers accelerate this process especially in the absence of regulation.
- Upgrading targets should be defined and monitored.
- Ensure that only equipment which meets BMPs requirements reaches the market (new equipment).
- Define upgrading needs for old machines, define time frame for upgrades.

c) Improvement of infrastructure

Aspects concerning transport and storage are regulated and controlled in most countries.
As most farmers are filling and clean their sprayers on the farmyard infrastructure able to collect and to treat contaminated liquids are key to mitigate the risk of water pollution.

Proposal:

- Alternative of filling and cleaning in the field should be put forward in case infrastructure on farm is not suited to mitigate pollution risk.
- Installation or upgrading of filling and cleaning places on farm as proposed in BMPs should be enforced if filling and cleaning is done on the farmyard.
- Rules for upgrading needs to be defined mandatory / voluntary (Regulation or incentives)
- Regulations to use bio-purification systems which can treat remnants should be developed and bio-purification systems should be included in upgrading requirements if cleaning and filling is done on the farmyard.
- Upgrading targets should be defined.

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ANNEXES

Annexe 1 : Criteria list to classify risky/not recommended practices versus safe/advised practices
Annexe 2 : Evaluation of risky and safe practices based on application of the criteria list
Annexe 3 : Regulatory overview by working process in catchment area
Annexe 4: Costs estimates to upgrade equipment and infrastructure

Annexe 1 : Criteria list to classify risky/not recommended practices versus safe/advised practices (Analysis Cemagref)

Criteria list based on results from farmer survey 2007

Process	Sub-process / Detail	Risky/not recommended practices	Safe/advised practices
Transport	Quantity of PPP transported	The quantity of hazardous pesticides transported by the farmer is over 50kg (with car) or 1 ton (with farming vehicle) AND packaged in volumes more than 20L	The quantity of pesticides transported by the farmer is under 50kg (with car) or 1ton (with farming vehicle) AND packaged in volumes less than 20L
Storage	Location	The mixing and loading area are not near the storage room (*except when filling is done in the field*)	The mixing and loading area are near the storage room
Storage	Storage room	In the overall storage room for agricultural supplements ; in the boiler room / heated room (*except if cupboard is used*)	In a separate room exclusively for storing PPPs ; in a cupboard ; I do not need to store PPPs because I buy a proper amount just before application, safe practice but not really possible in practice
Storage	Storage room & Access	Not specific OR not locked storage room	Specific AND locked storage room
Storage	Access	Danger and forbidden access signs OR emergency telephone numbers OR security instructions not clearly shown	Danger and forbidden access signs AND emergency telephone numbers AND security instructions Information available only for Poland, Denmark and Italy clearly shown
Storage	Retention capacity	Floor permeable OR incapable of retaining spillage i.e. the retention capacity of the storage room < 10% of the maximum volume stored	Floor water resistant AND capable of retaining spillage i.e. the retention capacity of the storage room = 10% of the maximum volume stored
Storage (& Filling)	Spills management	no absorbent material available nearby	absorbent material available nearby
Storage	Fire resistance	No fire resistant material	Fire resistant material
Storage	Emergency	No fire extinguisher outside	Presence of a fire extinguisher outside
Storage	Equipment	Absorbent and not easily washable shelves	Non-absorbent and easily washable shelves
Storage	Management of PPPs	Products are not stored in their original packages with labels	Products are stored in their original packages with labels
Storage	Management of PPPs	Yearly PPPs inventory not carried out	Yearly PPPs inventory carried out
Storage	Quantity of PPP stored	If quantity max. stored much greater than quantity used in the year	If quantity max. stored almost the same as quantity used in the year
Before spraying	Frequency of inspection by external people	More than 3 years	3 years or less

