



STUDY SUPPORTING THE EVALUATION OF DIRECTIVE 2009/128/EC ON THE SUSTAINABLE USE OF PESTICIDES AND IMPACT ASSESSMENT OF ITS POSSIBLE REVISION

Case Study Compendium

Written by Ramboll and Arcadia International
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**Study supporting the
Evaluation of Directive
2009/128/EC on the
Sustainable Use of Pesticides
and Impact Assessment of its
possible revision**

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EVALUATION OF DIRECTIVE
2009/128/EC ON THE
SUSTAINABLE USE OF PESTICIDES
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POSSIBLE REVISION**

**FINAL REPORT – CASE STUDY COMPENDIUM
EUROPEAN COMMISSION, DG SANTE**

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STUDY SUPPORTING THE EVALUATION OF DIRECTIVE 2009/128/EC ON THE SUSTAINABLE USE OF PESTICIDES AND IMPACT ASSESSMENT OF ITS POSSIBLE REVISION FINAL REPORT – CASE STUDY COMPENDIUM

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Date

October 2021

Reference

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Economic analysis of environmental policies and analytical support in
the context of Better Regulation ENV.F.1/FRA/2019/0001**

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Appendix 1: CASE STUDY I - NAPs

1. Introduction to the case study

Directive 2009/128/EC¹ (the 'SUD') defines "a framework to achieve a sustainable use of pesticides by reducing the risks and impacts of pesticide use on human health and the environment and promoting the use of integrated pest management and of alternative approaches or techniques such as non-chemical alternatives to pesticides".

Article 4 of the SUD defines a National Action Plan (NAP) as the document adopted by the respective Member State authorities that sets quantitative objectives, targets, measures, timetables and indicators to reduce the risks and impacts of pesticide use on human health and the environment, and to encourage the development and introduction of integrated pest management (IPM) and alternative approaches or techniques in order to reduce dependency on the use of pesticides.

The SUD makes provision for the development of NAPs². NAPs have been audited by the European Commission (EC), and findings are publicly available³. In 2017, the EC published its first report⁴ produced by the Member States and on the progress in the implementation of the SUD including an analysis of the NAPs. This first report concluded that "the NAPs are the means by which Member States establish targets and actions to achieve the objective of the Directive, and they can be seen to represent a significant step towards the sustainable use of pesticides".

Letters with the EC's findings have been sent to Member States, which answered in written form to justify their NAPs. In 2020, the EC published its second report⁵ on NAPs regarding the implementation of Member States' measures to achieve the sustainable use of pesticides. This report highlights that (European Commission, 2020b, p. 4 - 6):

- "More than two thirds of Member States failed to complete the review of their initial NAP within the five-year legal deadline";
- "Only a small minority of Member States identified specific examples of useful targets and indicators based on the review of their initial NAP";
- "Most Member States have not addressed the weaknesses identified by the Commission in their initial NAPs in their revised NAPs, so that the majority of revised NAPs lack ambition and fail to define high-level, outcome-based targets, so as to reduce the risks associated with and dependency on PPPs"; and
- "Just half of the revised NAPs identified priority items or good practices and just one identified active substances of particular concern."

The EC's conclusion was that "despite widespread delays in the revision of NAPs, and the absence of high-level, outcome-based targets in most of the revised NAPs, Member States have made progress in the implementation of the SUD over the last two years. In cases where progress has not been satisfactory, the EC is currently considering a range of actions, including infringement procedures".

- In terms of measures that have been included in NAPs, the EC indicated that: "three Member States [Denmark, Germany and Sweden] highlighted useful indicators of risk reduction based on the review of their initial NAPs. [...] Other Member States highlighted measures, as distinct from indicators, that they considered useful. These included the Number of Dose Units [...], residues of active substances in food, findings of active substances in water, the number of

¹ Directive 2009/128/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for Community action to achieve the sustainable use of pesticides

² https://ec.europa.eu/food/plant/pesticides/sustainable_use_pesticides/nap_en

³ https://ec.europa.eu/food/plant/pesticides/sustainable_use_pesticides_en

⁴ https://ec.europa.eu/food/system/files/2017-10/pesticides_sup_report-overview_en.pdf

⁵ https://ec.europa.eu/food/system/files/2020-05/pesticides_sud_report-act_2020_en.pdf

trained persons and the quantities of PPPs placed on the market” (European Commission, 2020a).

The objective of this case study, which considers five Member States (Austria, Belgium, Bulgaria, Ireland, Poland) is to provide deeper insight into several elements of the NAPs as presented in Chapter 2 below. The research for the case study was based on a desktop review complemented by stakeholder interviews to elaborate certain aspects and reflect Member States’ perspectives. The interviews have especially shed light on aspects of funding of the NAPs as well as the alignment of the NAPs with the Farm to Fork (F2F) strategy.

2. Research theme for the case study

The aim of this case study is to **evaluate the following aspects of the NAPs for a selection of Member States** with the purpose of identifying enablers and barriers for the development of the NAPs and investigating aspects of funding and alignment with the F2F strategy.

More specifically, the case study aims to answer the following research questions:

- Does the plan fulfil the requirements of Article 4 of the SUD?
- Which quantitative objectives and/or targets are included in the NAPs to achieve the reduction of risks and impacts, if any?
- How have Member States described their approach to fulfil the obligations of each of articles 5 to 15 (objective, activities to be performed, funding, measurement of achievements) in their NAP?
- Have Member States added additional measures than the ones of articles 5 to 15? If yes, which ones (objective, activities to be performed, funding, measurement of achievements)?
- Are there criteria in the NAP, that indicate the progress of implementation?
- Are the requirements in the SUD too prescriptive as opposed to concrete/quantifiable?
- Have Member States revised their NAP? If so, why and what has been adjusted in comparison to the original one (lessons learned)?
- To what extent is the NAP effective as a guidance document?
- Which resources were allocated/utilised for the development of the NAP?
- What have been the impacts of the NAP? Has it been properly implemented and monitored?
- Are there tangible / concrete consequences of NAP implementation. What are measurable differences between before and after the implementation?
- Are there further measures planned for the future revised NAP? If yes, which ones?

Aspects of alignment with the F2F strategy are addressed by the following research questions:

- Are the tools/provisions currently listed in the NAPs sufficient to reach the F2F objectives/targets?
 - a) To what extent are tools/provisions currently listed in the NAP to reach the F2F strategy targets?
 - b) Which additional tools would you recommend in the revised NAP in order to achieve the F2F targets?

3. Methodology

The starting point for the NAP case study was the selection of Member States and the formulation of research questions. The questions were formulated in a manner, that can be applied equally to the NAP of each of the selected Member States and cover various aspects of the plans (e.g. status of the NAP, measures formulated in the NAP, assessment of the plan). The aim of the research questions was to determine to what extent the different plans define quantitative objectives and to what extent they are oriented towards Article 4 and 5-15 of the SUD. Additionally, interviews with stakeholders from the competent authorities (CAs) were carried out. If possible, these interviews were set up as virtual meetings (Ireland, Poland), if not written answers were received from the relevant stakeholders (Austria, Belgium, Bulgaria). The interviews were used to gather additional information, especially on conformity with the F2F strategy and the funding of the development and implementation of the NAP. Therefore, for each Member State the following setup is provided (chapter 4.2.1 – 4.2.5):

- A chapter on the status of the NAP according to Article 4 of the SUD;
- A chapter containing the assessment of measures put in place according to Article 5-15 of the SUD; and,
- A chapter on the overall assessment of the NAP including the stakeholder input.

For better visualisation, the following intervention logic was developed.

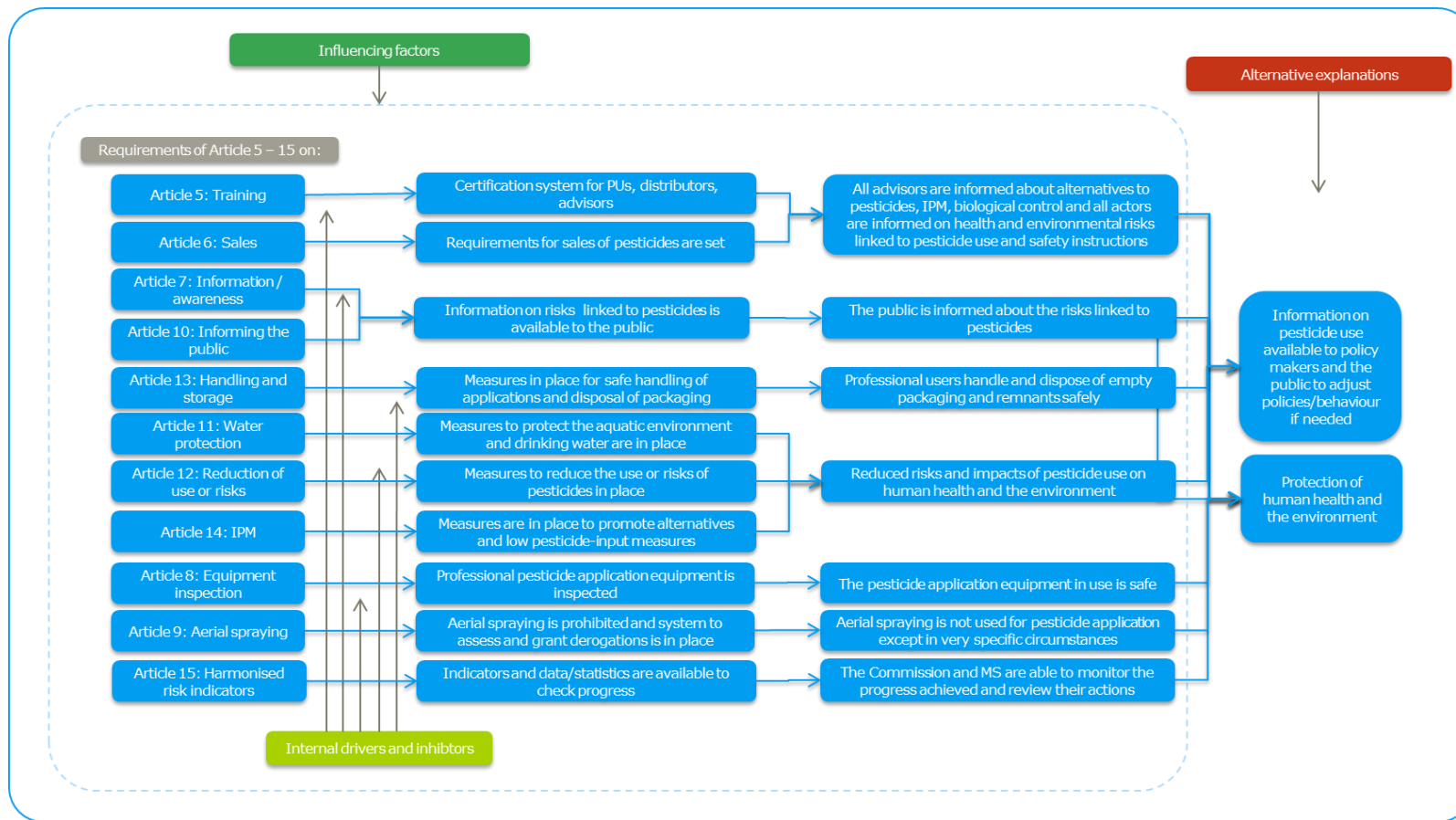


Figure 1 - National Action Plans Intervention Logic

The intervention logic for this case study reflects the measures that should be put in place according to Articles 5-15 of the SUD and as such be included in the NAPs according to Article 4. The outcomes and impacts of these measures as the result of a successful implementation of the NAP are indicated. Possible influencing factors could be e.g. industry interests, or geographical conditions, whereas examples of internal drivers and inhibitors are national / regional law or policies on national or lower level, that correlate with the objectives of the NAP. The case study will seek to identify these influencing factors, drivers, and barriers. Alternative explanations for the impacts (i.e. the achievement of impacts through means other than the outlined measures) will also be explored as part of the case study.

3.1 Data collection

The data collection entails three steps:

- Step 1: Preparation (literature review, scoping interviews). The literature review has consisted of analysing the NAPs, the EC audits of each of the five Member States selected, and other ad hoc reports collected at Member State level.
- Step 2: Conducting semi-structured interviews with the national authorities involved in the implementation of NAP of the selected Member States
- Step 3: writing-up of the case study report.

The outputs of the case studies will be reviewed as part of a fourth step for validation and for ensuring the integration of the case study results within the main report of the evaluation.

3.2 Member State Selection

The following Member States have been selected for this case study: **Austria (AT), Belgium (BE), Bulgaria (BG), Ireland (IE), and Poland (PL)**. The criteria for selection as well as the choice of Member States were agreed upon with the EC to reflect the following criteria:

- A balanced geographical representation across the EU 27 Member States and the UK
- A balanced split between old Member States and new Member States (the ones that accessed the EU post-2004)
- The importance of crop production associated to volumes of sales of PPPs
- Holding typology
- The level of implementation of the SUD.

3.3 Limitations

Originally, it was planned to conduct field trips to enhance the case studies, but due to the ongoing COVID-19 pandemic situation this did not take place.

Another limiting factor was the limited literature published by the Member States on the implementation and enforcement of their NAPs. Most available information could be found in the NAPs themselves and in the EC's publications.

Furthermore, as every NAP has a different structure, layout and uses the terms outlined in in Article 4 differently (objective, measure, targets etc...), direct comparability is limited. For the same reason it was not possible to fill the tables in Chapter 4.2. in a unified manner; judgement needs to be made carefully when comparing the assessments of the NAPs of the different Member States.

Moreover, as part of the research, it was attempted to reach out to private as well as public stakeholders. The project team reached out to farmers associations, chambers of agriculture etc.

and sent follow-up mails. However, no feedback was received. Therefore, the stakeholder input is limited to public stakeholders.

Another limitation was the inability of the different Member States to provide concrete numbers and figures regarding the financial and administrative resources associated with the development and implementation of the NAPs.

4. Situation analysis in the EU

4.1 General overview in the EU

According to a report from the EC on the experience gained by Member States on the implementation of national targets established in their NAPs and on progress in the implementation of the SUD, more than two thirds of the EU Member States have not managed to complete the review of their initial NAP within the five-year-deadline. The EC concluded that only few Member States included specific targets and indicators in the context of the review of their initial plan. Moreover, most Member States have not adjusted their NAPs according to the weaknesses identified by the EC. It also states that for most Member States, the targets set in the plans are neither ambitious nor outcome-based. Nonetheless, Member States have made progress regarding the implementation of measures included in their NAPs, especially when it comes to training and certification of operators, water protection and safe handling and storage of pesticides. The EC has identified potential for further risk reduction especially in the fields of IPM (European Commission, 2020b).

4.2 Selected Member States analysis

4.2.1 Austria (AT)

4.2.1.1 Status of NAP

For the period of 2012-2016 a compendium of nine plans (Land Action Plans), one for each of the nine provinces, was adopted in Austria. For the period of 2017-2021 a consolidated version of the NAP on national level was adopted and transferred to the EC in 2018 (European Commission, 2018b). Representatives of the Federal Government, the provinces, interest groups and other stakeholders were involved in the development of this plan (Austrian Ministry for Rural Affairs, 2017).

Requirements of Article 4 of the SUD

An overview analysis of whether the Austrian NAP fulfils the requirements of Article 4 of the SUD is presented in Table 1 below.

Table 1 Requirements of Article 4 of the SUD

Article 4. Reduction of risks and impacts of pesticide use on human health and the environment and encouragement of the development and introduction of IPM and of alternative approaches or techniques in order to reduce dependency on the use of pesticides			
	Yes	No	Description
Quantitative objectives		X	-
Targets	X		The Austrian NAP sets 40 objectives/targets/measures for several

Article 4. Reduction of risks and impacts of pesticide use on human health and the environment and encouragement of the development and introduction of IPM and of alternative approaches or techniques in order to reduce dependency on the use of pesticides			
			topics. However, these do not include clear quantitative aspects. No clear distinction between objectives, targets and measures is indicated.
Specific measures		x	-
Timetables (detailed deadlines)	X		Out of the 40 measures/targets/objectives, 8 are connected to a clear timetable/deadline.
Which of the following aspects are covered by these objectives/targets?			
	Yes	No	Description
Worker protection		x	Worker protection is not included as an objective/target. However, targets allocated to other topics could contribute to worker protection (e.g. training for professional users, inspection targets etc.)
Protection of the environment	X		Targets are included for the protection of the aquatic environment, also other target, e.g. on IPM could contribute to this aspect.
Residues	X		A target is included on raising awareness for spray mixtures in order to keep residues to a minimum
Use of specific techniques	X		-
Use in specific crops	X		Included, e.g. a target on targeted expert advice to users in the selection of crops and crop rotation.
Indicators to monitor the use of plant protection products containing active substances of particular concern		x	Not included

Funding

There is no indication on the source of funding of the targets included in the plan.

4.2.1.2 Measures put in place

In its NAP, Austria describes its approach to fulfil Article 4 by setting up quantitative objectives/measures and timetables according to Article 5-15 of the SUD. The plan does not differentiate measures from objectives; hence the column "measures" has been left out in the table below. The indicators are not translated one to one to the objectives/measures in the NAP, so there does not necessarily have to be a connection between the objective/measure and the indicator in the cells of the column "example".

Table 2 Requirements of Articles 5-15 of the SUD

Article	Included as separate chapter	Objectives	Measures	Indicators
Article 5: Training	Yes	6 objectives / measures None quantitative one with a timetable	-	Three quantitative indicators are included for information, training and awareness-raising. One of them refers to the number of certificates issued.
Article 6: Requirements for sales of pesticides	No	Not included	-	-
Article 7: Information and awareness-raising	Yes	12 objectives / measures None quantitative 4 with a timetable	-	Three quantitative indicators are included for information, training, and awareness-raising. Only one of them directly refers to the availability of advice and therefore Article 7.
Article 8: Inspection of equipment in use	Yes	5 objectives / measures None quantitative No timetable	-	No indicators are included
Article 9: Aerial spraying	No	The aerial spraying of PPP is prohibited in Austria. Individual licences may be issued upon request.	-	No indicators are included
Article 10: Information to the public (persons who could be exposed to the spray drift)	Yes, included as a subchapter in the chapter on awareness-raising	3 objectives / measures None quantitative 1 with a timetable	-	Three quantitative indicators are included for information, training and awareness-raising.
Article 11: Specific measures to protect the aquatic environment and drinking water	Yes	5 objectives / measures None quantitative no timetable	-	Two indicators setting clear quantitative criteria are included
Article 12: Reduction of pesticide use or risks in specific areas	No	A non-quantitative objective/measure referring to specific areas according to Article 12 is included in the chapter on the protection of the aquatic environment.	-	All of the 19 indicators can be regarded as risk indicators. No indicator allocated to the reduction of pesticide use is included. However, in the context of IPM, an indicator is included referring to the independent national alert service, which

Article	Included as separate chapter	Objectives	Measures	Indicators
				helps to use PPP more efficiently.
Article 13: Handling and storage of pesticides and treatment of their packaging and remnants	A chapter is included on the use of PPP and cleaning of plant protection equipment:	6 objectives / measures None quantitative 1 with a timetable	-	No indicator allocated to the relevant aspects of this article is included.
Article 14: Integrated pest management	Yes	11 objectives / measures No quantitative 2 with a timetable	-	10 indicators allocated to IPM are included.
Article 15: Harmonized indicators	No	-	-	Separate chapter on indicators is included: 19 indicators 4 defining or referencing clear quantitative criteria. However, no harmonized risk indicators as described in EU law are included.

Measures beyond Articles 5 to 15

No measures that are not linked to articles 5-15 have been identified.

4.2.1.3 Assessment

The aspects described in Article 5-15 of the SUD are included in the NAP as a description of requirements according to European and national law or as further steps to be taken in these fields. However, for some of them, no actions/measures are clearly allocated. Also, there is no clear differentiation/definition between objectives, targets, measures, and indicators included in the NAP. Many objectives/measures reported in the NAP have no specific indicator of progress. Most of the objectives/measures are not quantitative or are formulated very vaguely. The indicators included in the plan are mostly non-quantitative, however, some of them include clear quantitative criteria (e.g. water pollution thresholds).

Stakeholder input

For the assessment of the Austrian NAP, a stakeholder interview with a representative of the CA was conducted. The following aspects summarize the stakeholder input. According to the CA, the NAP is an important component of responsible use and reduction of PPP in Austria and serves as a guideline for the responsible authorities in their work of implementing the SUD.

Austria is currently revising its NAP and the measures included in the current version will also be part of the updated one. Additionally, the aim of the updated NAP 2022 - 2026 will be to follow the recommendations of the EC and the conclusions of the European Court of Auditors, and to take into account other EU strategies.

According to stakeholder input, some of the requirements on the NAP in the SUD are open to interpretation and should be harmonized. One example is the principles of IPM and how to implement them, especially regarding control mechanisms.

Farm to fork strategy

A broad range of measures and initiatives to reduce the use of chemical-synthetic PPP as well as fertilizers have been implemented in Austria. For instance, 26% of the total farming area in Austria is organically farmed.

The F2F strategy and the Biodiversity Strategy objectives will be addressed in the updated NAP for 2022 – 2026. The revised NAP will place special focus on IPM to reduce the use of chemical pesticides and to be less dependent on them in general and on the use of higher risk pesticides in particular. The chapter "*Further development of Integrated Pest Management*" will therefore be one of the main topics of the revised NAP 2022 – 2026.

Examples of successful measures related to the F2F strategy in the current NAP that have been named include the *Plant Protection Alert System*, and measures included in the Austrian agri-environmental program (ÖPUL) for farmers such as the limitation of yield increasing inputs, the promotion of organic farming and research and innovation activities with regards to sustainable crop protection.

Funding

The human and economic resources spent on the development of the NAP were very extensive because the NAP involves the Federal government as well as the nine provinces (Länder) and other stakeholders like the chambers of agriculture in the nine provinces. The federal authorities, the provinces, interest groups and other stakeholders were part of the expert group working on the plan. The Federal Ministry for Agriculture, Region and Tourism and the joint representatives of the provinces (Länder) were responsible for the coordination. As a result of the broad distribution of competences, it is not possible to quantify the resources spent on the development and implementation of the NAP.

A clear wish to not have any further administrative and bureaucratic overheads, especially with regard to record-keeping obligations (PPP user and control by the authorities) was expressed.

4.2.2 Belgium (BE)

4.2.2.1 Status of NAP

Belgium concluded the review of its NAP within the prescribed five-year deadline. Clear indications were given for the involvement process and lines of responsibility. The following entities were involved: *Federal State, BCR (Brussels-Capital Region), Flanders Region and Walloon Region as well as a joint action of these entities*. The implementation of the NAP is coordinated by the NAPAN Task Force (NTF) comprising representatives from each authority responsible for the NAP in Belgium. The NTF is responsible for presenting each programme to the authorities with a view to public consultation. The Federal, regional and local authorities are responsible, within their respective areas of competence, for the implementation of the NAP by means of a new programme every five years. The Regional Pesticide Reduction Plan (PRRP) 2013-2017 (indicated by the Belgian NAPAN Task Force, 2014) identifies actions at regional level.

Various stakeholders (e.g. farmers, producers, retailers etc.) are adequately represented on the Board of the NAPAN. This Board collaborates closely to prepare and monitor programmes and meets quarterly.

Requirements of Article 4 of the SUD

An overview analysis of whether the Belgian NAP fulfils the requirements of Article 4 of the SUD is presented in Table 3 below.

Table 3 Requirements of Article 4 of the SUD

Article 4. Reduction of risks and impacts of pesticide use on human health and the environment and encouragement of the development and introduction of IPM and of alternative approaches or techniques in order to reduce dependency on the use of pesticides			
	Yes	No	Description
Quantitative objectives	x		The Belgium NAP sets clear objectives. however, no objectives are quantitative but rather qualitative or have a quantitative character but cannot be quantified e.g.: "Monitoring water contamination and eliminating pollution" does not state how many monitoring programmes should be established.
Targets		x	No distinction was made between targets and objectives.
Specific measures	x		For each target, the NAP highlights measures to be taken. In most cases this includes only one measure, however up to six were listed for individual objectives.
Timetables (detailed deadlines)		x	Although precise terms of implementation (e.g. year) have been reported in the initial NAP (NAPAN, 2014), the revised NAP does not identify timetables ("a communication strategy and plan will specify the target groups, messages, actions, arrangements and schedule for the period 2018-2022, so as to meet the general objectives of this pesticide reduction programme" (NAPAN, 2020)
Which of the following aspects are covered by these objectives/targets?			
	Yes	No	Description
Worker protection	x		Reducing the risks to agricultural workers has been set as a target. Furthermore, a study on the exposure of workers in green sectors has been carried out.
Protection of the environment	x		The NAP encourages the use of PPP for each crop that poses a lower risk to the environment. Protection of the aquatic environment has been thoroughly highlighted.
Residues	x		Handling/storage of PPP and their packaging/residues has been defined with 13 objectives and respective measures.
Use of specific techniques		x	No indication of specific techniques has been identified.

Use in specific crops	x	Specific crops are identified in a website. An informative list of crops is available with possible risks and impacts on the various aspects of the environment (available to professionals).
Indicators to monitor the use of plant protection products containing active substances of particular concern	x	An annual publication of the updated NAPAN scoreboard identifies trends in the use of certain active substances (e.g. those of particular concern), or practices which require particular attention, as well as good practices to be encouraged

Funding

Funding is not indicated in the NAP. Further indication on financial aspects is reported in Chapter 4.2.2.3.

4.2.2.2 Measures put in place

Belgium has described in its NAP its approach towards fulfilling each of the articles 5 to 15 by highlighting objectives, measures, and indicators. This description is very detailed, and information is reported in a well-structured manner (table with good overview).

Table 4 Requirements of Articles 5-15 of the SUD

Article	Included as separate chapter	Objectives	Measures	Indicators
Article 5: Training	Yes	<p>Number of objectives: 17</p> <p>None are quantitative</p> <p>No timetables provided</p> <p>For two objectives the federal government is responsible, the Brussels-Capital region for eight, the Flanders region for two and the Wallonia region for five.</p>	Each objective has one measure allocated to it	<p>The NAP contains a column called "Key success factors" (KFS) which include a "combination of significant facts and/or deliverables required to meet the objective". Some of these can be interpreted as "indicators" and have a quantitative character, however none can be reasonably applied as no thresholds are set e.g.: "Number of training activities and participants" cannot be measured, as the objective does not set a specific number. In total 5 indicators are fully quantifiable with a timetable such as "Organising at least one session annually of initial training for each type of phytoliceance" in order to provide training for pesticide users.</p>
Article 6: Requirements for sales of pesticides	Yes	<p>Number of objectives: 13</p> <p>None are quantitative</p> <p>No timetables are provided.</p> <p>For one objective a joint action of all federal and regional governments is responsible, for six the federal government, for one the Brussels-Capital region and for five the Wallonia region.</p>	Each objective has one, and in one case two measures allocated to it	<p>The KFS column contains some quantitative indicators such as the "number of visitors per website" in order to raise "the awareness of and encouraging private individuals to adopt a more responsible attitude towards PPPs" through an established webpage, however these can again not be measured, as a quantitative goal is missing. On the other hand, some indicators are not quantifiable but contain a date until which the objective needs to be realised e.g. "Availability of new instructions for amateur PPP distributors in 2019".</p>
Article 7: Information and awareness-raising	Yes	<p>Number of objectives: 16</p> <p>None are quantitative</p> <p>No timetables are provided</p> <p>For one objective a joint action of all federal and regional governments is responsible, for five the federal government, for four the</p>	Each objective has at least one and up to four measures allocated to it	<p>The KFS column contains some quantitative indicators such as the "number of visitors to the websites" in order to promote "pesticide-free management" through an Awareness-raising campaign, however these can again not be measured, as a quantitative goal is missing. Some indicators are fully quantitative and include a timetable such as "At least two meetings (or workshops or round tables) per</p>

Article	Included as separate chapter	Objectives	Measures	Indicators
		Brussels-Capital region, for two the Flanders region and for four the Wallonia region.		year". In total seven indicators are fully quantifiable. On the other hand, some indicators are not quantifiable but contain a date until which the objective needs to be realised e.g. "Practical measures to encourage the wearing of suitable gloves will be made available at points of sale for amateur use PPPs by 2022 at the latest".
Article 8: Inspection of equipment in use	Yes	Number of objectives: 3 None are quantitative No timetables are provided. For all objectives, the Flanders region is responsible.	One objective has three measures allocated to it and the other two only one.	The KFS column contains three quantitative indicators two of which contain a date of completion e.g.: the regular checks of pesticide equipment which is further defined as being performed every three years. The quantitative indicator which, however, does not have an implementation date is, that "100% of the dispersers are fitted with 50%-minimum drift-reducing caps"
Article 9: Aerial spraying	No, but it is mentioned, that is it forbidden in Belgium	The aerial spraying of PPP is prohibited in Belgium. Under exceptional circumstances, in extreme situations, a derogation may be granted with very specific conditions which are subject to checks carried out by the Federal authority.	-	-
Article 10: Information to the public (persons who could be exposed to the spray drift)	Yes	Number of objectives: 1 and it is neither quantitative nor provides a timetable. The Brussels-Capital region is responsible for this objective.	The objective has two measures allocated to it.	The KFS column contains two indicators however neither is quantitative nor provide a timetable. ("Availability of appropriate templates" and "Coordinating the Good Food Strategy")
Article 11: Specific measures to protect the aquatic environment	Yes	Number of objectives: 15 None are quantitative No timetables are provided	Every objective has at least one and up to four measures allocated to it.	The KFS column contains two quantitative indicators. For example, the development of one pesticide alternative on the basis of an herbivore fish species to limit aquatic plants in basins. There are also some semi-quantitative indicators such as the "number of

Article	Included as separate chapter	Objectives	Measures	Indicators
and drinking water		For one objective a joint action of all federal and regional governments is responsible, for three the Brussels-Capital region, for seven the Flanders region and for four the Wallonia region.		workshops/lectures/classes given and the number of participants”, however they cannot be evaluated as the objective does not state a threshold to be reached. None contained a timetable.
Article 12: Reduction of pesticide use or risks in specific areas	Yes, and the chapter is divided into several sub areas such as the protection of wildlife	Number of objectives: 17 None is quantitative No timetables are provided For one objective a joint action of all federal and regional governments is responsible, for two the federal government, for six the Brussels-Capital region, for four the Flanders region and for four the Wallonia region.	Every objective has at least one and up to four measures allocated to it.	The KFS column contains six quantitative indicators e.g. an “interregional meeting annually with the public authorities” to harmonise the approach on the use of pesticides. There are also some semi-quantitative indicators such as the “Number of subsidies granted”, however they cannot be evaluated as the objective does not state a threshold to be reached. Some indicators also contained a defined date of completion e.g.: the “Publishing” of “the regulations no later than 2019”.
Article 13: Handling and storage of pesticides and treatment of their packaging and remnants	Yes	Number of objectives: 12 None is quantitative No timetables are provided. For one objective a joint action of all federal and regional governments is responsible, for three the federal government, for one the Brussels-Capital region, for two the Flanders region and for five the Wallonia region.	Every objective has at least one and up to two measures allocated to it.	The KFS column contains three quantitative indicators one also with a timetable e.g. the establishment of a “Sectorial agreement/legislation by no later than 2021” to reduce “Reducing the confusion surrounding PPPs and induced resistances through new labelling”. There are also some semi-quantitative indicators such as the “Number of advanced dispersers and cleaning systems”, however they cannot be evaluated as the objective does not state a threshold to be reached.
Article 14: Integrated pest management	Yes	Number of objectives: 22 None are quantitative No timetables are provided. For one objective the federal government is responsible, for eight the Brussels-Capital region, for five the Flanders region and for eight the Wallonia region.	Every objective has at least one and up to six measures allocated to it.	The KFS column contains five quantitative indicators e.g. the establishment and making available of a “fast-track procedure for biopesticide authorisations to support “the use of Biopesticides”. There are also some semi-quantitative indicators such as the “number of organic farmers”, however they cannot be evaluated as the objective does not state a threshold to be reached. Some of the quantitative indicators also stipulate a

Article	Included as separate chapter	Objectives	Measures	Indicators
Article 15: Harmonized indicators	Yes	Only one objective is for harmonised indicators stating, that Belgium should develop and actively pursue European indicators, however no harmonised indicator is presented. Some national indicators are listed or being developed (five in total).	-	frequency e.g.: "Organising at least one round table per year".

Measures beyond Articles 5 to 15

There are two additional chapters on "Risk mitigation measures" and the "Management of and follow-up to the plan". The first contains only one objective to assess "the relevance and practicability of risk mitigation measures to be applied by PPP users", which can also be interpreted as being relevant to Article 12 to reduce the risks of pesticides in specific areas. The second chapter focuses on organisational aspects on how to improve and manage the NAP.

4.2.2.3 Assessment

Based on the above table, Belgium's NAP provides objectives corresponding to articles 5-15, with the exception of aerial spraying (Article 9) which is forbidden in Belgium with some very strict derogations. For each article multiple objectives are listed, most with only one measure, however, some also contain more (up to 6). Nonetheless, the objectives are not quantifiable, nor do they have respective timetables. In many cases the objective could be formulated in a quantifiable manner, however this is often not the case e.g. "Promotion of organic farming" is measured by the number of organic farmers, however the objective does not reflect the quantitative character of the indicator.

For each objective there is a column called "KFS" (Key Success Factors⁶), which sometimes can be interpreted as indicators but sometimes represents more abstract concepts such as the "knowledge exchange" and "harmonised communication". Many indicators have a quantitative nature such as measuring the number of performed demonstrations, however the objective does not state how many demonstrations should be performed and as such the indicators cannot be assessed (see also above). There are however some indicators which are fully quantitative e.g.: the organization of two workshops per year. Such indicators contain a completion date (e.g. two per year; by the end of 2022), however no concrete timetable could be observed for any indicator.

Stakeholder input

Many of the measures listed in the Belgian NAP have been translated into national legislation and some are in the process of being implemented. Given that many aspects have been transposed into national legislation, the NAP is not viewed as a guidance document. IPM crop-specific guidelines in the different sectors are used, which are also used to carry out controls.

The implementation of the NAP has had numerous measurable consequences. For example, all professional users of PPP now possess knowledge certificates, a system of continuous training has been put in place, the pesticide markets have been split into professional and amateur users and information for both professionally and amateurs is provided. Additionally, many projects have been carried out since the beginning of 2006, however their effect on the public health and the environment is hard to measure. As such it may be, that the efforts are insufficient in some areas.

To ensure continuous improvement, the NAP is revised every five years with the next deadline being in 2023. During each review, new initiatives are implemented, and useful projects and services maintained. It is envisaged that a few hundred projects will be implemented in the coming years leading to real structural changes in the professional use of pesticides. The projects are structured around the articles of the SUD, although it was indicated, that Article 15 is problematic due to the lack of relevant indicators at both European and national level. Belgium hopes to develop a scoreboard containing all the indicators that are useful for a risk assessment policy.

Farm to fork strategy

One of the goals of the F2F strategy is to achieve 25% of agricultural land under organic farming by 2030. However, Belgium indicated that it will unlikely reach this goal. A main factor for this is

⁶ the combination of significant facts and/or deliverables required to meet the objective

enabling a fair competition in the context of free trade. It is necessary to first and foremost define and protect regional food production objectives that are compatible with the protection of the environment and public health. However, none of these means are available at the NAP level as this is an issue that remains partly dependent on European economic policy.

Another goal of the F2F strategy is the 50% reduction of the use and risk of chemicals pesticides by 2030. Two F2F targets are derived from elements of the Harmonized Risk Indicator (HRI) 1. The first one concerns all pesticides, except those listed in category A and C (microorganisms) and is based on the sum of the sales volumes of the active substances multiplied by a weighing factor dependent on their hazard profile. The second one is for pesticides in group C (candidates for substitution) and shows the sales of pesticides composed of at least one substance which is a candidate for substitution. The Belgium NAP contains measures that promote IPM and encourage the marketing of low-risk pesticides, however there are no measures in the NAP to replace candidates for substitution-based pesticides. As the first and second F2F indicators are still under discussion at the EU level, the revised Belgian NAP does not envision any additional tools to achieve these targets. Belgium is unsure whether the first objective will not simply be achieved by removing many active substances from the market. It was additionally stated that the first indicator will not show an increase in the use of pesticides from category A and C, which is counter intuitive as they are the alternatives to the use of other pesticides. Furthermore, there seems to be a lack of relevant indicators linking the level of pesticide use to the pressure on the environment and human health, as these are essential for managing the risks associated with the use of pesticides. In general, the reduction in the use of certain active substances depends on the availability and effectiveness of alternatives, which requires research and development efforts to realize.

Funding

As an estimate, Belgium requires three full-time equivalents to coordinate the NAP at the federal level. The implementation of the many projects is however much more expensive and very difficult to estimate. Some of the expenses were covered by existing budgets that were used for the NAP and others were found in specific research and risk management for pesticide funds. Some of the costs are also borne by the users, distributors, and producers of pesticides.

4.2.3 Bulgaria (BG)

4.2.3.1 Status of NAP

Bulgaria did not conclude the review of its first NAP (Bulgarian Council of Ministers, 2012) within the five-year deadline⁷. The EC audit in 2018 reports recommendations for improvement (European Commission, 2017). In response (Bulgarian Council of Ministers, 2019), Bulgaria revised its NAP in 2020 (Bulgarian Council of Ministers, 2020) with additional actions proposed to fulfil the requirements.

The CAs involved in the development of the NAP are listed with a description of the respective areas of responsibility (*refer to Case Study 3 on aquatic protection for further details*) (NAP 2020, page 17) – responsibilities are clearly outlined for each action in the NAP.

Bulgaria draws up and implements on an annual basis a *National Programme for the Control of Pesticide Residues in and on Foods of Plant and Animal Origin*.

Requirements of Article 4 of the SUD

⁷ https://ec.europa.eu/food/sites/food/files/plant/docs/pesticides_sud_report-act_2020_en.pdf

An overview analysis of whether the Bulgarian NAP fulfils the requirements of Article 4 of the SUD is presented in Table 5 below.

Table 5 Requirements of Article 4 of the SUD

Article 4. Reduction of risks and impacts of pesticide use on human health and the environment and encouragement of the development and introduction of IPM and of alternative approaches or techniques in order to reduce dependency on the use of pesticides			
	Yes	No	Description
quantitative objectives		x	The NAP does not establish quantitative objectives. Some objectives are of a quantitative nature and could be measured, however no clear goal is set and as such the objective cannot be assessed in a quantitative matter.
Targets		x	Targets are not included in the NAP
(Specific) measures	x		The measures presented in the Bulgarian NAP represent the article of the SUD (i.e. measure=Article). Every measure has one or multiple "actions"
timetables (detailed deadlines)		x	Although deadlines for implementing actions were indicated, many of them are expressed as "ongoing" – a timetable was not clearly indicated. The revised NAP did not identify clear deadlines
Which of the following aspects are concerned by these objectives/targets?			
worker protection	x		Specific indication of measures for agricultural workers are indicated (e.g. increase of awareness, rules for areas in which agricultural workers operate)
protection of the environment	x		Environmental protection measures are highlighted and presented in tables with indication of priority, responsible institution, and expected results
residues	x		Measures for reducing pesticide residues are identified with thorough descriptions.
use of specific techniques	x		Specific techniques are identified (e.g. specific spraying techniques and in particular for the aquatic environment)
use in specific crops	x		47 types of agricultural crops, divided in seven groups, are identified. Guides are given for IPM of them with explanation of general principles and specific principles
indicators to monitor the use of plant protection products containing active substances of particular concern	x		Monitoring data on pest management is presented in bullets with detailed information (i.e. appearance, spread, density, level of attack, times and methods to deal with). An annual report on the state of the environment is planned to be published for some pesticides (e.g. persistent organochlorine pesticides in soil).

Funding

In general, the NAP does not include information on funding. However, the NAP illustrates that IPM in Bulgaria was promoted through the introduction of incentives (e.g. financial incentives for agricultural producers) as stated *"funding to support the actions of state-financed organisations in implementing the National Action Plan is to be provided from the budget of the relevant ministries, within their expenditure ceilings"* (see NAP, VII.).

4.2.3.2 Measures put in place

In its NAP, Bulgaria describes its approach to fulfil each of the articles 5 to 15 by highlighting objectives, measures, and indicators. In Chapter IV general objectives for the protection of humans and the environment are set out, however these objectives do not have a quantitative character (e.g. avoiding and/or reducing pesticide pollution of water and soil) and are not further attributed to the specific articles or measures. Each article is described in its own chapter called "measures". Each measure (i.e. article) has one of multiple "actions" associated to it. At the end of the document a table summarises this information and lists all measures and actions. As the "measures" are rather general and only reflect the phrasing of the article (e.g. "Measure 2. Requirements for the sale of pesticides") the listed "actions" are more in line with the "measures" as described in article 4 of the SUD. Each of the measures/actions has a responsible institution, implementation deadline, progress indicators, priority and expected results associated to it, however none of the measures/actions have a detailed timeline, but only an implementation deadline. The following table summarises this information. As the objectives are formulated in a very general manner, they cannot be assigned to the Articles 5-15. Therefore, the column "Objectives" was left empty for most of the Articles.

Table 6 Requirements of Articles 5-15 of the SUD

Article	Included as separate chapter	Objectives	Measures	Indicators
Article 5: Training	yes	The objectives are listed in chapter IV in a general matter and are not attributed to the specific measures/actions)	Three measures are identified two of which are ongoing, and none contain a clear timetable. None of the measures/actions are quantifiable.	Each measure/action has multiple indicators most of which have a quantitative character, but do not have a specific target and as such cannot be quantified e.g. "Number of individuals trained by 2022" could be quantified, however no target number is defined. One indicator is fully quantitative: "An annual increase by 5% of the number of trained farmers as a percentage of the total number of registered farmers until the goal of 100% trained farmers applying professional-category PPPs is achieved."
Article 6: Requirements for sales of pesticides	yes	-	Four measures are identified all of which are ongoing and as such do not contain a clear timetable. None of the measures/actions are quantifiable.	The indicators are grouped for three of the four measures and are all of a quantitative character, but do not have a specific target and as such cannot be quantified e.g. "Number of persons holding a trade licence for PPPs" could be quantified, however no target number is defined.
Article 7: Information and awareness-raising	yes	-	Three measures are identified all of which are ongoing and do not contain a timetable. None of the measures/actions are quantifiable.	Each measure/action has one or up to three indicators most of which have a quantitative character, but do not have a specific target and as such cannot be quantified e.g. "Number of cases of acute and chronic pesticide poisoning of professional users, operators and agricultural workers." could be quantified, however no target number is defined.
Article 8: Inspection of equipment in use	yes	-	Four measures are identified two of which have a clear timetable set out e.g. after 2020 inspections are to be carried out every 3 years. None of the measures/actions are quantifiable.	Each measure/action has one or two indicators all of which have a quantitative character, but do not have a specific target and as such cannot be quantified e.g. "Percentage of equipment mounted on trains inspected compared to total equipment subject to inspection." could be quantified, however no target percentage is defined.