Filling	Place to fill PPP	Filling in the field less than 10 meters from a water point ; filling on farm on grass place at less than 10 meters from a water point ; filling on farm on hard surface without collection of water	Filling in the field at more than 10 meters from a water point ; filling on farm on grass place at more than 10 meters from a water point ; filling on farm on hard surface with collection of water ; on farm in a biobed
Filling	Retention capacity (*Except for Belgium and France, there is no information about the retention capacity (in Litter) of filling area*)	If permeable platform unable to collect potential spill & overflow OR no precaution tools to collect them	If waterproof platform able to collect potential spill & overflow (*For FR&BE If retention capacity of the filling area = 0-20L: able to collect spillages ; if retention capacity = 20-50L: able to collect a full container spilled ; if retention capacity >50L: able to collect overflow*) OR precaution tools to collect them
Filling	Sprayer's filling equipment	No device for filling PPP	Device for filling PPP *« anti-back flow device » and « induction bowl »*
Filling	Network protection	No intermediary tank OR no gallows (*Information available only for France and Belgium*) OR no anti back flow device OR any device to avoid network contamination	Intermediary water storage OR gallows (*Information available only for France and Belgium*) OR anti back flow device OR other device to avoid network contamination
Filling	Calibration of the mixture (& overflow management	Only visual control of liquid level in the tank	(*From safer to less safe: programmable pump meter > simple pump meter > graduation or tank gauge*) Programmable pump meter OR simple pump meter OR graduation or tank gauge
Filling	Calibration of the mixture	To ensure that I have enough spray liquid, I add about 5 to 10% more water as a reserve	I make the exact calculation of the mixture prepared
Filling (& Storage)	Neutralization of spillage	I wash-off the spills with water ; no specific precaution	I have a plastic cover below to collect any spills ; I have absorbing materials at hand to collect any spills ; I mix on the filling area in a place where water is collected ; I dispose it to the slurry/manure/compost material
Spraying	Sprayer's anti-drift equipment	No anti-drift nozzles	Anti-drift nozzles
Spraying	Sprayer's anti-drip equipment	No anti-drip devices on nozzles	Anti-drip devices on nozzles
Spraying	Practice	I don't stop spraying when turning at the field edges	I stop spraying when turning at the field edges
After spraying	Sprayer's internal cleaning equipment	No additional rinsing tank AND no device for internal cleaning	Additional rinsing tank AND device for internal cleaning *« inside tank cleaning nozzles »*

After spraying	Calibration of the mixture	I have from time to time left-over in my sprayer ; I have often left-over in my sprayer	I have never left-over in my sprayer
After spraying	Management of the remaining spray liquid	I let the remaining spray out in the field ; I spray the remaining out in the field without dilution	I let the remaining spray in the tank and reuse it again with the next spray ; I dilute the remaining spray and spray it out in the field ; I drive back to my farm and clean the sprayer on a special place where washing water is collected (*if bioactive collection system, the remaining spray need to be diluted before*) ; I dilute the remaining spray and let it out in the field
After spraying	Sprayer's external cleaning equipment	No device for external cleaning in the field (*except if external cleaning is managed in an appropriate place on farm*)	Device for external cleaning in the field
After spraying	Place of the external cleaning of the sprayer	In the field at less than 10 meters from a water point ; in a field close to the farm at less than 10 meters from a water point On my farm on a grass surface at less than 10 meters from a water point ; on my farm without collecting water ; on my farm bounded without manure tank ; on my farm unbounded without vegetation	In the field at more than 10 meters from a water point ; in a field close to the farm at more than 10 meters from a water point On my farm on a grass surface at more than 10 meters from a water point ; on my farm, in a special place where I can collect the washing water Including « biobed or other biological neutraliser of PPPs (PO) » and "special container for remnants (DE) " ; on my farm bounded with manure tank ; on my farm unbounded with vegetation
After spraying	Frequency of the external cleaning	Less than 4 per year (*for field sprayers*) Less than 8 per year (*for orchard sprayers*)	4 or more per year (*for field sprayers*) 8 or more per year (*for orchard sprayers*)
After spraying	Place where sprayer is parked	In the open on my farm	Dry under a roof
Waste management	Management of spills and contaminated absorbing materials	I dispose it with the overall wastes ; no specific action / practices	I dispose it to the slurry/manure/compost material ; I throw it away into the fields where I apply the PPP ; I bring them in authorised waste collection point ; I manage them as hazardous waste ; I put them in biobed / place where water is recycled
Waste management	Rinsing of empty containers	I don't rinse my empty containers ; I rinse my empty containers less than 3 times	I rinse my empty containers 3 times or more ; I rinse my empty containers ones with rinsing nozzles