Article	Included as separate chapter	Objectives	Measures	Indicators
Article 9: Aerial spraying	yes	In general, aerial spraying is only allowed with a written authorisation of the Director of the Bulgarian Food Safety Agency.	Seven measures are identified however none have a clear timetable, instead they are all ongoing measures e.g. "Control of the ban on aerial spraying of PPP." None of the measures are quantifiable.	Each measure/action has one or multiple indicators. One measure (informing the public of an aerial spraying event) does not have an indicator. All but one indicator have a quantitative character, but do not have a specific target and as such cannot be quantified e.g. "Number of irregularities and non-compliances." could be quantified, however no target number is defined.
Article 10: Information to the public (persons who could be exposed to the spray drift)	yes	-	This measure is reported in the summary table under "Aerial spraying" as an action and does not have its own actions.	This measure/action does not have an indicator associated with it.
Article 11: Specific measures to protect the aquatic environment and drinking water	yes	-	In total 16 measures are identified however none have a clear timetable, instead most are ongoing measures e.g. "Monitoring drinking water quality." None of the measures/actions are quantifiable however some have a quantifiable character without setting clear goals e.g.: Reducing or eliminating the application of PPP on or along highways, railway lines [...]" which could be quantified, however no clear goal is set.	Each measure/action has one or multiple indicators, however some also have none. All listed indicators have a quantitative character, but do not have a specific target and as such cannot be quantified e.g. "Number of inspections." could be quantified, however no target number is defined.
Article 12: Reduction of pesticide use or risks in specific areas	yes	-	Six measures are identified, all of which are still ongoing and as such do not have a timetable. None of the measures/actions are quantitative.	Each measure/action has one or multiple indicators, however some indicators are allocated to multiple measures/actions. All listed indicators have a quantitative character, but do not have a specific target and as such cannot be quantified e.g. "Amount of empty PPP packages collected." could be quantified, however no target number is defined.
Article 13: Handling and	yes	-	Five measures are identified all of which are still ongoing and as	Each measure/action has one or multiple indicators, however some indicators are allocated to multiple measures/actions. All

Article	Included as separate chapter	Objectives	Measures	Indicators
storage of pesticides and treatment of their packaging and remnants			such do not contain a timetable. None of the listed measures/actions are quantitative.	listed indicators have a quantitative character, but do not have a specific target and as such cannot be quantified e.g. "Number of proven cases of pesticide poisoning of bees." could be quantified, however no target number is defined.
Article 14: Integrated pest management	yes	-	15 measures/actions are identified most of which are ongoing. Two measures have a clear schedule e.g. "updating of the scientific basis of the economic damage thresholds of major crops" which is supposed to be done each year. None of the measures/actions are quantifiable, however some have a quantitative nature such as "Areas for organic farming – size of utilised agricultural land farmed organically." although no clear goal is set.	Most measure/action have one or multiple indicators, however some have none such as the "Maintenance of a public register of persons who are registered and offer integrated pest management advisory services.". Most listed indicators have a quantitative character, but do not have a specific target and as such cannot be quantified e.g. "Number of IPM guides updated." could be quantified, however no target number is defined.
Article 15: Harmonized indicators	No, however a chapter summarizing all used indicators is available.	-	No harmonised indicators are presented.	-

Measures beyond Articles 5 to 15

There are two additional chapters called "Reducing the levels of pesticide residues in foods of plant origin (produced in Bulgaria)" and "Additional measures to protect the environment". The first aims at reducing the residues of pesticides on crops by strengthening controls and monitoring the pesticide residues. The second measure aims at the protection of soil from organochlorine pesticides by monitoring their residues in the soil.

4.2.3.3 Assessment

As can be seen, Bulgaria's NAP addresses Articles 5-15 of the SUD. Each Article is identified as a measure and is elaborated in a separate chapter. The chapters often explain the background of the relevant authorities, the associated risk(s), the objective(s) and also the expected outcomes. At the end of each chapter, actions under the specific measure (article) are listed, including the deadline and responsible institution. The NAP only identifies two main objectives each with sub-objectives, however these are kept very general (e.g. "avoiding and/or reducing pesticide pollution of water and soil") and cannot be directly associated to the laid-out measures/actions.

At the end of the plan, a table is listed containing a summary of all the separate chapters (measures). There each measure including its actions, the responsible institution(s), implementation deadline, progress indicators, the priority and the expected result(s) is listed. However, the majority of the listed actions are not quantifiable and do not have a clear timetable, instead most are "ongoing". On the other hand, most of the progress indicators have a quantifiable nature e.g. "Number of registered farmers by year", however no clear goal as to how many farmers should be registered is set. No harmonized indicators were mentioned.

Stakeholder input

For the assessment of the Bulgarian NAP a stakeholder interview with a representative of the CA was conducted. The following aspects summarize the stakeholder input. According to feedback received from the CA, the NAP was transposed into the national legislation i.e. the Plant Protection Act and related ordinances and it is used as a guidance document in some respects. For example, during inspections, compliance with the basic principles of IPM is also assessed and for an authorization for aerial spraying a 100% on-site inspection is carried out. Additionally, to counteract the illegal import of pesticides, a new activity was included in the NAP and following that several actions were carried out.

The implementation of the NAP has also led to numerous positive consequences such as an increase in the number of trained farmers, the trade of professional pesticides only being performed by people with a certificate and the collection of empty PPP packages. On 26 February 2021, the Ordinance 9 on integrated production of plants and plant products and control over integrated production was adopted and, in this regard, the IPM guidelines will be updated within one year.

Bulgaria intends to update its NAP in five years if deemed necessary. Its structure follows the requirements of Article 4 and Article 5 to 15 and during the update new quantitative indicators were introduced to measure the progress of the NAP implementation.

Farm to fork strategy

It was indicated that the goal of 50% reduction in pesticide use is not realistic, as Bulgaria has a much warmer climate compared to northern Europe and as such provides a favorable environment for the development of weeds, pests and diseases. The implementation of the NAP shows a trend of a permanent reduction in pesticide use in Bulgaria, however the 50% goal will very likely not be achieved.

The most important factors for achieving the targets of the F2F strategy are the application of the IPM and new alternative techniques and methods (See case study on new application techniques). Despite this, no applications for inclusion in the register of farmers engaged in the integrated production of plants and plant products have been received from farmers. As such, financial incentives are needed for farmers to apply the specific principles of IPM. Additionally, it is important to implement and use advisory systems and mathematical models to predict the development of key pests in strategic crops for the Member State. This can help reduce the risks and impacts of pesticide use on human health and the environment by achieving a balance between environmental and economic needs when using PPP. Lastly, to measure the progress towards the F2F strategy goals, an information system for PPP, which is set out in the NAP, is developed. This will provide full traceability of the used PPPs throughout their lifetime, from the placing on the market to the end user.

Funding

According to the CA, the administrative and human resources for the development of the NAP were expended from several organizations, e.g. Ministry of Agriculture, Food and Forestry, Ministry of Health, Ministry of Environment and Water, Ministry of Transport, Center for Risk Assessment in the Food Chain, experts from laboratories, etc.

The budget for the implementation of the NAP lies within the budget of the expenditure ceilings of the respective ministries. No additional specific funds have been used to develop and implement the NAP.

4.2.4 Ireland (IE)

4.2.4.1 Status of NAP

Ireland adopted its first NAP in 2013 but did not conclude its revision within the assigned five-year deadline (European Commission, 2020a). After an audit by the EC in the beginning of 2019, a revised plan was adopted in 2019 for the five-year period 2019 to 2024 (GD SANTE, 2016). According to information provided during an interview with the CA, the next revision of the plan will take place before 2024 due to the introduction of the F2F strategy. The Department of Agriculture, Food and the Marine (DAFM) is responsible for the development and implementation of the NAP (Irish Department of Agriculture Food and the Marine, 2019). No clear timetable in terms of deadlines for measures to be implemented is indicated in the NAP (Irish Department of Agriculture Food and the Marine, 2019).

Requirements of Article 4 of the SUD

An overview analysis of whether the Irish NAP fulfils the requirements of Article 4 of the SUD is presented in the table below.

Table 7 Requirements of Article 4 of the SUD

Article 4. Reduction of risks and impacts of pesticide use on human health and the environment and encouragement of the development and introduction of IPM and of alternative approaches or techniques in order to reduce dependency on the use of pesticides			
	Yes	No	Description
Quantitative objectives		x	The Irish NAP sets 7 objectives on several topics. However, these do not include clear quantitative aspects.
Targets	x		The NAP includes 36 targets

Specific measures	x		81 actions are included in the NAP.
Timetables (detailed deadlines)		x	Out of the 81 actions, none are connected to a clear timetable /deadline
Which of the following aspects are covered by these objectives/targets?			
	Yes	No	Description
Worker protection		x	Worker protection is not included as an objective/target.
Protection of the environment	x		Objectives, targets and actions are included for the use of the aquatic environment. Also, other targets, e.g. on IPM relate to this aspect.
Residues	x		A target it included concerning data gathering on scrutinising breaches of maximum residue levels in food.
Use of specific techniques	x		A target is included on IPM techniques.
Use in specific crops		x	Not identified
Indicators to monitor the use of plant protection products containing active substances of particular concern	x		An indicator on the recording of breaches of maximum residue levels is included.

Funding

No indication on how to finance the implementation of the plan could be identified.

4.2.4.2 Measures put in place

The table below contains an assessment of the objectives, measures, and indicators included the Irish NAP according to Article 5-15 of the SUD.

Table 8 Requirements of Articles 5-15 of the SUD

Article	Included as separate chapter	Objectives	Measures	Indicators
Article 5: Training	Yes	One objective is included, that is of quantitative character ([...] all individuals, involved at every level in the PPP industry, are trained in a manner that is appropriate to their particular role and responsibility [...]). However, no clear quantitative threshold is set. 9 targets are defined, some of them use quantitative terms (e.g. all, every etc). However, no clear thresholds are defined.	19 Actions are included, some of them are already in place, for others it is uncertain if they refer to existing measures or will be implemented in the future. No clear timetable is included.	9 Indicators are included.
Article 6: Requirements for sales of pesticides	Yes, a chapter on supply of PPP is included, sales is also subject to objectives/targets in other chapters,	There is one non-quantitative objective for the three subchapters: Controls on storage, supply and disposal of PPPs.	3 actions are included, no clear timetable is included.	2 indicators are included.

Article	Included as separate chapter	Objectives	Measures	Indicators
	e.g. on information exchange (section 1b) or data gathering (section 1c). Since they are mainly subject to other Articles, they weren't considered in this line.	Concerning sales, the aspects of authorization, packaging and labelling are addressed in this objective. For supply of PPP, two targets are included. some of them use quantitative terms ("all"). However, no clear thresholds are defined.		
Article 7: Information and awareness-raising	Yes, for information exchange a chapter is included. However, awareness-raising is included in the objective on IPM. Objectives / targets in other chapters include aspects on information.	One objective (for the general public and amateur users) is defined (non-quantitative) 4 targets are included. They are partly formulated in a quantitative manner (e.g. increase knowledge), however, no clear quantitative targets are set.	5 actions are included. Some are already in place; others are implemented if needed. No timetable is indicated.	3 indicators are included.
Article 8: Inspection of equipment in use	Yes, a chapter is included on controls on application equipment	1 objective in set, that specifies a clear scope on equipment that is to be tested. 4 targets have been defined. The objective and the targets are formulated in a quantitative manner (e.g. "[...] all PAE more than 5 years old [...]"). However, no clear quantitative goals are defined.	12 actions are included in the plan. No schedule is included. However, a schedule of testing requirements should have been published on the CA website according to one of the targets.	5 indicators are included.
Article 9: Aerial spraying	Yes, a chapter on aerial application is included	One objective is included for aerial application, spray trains, reduction of risk in sensitive areas and protection of Water.	Not included since aerial spraying is prohibited in Ireland.	Not included since aerial spraying is prohibited in Ireland.
Article 10: Information to the public (persons who could be exposed to the spray drift)	See line on Article 7 above	See line on Article 7 above	See line on Article 7 above	See line on Article 7 above.
Article 11: Specific measures to protect the aquatic environment and drinking water	A separate chapter is included	Water protection is one aspect included in the objective concerning aerial application, spray trains, reduction of risk in sensitive areas and protection of water. The objective in non-quantitative.	10 actions are included. To some extent they include clear obligations. However, is seems to refer mostly to measures already implemented. No timetable included.	2 indicators are included.

Article	Included as separate chapter	Objectives	Measures	Indicators
		One non-quantitative target is included on water protection. No timetable included.		
Article 12: Reduction of pesticide use or risks in specific areas	A separate chapter is included	Reduction of risk in sensitive areas is one aspect included in the objective concerning aerial application, spray trains, reduction of risk in sensitive areas and protection of water. The objective is non-quantitative. One non-quantitative target is included, without a timetable.	4 actions are included. They are not quantitative, no timetable provided.	1 indicator is included.
Article 13: Handling and storage of pesticides and treatment of their packaging and remnants	A separate chapter is included	There is one non-quantitative objective for the three subchapters: Controls on storage, supply, and disposal of PPPs. 6 Targets are included in the subchapter storage and disposal. No clear quantitative targets are set.	7 actions are included, of which 1 provides a timetable	3 indicators are included.
Article 14: Integrated pest management	A separate chapter is included	One non-quantitative objective is included. 4 targets are included in this chapter.	12 actions are included without a timetable.	5 indicators are included
Article 15: Harmonized indicators	Not included	Not included	Not included	Not included

Measures beyond Articles 5 to 15

Apart from the requirements in Article 4 - 15 the Irish NAP puts focus on data gathering. A separate chapter is included for this.

4.2.4.3 Assessment

Based on the above it can be seen that the Irish NAP includes objectives, targets, and actions on all relevant aspects of Article 5-15. Not each of these Articles is represented by a separate chapter; some aspects are summarized in a chapter, other requirements are represented all over the plan, e.g. as several targets in different sections. Some of the targets are formulated in a quantitative manner, however, no specific thresholds for their fulfilment are defined. Therefore, the provided indicators have limited applicability. No clear timetables are included for the implementation of the plan. Some of the actions included in the plan refer to measures that are already implemented. For others, it is not clear if the indicated measures are planned or in place.

Stakeholder input

In the context of this case study, an interview was conducted with a representative of the Irish CA. The representative indicated that all measures included in the NAP have been transposed into national law. According to the interview the NAP is more than a guidance document, since it is used to outline a strategy, to achieve the SUD and to establish objectives, targets, measures, and timeframes to reduce the risks and impacts associated with the use of pesticides on human health and the environment and to encourage the development and introduction of IPM. In addition, the

NAP recognises that the implementation of the SUD must take into account actions under other Community legislation that have impacts on the use of pesticides, e.g. the Birds and Habitats Directive and the Water Framework Directive. It was also outlined that there are tangible / concrete consequences stemming from the implementation of the Irish NAP, these include among others:

- Successful implementation of formal trainings for users, distributors, advisors, and inspectors
- Successful implementation of the Testing of pesticide application equipment
- Successful implementation of DAFM online recording of pesticide application equipment. inspections and registration of PAs, PDs, PUs and Equipment inspectors
- An improved compliance level, since the online registration system can be used for SUD compliance purposes
- Improved statistics regulation, which data on sales and usage data of pesticides
- Two initiatives on water protection were started, that contribute to the compliance with the Drinking Water Directive. The initiatives include an enhanced sampling and monitoring program
- Safe & effective disposal of pesticides and containers—Farm Hazardous Waste Scheme. Collected farm wastes including pesticides. Operated for 5 years and collected 68 tons of pesticides

Measurable differences between before and after the implementation of the NAP are among others: 36,000 trained professional users, 900 trained distributors, 800 trained advisers, 160 trained inspectors of pesticide application equipment and approximately 6,500 inspected pesticide application equipment.

According to the interviewee, one of the most important aspects of the NAP and the SUD is IPM. However, it is difficult to quantitatively measure the impact of IPM. As such, research and funding for IPM, including quantifiable measurement and recording of its use and benefits, need to be a priority especially in the context of a revised SUD going forward.

Apart from including the F2F targets, the updated NAP will focus on a clear reduction of pesticide use.

Farm to fork strategy

According to the interview, the current plan was updated before the F2F targets were announced. Therefore, the plan will be updated before the regular program period of 5 years to include the F2F targets. However, the targets, measures, and timeframes to reduce the risks and impacts of pesticide use and encouraging the introduction of IPM as included in the current version of the NAP may also contribute to the achievement of the F2F targets.

Funding

The economic resources spent on the development of the plan have not been quantified or estimated. This is due to the communication effort and the collaboration with various stakeholders, which continues beyond the finalization of the NAP, as the implementation of the NAP and its evolution is an ongoing process.

The financial burden on the industry side is estimated to exceed millions of euros by the CA. For the administrative work, there is no fixed budget. One explanation for this is that the implementation of the NAP is not finished at a certain point, but processes are being improved constantly.

4.2.5 Poland (PL)

4.2.5.1 Status of NAP

Poland adopted its first NAP in 2013 (Polish Ministry of agriculture and rural development, 2013), and revised it in 2018 (Polish Minister of agriculture and rural development, 2018) based on the EC's audit report of 2017 (European Commission, 2018a). Poland's NAP is described as "*direct implementation of the objectives adopted in the Strategy for sustainable development of rural areas, agriculture and fisheries for 2012-2020*" of 2012 (Polish Ministry of agriculture and rural development, 2013). This document illustrates courses of action financed or co-financed with public funds, both national and EU.

The following entities were involved in the development of the NAP: the Ministry of Agriculture and Rural Development, the Agricultural Advisory Centre, the provincial agricultural advisory centres, the Institute of Plant Protection (National Research Institute), the Research Institute of Horticulture, the State Plant Health and Seed Inspection Service. The implementation of the NAP has been conducted via multi-annual programmes (implemented by the institutions involved).

Requirements of Article 4 of the SUD

To highlight whether the NAP fulfil the requirements of Article 4 of the SUD, the following table presents the results.

Table 9 Requirements of Article 4 of the SUD

Article 4. <i>Reduction of risks and impacts of pesticide use on human health and the environment and encouragement of the development and introduction of IPM and of alternative approaches or techniques in order to reduce dependency on the use of pesticides</i>			
	Yes	No	Description
quantitative objectives	x		Measurable objectives have been set in the previous NAP. In many actions, the revised NAP indicates thresholds.
targets	X		Targets are identified by citing objectives reported in the Directive 2009/128/EC.
specific measures	X		Specific measures are identified for each target.
timetables (detailed deadlines)		x	Whereas the first NAP sets clear timetables, the revised one clearly indicates timetables only for some of the actions (by indicating the year), but not for all of them.
Which of the following aspects are concerned by these objectives/targets?			
	yes	no	Description
worker protection		X	No specific indication for worker protection is identified.
protection of the environment	X		Protection of the environment is identified for pollinators (Action 3 and 9), minor crops (Action 5), groundwater and aquatic environment in general (Action 7)

residues	X	Measures to determine pesticide residues are identified, as well as responsibility for checking food of animal origin for residues of PPP (Action 11).
use of specific techniques	X	Specific methods for plant protection activities are identified (Action 9).
use in specific crops	x	IPM methodologies for various crops (69 methodologies were prepared, in Action 1).
indicators to monitor the use of plant protection products containing active substances of particular concern	x	Quantitative indicators are used in the previous NAP, to assess the risks associated with the use of PPPs (e.g. level of pesticide residues in surface water and groundwater, statistics on the use of PPPs). Although no precise indication in the revised NAP has been set ("indicators of risks [...] developed for 2013-2017 will be refined"), a specific website for controlling pest management and defining risk indicator has been published ⁸ . All relevant information about alerts on pest risk assessment are highlighted and explained. The previous NAP defined that results of monitoring of the objectives, including a risk assessment associated with the use of PPP, are annually available on a website administered by the office, which includes IPM measures.

Funding

The NAP states the following "the tasks defined in the National Action Plan will be financed with funds allocated to the individual units of the public administration and institutions under the Budget Acts for the individual years, subject to the limits of financial resources available to the respective institutions and budgets managed by budget administrators" (Polish Minister of agriculture and rural development, 2018). Further indication on financial aspects is reported in Chapter 4.2.5.3.

4.2.5.2 Measures put in place

Poland describes its approach for fulfilling each of the Articles 5 to 15 by highlighting objectives, measures (actions sometimes grouped in specific tasks) and indicators.