Waste management	Empty containers disposal	Bury or burn the containers ; store the empty containers outside the farm ; dispose the containers with the other waste materials (*if containers not rinsed*) ; not to give empty containers to a special collection service Right for DE, FR, BE and PL but not for DK and IT catchment area	give empty containers to a special collection service ; store the empty containers in a dry place ; store the containers in the PPP storage room ; dispose the containers with the other waste materials (*if containers properly rinsed*) Right for DK and IT catchment area but not for DE, FR, BE and PL

Annexe 2. Evaluation of risky and safe practices based on application of the criteria list (Analysis Cemagref)

(Percentages indicate based on the survey the current practices by farm categories risky /save practice)

- When multiple answers are given by farmers the most « bad practices » is taken into account,
- When the addition of "safe" and "risky" practices are different to 100%, the difference corresponds to the category "no information" including the "no/don't know/other (without detail)" answers

Process	Detail	BE		DE		DK		FR		IT		PL		Comme
		Safe	Risky	Safe	Risky	Safe	Risky	Safe	Risky	Safe	Risky	Safe	Risky	
Storage	Location	92%	6%	89%	10%	57%	33%	97%	2%	89%	12%	86%	12%	
Before spraying	Frequency of inspection by external people	99%	1%	98%	2%	34%	24%	83%	16%	63%	37%	83%	13%	*! This indicator applies on to the sprayers aged more than 3 yea → BE(36 DE(12 - DK(50) - FR(122) - IT(121) - PL(102)*
Filling	Place to fill PPP	8%	91%	46%	50%	47%	29%	14%	80%	25%	75%	38%	61%	*! For the moment th indicator i built with minimum distance o 20m → but it realistic*
Filling	Sprayer's equipment (device for filling PPP)	69%	31%	66%	32%	34%	66%	69%	31%	68%	32%	41%	58%	*! This indicator applies to the spraye (Boom/Fie & Orch/Vi → BE(150 DE(161) - DK(59) - FR(151) - IT(199) - PL(123)*
Filling	Neutralization of spillage	31%	68%	75.5%	10.5%	18.5%	10%	35%	61%	33%	67%	64%	35%	

Spraying	Sprayer's equipment (anti-drip device on nozzles)	86%	14%	89%	9%	76%	24%	62%	38%	76%	24%	82%	18%	*! This indicator applies to the spraye (Boom/Fie & Orch/Vi → BE(150 DE(161) - DK(59) - FR(151) - IT(199) - PL(123)*
Spraying	Practice	100%	0%	98%	2%	88%	4%	96%	3%	91.5%	8%	98%	2%	
After spraying	Sprayer's equipment (device for inside cleaning)	72%	28%	82%	16%	64%	36%	79%	21%	81%	19%	18%	81%	*! This indicator applies to the spraye (Boom/Fie & Orch/Vi → BE(150 DE(161) - DK(59) - FR(151) - IT(199) - PL(123)*
After spraying	Management of the remaining spray liquid													*! Not calculated for the moment because ne to be clarified*
After spraying	Sprayer's equipment (device for outside cleaning)	4%	96%	29%	70%	10%	90%	26%	74%	32%	67%	10%	89%	*! This indicator applies to the spraye (Boom/Fie & Orch/Vi → BE(150 DE(161) - DK(59) - FR(151) - IT(199) - PL(123)*
After spraying	Place of the outside cleaning of the sprayer													*! Not calculated for the moment because minimum distance n to be validated: 10m? 20m*
After spraying	Place where sprayer is parked	99%	1%	99%	1%	84%	6%	97%	3%	98.5%	1.5%	98%	3%	