Table 10 Requirements of Articles 5-15 of the SUD

Article	Included as separate chapter	Objectives	Measures	Indicators
Article 5: Training	Yes	One objective is included only citing the SUD. The specific non-quantitative objective is indicated in the introduction of the NAP: "compliance by professional users of PPPs with the general principles of integrated	Four measures are included. Timetable is reported as report on irregularities in 2022 (see indicators)	One indicator is included: "The effectiveness of the Action will be assessed on the basis of the level of irregularities regarding the fulfilment of the obligation to undergo training by persons

⁸ <https://www.agrofagi.com.pl/>

Article	Included as separate chapter	Objectives	Measures	Indicators
		pest management". It is reported in the NAP that "in 2017 the value of the measure should be at least 90%". Therefore, a tracking system has been established. However, no clear threshold is defined.		who use PPPs. In 2022, the level of irregularities in this respect detected through planned checks carried out by the State Plant Health and Seed Inspection Service should be below 1%." This type of indicator is used in the NAP for all other articles.
Article 6: Requirements for sales of pesticides	Yes	There is one non-quantitative objective: "Reducing the risks associated with dealing in PPPs delivered under the National Action Plan will focus on eliminating the sale of PPPs to unauthorised persons and the distribution of counterfeit or unauthorised products." However, no clear thresholds are defined.	Two measures are included. Timetable is reported as report on irregularities in 2022 (see indicators)	One indicator as threshold on the basis of the level of irregularities is set
Article 7: Information and awareness-raising	Yes	There is one non-quantitative objective: "reduce risks associated with the use of PPPs for human and animal health and for the environment".	Two tasks are identified: the first with 5 measures and the second with 4 measures. Follow-up measures are further indicated (e.g. statistical surveys on PPP, improvement and refinement of the quality of training).	For Task 2, one indicator as threshold on the basis of the level of irregularities is set
Article 8: Inspection of equipment in use	Yes	There is one non-quantitative objective: "reduce the risk associated with the use of defective pesticide sprayers, and thus mitigate the risk of improper application of PPPs"	Four measures are included. Timetable is reported as report on irregularities in 2022 (see indicators)	One indicator (% of PAE) is considered. The threshold is set on the basis of the level of irregularities
Article 9: Aerial spraying	Yes	There is one non-quantitative objective: "ensure that the risk associated with aerial pesticide spraying is minimised"	Five measures are included. Timetable is reported as report on irregularities in 2022 (see indicators)	One indicator as threshold on the basis of the level of irregularities is set
Article 10: Information to the public (persons who could be exposed	Yes	There is one non-quantitative objective. This objective is to reduce the risk in the event of accidentally exposure with plant	Two measures are included. Timetable is reported as report on irregularities in	One indicator as threshold on the basis of the level of irregularities is set

Article	Included as separate chapter	Objectives	Measures	Indicators
to the spray drift)		protection treatments (for humans, farm animals including honeybees)	2022 (see indicators)	
Article 11: Specific measures to protect the aquatic environment and drinking water	Yes	There is one non-quantitative objective: "Improperly applied PPP penetrate into natural reservoirs and watercourses, thus causing contamination of such environments. This poses risks to both aquatic organisms and humans, who use water resources in different ways (for consumption or recreation). Some PPPs can also accumulate in bottom sediments and be detected in water long after their use." The objective is to reduce this risk.	Four tasks are identified with many measures, that are set with specific parameters (e.g. the maximum wind velocity at which treatments can be performed to avoid the risk of spray drift). No indication on terrestrial wildlife is nevertheless given. A general timetable for the whole objective on the basis of the results of water quality testing.	One precise indicator on the basis of the results of water quality testing is given ("the quality of water [...] should classify more than 95% of the samples as A1 category").
Article 12: Reduction of pesticide use or risks in specific areas	Yes	There is one non-quantitative objective: "limiting the use of PPP in particularly sensitive areas, especially in areas where people particularly vulnerable to the risks posed by PPPs (children, the elderly, sick people) are likely to be present."	Two general measures are included. Timetable is reported as irregularities in 2022 (see indicators)	One indicator as threshold on the basis of the level of irregularities is set. It should be noted that quantitative indicators are used in previous NAP (2013) to assess the risks associated with the use of PPP (e.g. level of pesticide residues in surface water and groundwater, statistics on the use of PPP). Although no precise indication in the revised NAP has been set ("indicators of risks [...] developed for 2013-2017 will be refined"), a specific website for controlling pest management and defining risk indicator has been published ⁹ . All relevant information about alerts on pest risk assessment are highlighted and explained.
Article 13: Handling and storage of pesticides	Yes	There are two non-quantitative objectives: "prevent PPP from penetrating into waters or soil in the event of	Six measures are included (with two actions). Timetable is reported as report on	One indicator as threshold on the basis of the level of irregularities is set.

⁹ <https://www.agrofagi.com.pl/>

Article	Included as separate chapter	Objectives	Measures	Indicators
and treatment of their packaging and remnants		accidental spillage or scattering, accidental contact with unauthorised persons or with animals – a particularly serious risk is posed by ingestion, which may happen when PPPs are stored in food packaging” and reduce “high risk of spillage and spot contamination” during the preparation of the spray liquid.	irregularities in 2022 (see indicators)	
Article 14: Integrated pest management	Yes	Non-quantitative objectives are set in the revised NAP as a continuation from the previous NAP. The same principles are highlighted, e.g. “The implementation of the principles of integrated pest management, the key assumption of which is to use PPPs in a rational way, based on the actual need for treatment, and considering non-chemical methods first, reduces the risks associated with the use of PPPs in the most effective way.”	Eleven tasks are identified with many measures.	One indicator as threshold on the basis of the level of irregularities is set.
Article 15: Harmonized indicators	Yes	There is one non-quantitative objective: to “checks, monitoring, and statistical surveys will be carried out within the framework of the National Action Plan to obtain information on the effect of PPP on the environment. The thus obtained data will be used to calculate pesticide risk indicators.”	Three tasks are identified with many measures.	“Given the nature of this Action, which works towards improving the effectiveness of the other actions under the National Action Plan, no individual metrics have been defined to assess its implementation.” Despite the indication of reporting objective of the Article 15, no reference to “harmonized indicators” is given (see further information in Section 4.2.5.3)

Measures beyond Articles 5 to 15

The promotion on the use of non-chemical methods has been introduced in the previous NAP under the provisions of the Act¹⁰ of 8 March 2013 ("Protection against particular hazards"). However, measurable increments of less hazardous and non-chemical alternatives for pest control have not been clearly indicated either in the previous NAP or in the revised one.

4.2.5.3 Assessment

As can be seen, Poland's NAP addresses Articles 5-15 of the SUD. Each article is identified as an "action" and is elaborated in a separate chapter. Each chapter may contain specific tasks, that introduce background (with associated risks and national regulations of Poland related to the topic) and define delivery method, measures used for monitoring, and entities responsible for the implementation of the task.

The NAP reports many actions by indicating thresholds for completion, and clearly indicates timetables only for some of the actions (by indicating the year), but not for all of them. At the end of the document, a final section regarding the consistency of the NAP with strategic documents concerning agriculture is presented.

Stakeholder input

Additionally, an interview with a representative of the CA was conducted. It was stated that the participation of different stakeholders (e.g. academia) is considered an enabler, as well as the publication of a specific website for disseminating methods, actions, alerts on plant pests, pest risk assessment, information material (e.g. programmes for IPM, labels of products, guides on reporting and warning illegal actions). As reported in the EU report (European Commission, 2020a), Poland has established, in particular, an indicator based on compliance levels (e.g. compliance with the requirement for professional users to be trained).

Several barriers for the effective implementation and enforcement of the actions identified in Poland's NAP were identified. Some of the main issues that Poland struggles with are of the reduction in the use of chemical pesticides, and the definition of precise and measurable targets for tracking the increment of less hazardous and non-chemical alternatives for pest control. This is largely due to the resistance from big pesticide companies, which lobby to increase the sales of their products. This also negatively impacts the progress that authorities have made with providing stakeholders (e.g. farmers) with training. Whereas, the authorities advocate for lesser use of pesticides, there is an opposing current coming from industry.

Another challenge relates to the definition, assessment, and implementation of HRIs. This currently only considers the volume of PPP sales and does not establish a link to usage and risk. As such, an understanding of weighting factors needs to be properly defined at EU level and harmonised among the different Member States.

Farm to fork strategy

Although a clear link between the NAP and the F2F strategy cannot be found, the NAP establishes a link to the preservation of biodiversity (EU Biodiversity Strategy). For example, the NAP highlights that it is "under the provision of the EU Biodiversity strategy". The NAP is also linked to Poland's national *Responsible Development Strategy for 2020*¹¹, adopted 2017, which supports agri-food producers by integrating the food chain and fairer distribution for ensuring the sustainable and responsible development of the Member State.

¹⁰ Act of 8 March 2013 on Plant Protection Products [pesticides] (Dz.U. 2013 nr 0 poz. 455)

¹¹ https://www.gov.pl/documents/33377/436740/SOR_2017_streszczenie_en.pdf

Funding

It was highlighted that all institutions responsible for the implementation of the NAP tried during its preparation to use the available resources without requiring additional funds. They are only used for activities of institutes and come from multi-annual research programs, where there is certain amount of money for example water analysis. Furthermore, as noted by an expert interviewee, incentives for the implementation of IPM are absent given the fact that it is regarded to be farmers' obligation. Whereas this might well be the case, it does not negate the potential for improved implementation or compliance should farmers be offered suitable incentives.

5. Discussion and conclusions

In summary, three of the Member States assessed above did not finalise their NAP within the five-year deadline (IE, BG, PL). Furthermore, most of the NAPs assessed associated different connotations to the terms '*objectives*', '*indicators*', '*measures*', '*targets*' and '*actions*' and did not apply the terminology in a unified manner. This makes it hard to conduct a comparable analysis amongst them.

Also, in many cases, Member States have not defined quantitative goals included in the objectives/measures/actions but did mostly select quantifiable indicators. However, these often lack concrete utility or applicability given that thresholds and baselines are largely missing. For instance, one stakeholder stated that in order to set quantitative objectives, more data on the implemented measures needs to be gathered. One problematic area here is lack of data availability on IPM and its status quo, which makes it difficult to develop quantitative goals. Data limitations may also influence the lack of timelines and partly explain why most of the Member States assessed did not indicate a clear schedule/timetable/deadline and, those that did, only did so for a few objectives (for example on information and awareness raising).

Another point worth making is that the HRIs as referred to in Annex IV of the SUD were not included in any of the NAPs. In one of the cases and interviewee pointed out that not enough data could be gathered to implement the HRIs.

Funding

Member States indicated that the development and implementation of the NAPs requires extensive resources. However, according to the interviews, no quantitative estimation of economic resources could be provided. This is mainly because the NAPs are in ongoing revision and no fixed budget is assigned for either the development or the implementation of the plans. The amount of human resources necessary for the development of the NAPs ranges from a minimum of one person to many experts from different organizations and authorities actively involved in drafting the plan.

Farm to Fork Strategy and other opportunities identified by stakeholders

The analysis and stakeholder feedback indicated that many of the goals of the F2F strategy, such as organic farming or pesticide use, are reflected in the NAPs. It also confirmed that the F2F strategy and its targets will play an important role in future revisions. IPM is an aspect included in all reviewed NAPs and which, in the interviewees' opinion, contributes to the F2F targets. For example, the Belgian NAP includes measures to improve IPM and to encourage the marketing of low-risk PPPs which, according to the CA, supports the achievement of the F2F targets.

One stakeholder indicated, that for some countries it is more challenging to meet the F2F targets because of their geographical location. According to the statement, warmer regions struggle with a larger number of pests.

Potential improvement

One point or opportunity for improvement that was identified in the analysis and by the stakeholders, relates to the need for a clear and general guidance on Article 4 (NAP) of the SUD, and a coherent definition of terminology. One stakeholder indicated here that an improved briefing for writing the NAPs would be helpful.

Another point relates to IPM (please refer to the IPM case study for more detail). In this case, whereas Members States apply different aspects of this broad field, a consistent understanding or guidance seemed lacking. One suggestion made by a representative, related to making increased funding of research and data gathering on IPM a more central aspect of future NAPs.

6. Bibliography

- Austrian Ministry for Rural Affairs. (2017). *National Action Plan AT for the sustainable use of plant protection products for the period 2017–2021* (Vol. 2021).
- Bulgarian Council of Ministers. (2012). *National Action Plan for sustainable pesticide use in the republic of Bulgaria*.
https://ec.europa.eu/food/sites/food/files/plant/docs/pesticides_sup_nap_bgr_en.pdf
- Bulgarian Council of Ministers. (2019). *Competent Authority's response to the report recommendations received 14 January 2019 - Response of the competent authorities of Bulgaria to the recommendations of report ref. DG(SANTE)/2018-6364-MR of the audit carried out from 10 September 2018 to 20 Se*.
- Bulgarian Council of Ministers. (2020). *National Action Plan for Sustainable Pesticide Use in the Republic of Bulgaria - UPDATED*.
https://ec.europa.eu/food/sites/food/files/plant/docs/pesticides_sup_nap_bgr_rev_2020_en.pdf
- European Commission. (2017). *COM(2017) 587. Report from the commission to the European parliament and the council on Member State National Action Plans and on progress in the implementation of Directive 2009/128/EC on the sustainable use of pesticides*.
https://ec.europa.eu/food/plant/pesticides/sustainable_use_pesticides_en
- European Commission. (2018a). *FINAL REPORT OF A FACT-FINDING MISSION CARRIED OUT IN POLAND FROM 07 JUNE 2017 TO 14 JUNE 2017 IN ORDER TO EVALUATE THE IMPLEMENTATION OF MEASURES TO ACHIEVE THE SUSTAINABLE USE OF PESTICIDES*.
- European Commission. (2020a). *COM(2020) 204 final. Report from the Commission to the European Parliament and the Council on the experience gained by Member States on the implementation of national targets established in their National Action Plans and on progress in the implementation: Vol. COM(2020)*.
- European Commission. (2020b). *On the experience gained by Member States on the implementation of national targets established in their National Action Plans and on progress in the implementation of Directive 2009/128/EC on the sustainable use of pesticides*.
https://ec.europa.eu/food/sites/food/files/plant/docs/pesticides_sud_report-act_2020_en.pdf
- European Commission, D. for H. and F. S. (2018b). *FINAL REPORT OF AN AUDIT CARRIED OUT IN AUSTRIA*.
- GD SANTE. (2016). *FINAL REPORT OF AN AUDIT CARRIED OUT IN IRELAND* (Issue February).
- Irish Department of Agriculture Food and the Marine. (2019). *Review of Irish National Action Plan for the Sustainable Use of Pesticides* (Issue February).
<http://link.springer.com/10.1007/s13593-011-0065-6>
<http://link.springer.com/10.1007/s10460-007-9073-1>
<http://link.springer.com/10.1007/s10460-006-9016-2>
<http://link.springer.com/10.1007/s10460-013-9424-z>
<http://linkinghub.elsevier.com/retrieve>
- NAPAN. (2014). *Belgian action plan to reduce the risks and impacts linked to pesticides 2013-2017*.
- NAPAN. (2020). *NAPAN (Nacitonal Action Plan Action National) Programme 2018-2022 - Revised on May 2020*.
- Polish Minister of agriculture and rural development. (2018). *National Action Plan to Reduce the Risk Associated with the Use of Plant Protection Products 2018-2022*.
https://ec.europa.eu/food/sites/food/files/plant/docs/pesticides_sup_nap_pol-rev-2018_en.pdf
- Polish Ministry of agriculture and rural development. (2013). *National Action Plan to reduce the risk associated with the use of plant protection products*.
https://ec.europa.eu/food/sites/food/files/plant/docs/pesticides_sup_nap_pol_en.pdf

Appendix 2: CASE STUDY II - IPM

1. Introduction to the case study

Article 3(6) of the Sustainable Use of Pesticides Directive (Directive 2009/128/EC, SUD) provides the following definition for Integrated Pest Management (IPM): *"integrated pest management' means careful consideration of all plant protection methods and subsequent integration of appropriate measures that discourage the development of populations of harmful organisms and keep the use of plant protection products or other forms of interventions to levels that are economically and ecologically justified and reduce or minimise risks to human health and the environment. 'Integrated pest management' emphasizes the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms".*

Recital 5 of the SUD mentions that *"National Action Plans aimed at [...] encouraging the development and integration of integrated pest management and of alternative approaches or techniques in order to reduce dependency on the use of pesticides should be used by Member States in order to facilitate the implementation of this Directive. "*

Recital 18 adds that *"the application of general principles and crop specific guidelines with respect to integrated pest management by all farmers would result in a better targeted use of all available pest control measures, including pesticides. There it would contribute to a further reduction of the risks to human health and the environment and the dependency on the use of pesticides. Member States should promote low risk pesticide-input pest management, in particular integrated pest management, and establish the necessary conditions and measures for implementation."*

Recital 19 indicates that *"on the basis of Regulation (EC) No 1107/2009 and of this Directive, implementation of integrated pest management is obligatory, and the subsidiarity principle applies to the way the principles of integrated pest management are implemented. Member States should describe in their National Action Plan how they ensure the implementation of the principles of integrated pest management, with priority given wherever possible to non-chemical methods of plant protection and pest and crop management."*

Article 55 of Regulation (EC) No 1107/2009 requires PPPs to be properly used. This means the application of the principles of good plant protection practice and compliance with the conditions established in accordance with Article 31 of the same Regulation and specified on the label. In addition, Article 55 also stipulates that proper use includes compliance with the provisions of SUD and, in particular, with the general principles of IPM, as referred to in Article 14 and Annex III to SUD (which shall apply at the latest by 1 January 2014).

With effect from 14 December 2019, **Article 9 of Regulation (EU) 2017/625** requires MS to carry out official controls in order to verify compliance with the rules referred to in its Article 1(2), including requirements for the placing on the market and use of PPPs and the sustainable use of pesticides, with the exception of PAE. (Prior to 14 December 2019, Article 68 of Regulation (EC) No 1107/2009 required MSs to carry out official controls in order to enforce compliance with Regulation (EC) No 1107/2009, including Article 55.).

As such, Member States (MS) need to comply with the following IPM provisions per Article 14 of the SUD:

- MS shall take all necessary **measures to promote low pesticide-input pest management**, giving wherever possible priority to non-chemical methods (Article 14(1)).
- MS shall establish or support the **establishment of necessary conditions** for the implementation of IPM. MS shall ensure that professional users have at their disposal information and tools for pest monitoring and decision-making, as well as advisory services on IPM (Article 14(2)).

- MS shall **report to the Commission** on the implementation of the first two provisions mentioned above by 30 June 2013 (Article 14(3)).
- MS shall **describe in their National Action Plans (NAPs) how they ensure that the general principles of IPM are implemented by all professional users** by 1 January 2014 (Article 14(4)).
- MS shall establish **appropriate incentives** to encourage professional users to implement crop or crop-specific guidelines for IPM on a voluntary basis. **Public authorities and/or organisations representing particular professional users may draw-up such guidelines.** MS shall **refer to those guidelines that they consider relevant and appropriate in their NAP** (Article 14(5)).

To complete these obligations, the eight general principles of IPM are specified in Annex III of the SUD.

Several reports (Commission fact-finding and audits missions) have already reported on the level of implementation and application of the IPM principles by MS. Conclusions of these reports are presented in two Commission reports.

The first Commission Report from the Commission to the European Parliament and the Council on Member State National Action Plans and on progress in the implementation of Directive 2009/128/EC on the sustainable use of pesticides from 2017¹² highlights that "Member States have not converted the IPM principles into prescriptive and assessable criteria. They see IPM mainly as an education tool for farmers and have no methods in place to assess compliance with IPM principles. While Member States take a range of measures to promote the use of IPM, this does not necessarily ensure that the relevant IPM techniques are actually implemented by users. Farmers are economic operators, and while IPM techniques are sustainable from a long-term perspective, IPM can mean a higher economic risk in the short-term. For example, it may be seen as preferable to grow maize or wheat in monoculture for economic reasons. However, this short-term approach to land management comes at considerable risk of longer-term cost, for example due to increasing populations of pests or weeds in monoculture. Ultimately, monoculture can cause loss of biodiversity, soil erosion and even desertification. As an example of a short-term approach, Romania granted emergency authorisations for using neonicotinoids as seed treatment in an undefined area of maize, without investigating the potential of crop rotation as an alternative."

In its second report published in May 2020¹³, the Commission highlights that "*the assessment of the implementation of IPM by Member States continues to be the most widespread weakness in the application of the SUD [...] Consequently, Member States have failed to exploit the significant potential for greater adoption of IPM, including the more widespread adoption on non-chemical pest control techniques.*" Even though several MS have advisory services dedicated to providing specific advice on IPM methods and have made institutional efforts to promote IPM, the level of IPM adoption and implementation by farmers across the EU remains mostly unknown. To date, most MS have not developed a system that allows them to monitor and evaluate the changes in farming practices and to determine the level of IPM uptake. At the same time, a widely recognised set of defined criteria is missing to decide whether the general principles of IPM were adopted or not.

¹² European Commission. (2017). Report from the commission to the European parliament and the council on Member State National Action Plans and on progress in the implementation of Directive 2009/128/EC on the sustainable use of pesticides. https://ec.europa.eu/food/plant/pesticides/sustainable_use_pesticides_en

¹³ European Commission. (2020). Report from the Commission to the European Parliament and the Council on the experience gained by Member States on the implementation of national targets established in their National Action Plans and on progress in the implementation of Directive: Vol. COM(2020).

The *European Implementation Assessment* (EIA) published by the European Parliament (EP) in 2018 and the *Report from the European Court of Auditors*¹⁴ confirm these conclusions.

Eventually, the *European Parliament resolution of 12 February 2019 on the implementation of the SUD*¹⁵, following the above-mentioned EIA, “regrets the fact that in many Member States there is not sufficient commitment to IPM practices based on its eight principles with the prioritisation of non-chemical alternatives to pesticides; regrets that one of the main challenges regarding the implementation of IPM, which is the cornerstone of the Directive, seems to be the current lack of appropriate control instruments and methods to assess compliance in the Member States, as well as of clear rules and guidance; underlines the fact that comprehensive implementation of IPM is one of the key measures for reducing dependency on pesticide use in sustainable agriculture, which is environmentally friendly, economically viable and socially responsible and contributes to Europe’s food security while strengthening biodiversity and human and animal health, boosting the rural economy and reducing costs for farmers by facilitating the market uptake of non- chemical alternatives and low-risk PPPs in the different European zones; stresses that additional financial incentives and educational measures are needed to strengthen the uptake of IPM practices by individual farms”.

2. Research theme for the case study

The purpose of this case study is therefore to analyse each provision of the SUD on IPM (Article 14) and assess available data on enforcement, implementation, and application in several MS, while also identifying influencing factors and aspects of coherence with other EU legislation. This analysis goes further than the Commission’s fact-finding and audit reports which do not go into the details of each of the IPM requirements This will be achieved through the examination of the situation in the following five MS: Belgium, Denmark, France, Germany, and the Netherlands.

On this basis, the research theme is a series of descriptions related to the IPM obligation as follows:

- Governance established by MS to enforce and implement IPM
- Measures taken by MS to promote low-risk substances
- How MS have given priorities to non-chemical methods
- How MS have established or support the establishment of necessary conditions for the implementation of IPM including the description of the information flow on IPM/agronomic practices to farmers
- Measures and tools developed and implemented by MS for the monitoring of pests and for decision-making
- How MS are measuring progress in terms if IPM uptake achieved over the last 10 years
- Methodologies related to the uptake of IPM by professional users (control).

As a background to the presentation of IPM development and uptake in the selected MS, the case study starts with a brief history of IPM development and implementation.

¹⁴ European Court of Auditors. (2020). Sustainable use of plant protection products: limited progress in measuring and reducing risks. <https://www.eca.europa.eu/en/Pages/DocItem.aspx?did=53001>

¹⁵ European Parliament resolution of 12 February 2019 on the implementation of Directive 2009/128/EC on the sustainable use of pesticides (2017/2284(INI))

3. Methodology

3.1 Data collection

The data collection entails three steps:

- Step 1: Preparation (literature review, scoping interviews). The literature review has consisted of analysing the NAPs and the Commission audits of each of the five MS under study; the 2013 reports from NCAs to Commission as foreseen under Article 14(3) of the SUD and other ad hoc reports collected at MS level.
- Step 2: Conducting semi-structured interviews in the selected MS with national authorities and actors involved in the implementation of IPM:
 - Technical institutes/researchers in charge of developing/proposing IPM measures and alternatives to pesticides
 - Technical advisors (public and private) responsible for disseminating IPM solutions down to farmers
 - Farmers through their national/regional associations; and
- Step 3: writing-up of the case study report.

The outputs of the case studies will be reviewed as part of a fourth step for validation and for ensuring the integration of the Case Study results within the main report of the evaluation.

3.2 Member State Selection

For the purpose of selecting the MS analysed within this case study, the level of enforcement of IPM obligations and the presence of interesting and relevant activities, initiatives, and research in the field of IPM as summarised in the *European Implementation assessment for the EP* in 2018 were critical.

In Denmark, an IPM task force was set up with representatives from key stakeholders, research authorities and relevant authorities. This approach also applies in France under the Ecophyto program.

Germany has adopted a quite unique approach as the guidelines are developed by grower organisations with the support of the Federal Research Centre on Cultivated plants.

In France, the dissemination of innovative low-risk plant protection product practices is currently carried through the DEPHY network which consists of 3,000 farms that work together with researchers and advisory services, in developing new practices in crop protection on a crop-by-crop basis.

In the Netherlands guidelines are developed by both public and private authorities.

National funds to support the development and implementation of IPM measures are mentioned in the Belgium NAP. In Flanders, IPM is developed through aid from the Flemish Agricultural Investment Fund.

4. Situation analysis in the EU

This section presents how IPM obligations have been implemented in each of the five MS following the research themes that are presented above under Chapter 2. In order to set up the scene and establish the baseline, two paragraphs summarising the governance approach and the history of IPM development and implementation per MS are presented.

4.1 History of IPM development and implementation

The concept of IPM is not new and has been around longer than the SUD itself, with several initiatives and national plans already in place in late 2000

For example, in Germany, the first reduction programme for chemical PPPs dates to 2004. Since the late 1980s there are Integrated Production Systems (with inspections) for several crops, e.g., pome fruits, vegetables, vineyards in place, which are steered and run by grower associations. Germany also formally established basic guidelines on good plant protection practices in 2005, which included the principles of integrated plant protection. In Belgium and in the Netherlands, national authorities have reported that national plans including IPM activities and initiatives were already in place in 2010. In France, the Ecophyto programme (I) was launched in the course of the Grenelle Environment round table¹⁶ that took place in 2008. Monitoring of pests as well as the development of decision-making tools were performed by the Service de la Protection des Végétaux (SPV) for years on all crops. Such elements clearly demonstrate that the IPM requirements came to reinforce MS initiatives that were already in place, and to act on their awareness of the importance of the issue.

4.2 Description of the governance established by MS to enforce and implement IPM

The governance set up by MS to implement IPM requirements gives an important role to regional authorities. In Germany and Belgium, regional authorities are in charge of implementing IPM requirements and IPM principles down to farm level. In Belgium, both the Wallonia and Flanders regions have drafted regional action plans which are then part of the federal action plan which is the NAP. In Germany, IPM is under the responsibility of the regional regions (Länder), but these regions may not be responsible for tasks as listed in the German NAP. The same approach is observed in other countries such as Austria, Italy, and Spain. For the three other MS, the responsibility lies with the Ministry of Agriculture for France and the Netherlands and the Ministry of Environment in Denmark. It should be noted that in the Netherlands, programmes are set-up in very close contact and collaboration with the so-called 'water boards' and in collaboration with stakeholder organisations. France's governance structure also includes the Strategic Committee (Comité d'orientation stratégique et de suivi – COS) which includes all groups of stakeholders as well as public advisors and researchers). Such a governance approach including all key actors (authorities, advisors, technical institutes/researchers and farmers) is key for securing the dissemination of information along the entire chain as long as mechanisms to secure optimal flow of information across different actors are established by authorities.

¹⁶ The "Grenelle Environnement" brought together the government, local authorities, trade unions, business and voluntary sectors to draw up a plan of action of concrete measures to tackle the environmental issue. The name "Grenelle" came from the first conference bringing all these players together which took place in May 1968 in the Rue de Grenelle. Officially launched on 6 July 2007, the "Grenelle Environnement" combined the state and civil society in order to define new actions for sustainable development in France.

Each of the five MS under analysis has set-up a governance structure which includes most of the actors active in IPM, ranging from researchers to individual farmers, and including regional or local authorities, public and private advisors, technical institutes, farmers' representatives, and the Plant Protection Product (PPP) industry.

4.3 Description of the measures taken by MS to promote low-risk substances

The main measures taken by MS to promote the uptake of low-risk substances can be categorised into three groups: awareness-raising campaigns, development of farm demonstration networks, and legal instruments.

Awareness-raising campaigns

Launching of **awareness-raising campaigns** targeting the technical advisors and the farmers directly. Such campaigns are often based on several tools such as agricultural newspapers, agricultural shows, conferences, web portals and the presentation of best/good practices to encourage the development and uptake of IPM. All MS have launched such initiatives over the last decade, in varying formats. The French case presents an interesting approach which is the ECOPHYTOPIC portal which consists of a cross-sectoral portal and also six specialist platforms dedicated to the most grown crop groups. The guidance given in this portal covers rotation, monitoring methods, alternative management methods and biological pests, as well as the applicable legislation and research. The IPM guidelines are also made available online via the portal. The French Ministry of Agriculture stated that this portal receives around 10 000 visits per month.

Development of farm demonstration networks

In recent years, the Netherlands has invested in the development and dissemination of knowledge on IPM through demonstration projects at farm level. A network of demonstration farms is already in place for years. As of 2010, demonstration farms became private, and these are neither listed nor registered. The network, which covers all types of soil and all types of crops, is linked to the public private IPM research programme ('top sector research'). At the farms, research is being performed and demonstrated during open field and indoor cultivation days. Visits to IPM fields/demonstration farms/workshops for farmers and non-agricultural professional users could be included as part of the additional training for the renewal of certificates of competence. In France, the DEPHY FERME network, funded by Ecophyto, was created in 2010 for the demonstration, testing and identification of systems to reduce PPP use. Today, this network consists of 3 000 farms which are changing their existing farming practices and receiving technical support for this. Such networks have shown their usefulness with reductions up to 20% of pesticide being observed in the French network for example. The H2020 project IPMWORKS, that recently started, has the objective to replicate this initiative in other EU countries given its effectiveness. In Germany, a network of farms was also set-up in early 2010s but it seems that, due to lack of financial support, these networks have not developed.

Legal measures – taxation

In France, the VAT standard rate is of 20% for PPPs except for PPPs used in the context of organic production where the VAT is reduced to 6%. The General Tax on Polluting Activities (TGAP) has been applied to "antiparasitic products for use on farms, and other similar products" since the year 2000. But since 2008, the TGAP was replaced by a fee on diffuse agricultural pollution collected by public water agencies from pesticide distributors, according to the quantity of active substance sold by products distributors in France and the toxicity level. The rate was equal to 2 €/kg for dangerous organic substances and 0.90 €/kg for mineral substance. This tax is paid by PPP users and is collected by PPP distributors/traders according to the quantity of dangerous or toxic substances contained in the marketed products. In 2019 the tax rate has increased for most substances of

particular concerns. The proceeds of the tax are distributed amongst the water and waste-treatment plant operators. The VAT is allocated to the general budget while about half of the budget of the specific tax on pollution is allocated to the ECOPHYTO plan (about EUR 70 Mio). A third tax on sales of pesticides is in place. As of 2020, the tax amounts 0.9% of the selling price (excluding VAT) except 0.1% for biocontrol products (revenues of EUR 18 Mio in 2020).

Denmark implemented a pesticide fee in 1972 and supplemented this with a pesticide tax in 1982 (only covering households). The fee and tax were reformed to become a general ad valorem tax covering all types of pesticide consumption (including agricultural) taking effect from 1996. In 1998, tax rates were doubled (on average). From 2013 a reformed tax was implemented, changing the pesticide tax to a tax based on environmental load. The tax on plant protection products was changed from a value-based tax to a tax differentiated one. This differentiated tax is composed of a flat base tax, based on the amount of active substance in the pesticide products and a differentiated tax based on the load on human health, environmental fate and environmental toxicity. The value-based tax is still in place for microbial PPPs. Furthermore, tax levels were increased on average. Approximately 93% of Danish pesticide use is agricultural. Expected revenue of the reformed tax is DKK 650 million annually (EUR 87 million). The full revenue is reimbursed to the agricultural sector – primarily through reduced land value tax. The evaluation of the taxation approach shows that the tax has provided the expected results as regard to the substitution of substances with a higher pesticide load to substances with a lower load. The objective of reducing pesticide load by 40 % compared to 2011 based on sales figures has been achieved. However, the volumes of pesticide used has increased due to the fact that alternatives products to chemical pesticides are used at a higher rate per hectare.

Germany studied the principle of pesticide taxation but rejected it.

In addition to these legal tools, the following additional ones are interesting to mention:

The CEPP¹⁷ in France is an innovative scheme that imposes an obligation on PPP distributors to promote implementation by farmers of recognised actions, validated by a committee of experts, in order to reduce the dependency on the use of pesticides, without negatively impacting the economic profitability of the farms.

Germany has approached the promotion of IPM in a multifaceted manner. Firstly, biodiversity, IPM and the sustainable use of pesticides is addressed at a federal level through a range of strategic initiatives, such as the National Biodiversity Strategy, which plans to reverse the decline of relevant birds and animals by 2020 and the Federal Programme for Organic Farming and other forms of Sustainable Agriculture (BÖLN), which aims to promote organic farming and greater use of IPM techniques in conventional farming. These strategic initiatives are complementary to measures taken under the NAP. Secondly, Germany has made extensive use of EU CAP funding mechanisms (Pillar II) to promote the use of non-chemical techniques to protect plants and plant products that are available, but not economically viable. For example, growers can claim additional payments for IPM related measures such as using BCAs (*Trichogramma sp.*) against the European corn borer in maize and pheromones in orchards to control codling moth, establishing buffer zones adjacent to water courses and including flower strips in arable fields.

4.4 Description on how MS have given priorities to non-chemical methods

The main actions that MS have taken in order to give priority to non-chemical methods can be categorised into three groups as reported below.

Drafting and dissemination of crop or sector specific technical guidelines for promoting the existing non-chemical methods available to farmers.

¹⁷ certificats d'économie de produits phytopharmaceutiques

In practice, farmers are not fully aware about existing alternatives to chemical pesticides and therefore they need to be informed/trained to ensure preferential use of non-chemical methods. Measures to promote low pesticide-input pest management are required. In Denmark, the SEGES (advisory service) has developed about 70 crop specific guidelines which have been widely distributed to farmers. These guidelines are including good practices for all agronomical practices from seeding to harvest. These guidelines are crop specific in the sense that they consider individual supply chains for a given crop (e.g. winter wheat vs. spring wheat). In Germany, the same types of guidelines have been developed at Lander level by the technical and advisory bodies (e.g. Chambers of Agriculture). In France and the Netherland, such guidelines are developed by the national technical institutes which are part of ACTA and then further adapted at farm level by local advisors. The French ECOPHYTOPIC platform is being used to disseminate good practices on the reduction of use of pesticides. In Belgium, guidelines are developed by regional agricultural services. Farmers have access to other sources of information via the 'private' guidelines being developed by cooperatives and other distributors of PPPs. In Germany, 12 sector-specific guidelines have been approved and seven other ones are currently drafted.

Research on IPM

Innovation research programmes have been initiated in each of the five Member States under analysis. Therefore, these countries support research and innovation regarding non-chemical / biological plant protection measures as in many cases economically viable alternatives to chemical pesticides are currently not available. Such approach is needed to contribute to ensuring implementation of the requirements outlined in the SUD that professional users of pesticides switch to practices and products with the lowest risk to human health and the environment among those available for the same pest problem.

Use of demonstration farms

The demonstration farms as described above under Chapter 4.3 are also used to promote non-chemical methods through for example the DEPHY EXPE initiative which aims at developing alternative approaches to chemical products through agronomy and/or non-chemical PPP (biological control agents-BCAs, plant bio stimulants, beneficial organisms etc).

4.5 Description on how MS have established or support the establishment of necessary conditions for the implementation of IPM including the description of the information flow on IPM/agronomic practices down to farmers

Each of the five MS have been active in promoting IPM mainly through the existing advisory services networks being public or private ones.

In Belgium, public and private crop-specific advisory services are in place for years. Advisory services are organised per crop. They usually are 'pilot centres' (extension services), have a status of non-profit organisations and are partly subsidised by the regional state and by members (farmers). There are 12 pilot centres in Wallonia. They work independently of one another. The exact number of advisors in Belgium is difficult to quantify, notably because of the lack of a legal definition of an advisor. The services are not certified but the advisors themselves have a certificate as advisor for professional users (fytolicense). They have to follow permanent training, also concerning IPM and alternative techniques. Most of the advisors are also, working in a research or demonstration centre or collaborating with them.

Nearly the same structure is in place in France. Instead of pilot centres, 18 crop/sectoral technical institutes, grouped under the ACTA umbrella, develop knowledge on IPM which is disseminated through advisory services (Chamber of Agriculture, regional research, and testing centres) which are funded mainly by the farmers themselves and by public bodies, cooperatives which often have

a technical department aiming at providing technical support to farmers, and other private traders. Each of these advisors are certified via the Certiphyto programme. As of January 2021, Advisory services cannot sell PPPs any longer as it was the case previously (advise and sales have to be done by different entities).

In the Netherlands, advisors are private bodies which in most of cases are funded by farmers through taxes. In total, there is about 850 advisors in the country. Advisors associated to pesticide traders are trained and certified by agricultural schools. Training and certification are not mandatory for advisors that do not sell pesticides. In addition, there are some publicly and/or privately funded projects aiming at providing advice and encouraging growers to implement IPM. As Dutch authorities were not fully convinced of the effectiveness of the system, the 'System Approach to Sustainable Plant Protection' project was launched, aiming to resolve constraints with regard to IPM implementation. A series of pilot sub-projects were launched in September 2016, covering seven crops. The main goal was to re-design the use of plant protection measures as part of the entire cropping system, with more resilient crops and taking advantage of newly developed breeding techniques.

In Denmark, the Danish Agricultural Advisory Service - SEGES (31 local advisory centres), which is 100% owned by the Danish Agriculture and Food Council, is the main independent advice to farmers. SEGES is contracted to transfer the overall IPM principles to concrete tools and best management practices. SEGES estimates that the 31 centres provide advice to about 80% of the Danish growers. The Knowledge Centre for Agriculture is responsible for organising advisory services, development of materials and tools and leading the work with demonstration farms. About 70 advisors are trained specifically to advise about IPM. The advisors are mainly working for the Danish Agricultural Advisory Service, but also other private advisers are involved. About 400 advisers are included in the Danish advisory service and 30 are individual private advisers or employed in small private companies. Authorities have funded the establishment of seven IPM demonstration farms since 2010 to which many farmers, advisory services, students. This programme was ended in 2015, and there are no current plans to re-establish demonstration farm networks.

In Germany, advisory services are organised at Länder level. These services, provided by about 600 advisors all over the country, are either free or greatly subsidised. They are currently limited by financial constraints within the Länder. Advisors are trained in IPM as part of their education and regular training/further training but are not certified specifically for IPM. As for France, such advisory services are acknowledged by farmers to provide excellent technical advice available from pesticide companies and retailers, as well as independent advisory services, particularly in promoting alternative techniques to protect plants and plant products. In addition, Germany has launched a network of demonstration farms, using the pilot scheme 'Demonstration project for integrated plant protection', which currently includes 52 demonstration farms (66 farms in 2015), covering the main crops throughout the country. These farms are used to demonstrate tried-and-tested and innovative procedures in IPM. The farmers receive intensive advice from the Länder advisory services, with one full time equivalent advisor per five demonstration farms. The approach is rather similar to the French DEPHY FERME approach even if in the case of the German network, the demonstration farms do not search for alternative methods but rather limit their activities to demonstrating what advisory services recommend.

4.6 Description of measures and tools developed and implemented by Member States for the monitoring of pest and decision-making

Article 14(2) foresees that MS shall establish or support the establishment of necessary conditions for the implementation of IPM, and, more specifically, MS shall ensure that professional users have

information and tools for pest monitoring (and early warning/diagnosis systems) and decision making at their disposal.

In Denmark, farmers can use the pesticide load calculating tool to determine the pesticide load arising from their planned use of pesticides. SEGES have also developed an early warning system that provides information to growers on the development of diseases and pests on cereals, oil seed rape and maize crops based on weekly monitoring data in the fields. The Sortinfo Crop Protection Online decision system provides information on the pest population, the development of the disease or insect based on forecasting and information on pest/disease thresholds. On the basis of such information, Sortinfo recommends treating against a pest or disease or not, based on the situation as regards the threshold. Sortinfo also provides advice as regards the dosages to be used and frequently recommends reduced dosages of pesticides compared to the authorised dosage for a given use. Sortinfo also includes data on the relative resistance of crop varieties to a range of pests, thus providing growers with the information necessary to select more resistant varieties.

The French authorities have reshaped the previous public pest monitoring program managed by the Service de la Protection des Végétaux (les avertissements agricoles) when launching the Ecophyto program in 2009. The monitoring activities were transferred to the private sector (farmers, advisory services and technical institutes) under the name of the pest monitoring network (reseau d'épidémiosurveillance) and the production of a warning document called Bulletin de Santé Végétale (BSV). If the epidemiological surveillance network is a component of the Ecophyto plan, it is not only devoted to reducing the use of plant protection products. It also intervenes to know the health status of plants throughout the territory (monitoring quarantine pest), monitor in time and space the evolution of pests, qualify export productions and support alternative techniques to chemicals. Excluding self-financing, the financial resources of the epidemiological surveillance network come from grants awarded by the French Biodiversity Agency from the product diffuse pollution charges. Managed by the regional chambers of agriculture, they are distributed entirely between the regions. The 23% reduction in resources led to the shutdown in 2019 of some plant health bulletins, mainly in non-agricultural areas. Two evaluations of the network were performed in 2012 and 2019 concluding that the scheme needs to be updated and reviewed to become more efficient. To the contrary of the past 'avertissements agricole', the BSV doesn't indicate if the farmer should spray or not to protect crops against a given pest disease leading to uncertainties on what to do.

In the Netherlands, there are no publicly funded forecasting, warning, and early diagnostic systems in place. Although publicly funded research has contributed to developing new systems, these are optimised for use in practice and brought to the market by private companies

In Germany, pest monitoring, and the dissemination of the resultant information has been a cornerstone of IPM in Germany for decades. The ISIP system (Information System for Integrated Plant Production, <http://www.isip.de/isip/servlet/isip-de/infothek/uebersicht>), collates all official pest monitoring information for over 150 different pests on all major agricultural and horticultural crops. This data is then used, in conjunction with data from 600 weather stations, and scientifically based pest thresholds, to guide growers in taking appropriate plant protection measures.

4.7 Description on how Members States are measuring progress in terms of IPM uptake achieved over the last 10 years

In Denmark, a detailed IPM questionnaire has been developed with the view to be used prior to and after each two-year IPM advisory programme for individual farmers. Furthermore, the new indicator pesticide load indicator (PLI) will show the yearly development in pesticide load on human health and environment. This development will partly indicate the implementation of IPM. In addition, Danish authorities monitor the use of pesticides in all sectors: Yearly statistics on total use of

pesticides, including calculation of treatment frequency index and pesticide load indicator, is published on a website site available to the public. Additional statistics on total use and pesticide load on golf courses and in private gardens are also collected. Such statistical data are used to develop new incentives or/obligations to be included in future action plans if the development in the pesticide load is not moving in the wrong direction.

In France and the Netherlands, evaluations of the implementation of the SUD obligations are regularly carried out to measure progress and issues arising in implementing programmes. However, no detailed approach has been designed as regards IPM uptake. Both countries are currently developing a template rather similar to the Danish one. The objective is to provide professional users with a self-assessment tool to evaluate compliance.

4.8 Description of the methodologies related to the uptake of IPM by professional users (control)

In Wallonia (Belgium), regional authorities have developed two specific guidelines (one for ornamental crops and another one for all other crops) which consist of a list of obligations that farmers have to fulfil to comply with their obligation to implement IPM requirements. The guidelines contain three types of obligations (mandatory obligations that farmers must comply with, IPM activities farmers are invited to implement on a voluntary basis and a list of other IPM techniques farmers have the obligation to implement for 70% of them). External companies, mainly involved in certifying farmers for organic production, have been appointed to control individual farms.