Remnant management	Management of spills and contaminated absorbing materials	54%	11%	88%	5%	26%	2%	38%	3%	67%	34%	49%	31%	
Remnant management	Rinsing of empty containers	86%	14%	41%	58%	10%	88%	41%	53%	15%	86%	63%	38%	*! Criteria "3 rinsing is very exacting – informatio about usin rinsing nozzles wa available f Belgium a not for the other countries, that could explain be result*
Remnant management	Empty containers disposal	100%	0%	79%	20%	51%	22%	81%	19%	87%	10%	59%	40%	

Annexe 3. Regulatory overview by working process in catchment area (Cemagref + partners)

NB: The green colour means “mandatory aspect” – the yellow colour means “non-mandatory aspect” (i.e. advice, voluntary, compulsory via cooperation agreement aspect, etc.)

Legal constraints on process by catchment area

Process	Sub-process / Detail	Local (or national) regulation conformity						
		BE	DE	DK	FR	NL	IT	PL
Transport	The quantity of pesticides transported by the farmer must be under 50kg (with car) or 1ton (with farming vehicle) & packaged in volumes less than 20L	In a car: the quantity transported is depending on the product (+ the number & kind of container used). Check the MSDS. This will also determine if its under ADR regulation or not. On a farming vehicle: no limitation, no ADR.	Yes	Yes (farmer may transport: Very toxic products max 25 kg ; toxic products max 250 kg ; classified products max 1.000 kg)	Yes (farmer may transport quantity under 50kg by car or 1ton by farming vehicle – otherwise ADR)	?	No	No
Storage	The mixing and loading area must be near the storage room	No	No	No	No	No	No	No
Storage	PPP must be stored in a separate room or cupboard exclusively for storing PPPs	Yes	Yes	Yes (PPPs must be separated from fodder and food)	Yes	Yes	Yes	Yes

Storage	The storage room must be locked	Yes	Yes	Yes (only toxic and very toxic products have to be in a locked place)	Yes (closure is obligated only if presence of T,T+ PPPs)	Yes	Yes	Yes
Storage	Danger/forbidden access signs + emergency telephone numbers + security instructions must be clearly shown	Yes (but only for the danger and forbidden access)	No	Yes (but signs only for toxic and very toxic PPP ; Emergency numbers have to be noted in a 'safety' book which should be available for the operator)	Yes (storage must be clearly identified ; emergency telephone numbers & security instructions must be clearly shown)	Yes (but only for the danger and forbidden access)	Yes	Yes
Storage	The storage must have a water resistant floor and be capable of retaining spillage	Yes (Flemish environmental law)	Yes	No (but implemented because users of PPP are not allowed to contaminate soil and water)	No	Yes	No	Yes
Storage (& Filling)	Absorbent material must be available nearby	Yes	No	No	No	Yes	No	No
Storage	Fire resistant material must be used	No (but is taken up in a book of charge to have a certification label)	Yes	No	No	Yes (for step-in storage 60 min)	No	No

Storage	A fire extinguisher must be available outside	No	Yes	No	Yes	Yes	Yes	No
Storage	Non-absorbent and easily washable shelves must be used	No (but is taken up in a book of charge to have a certification label)	No	No	No	No	No	No
Storage	Products must be stored in their original packages with labels	Yes	No	Yes	Yes	Yes	Yes	Yes
Storage	Yearly PPPs inventory must be carried out	No	Yes	No	No	No	Yes	no (however the list of stored PPPs must be present in the store)
Storage	Quantity max. stored must be almost the same as quantity used in the year	No (but the amounts that were bought and used, should match with what is available on bills and what remains in the stock)	No	No	No	No	No	No
Before spraying	Mandatory inspection of the sprayer by external people (frequency)	Yes (every 3 years)	Yes (every 2 years)	No	No (but it will be the situation from 2009 – every 5 years)	Yes (every 3 years)	No (except for farms joining EU funded agriculture plans - every 5 years)	Yes (every 3 years)

Filling	Minimum distance between the filling place (field / farm / grass place) and a water point	Yes (but product dependin g - written on the label of the container s)	No	Yes (10m minimum but larger distances are expected to be implemen ted)	No	Yes (2m minimum from ditch side)	No	Yes (20m minimum between any place where PPPs are used and water point)
Filling	Filling place must have a waterproof platform able to collect potential spill / overflow or precaution tools to collect them	No	No (only compulso ry via cooperati on agreemen t and subsidize d)	No (but it will be the situations within a year or so)	No	Yes	No	No
Filling	Filling place must be equiped with device for filling PPP	No	No	No (chemfill er is expected to be mandator y within a year or so)	No	No	No	No
Filling	Farmer must avoid network contamination (e.g. intermediary water storage, gallows, anti back flow device or other device)	No (but is good agricultur al practice)	Yes	No (requirem ents are expected within a year or so)	Yes (obligatio n to preserve the water ressource)	Yes	No	No
Filling	Farmer must used avoid overflow during filling (e.g. programmable pump meter or simple pump meter)	No	No	No (the process filling of water are expected to be controlle d within next years)	No	No	No	No

Filling	Farmer must make the exact calibration of the mixture prepared	No (but farmer must respect the doses mentioned on the labels of the products and it's good agricultural practice)	No	No (but it is Good Agricultural Practice)	No	No	No	No (required only in Integrated Production and GlobalGAP)
Filling (& Storage)	Farmer must neutralize spillage (e.g. plastic cover, absorbing materials at hand, using of a place where water is collected, connection with a slurry/manure/compost tank)	No (but contamin. absorbing material is collected by Phytofar Recover or if collection then the contamin. water must be treated and it's good agricultural practice) ! disposing with slurry is not allowed	No (only compulsory via cooperation agreement and subsidized)	No (but users of PPP are not allowed to contaminate soil and water)	No	Yes (spillage collection is obligated on hard surface)	No	No
Spraying	Sprayer must be equiped with anti-drift nozzles	No (but can be used to reduce the buffer zone)	Yes (In relation with the buffer zone regulation)	No	No	Yes (but depending on distance to surface water , area and ppp choice)	No	No

Spraying	Sprayer must be equiped with anti-drip devices on nozzles	No (but in practice all sprayers are equipped with anti-drip nozzles)	Yes	No (but in practice all sprayers are equipped with anti-drip nozzles)	Yes	No	No (except for ENAMA certified sprayers)	Yes
Spraying	Farmer must stop spraying when turning at the field edges	No (but it is good agricultural practice)	No	No	No	No	No	No
After spraying	Sprayer must be equiped with internal cleaning equipment (e.g. additional rinsing tank, device for internal cleaning)	No (but the presence of a rinsing tank is financially supported by the Flemish government)	Yes	No (rinsing tank is expected to be mandatory within a year or so)	No	No	No	No
After spraying	Farmer must manage his remaining spray liquid correctly	Yes (Left over must be diluted and sprayed out in the treated field) ! Bioremediat. systems are not allowed in Flanders	No	No (Dilution of the remaining spray and spraying it out in the field is expected to be mandatory within a year or so)	Yes (Dilution of the remaining spray and spraying it out in the field and management on the farm are authorized with certain restriction)	yes	No	Yes (Dilution of the remaining spray and spraying it out in the field is authorized)
After spraying	Sprayer must be equiped with external cleaning equipment if rinsing is managed in the field	No	No	No	No	No	No	No