In the Netherlands, there is a long history of control. Before 2015, all professional users were obliged to have plant protection plans (covering IPM), which was a condition under national legislation and, therefore, were subject to control during cross-compliance checks. In 2015, the plant protection plans were replaced by mandatory 'plant protection monitors', where all IPM-measures (chemical and non-chemical) have to be recorded by the farmer. The national authority staff checks if the monitor is available and kept up-to-date during the growing season. However, as IPM is no longer a condition under national legislation for CAP subsidies, it is not currently checked during cross-compliance checks. The plant protection monitor should be kept up to date during cultivation and completed within two months after the end of the growing season. The plant protection monitor is meant to help growers to evaluate their IPM approach and adapt it for the following growing season, which is considered a good practice.

In Denmark, national authorities have developed an online tool available to growers to assess their level of IPM implementation through a scoring system. In January 2020, a new legislation came into force requiring (most) farmers to fill out a digital IPM scoring system with 14 IPM questions to be filled in each year based on the agricultural practices in the previous growing season. Eight questions are answered automatically based on data submitted previously (spraying journal and data on crop cultivated during the past 10 years). The six other questions are answered by farmer himself. Answers are not visible for the authorities –we can only check if the farmer has filled in the IPM scoring system. This scoring system at farm level should allow farmers the farmer to measure the IPM implementation and highlight the possibilities for IPM improvement. Up to date, Danish authorities have until now not carried out any control at farm level regarding IPM implementation.

In Germany, measures to control the IPM uptake and implementation have been developed by the Federal Government and the "Länder". The German legal framework highlights that everyone who carries out plant protection measures (not only when using plant protection products) is obliged by §3 of the Plant Protection Act to observe "good professional practice in plant protection" and in particular the general principles of IPM in accordance with Annex III of Directive 2009/128/EC. In addition, there is no legal obligation in Germany to record particular subjects of IPM or the IPM principles. The plant protection services of the "Länder" are responsible for farm inspections, given

that the federal and “Länder” competent authorities have no legal basis for access to digital records, to collect the records regularly (only in single cases with legitimate interest) and have little capacity for additional inspections. A working group (WG) of experts from the responsible federal and state authorities was set-up after an IPM workshop in May 2019. The WG developed a draft checklist based on the eight general principles amended with detailed measures for German farms. The checklist is used as a guideline by the inspector for an interview with the grower at farm level. This system to assess IPM implementation at farm level was introduced recently (in early 2021).

In France, based on the Commission audit performed in May 2018, French authorities are currently developing a template for controlling implementation of IPM by farmers, but this template has not yet been finalised. No control has been performed to date in France.

All MS have highlighted the difficulties in controlling all aspects of IPM as IPM adopts a holistic approach and aims at low pesticide input pest management, giving wherever possible priority to non-chemical methods. Farmers should not regard IPM as a fixed way of cultivating the individual crops as IPM can be applied in many different ways and there will be constant development of new decision support systems, new alternative mechanical control methods, new low risk pesticides, new monitoring systems etc. The farmer should constantly be searching for new methods and techniques to cultivate crops with as little use of pesticides as possible. The implementation of the IPM-principles must provide support and guidelines for continuous improvement of agricultural practices. If specific IPM detailed criteria are established based on the eight IPM principles such criteria would often need to be updated to include new IPM tools and new innovative solutions. Such approach is hardly possible. Thus, it is not feasible to establish specific IPM criteria to determine compliance with the eight principles of IPM at grower level and such IPM criteria would not be relevant for the control and enforcement of IPM. The Danish authorities have noted that authorities can never truly tell if a farmer has fully implemented IPM at farm level but can ask the farmer to what extent he has considered and focused on IPM and, in this way, further emphasise the possibilities for improvement of IPM implementation at farm level. Such a flexible approach is necessary but makes it difficult to define elements which can be controlled as legal compliance. Also, the development of a sophisticated system is necessary but takes time and effort to implement on farm and at authority level. Eventually, when analysing the Belgian and German checklists, it can be observed that most obligations, if not all, are not technically binding with regard to their traditional cultivation practices.

5. Conclusions

Through the SUD and Article 55 of Regulation (EC) no 1107/2009, the EU has made the implementation of IPM general principles mandatory for all European farmers. Over the years, a number of instruments has been proposed to influence farmers’ decisions with regard to crop protection and the uptake of IPM. They can be classified in three categories: regulatory instruments, information dissemination measures, and incentive-based instruments.

The approaches taken by MS to implement IPM through regulatory instruments, as presented above, show that significant efforts have been devoted for the adoption of IPM in the MS observed. For these MS, adoption of IPM was a national objective before the entry into force of the SUD and efforts intensified with the SUD. This is reflected in the assessment performed by the Commission and are reported in the Annex of the second Commission report published in May 2020 which presents an assessment indicating that each of the five MS under study have already developed promotion actions and other IPM tools showing that implementation is satisfactory (see Table 11 below).

Table 11 Progress in the IPM promotion actions

MS	2017 score	2019 score
BE	4	4
DE	2	4
DK	4	4
FR	4	4
NL	2	2

Source: Commission services

This level of implementation does not necessarily translate into reduced dependency on pesticide use, meaning a reduction of volumes of pesticides being used (see Table 12 below). In addition, monitoring of uptake of IPM measures at farm level remains difficult as no satisfactory guidelines for controlling IPM implementation have been drafted.

Table 12 Progress in the enforcement of IPM

MS	2017 score	2019 score
BE	3	3
DE	2	2
DK	1	1
FR	1	1
NL	2	2

Source: Commission services

All in all, the effectiveness of the legal provisions of Article 14 of the SUD remains unknown while the description of the activities implemented by the MS under study demonstrates that significant efforts have been devoted to the promotion and adoption of IPM at farm level.

6. Bibliography

Anonymous. (2012d). Model Project “Demonstration Farms Integrated Plant Protection”. http://www.ble.de/EN/03_ResearchFunding/05_MaDProjects/02_PlantProtection.html.

Anonymous. (2012e). Communication from the Commission to the European Parliament and the Council on the European Innovation Partnership “Agricultural Productivity and Sustainability”. European Commission, COM (2012) 79 final, pp. 9. http://ec.europa.eu/agriculture/eip/pdf/com2012-79_en.pdf.

Description of the ECOPHYTO project in France (<https://agriculture.gouv.fr/ecophyto>)
European Commission report - Denmark - June 2014 - Available at:
https://ec.europa.eu/food/audits-analysis/audit_reports/details.cfm?rep_id=3400

European Commission report - Denmark - May 2017 - Available at: https://ec.europa.eu/food/audits-analysis/audit_reports/details.cfm?rep_id=3897

European Commission report - France - March 2012 - Available at:
https://ec.europa.eu/food/audits-analysis/audit_reports/details.cfm?rep_id=2980

European Commission report - France - November 2018 - Available at: https://ec.europa.eu/food/audits-analysis/audit_reports/details.cfm?rep_id=4123

European Commission report - Germany - June 2012 - Available at:
https://ec.europa.eu/food/audits-analysis/audit_reports/details.cfm?rep_id=2999

European Commission report - Germany - May 2017 - Available at:
https://ec.europa.eu/food/audits-analysis/audit_reports/details.cfm?rep_id=3896

European Commission report - the Netherlands - May 2017 - Available at:
https://ec.europa.eu/food/audits-analysis/audit_reports/details.cfm?rep_id=3895

European Commission report - the Netherlands - October 2020 - Available at: https://ec.europa.eu/food/audits-analysis/audit_reports/details.cfm?rep_id=4345

European Commission. (2017). Report from the commission to the European parliament and the council on Member State National Action Plans and on progress in the implementation of Directive 2009/128/EC on the sustainable use of pesticides. https://ec.europa.eu/food/plant/pesticides/sustainable_use_pesticides_en

European Commission. (2020). Report from the Commission to the European Parliament and the Council on the experience gained by Member States on the implementation of national targets established in their National Action Plans and on progress in the implementation of Directive: Vol. COM(2020)
https://ec.europa.eu/food/plant/pesticides/sustainable_use_pesticides_en

European Court of Auditors. (2020). Sustainable use of plant protection products: limited progress in measuring and reducing risks. <https://www.eca.europa.eu/en/Pages/DocItem.aspx?did=53001>

European Parliament resolution of 12 February 2019 on the implementation of Directive 2009/128/EC on the sustainable use of pesticides (2017/2284(INI))

Member States reports to the Commission on the implementation of paragraphs 1 & 2 of Article 14 of the SUD (provided by Commission services)

National action plans of each of the five Member States under study – Available at
https://ec.europa.eu/food/plants/pesticides/sustainable-use-pesticides/national-action-plans_en

Appendix 3: CASE STUDY III – SUD provisions on water protection

1. Introduction to the case study

The pollution of surface and groundwaters by pesticides may adversely impact fauna, flora, and human health either directly or indirectly. Whereas Member States (MS) achieve high rates of compliance with the list of pesticides, some exceptions¹⁸ and issues remain (EEA, 2020). Simultaneously, MS and their authorities are becoming increasingly aware of the importance of prevention over treatment, and there is an increasing trend for opting towards protection measures at source for water rather than downstream treatment (e.g. Augsburg in Germany is investing in improved agricultural practices in its catchment area to avoid downstream treatment (Trémolet et al., 2019)).

Given the importance of the issue, Article 11 of the Sustainable Use of Pesticides Directive (Directive 2009/128/EC, SUD) articulates specific measures for the protection of aquatic environment and drinking water. This stipulates that MS need to identify and adopt appropriate measures for the protection of the aquatic environment and drinking water supplies from the impact of pesticides and that these should be in line with the Water Framework Directive (Directive 2000/60/EC, WFD) and the Regulation on Plant Protection Products (PPP) (Regulation (EC) No 1107/2009). The SUD provides **four measures** that MS are to adopt *including (1) giving preference to pesticides that are not classified as dangerous for the aquatic environment, (2) giving preference to the most efficient application techniques, (3) using mitigation measures to minimise the risk of offsite pollution by spray drift, (4) eliminating or reducing as much as possible the application along any infrastructure or surfaces that pose a high risk of run-off into surface water or sewage systems*. As per Article 4.1 of the SUD which states that "*Member States shall describe in their National Action Plans how they will implement measures pursuant to Articles 5 to 15 in order to achieve the objectives referred to in the first subparagraph of this paragraph*", these measures for the protection of the aquatic environment need to be reflected in the MS National Action Plans (NAPs).

The **WFD** was introduced in 2000 as the umbrella Directive for European water policy. It aims to achieve 'good status' for all of Europe's surface and groundwater bodies at river basin level. MS regularly submit River Basin Management Plans (RBMPs) and develop Programmes of Measures (PoMs). The **Groundwater Directive** (Directive 2006/118/EC, GWD) and the **Directive on Environmental Quality Standards** (Directive 2008/105/EC and amended in 2013, EQSD) set quality standards and targets for pesticides in surface and groundwater. Furthermore, the **revised Drinking Water Directive** (Directive 2020/2184/EC, DWD) was adopted by the Commission in 2018 and revised end of 2020 to include considerations for all pesticides and their degradation products. A fitness check of the European Union's (EU) water legislation was completed in 2019 revealing that implementation has been significantly delayed and that less than half of the EU's water bodies are in good status (European Commission, 2020e).

The WFD requires MS to develop PoMs as part of their RBMPs and obliges them to report on 25 Key Types of Measures (KTM) (European Commission, 2016, p. 234). Of these, four¹⁹ are related to pesticide reduction in water bodies. The DWD also required MS to develop mitigation measures to mediate exceedances where they existed, whereas the newer Directive (2020) additionally prescribes a risk-based approach for the protection of raw water (European Commission, 2020d).

¹⁸ e.g. over half of the groundwater area in Luxembourg is affected by herbicides, and about half of that in the Czech Republic (EEA, 2020).

¹⁹ KTM 3: Reduce pesticide pollution from agriculture

KTM 12: Advisory service for agriculture

KTM 13: Drinking water protection measures (e.g. establishment of safeguard- or buffer zones)

KTM 15: Measures for the phasing-out of emissions, discharges and losses of Priority Hazardous Substances or for the reduction of emissions, discharges and losses of Priority Substances.

Despite extensive legislation, **implementation** of the WFD and Article 11 of the SUD **remain lagging**²⁰. Reports published by the Commission (European Commission, 2020c; European Parliament, 2017) indicate that whereas the majority of MS have established a range of measures for water protection, "... *in the absence of measurable targets in most national action plans it is difficult to assess the progress achieved*".

Some of the main challenges encountered include:

- Most NAPs lack measurable targets for the protection of aquatic environment and drinking water from the impact of pesticides making it difficult to measure progress
- The targets and timetables established in the NAPs for this purpose are not always explicitly linked to the objectives of the WFD and its daughter Directives.
- The monitoring frameworks and associated indicators are often inconsistent amongst MS and do not adequately cover the multiple aspects needed (e.g. bioaccumulation)
- Little evidence to show whether this legislation has been effective, mainly because of limited data on the actual risk from pesticides in surface waters and groundwater at the European level (EEA, 2020)
- Limited knowledge about the actual levels of pesticides and their metabolites and transformation products in surface and groundwater. Also, of the combination and mixing effects with other substances.

2. Research theme for the case study

The purpose of this case study is to analyse the provisions of the SUD on water protection, including coherence and complementarity with the WFD and its daughter Directives (GWD, EQSD, DWD) and the Regulation on PPPs. This includes assessing available data on addressing pesticide metabolites and their transformation products and their impact on water quality and the cost savings that can be achieved by reducing the levels of PPPs entering close to water or on run-off areas of pesticides as opposed to the need to subsequently remove them from polluted water.

This is achieved through the examination of the situation in the following five MS: *Belgium, Bulgaria, the Netherlands, Poland, and Spain*. The strengths and weaknesses in the implementation, application and enforcement of the water provisions will be assessed and a gap analysis conducted. Based on the outcomes of the analysis and the stakeholder consultation, concrete policy recommendations at both EU and MS level will be made to improve coherence, implementation, and enforcement. This case study will seek to answer the following questions:

- What measures have the selected MS enacted for the protection of the aquatic environment and drinking water supplies under the SUD? To what extent (qualitative assessment) have these been successful in achieving the intended objectives?
- Which were the key contributing factors in achieving the intended objectives? (strengths)
- Which were the key hindering factors in achieving the intended objectives? (weaknesses)
- What are the factors hampering the efficient implementation of the measures? How can they be overcome?
- To what extent are the measures identified by the MS under the SUD water provision coherent with those in the MS' PoMs under the WFD (for example)?
- How can the coherence and complementarity between the SUD and the EU water legislation be enhanced to achieve good water status?

²⁰ The results from the 2017 progress report show that pesticides contribute to poor status of water bodies in sixteen MS affecting 20% of groundwater and 16% of rivers and transitional water bodies.

3. Methodology

Building on the intervention logic (See Figure 2 below), this case study will employ an analytical approach to critically assess whether the actions and measures prescribed by the MS per the four categories of measures prescribed in Article 11 of the SUD, do indeed lead to the protection of the aquatic environment and drinking water. To our understanding, the outcomes which lead to this impact relate to aspects of compliance with the pesticide values set out in the EQSD, GWD and the revised DWD, as well as the relevant articles in the Regulation on PPPs.

This has been the basis for the formulation of the research questions above, thereby putting the focus on how successful have MS been in implementing the measures they have identified under Article 11, what the “outputs” of these measures have been, and which influencing factors, barriers or drivers have been critical. Alternative explanations are considered where relevant, for example, is compliance with the DWD a result of pesticide reduction at source/success of the implemented measures or rather of more expensive and advanced treatment?

Given the high interdependence between the SUD and the identified Directives and Regulation, and the fact that the ultimate goal is ‘good water status’ as defined by the WFD, coherence aspects are also considered in this case study and the subsequent assessment.

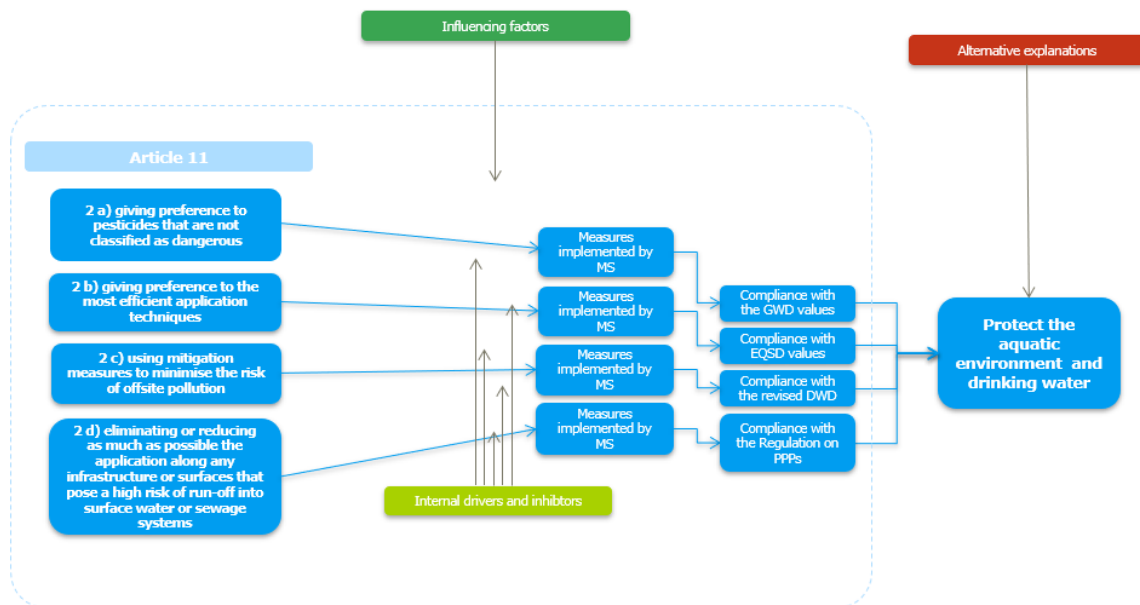


Figure 2 - Conceptual intervention logic adapted for the case study

3.1 Data collection

The data collection entails three steps:

- Step 1: Preparation (literature review, scoping interviews). The literature review has consisted of analysing the NAPs, the European Commission (EC) audits of each of the five MS selected, and other ad hoc reports collected at MS level. Given the clear link of Article 11 of the SUD to the WFD, relevant water legislation and MS reporting on water parameters related to pesticides have additionally been reviewed.

- Step 2: Conducting semi-structured interviews with the national authorities and actors involved in the implementation of NAP and specifically its water provision of the selected MS:
 - Farmers through their national/regional associations, and
 - Water utility representatives (e.g. EurEau).
- Step 3: writing-up of the case study report.

The outputs of the case studies will be reviewed as part of a fourth step for validation and for ensuring the integration of the case study results within the main report of the evaluation.

3.2 Member State Selection

The following MS have been selected for this case study: **Spain (ES)**, **Belgium (BE)**, **Bulgaria (BG)**, **Poland (PL)** and the **Netherlands (NL)**. The criteria for selection as well as the choice of MS were agreed upon with the EC and are outlined thoroughly in the Inception Report. Additional criteria considered specifically for this case study were as follows:

- Extent to which the MS are fulfilling their obligations under the WFD and its daughter Directives to ensure good coverage of those who have significantly progressed and those who have been less active.
- Coverage of a diversity of measures and techniques utilised in the MS for the removal of PPPs residues from the polluted water or innovative prevention measures.
- A balance of different geographical areas and sources of water supply (e.g. surface water vs. groundwater).
- Possibility to identify successful practices and to describe their effects (e.g. of special interest would be the application of the producer-pays principle).

3.3 Limitations

It was originally planned to conduct field trips to enhance the case studies but, given the ongoing pandemic, this could not take place. It must therefore be noted that the recommendations and a large part of the assessment are dependent on a sample of interviews and reflect statements that are hard to verify. Therefore, any extrapolation of the results must be considered with care.

Another limitation was the limited literature published by MS on the implementation and enforcement of the NAPs. Most available information could be found in the NAPs themselves and in relevant EC publications.

4. Situation analysis in the EU

4.1 General overview in the EU

Status of European water

According to the European Environmental Agency (EEA) report on “European waters – assessment of status and pressures”(2018b), results of the assessment of the second round of RBMPs²¹ reveal that 0.4% of all surface water bodies fail good chemical status because of pesticides in the priority substances list, and 6.5% of the area of groundwater bodies fail good chemical status because of pesticides (EEA, 2020). However, this remains an understatement, as the real impact of pesticides on the aquatic environment is largely unknown or unrecorded due to the fact that current WFD reporting does not fully cover the pesticides in use nor the full range of impact, and metabolites and transformation products remain largely unaccounted for (EEA, 2020).

More specifically, the monitored data for European surface water between 2007 and 2017 records exceedances of 5–15% by herbicides, 3–8% by insecticides, and negligible exceedances for fungicides. Whereas for groundwater, the exceedances were about 7% for herbicides and below 1% for insecticides, while also being negligible for fungicides (EEA, 2020).

Based on its use of PPPs, the agricultural sector remains one of the main polluters of Europe’s aquatic environment. In the case of surface waters, diffuse pollution poses as the second main pressure (38%)²² with agricultural being the main contributor there (EEA, 2018b). Whereas for groundwater, agriculture is the main cause for failure to achieve good chemical status due to diffuse pollution from nitrates and pesticides.

It is with this knowledge that the WFD, its daughter Directives, the DWD, the Regulation on PPPs and the SUD seek to limit and find alternative solutions to the pollution caused by pesticides.