After spraying	Minimum distance between the external rinsing place (field / farm / grass place) and a water point	No (but it is good agricultural practice)	No	No (but 10m are in reality used at the moment ; larger distances expected to be implemented but not yet known)	Yes (50m from a water point and only one time per year in the same place)	Yes (more than 5m if at non hardened surface or at special surface with water collection)	No	Yes (20m minimum between any place where PPPs are used and water point)
After spraying	Mandatory minimum number of external rinsing per year	No	No	No	No	No	No	No
After spraying	The sprayer must be parked on a dry place under a roof	No	No	No (under a roof are expected to be mandatory)	No	Yes	No	No
Waste management	Farmer must manage his spills and contaminated absorbing materials safely (e.g. dispose them to the slurry/manure/compost material ; throw them away into the fields where they apply the PPP ; bring them in authorised waste collection point ; manage them as hazardous waste ; put them in biobed / place where water is recycled)	Yes (collected by Phytofar Recover collection system)	No	Yes (Should be managed as hazardous waste)	Yes (It is prohibited to leave them in the environment or burn them)	Yes (reuse, apply in the field (diluted) or discharge to waste processing company are authorized)	Yes (All the PPP contaminated wastes exported out of the farm are considered as special wastes)	No

Waste management	Farmer must rinse his empty containers 3 times or more or ones with rinsing nozzles	Yes (empty containers must be rinsed before collection by Phytofar recover but no specification on how many times the container must be rinsed)	No	Yes (Empty not classified and classified PPP containers deliver as normal waste + 3 risings ; T and T+ PPPs containers deliver as hazardous waste)	Yes (but the number of rinsing is not specified and if no rinsing, should be considered and managed as hazardous waste with specific collect)	Yes (rinsing tool on sprayer is obligated)	Yes (local regulation)	Yes (empty packaging must be rinsed before returning it to the collection service (PPP supplier) but no method of rinsing is described)
Waste management	Farmer must manage his empty containers safely (e.g. give them to a special collection service ; store them in a dry place ; store them in the PPP storage room ; dispose them with the other waste materials (*if containers properly rinsed)*)	Yes (Collection by Phytofar recover)	No	Yes (ibid above + no specified regulation for storage of empty containers)	Yes (if rinsing: normal waste/ Adivalor; if no rinsing: hazardous waste)	Yes	Yes (local regulation)	Yes (1. rinse the empty containers 2. store them in the PPP storage room AND return to a special collection service (PPP supplier))

Annexe 4: Costs estimates to upgrade equipment and infrastructure

This document aims to connect BMPs with the costs which are involved for their implementation on farm. The indicated prices are orders of magnitude based on literature or evaluation of experts.

1. Transport

Two sort of possible organisation :
- PPPs delivered by a dealer:
    - Free delivery
    - Forwarding charges: included in the price of the PPPs ?
- PPPs transported by the farmer himself: price to equip car, tractor or van (loading space, pallets, devices to stow containers,…)
    - Plastic/alu box for use on vehicles or fixed plastic/alu box on the sprayer: 50-200€

Equipments for security:
- Emergency sets (gloves, granulates for spills, protective clothing, disposal bags, …): 70-500€
- Protective clothing: ~10€

2. Storage

Various sort of possible storage (various capacities, from existing infrastructures or built by a registered company, building or cupboard,…)
- Cupboard:
    - Capacity of approx. 200 kg – 2/4 shelves – unsuitable for flammable PPPs): 500-1500€
    - Capacity of approx. 100-200 L: 450-700€
    - Capacity of approx. 200 kg – 2/4 shelves – suitable for poisonous and flammable PPPs): 1000-3000€
    - Fireproof & fire resistant – ventilated: 1500-2500€
- Mobile storage room:
    - Capacity more than 200 kg – ventilated: 1000-7000€
    - Equipped: 2500-7500€
- Storage room (building):
    - Self-made by farmer – with collecting tray/floor: 1200-2500€
    - Self-made by farmer from an existing building: 1500-8000€ (according to the size of the building)
    - Built by a registered company – with collecting tray/floor: 3000-5000€
    - Built by a registered company from an existing building: 2000-13000€ (according to the size of the building)

Details of requirements :
- Lockable storage room → secured door : 250-450€
- Danger/forbidden access signs & security instructions signs: 10-20 €*
- Fire resistant storage room → insulating material: 5-20€ /m²
- Fire extinguisher ABC : ~100€
- Properly ventilated storage room: 50-150€
- Thermal insulating store → radiator: 70-150€