Pesticide metabolites and transformation products in European water

As pesticides disperse into the environment, they find their way into plants and soil, from where they can transform into one or more compounds called “metabolites”. Metabolites present intermediate or end products of the pesticide through metabolism, and the frequency of their detection in groundwater can exceed that of their parent compounds as they can be more polar, less volatile and less biodegradable than their parent compounds resulting in higher mobility. These characteristics also enhance their transfer along surface water – ground water interfaces (Hintze et al., 2020). Moreover, metabolites can still be toxic and pose the risk of contaminating drinking water sources (Kotal et al., 2021a), and some metabolites of parent compounds are also registered as active ingredients (e.g. Clothianidin). Even if metabolites display no immediate health risk, the increased presence of pesticides and their metabolites in drinking water can undermine the public’s trust in drinking water safety as stated in Kotal et al. (2021b).

Within Europe, the DWD sets general parametric values for the quality of drinking water for pesticides and their metabolites²³. The GWD sets the same quality standards. The relevant parametric values/quality standards are presented Table 13 below:

²¹ As required by the WFD and submitted by the MS in 2016.

²² Hydro-morphological pressure is the main source of pressure on water (40%)

²³ As define in Regulation (EC) No 1107/2009 §3(32)

Table 13. Parametric value/quality standards for pesticides and metabolites

Parameter	Parametric values in $\mu\text{g/l}$	Directive	Notes
Pesticides and metabolites, that are considered relevant for water intended for human consumption	0.10	DWD	A pesticide metabolite shall be deemed relevant for water intended for human consumption if there is reason to consider that it has intrinsic properties comparable to those of the parent substance in terms of its pesticide target activity or that either itself or its transformation products generate a health risk for consumers
Pesticides Total	0.50	DWD	'Pesticides Total' means the sum of all individual pesticides and their metabolites
Active substances in pesticides, including their relevant metabolites, degradation and reaction Products	0.1	GWD	
Total Active substances in pesticides, including their relevant metabolites, degradation and reaction Products	0.5	GWD	

Moreover, the DWD specifies that MS shall define a guidance value to manage the presence of non-relevant metabolites of pesticides in water intended for human consumption. Groundwater contamination with non-relevant metabolites is generally considered undesirable, thus a guide value of 10 $\mu\text{g/l}$ is used in the authorisation process for PPPs (Bund/Länder-Arbeitsgemeinschaft Wasser, 2019; European Commission, 2003; Sjerps et al., 2019).

The gap in available information on metabolites was further verified in an interview with the JRC. Whereas some tracking of "famous" metabolites is done in some MS, there is certainly a lack of information on metabolites, and there are less known metabolites where the effects are less clear

MS Measures

According to the EC's assessment of the NAPs published in 2017, twenty-seven NAPs include substantial detail on water protection, with only France failing to do so. In line with the four categories of measures stipulated in the SUD, the actions proposed by the MS cover multiple areas including *pesticide application* (e.g. the use of drift reduction technology, bans on sprayer filling from water courses), *financial incentives* (e.g. funding for buffer zones adjacent to water courses in agro-environmental schemes, capital grants for purchase of low drift nozzles, and construction of bio-beds to capture runoff from sprayer washing), the *establishment of buffer zones* around water bodies, and measures relating to *education and knowledge transfer* to name some.

Some of the actions outlined in the NAPs have resulted in big successes. One such outcome, for example, has been the decision taken by France, Luxembourg, Belgium, and the Netherlands, consistent with Article 12 SUD, to stop using pesticides in public areas. Despite of this, the spatial coverage of the measures identified in the MS NAPs remains limited, and concrete targets and timelines remain largely absent and greatly unambitious with MS, for example, citing existing

targets under other legislation or vague statements with no associated indicators (i.e. 'selling' measures included elsewhere). Additionally, detailed linkage with the relevant water legislation²⁴, coherence of targets and timelines, as well as clarity on how actions will be implemented and how progress will be measured remain insufficient. This makes it extremely challenging to track and evaluate progress.

Given the diversity of EU MS and to be able to delve into further detail, this case study will analyse the situation in five MS next and seek to draw out commonalities in the following *Discussion* section.

4.2 Selected MS analysis

4.2.1 Belgium

4.2.1.1 Status of water

In Belgium, the three regions (Wallonia, Flanders, and Brussels-Capital Region) oversee the management and protection of inland waters, while the Federal Government sets the legislation for coastal water (Quesada & Aubin, 2018a). Freshwater resources in Belgium are moderate, however due to the high population density, freshwater represents a scarce resource. The majority of freshwater (88.5%) is abstracted from surface water and a smaller share from (11.5%) from groundwater (Quesada & Aubin, 2018b).

The EC report concerning the assessment of the second RBMP concludes the following chemical status for surface and groundwater in Belgium (European Commission, 2019d):

Table 14. Chemical status of surface and groundwater in Belgium

Category	Good	Failing to achieve good status	Unknown status
Surface water	2%	98%	Less than 1%
Ground water	41%	59%	-

Surface water

Regarding surface water, Belgium is still relatively far from attaining good water status and it remains unknown when good chemical status is expected to be achieved for approximately 99.5 % of all water bodies (European Commission, 2019d). Diffuse pollution from agricultural sources is one of the most relevant pressures on rivers in Belgium, especially regarding nitrate input and eutrophication (European Commission, 2017b, 2019e). Pesticides are not among the top-10 priority substances causing failure of surface water bodies (European Commission, 2019d).

Concerning the monitoring of substances relevant to the WFD, a report of the **Flanders** Environmental Agency indicates that a limited number of pesticides exceeded standard values (VMM, 2016, 2019a)²⁵. The average concentration of pesticides for which restrictions are in place is decreasing, while the average concentrations of authorised pesticides are fluctuating or decreasing (VMM, 2016). Further data from VMM (2018) identifies trends for the annual mean concentration of 52 different pesticides in Flemish surface waters between 2000 and 2016. Thereof,

²⁴ Water Framework Directive, Environmental Quality Standards Directive, Groundwater Directive, Drinking Water Directive.

²⁵ Accordingly, the substances Imidacloprid, Flufenacet and Diflufenican were measured in excessive concentrations in 74%, 43% and 42% of the monitoring sites (VMM, 2016). Furthermore, levels of neonicotinoids were detected in around 80% (Imidacloprid) and 70% (Thiacloprid) of samples taken from Flemish water bodies. For the latter substances, the measurements exceeded the PNEC value. However, the measured concentrations decreased between 2018 and 2020 (VMM, 2019b).

24 pesticides show a significant decrease and 25 show no trend. Three pesticides show an increasing trend²⁶ (VMM, 2018b).

In **Wallonia**, substances detected in surface water between 2005 and 2011 include herbicides (Isoproturon, Linuron and Atrazin), insecticides (Lindane and Dimethoate) as well as some substances which have been banned (NAPAN, 2014). According to expert feedback, the main active substances and metabolites of concern are Diflufenican, Terbutylazine, Cypermethrin, Prosulfocarb and Flufenacet.

Groundwater

Generally, the share of Belgian groundwater area failing to achieve good chemical status due to pesticides was estimated to be 23.6 % (EEA, 2020). The most significant pressures on groundwater bodies are emissions from agriculture and industry (European Commission, 2019e). A total of 33 pollutants were reported to contribute to the deterioration of the chemical status of Belgian groundwater. In terms of affected groundwaters bodies, pesticides are the second most important pollutant. Thus, concentrations of pesticides were identified in 40 % of all groundwater bodies across six River Basin Districts (RBDs) (European Commission, 2019d). Furthermore, modelled data indicates that no significant changes in terms of pesticide releases from agriculture were observed in two Belgium RBDs (Maas and Schelde RBD) (EEA, 2020).

In 56 % of the groundwater samples analysed by the **Flemish Environmental Agency** taken in 2010, pesticides and their degradation products were identified in concentrations above the legal groundwater standard of 0.1 µg/l (VMM, 2012). Further data indicate decreasing trends for prohibited pesticides²⁷ and their degradation products (VMM, 2020). However, for other substances, e.g. Desphenyl-Chloridazon, an increasing trend can be observed (VMM, 2020).

In **Wallonia**, groundwater analyses for the period between 2007 and 2010 showed that 10 out of 33 groundwater bodies were affected by PPPs contamination (NAPAN, 2014). Between 2011 and 2014, pesticides were present in measurable concentrations in 65 % of the groundwater quality control sites. The most relevant pesticides were Atrazine and its metabolite Desethylatrazine, Bentazone, and BAM. Many of the pesticides detected have already been prohibited for years but can still be detected in water bodies due to their high persistence (État de l'environnement de Wallonie, 2018).

Drinking water

Concerning drinking water and the microbiological and chemical indicators defined by the DWD, Belgium shows high compliance rates of 99-100% (European Commission, 2017b). As relates to pesticides, data on groundwater quality analyses in **Flanders** from 2018 show, that two exceedances of Clopyralid were reported (0,114 µg/l and 0,103 µg/l). In 2019, no pesticide exceeded the precautionary value (VMM, 2019a). Pesticides have also been detected in excessive concentrations at monitoring sites of surface waters which are used for drinking water extraction. Thus, purification remains important for maintaining good drinking water quality. In **Wallonia**, 98.8% of drinking water meets the quality standards and only 0.0035% of the cases of non-conformity in tap water could be attributed to excessive concentrations of PPP (NAPAN, 2014).

4.2.1.2 Measures put in place

The Belgian NAP is referred to as Nationaal Actieplan Plan d'Action National (NAPAN). The first NAPAN addressed the period between 2013 and 2017 and was revised in 2018 and 2020. It includes the 1) Federal Plan for the Reduction of Plant Protection Products, 2) the Brussels-Capital Region

²⁶ Chlorotoluron, Metazachlor and Terbutylazine

²⁷ e.g. Atrazine, Chlorotoluron, Isoprotuton

pesticide reduction programme, 3) the Flemish Action Plan for the sustainable use of pesticides and 4) the Walloon pesticide reduction programme (PWRP). Relevant competences are distributed among the different Federal Bodies.

Therefore, it covers actions on the federal level as well as federal and joint actions²⁸ (NAPAN, 2014). Within this analysis, the focus is on the Flemish and Walloon programmes since these are of major importance in terms of agricultural production. Where necessary, references to the Brussels region are included.

Flanders

One of the main objectives of the Flemish Government is the continued reduction of the pressure from environmental pesticides on the aquatic environment (NAPAN, 2020). Thus, several actions which are directly related to the protection of the aquatic environment are addressed in the Flemish programme and relate to the four categories of measures identified by the SUD (Article 11) (NAPAN, 2020)²⁹.

In Flanders, the following actions for the protection of surface water were identified:

- Enforcement of buffer zones for horizontal and vertical crops
- Obligation to use drift-reducing caps and a ban on the filling and rinsing of dispersers on hard surfaces not provided with an adequate collection system for residual water
- Restoring and protecting surface water through the enforcement of a stricter policy for the presence of pesticide in surface waters

Moreover, concrete actions to reduce the contamination of **groundwater** by pesticides in Flanders mainly include:

- Monitoring of pesticides in groundwater (e.g. geostatistical analysis of data on groundwater quality, assessments on the current use of pesticides and possible policy adaptations)
- Designation of vulnerable areas of groundwater where the use of certain pesticides may be restricted or prohibited

As relates to the DWD, mitigation strategies are defined in the NAPAN. Actions for the protection of surface and ground water used for **drinking water** production include (NAPAN, 2014, 2020):

- Demarcating of protection zones for the use of pesticides to protect drinking water abstraction
- Restoring and protecting the quality of surface waters in drinking water protection areas by
 - annually evaluating the active substances in the raw water of the groundwater protection zones
 - updating environmental quality standards
- Mandatory exchange of information between the drinking water sector and producers of pesticides

Further measures taken to reduce pollution from pesticides in the Flanders region include the promotion of studies and research, the implementation of information and awareness raising campaigns and sanctions for the improper application of pesticides for professional users.

Wallonia

One of the main objectives of the Walloon Pesticide Reduction Programme is to implement concrete measures for the protection of surface and groundwater bodies, and to reduce the share of cases where standard thresholds are exceeded (NAPAN, 2014). The importance of protecting catchment areas against contamination by PPPs is also highlighted.

²⁸ Joint actions are actions implemented in coordination with the other members of the NAPAN Task Force (NTF)

²⁹ Some of the measures listed in the bullet points are directly copied from the NAPAN and its revisions.

The measures should enable Wallonia to move towards a 50% reduction in environmental impact for non-agricultural use and a 25% reduction in environmental impact for agricultural use. Besides actions such as public information campaigns, e.g. on good gardening practices, the program also defines actions to protect the aquatic environment and drinking water from PPPs. These actions include (NAPAN, 2014, 2020):

- Creation of buffer zones in and outside of crop areas and grasslands
- Prohibiting the use of PPPs on paved land not suitable for crops (e.g. roads or pavements) which are connected to a rainwater collection system or directly to surface water
- Better protection of waterbodies by defining areas vulnerable to PPPs
- Protection of surface waters with permanent vegetation
- Reduce drift and run-off of PPPs through permanent vegetation alongside surface waters
- Preference to low-risk PPPs
- Implementation of survey checks and the subsequent introduction of measures for restricting the introduction of pesticides into groundwater³⁰

Further action aims to enhance the awareness of professional users of pesticides for protecting the aquatic environment. In addition, as part of the transition to "zero PPPs", since June 1st 2019, managers of public areas have been required to manage the respective areas without using PPP (NAPAN, 2014).

Brussels-Capital region

With regard to the Brussels-Capital region, actions taken in the NAPAN include awareness raising campaigns among individuals and professionals concerning aspects such as limiting the use of pesticides in private gardens or respecting high-risk areas and established buffer zones (NAPAN, 2020).

Joint and federal actions

Relevant joint and federal actions listed in the NAPAN within the context of or related to Article 11 SUD are (NAPAN, 2020):

- Harmonising the approach to the use of pesticides for maintaining railways and exchanging good practices
- standardising the systems for emptying and rinsing containers when PPPs are transferred to the spraying tank
- mitigation of risks considered with the storage of PPPs
- introduction of regular inspections

Moreover, a new **joint action** addressed in the 2020 revision of NAPAN includes *a review of main risk mitigation measures with regard to their feasibility, relevance and practicability*. Based on this review, policy for the authorisation of risk-mitigation measures should be reconsidered (NAPAN, 2020).

Water Directives

³⁰ If the annual mean concentration of pesticides and their metabolites in receiving water exceeds 30% of the quality standard set out by the Groundwater Directive (0,1 µg/l per individual substance; 0,5 µg/l for the total value of substances), survey checks must be carried out. Based on the survey checks, actions must be organised for restricting the introduction of pesticides into groundwater until the concentration of pesticides has dropped below 30% of the quality standards. This level must be maintained for at least five years. Respective actions should ensure that pesticide users in local and distant protection areas apply pesticides according to good practice methods. If the mean concentration in receiving water exceeds 75% of the quality standards, reinforced measures must be organised. The exact nature of the corresponding actions is not described in more detail (#Napan 2014).

Similarly, the WFD requires MS to develop PoMs as part of their RBMPs and obliges them to report on 25 KTMs³¹. Of these, four³² are related to pesticide reduction in water bodies. Belgium is part of eight RBDs (European Commission, 2019d).

In the RBMPs there is a lack of information concerning the area of agricultural land to be covered by measures for achieving the environmental objectives of the WFD. Information is only provided for the North Sea RBD (European Commission, 2019d). Basic measures to control the diffuse pollution from agriculture at source are defined in the majority of RBDs. The measures cover nitrates, organic pollutants, pesticides, and phosphorus. In all RBDs supplementary measures in relation to agricultural pressures are implemented (European Commission, 2019d).

In general, the most significant pressures are covered by KTMs. The Scheldt and Maas RBDs in Flanders cover all KTMs. However, a few significant pressures are not covered. For instance, there is no operational KTM for diffuse agricultural pollution in groundwater in the Rhine RBD (European Commission, 2019d).

KTMs for tackling River Basin Specific Pollutants (RBSP) have been reported for surface and groundwater in the Flanders Region, while no corresponding KTMs have been reported for the Brussels and Walloon Regions (European Commission, 2019d).

In the RBMPs, specific measures referring to KTM 3, 12, 13 and 15 have been reported. RBDs in Flanders reported on KTMs used to address failures of good chemical status in groundwater and surface water bodies. Failures were reported for groundwater in the Schelde and Maas RBDs with most failures being due to nutrients and pesticides. Where failures have been reported, measures to address the RBSP have been implemented. Generally, pressures from agriculture on surface and groundwater are clearly identified in the RBMPs. In addition, all RBMPs indicate that surface water is affected by pesticides from point and diffuse sources (European Commission, 2019d).

4.2.1.3 Assessment

The following section will assess the extent to which the measures described in the previous chapters have been implemented in the administrative and enforcement practices of Belgium. Moreover, the main impacts of the measures and their coherence with the WFD and its daughter Directives will be analysed. For a large part, the subsequent assessment will be carried out on the regional level. Where reasonable, the analysis will be performed on the federal level.

Implementation of measures

In summary, many of the actions taken for the protection of ground, surface and drinking water in Wallonia and Flanders are directly related to the respective categories of measures under Article 11, while some, such as awareness raising- or information campaigns, can also be considered relevant in this context. Table 30 (see Annex 7.1) gives a comprehensive overview of the measures in place and the status of implementation. It is worth noting that for certain measures, the research and interviews conducted resulted in limited information on the status of implementation.

When it comes to the implementation of measures, it is important to consider the differences between the regions outlined previously. Hence, the highest number of measures for the protection of the aquatic environment are implemented in Flanders, while corresponding actions in the Brussels

³¹ This is a predefined set of measures developed within the framework of the WFD reporting.

³² KTM 3: Reduce pesticide pollution from agriculture

KTM 12: Advisory service for agriculture

KTM 13: Drinking water protection measures (e.g. establishment of safeguard- or buffer zones)

KTM 15: Measures for the phasing-out of emissions, discharges and losses of Priority Hazardous Substances or for the reduction of emissions, discharges

and Walloon region are fewer. Worth noting is that the 2018 revision of the NAPAN introduced four new actions to protect water bodies in Wallonia (NAPAN, 2018).

Enforcement of measures

The enforcement of measures depends on the respective actions since the competences are distributed among the different Federal bodies (NAPAN, 2014).

The Environmental Implementation Review of Belgium 2019 concluded that only Flanders provided annual reports on enforcement measures, while there is a lack of published information on enforcement actions such as warnings, sanctions, and compliance with follow-up measures in Wallonia and Brussels (European Commission, 2019e). Until 2019, the Flemish High Enforcement Council for Spatial Planning and Environment (VHRM) was the authority in charge of compiling the annual Environmental Enforcement Report (VHRM, 2020). From 2020 on, this competence will be transferred to the Department of Environment and Spatial Development (VHRM, 2020). In Flanders, enforcement activities are distributed among different regulations and administrations from the regional to the local level. Thus, the competent authority responsible for the enforcement depends on where the infraction was committed (as per stakeholder input). The Environmental Enforcement report summarizes information on all environmental enforcement activities including the number and type of inspections as well as the different enforcement instruments applied. However, no specific information on enforcement instruments and their evaluation with regard to pesticides is available (VHRM, 2020).

The authorized services of the Public Service of Wallonia (SPW – DG03) carry out control and missions in order to prevent environmental offences. The missions are conducted by the Police and Inspections Department (DPC) and the Nature and Forests Department (DNF) (SOERW, 2017). Enforcement measures include injunctions, warnings, and official reports. The number of annual surveys carried out by the different Directorates of the DPC decreased from 6,356 to 4,551 in the period from 2008 to 2015. This is primarily due to a reduced number of employees. However, there is no specific information available for enforcement measures in the context of the SUD in Wallonia (SOERW, 2017). Effective enforcement of measures is often challenging due to the difficulties in tracing the origin of use. Furthermore, monitoring compliance with buffer zones is difficult because they represent non-treated but cultivated zones. As of October 2021, grazed buffer zones will be mandatory. This will facilitate controls (as per stakeholder input).

Influencing factors

Limited statements can be made regarding influencing factors as it remains difficult to evaluate progress. The stakeholders interviewed highlighted several aspects which facilitate or hamper the effectiveness of the SUD's implementation and enforcement. These are:

- **Distribution of competencies:** Due to the distribution of competencies, the possibility of making quick and easy decisions is limited. On the other hand, this facilitates the exchange of information and an active involvement of involved stakeholders.
- **Different interests of involved sectors**
- **Actions are spread over several EU directives:** Overlaps within different EU Directives (e.g. WFD and SUD) lead to double exercises.
- **Lack of training on the ground in all aspects of IPM and sustainable use of pesticides:** Raising awareness of farmers and other users of PPPs is essential. The perceptions about the implementation of the SUD and the goals, the SUD is trying to achieve should be improved.
- **Resistance to policies by users**

In addition, there is a slow uptake of innovation and technologies, partly due to investment costs. Stakeholders also noted that the complex transfer paths of pesticides to water make it difficult to determine the point of pollution and to carry out effective enforcement measures.

In Wallonia, a factor facilitating the effectiveness of the implementation and enforcement of the SUD, was the strong political commitment during the development of the PWRP in 2013, which increased public awareness. On the contrary, the relatively powerful agricultural lobby and the resistance of farmers regarding changes has hampered an effective implementation of the SUD. Stakeholders interviewed further noted that the general lack of resources including human, financial and technical resources, represents another limiting factor in Wallonia.

Discussion of impacts

As can be seen in Table 30, the actions identified in the NAPAN for the protection of ground, surface and drinking water are relevant and quite comprehensive. However, although the measures in the NAPAN and its revisions are linked to Key Success Factors (KFS) which include deliverables for the achievement of associated objectives, there is almost a complete absence of clear timetables and/or quantifiable targets for reduction. This makes it extremely difficult to track and evaluate progress, and to draw a clear connection between the actions identified and the impacts on the ground.