- Water resistant floor → concrete flagstone: ~80€ /m² - epoxy paint: ~9€ /L
- Non absorbent, fire resistant and easily washable shelves --> metal shelves: 50-350€ (from 3 to 5 levels and according to the size)
- *Store capable of retaining spillage → bunded store or collection system: 70-1000€ - hermetic containers to secure damaged packing: ? € - absorbent material: nearly free*
- *Secure storage of empty containers : 5-150€*

3. Filling

- *Induction hopper : 450-1000€ ; 800-1500€*
- *Secured mixing and loading area :*
    - *~65m² - connected to the slurry tank: 1500-3000€ or ~30€ per m²*
    - *waterproof – bunded – equipped: 1500-5000€*
    - *collective equipped area (for 10 farmers, gallow-filling device-phytobac…): 10000€*
    - *collecting tray: 500-5000€ (according to the sprayer size, material…)*
- *Devices to not contaminate the water supply → non return valve: 15-100€ ; 15-600€, water intermediary tank: 150-450€ (second hand, from 1000 to 3000L) or 600-1500€ (first hand, from 1000 to 3000L), gallow: 150-450€*
- *Avoid overflows → quarter turn gate: 15-35€, simple filling device: 250-500€, electronically filling device: 800-1000€ ; 900-1200€*

4. Spraying

- Devices to adapt spraying to the weather → Anemometer : 45-150€ - thermo-hygrometer : 50-350€
- Tested sprayer → inspection : ~100€, CE labelled equipment and go for testing the sprayer (EN 13790): 50-400€
- Appropriate nozzles (in term of environment protection) → Nozzles check: ~15€, Anti-drift nozzles: ~5-10€ per nozzle, foam marking nozzle (2 nozzles at every end of the boom + hoses for the foam): ~1000€
- Multi nozzle holder with anti drip device: 20-40€ per piece
- Sprayer equipment → guiding system (e.g. track guide, GPS based…): 1800-3000€ ; 2000-3500€, spraying computer (calculating exact spraying liquid): 500-3000€, boom circulation system: 1500-3000€ or 100€ per m boom, electronically field index (recording of all necessary data's like field size, spraying liquid, PPPs used…): 200-500€, pressure gauge: 100-150€, speedometer: 100-150€,
- Operator's protection → protective clothing : ~10€, gloves : ~5€ or nearly free (offer by the chemical companies), safety glasses : 10€ / 10-250€, facemask : ~40€, washing hand tank on sprayer : ~20€, spraying sets (anemometer, thermo-hygrometer , maintenance nozzles box, protective clothing) : 250€

5. Rinsing

- Integrated pressure washer (for empty containers): 100-500€ (part of the induction bowl)
- Rinsing tank (ISO Standard): 100-1000€ (according to the size, by pumping or gravity…)
- Rinsing nozzles (rotating or fix): 200-500€ ; 50-650€
- External cleaning → Spraying lance : 100-400€, external cleaning kit (high pressure pump + spray gun): 1200-3000€ ; max. 500€*
- Internal & external cleaning kit with tank (50-100L tank with electrical pump + rotating nozzle + spray lance): 600-1500€
- Biodegradable cleaning agents: 10€*

6. Waste management

- Redemption of old and not listed PPPs : 2,90€ per kg (PAMIRA) ; 1,5-4€ per kg (ADIVALOR)
- Redemption of empty containers: 2,2€ per kg (ADIVALOR) ; possibly included in the price of the PPPs
- Redemption of hazardous material by a registered company: ? €
- Phytobac / Biobac (biological water treatment): 1000-10000€ (depend if it's second hand material or built by a registered company, size, effluents' volume…)
- Phytomax / Phytocat (physico-chemical water treatment): ~10000-15000€ (building) + ~500€ per year (maintenance)
- Biofilter: 1000-2000€*

7. Other

Farm audit: ~350-550€
Individual farmer training : ~100€ (1 day)
Adviser training: ~250€ (1 day)