Major points of criticism exist regarding the following aspects (European Commission, 2019e, 2019d):

- Financial aspects: Financing of agricultural measures is only secured in the RBDs in Wallonia through Rural Development Programmes, while it is not secured in RBDs in Flanders (Maas, Scheldt RBDs). Thus, clear financial commitments that could further reduce the impact of pesticides on the aquatic environment are missing.
- Judging the progress: Evaluating the progress (or the expected progress) made towards achieving the SUD and the WFD objectives is limited due to the almost complete absence of gap analyses. Thus, it is expected that the objectives will not be achieved in numerous water bodies even by 2027.

Since the majority of waterbodies have not achieved good status yet, Flemish stakeholders point out that measures in Flanders are not as effective as expected. Moreover, declining trends of the agricultural pressure on the aquatic life (Seq Indicator³³) can not only be attributed to the measures following Article 11 of the SUD or the WFD but also to the ban of certain pesticides. No specific information on the effectiveness of measures is available in Flanders. This is mainly due to time limitations and the mandatory downsizing of administration as per stakeholder input.

In Wallonia, the two main reasons for the absence of an impact assessment are the lack of human resources and the fact that impacts of the respective measures are difficult to assess. For instance, the impact of trainings and awareness raising- or information campaigns can hardly be quantified. This also the reason for the lack of quantitative targets in the NAPAN (as per stakeholder input). Moreover, as many of the actions represent continuous processes, it is still too early to evaluate their effectiveness (lag time) (SOERW, 2017).

Coherence with the water directives

As regards coherence with the WFD, the different approaches of the regions must be taken into account. In Flanders, the actions outlined in the NAPAN are closely connected to the WFD. The WFD represents the basis for most of the actions carried out under the NAPAN and associated with Article 11 of the SUD. NAPAN actions are proposed by VMM, the Department of Agriculture and Fisheries, as well as the Department of Environment. Moreover, in the NAPAN, additional actions not included in the RBMPs are carried out by the Department of Agriculture and Fisheries. Wallonia follows a contrasting approach. Here, all measures to protect waters from PPPs are included in the Walloon part of the NAPAN and referred to in the WFD (as per stakeholder input).

³³ The Seq (since 2011 Seq+) Indicator represents a measure of the risks of the aquatic life associated due to the use of PPP; <https://www.milieurapport.be/milieuthemas/waterkwaliteit/pesticiden/druk-op-het-waterleven-door-gewasbescherming>

Thus, there is a strong connection between the WFD and the NAPAN in Flanders and most of the NAPAN actions are carried out under the PoM of the WFD. In this context, Flemish stakeholders pointed out that the new NAPAN will contain various measures, where public consultation was not possible because the measures were already determined in the PoM. In addition, it was emphasized that issues such as water quality or protection of water used by drinking water production covered by the SUD benefit from the implementation of the WFD and the DWD (as per stakeholder input).

In Wallonia, coherence with the WFD is a central objective of the SUD. The Department of Environment and Water³⁴ is the competent authority for both Directives and there is close collaboration between the responsible colleagues (as per stakeholder input).

Information related to costs and finances

Within the NAPAN and its revisions, no data on potential cost savings through a reduced application of pesticides could be identified.

According to stakeholder input, 0.4 FTE are working on the non-agricultural and horticultural policy of the SUD and – for a small part – on agriculture and the related impacts on the environment within the VMM. It should be noted that no information on the number of FTE from other involved departments working on the implementation of the SUD was available. Generally, the lack of human resources hinders detailed assessments on the costs associated with the implementation and enforcement of the SUD. The costs are financed through the financial administrative package of the Belgian government and costs are available for specific measures. For instance, the cost for sponsoring the competition “Public Green Awards”³⁵ is approximately EUR 9,000. There are no specific costs for the treatment of water from pesticides available in Flanders, however, according to the stakeholders interviewed, the replacement of activated carbon filters due to the presence of pesticides significantly increases the operational costs for drinking water purification. Cost saving through a reduced application of pesticides can hardly be calculated due to various external costs which need to be considered (as per stakeholder input).

In Wallonia, 1.5 FTE have been working on the administration of the SUD until August 2020. Since then, the administration staff has included 2.5 FTE. Control staff accounts for 1.8 FTE. Generally, it was highlighted that assessing the resources, including financial costs and human resources, associated with the implementation of the SUD is difficult. The costs for the implementation and enforcement are mainly financed through the Environmental Protection Fund, which is financed by the cost of wastewater treatment and drinking water supply as per the stakeholders. The additional costs incurred for water treatment utilities due to pesticide pollution in Wallonia are around EUR 0.2 to 0.4 per m³, primarily caused by the costs for activated carbon filters (as per stakeholder input). Water catchment contracts are set up by the public water management company (SPGE) to avoid contamination of catchment areas. Therefore, the SPGE provides financial support for the implementation of respective measures. This specifically accounts for the control and enforcement measures, where more human resources would be needed to ensure effective enforcement (as per stakeholder input) (SPGE, 2018). In general, the authorities emphasize that all activities that require human resources pose a burden. This is particularly true for control and enforcement measures, where more human resources would be needed to ensure effective enforcement (as per stakeholder input).

Recommendations and actions for improving the implementation and enforcement of the SUD

³⁴ Département de l'Environnement et de l'Eau

³⁵ The Public Green Awards “Openbaargroen-awards” are a competition to promote sustainable public greenery and bee-friendly developments in Flanders.

According to the feedback of the stakeholders interviewed for the region of Wallonia, a harmonisation of rules between MS could improve the efficiency of the SUD. Moreover, in Belgium, the terminology is problematic as definitions vary on the federal and regional levels. This applies for instance to the definition of “surface water”. Guidance documents providing harmonized rules and clear definitions might therefore represent a means for improving the implementation of the SUD (as per stakeholder input). Furthermore, more realistic standards for the PPPs of concern for water quality would be required. In addition, the EQS of the Insecticide Cypermethrin is so low, that the Walloon authorities were not able to find a laboratory which could measure its concentration. Further aspects for improvement outlined by the Walloon authorities include the development of non-chemical alternatives to PPPs at a suitable level, and the facilitation and acceleration of the recognition of low-risk PPPs.

It is worth noting, that both, the Flemish and Walloon stakeholders, reported duplication of work due to the overlaps between the WFD and the SUD. According to the Flemish stakeholders an alignment of the cycles of the RBMPs and the NAPAN would be beneficial (as per stakeholder input). Moreover, it was highlighted that, because of the existing overlaps, Article 11 of the SUD might better be implemented through the WFD. Concerning the non-agricultural and horticultural use of PPPs, Flemish stakeholders point out that a certain reduction optimum has been reached. Accordingly, the amount of exemptions granted has been constant in recent years and further administrative measures would not necessarily lead to a higher reduction. This shifts the focus of VMM policy to drinking water source protection. In general, there is a strong focus on food and food safety within the SUD, while IPM also covers aspects related to the non-agricultural use of PPPs making gardeners a large and often overlooked group of PPP-users (as per stakeholder input).

4.2.2 Bulgaria³⁶

4.2.2.1 Status of water

Bulgaria is characterised by significant freshwater resources, both in absolute volume and per capita. However, as water resources are unevenly distributed throughout the country, certain regions may still experience water shortage. Around 90% of Bulgaria’s freshwater withdrawal is from surface water, with the remaining 10% being from groundwater. The industrial sector is responsible for around 70% of water withdrawal (Food and Agriculture Organization (FAO), n.d.).

According to the EC’s assessment, Bulgaria still has a long way to go to achieve the good status prescribed in the WFD (European Commission, 2019a). The chemical status of surface waters under the WFD is based on a comparison of measured concentrations of priority substances (set across the EU) with target levels established under the EQSD (EEA, 2018a).

The EC report on the assessment of the second RBMP concludes the following chemical status for surface and groundwater in Bulgaria:

Table 15. Chemical status of surface and groundwater in Bulgaria

Category	Good	Failing to achieve good	Unknown
Surface water	23% (in Bulgaria called high confidence)	44% (in Bulgaria medium confidence)	33% (in Bulgaria called low confidence)
Ground water		45%	-

Surface water

³⁶ Please note that it has not been possible to gather stakeholder feedback from Bulgaria.

Surface water bodies in Bulgaria are mostly impacted by nutrient pollution (40%) and organic pollution (25%). Chemical pollution accounts for 6%. Bulgarian rivers suffer from unknown anthropogenic pressure (23%), point source pressures from urban wastewater (22%) and diffuse pollution from agriculture (19%) (European Commission, 2019f).

Groundwater

Groundwaters are affected by nutrient pollution (27%) and chemical pollution (11%). For groundwater bodies the most significant pressure is diffuse pollution from agriculture (50%) and diffuse pollution related to discharges not connected to sewerage network (49%) (European Commission, 2019f).

Diffuse agricultural pollution accounts for 8% of the pressures overall affecting surface and groundwater. Organic pollution, nitrogen and phosphorus from diffuse sources and pesticides from diffuse sources are reported as the main pressures on water quality (European Commission, 2019a). Bulgaria has an agricultural area of over 5 Mio ha (around 46% of national territory). In 2017, 3,355 t of pesticides were sold (50% herbicides, 39% fungicides, 11% insecticides) (European Commission, 2018a). In the first cycle of the RBMPs, the West Aegean RBD was not listed to be affected significantly by agriculture but this is the case in the second cycle (European Commission, 2019a). Figure 3 below shows that pesticide consumption has rapidly increased in Bulgaria since 2014.

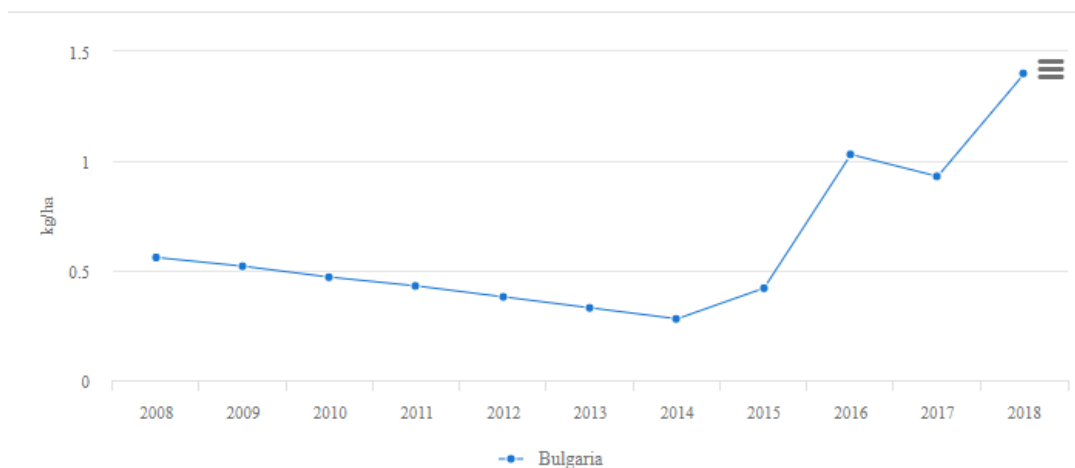


Figure 3 - Pesticides in Bulgaria - Average use per area cropland (2008 – 2018) (Retrieved from (Food and Agriculture Organization of the United Nations (FAO), n.d.))

Drinking water

The EC's Environmental Implementation Review 2017 states that Bulgaria reaches very high compliance rates of 99-100% for microbiological, chemical and indicator parameters as laid down in the DWD (European Commission, 2017a). Annex No 1, Table B 'Chemical indicators' of the Bulgarian Regulation No 9 of 16 March 2001 includes the threshold values set by the DWD (concentration limit of 0.1µg/l for individual pesticides, and of 0.5 µg/l for the total sum of pesticides).

A recent accident revealed that banned pesticides are still in use in Bulgaria and gave an indication of the severity of the problem. In 2019, four children and many bees were poisoned as a result of a nearby tractor spraying pesticides in the fields. Subsequent plant samples revealed traces of carbendazim, benomyl, epoxiconazole, thiophanatemethyl and florasulam. Carbendazim has not been re-approved for use in the EU since 2016 and epoxiconazole is banned. Samples of the bees

showed signs of the substances clotiniadin and thiamethoxam which are banned throughout the EU as well (EURACTIV, 2020).

Moreover, a recent newspaper article reported that tons of fish died in 2020 due to pesticides in the Maritsa River. A twice-than-normal concentration of two pesticide types was measured in the Pishmanka River which flows into the Maritsa (Fernsby, 2020).

4.2.2.2 **Measures put in place**

Bulgaria drew up its original NAP in 2012, and recently revised it in 2020. The measures for protection of the water environment and drinking water were updated, as well as measures for inspection of the used equipment for the application of pesticides (Bulgarian Council of Ministers, 2020). The measures are accompanied by a timetable for implementation, a list of the responsible institutions and a specification of progress indicators. Bulgaria states that its NAP was drawn up in line with other plans and measures that have already been drafted at national level (e.g. RBMPs) (Bulgarian Council of Ministers, 2020).

The first and the revised NAP both contain a separate chapter on “**Special measures to protect the aquatic environment and drinking water**” (**Measure 8**) dedicated to the protection of the aquatic environment and drinking water. At the beginning of the chapter, requirements that are already covered by existing national legislation are listed (Bulgarian Council of Ministers, 2012):

- requirements for the quality of fresh surface water and of water intended for drinking and household use
- prohibitions and restrictions, including those relating to the application of pesticides in the different belts of safeguard zones
- requirements for surface water and groundwater
- Water Protection Zones, as specified in the Water Act, are set out in the River Basin Management Plan

In the NAP, the **surface water monitoring** is described as followed:

- Monitoring of basic physical/chemical substances, priority substances and specific pollutants in all four River Basin Districts (RBDs) is carried out
- Water from surface sources used to supply water for drinking and household undergo a special pesticide monitoring

Groundwater monitoring is also described in the NAP:

- Control and operational monitoring of the chemical status of groundwater is performed
- Special monitoring points for the water protection zones exist
- One of the four indicators that are analysed are organic substances, including pesticides
- It is mentioned that pesticide monitoring is not planned or carried out for all groundwater monitoring points, only where necessary.

The monitoring activities described in the NAP include details on sampling frequency, the number of monitoring points and on monitoring indicators. Moreover, the NAP names all relevant actors that are involved in the water monitoring (e.g. the Bulgarian Executive Environment Agency). The NAP also references the RBMPs and states that an assessment of the risks posed to groundwater bodies is included there (Bulgarian Council of Ministers, 2012).

With respect to **drinking water control** and **aquatic environment protection** the NAP provides a list of actions to be carried out under Measure 8. This list of actions also includes the goals set in Article 11 of SUD (e.g. prioritisation of PPPs not hazardous to the aquatic environment). The following actions were planned in the first NAP:

- Establish untreated buffer zones near surface water to protect non-target aquatic organisms
Buffer zones are to be established on an individual basis for each plant protection product during the process of its assessment and licensing and are to be listed on the product label
- Prohibitions and restrictions on actions with PPPs in public health protection zones for surface water and groundwater that is used for drinking and domestic water supply
- Several measures on improvement of information exchange, development of information systems (e.g. on PPPs) and information gathering (e.g. on agricultural pressure)
- Improving controls on compliance with the requirements for the prohibition and restriction of pesticide use in safeguard zones.

Next to Measure 8 -dedicated to protecting the aquatic environment and drinking water- other measures related to Article 11 (SUD) were identified in the Bulgarian NAP:

- *Measure 12 on the reduction of pesticide use or risks in specific areas* sets that the use of professional-category PPPs is prohibited in three specific areas. If the treatment of such areas is needed, PPPs of the non-professional use category, low-risk PPPs or biological agents are to be used (Bulgarian Council of Ministers, 2020).
- *Measure 4 on inspection of the equipment used to apply pesticides* could be related to the goal "Give preference to the most efficient application technique". The measure sets out mandatory inspections with respect of the safety and protection of human health and the environment for specific auxiliary pesticide application equipment (e.g. spraying equipment mounted on aircraft) (Bulgarian Council of Ministers, 2020).

Water Directives

Bulgaria has four RBDs Districts (Danube, Black Sea, East Aegean and West Aegean), and thus four RBMPs. The updated RBMPs are designed for the period 2016 to 2021 (European Commission, 2019a). The NAP explicitly states that it is developed in line with the RBMPs.

The Danube RBD and the Black Sea RBD include all relevant KTMs (KTM3, KTM12, KTM13 and KTM15) in their RBMPs. The East Aegean RBD includes all mentioned KTMs but KTM 15. The West Aegean includes KTM3 (only basic measures) and KTM13. The EC declares that it is not clear why KTM15 measures are not mentioned in the RBMPs for the East and West Aegean RBDs (European Commission, 2019a).

In the East Aegean and West Aegean RBDs general binding rules to **control diffuse pollution** are not only applied to nitrates, organic pollution and phosphorus but also to pesticides (European Commission, 2019a). Basic measures as defined in Article 11(3)(h) of the WFD for the control of diffuse pollution from agriculture at source are applied only in Nitrate Vulnerable Zones except in the West Aegean RBD where the same rules apply across the whole RBD (European Commission, 2019a).

Although diffuse pollution from agriculture (nutrients, agri-chemicals, sediment, organic matter) has been identified as a significant pressure in Bulgaria (8% of the pressures overall) no common methods or methodologies for some pressure assessments i.e. diffuse sources and their source apportionment are found in the RBMPs. The EC recommends further progress and to complete a comprehensive gap assessment to understand diffuse pollutant loads from agriculture (European Commission, 2019a).

In 2014, the costs for wastewater treatment and disposal were responsible for the second largest share (31.5%) of expenditures with an ecological purpose (Executive Environment Agency, 2014).

4.2.2.3 Assessment

The following sections will provide an analysis of the extent to which the measures described in the previous section have been implemented in the administrative and enforcement practices of

Bulgaria. In addition, the main impacts of the measures and their coherence with the WFD and its daughter Directives will be discussed. Main sources of the analysis are:

- EC's audit report on the first NAP (European Commission, 2018a)
- First NAP (2012) (Bulgarian Council of Ministers, 2012)
- Revised NAP (2020) (Bulgarian Council of Ministers, 2020)

Implementation of measures

The Bulgarian NAP includes seven actions (five in the revised NAP) for the protection of drinking water and ten (eleven in the revised NAP) for the aquatic environment. For the purposes of this case study, the first and the revised NAP were compared with regards to the measures under Article 11 in the SUD. Several actions in the revised NAP are identical to the actions laid down in the first NAP; this may imply that these measures are not yet (fully) implemented as they are still listed. Moreover, measures were identified that only occurred in the first NAP but not in the second; it remains unclear whether these have been implemented in the meantime or are no longer considered relevant. Finally, the revised NAP includes new measures relating to Article 11 (SUD). As the NAP was only revised in 2020, it is not possible to make a statement about the implementation of these new measures yet. Table 31 in Annex 7.2 gives a comprehensive overview on the different measures from both NAPs.

Bulgaria's NAP and its revision cover all relevant aspects of Article 11, and specific measures are incorporated into the RBMPs. However, most of the actions drafted for the protection of the aquatic environment and drinking water lack clear deadlines. Most actions in the NAP (2012 and 2020) do not contain a deadline but are declared as "ongoing". Several other timelines refer to timelines set in the Regulation on PPPs or the WFD. The measures presented in the NAP are prepared in a structured table including deadlines, priority and responsible institution. Nonetheless, no quantitative objectives are given to evaluate the progress and success of implementation.

In 2020, the EEA stated that Bulgaria has regulations in place to determine the frequency of monitoring as well as databases for inserting the results. Moreover, an information system for permits and monitoring in water management also exists (Executive Environment Agency, 2020). Nonetheless, as concerns groundwater monitoring, samples taken are analysed for pesticides only when pesticide-related risks have been identified (European Commission, 2018a).

Enforcement of measures

The main entity responsible for the SUD measures on drinking water protection is the Bulgarian Ministry of Environment and Water (bulg. MOSV, engl. MEW). On the other hand, the SUD measures for the protection of the aquatic environment are mainly the responsibility of the Bulgarian Food Safety Agency (bulg. BABKh, engl. BFSA). Associations of agricultural producers are also seen as responsible for aquatic protection (Bulgarian Council of Ministers, 2020).

The Ministry of Environment and Water, with its Basin Directorates (BDs) and the Environmental Executive Agency, and the Ministry of Health are the competent authorities in charge of the monitoring programmes on water quality. Through the Agency, the MEW undertakes monitoring of underground and surface water in line with the Water Monitoring Ordinance (Bulgarian Council of Ministers, 2020).

Monitoring of drinking water quality in its full scope is the responsibility of the water supply organisations, in their capacity as suppliers of water for drinking and household use. The Regional Health Inspectorates carry out monitoring checks (Bulgarian Council of Ministers, 2020).

The National Water Monitoring System is the main source of information on water quantity and quality in Bulgaria. It identifies the causes of surface and groundwater pollution (total pollution, toxic substances, biogenic elements, etc.) and the pollution sources (point and diffuse), determines

the efficacy of various monitoring programmes and identifies water quality trends and the measures to be taken to improve water quality (Bulgarian Council of Ministers, 2012).

To fulfil Article 5 of the EQSD, Bulgaria reported an inventory of emissions for each of its RBDs. However, these inventories included only between four and six of the 41 Priority Substances (European Commission, 2019a). According to the Water Information System for Europe (WISE) some (groups of) priority substances are not monitored (e.g. two cyclodiene pesticides in the Danube, thirteen individual priority substances in the Black Sea, and 11 in the West Aegean RBD). The following table shows the water monitoring results from 2016 and 2017 including the exceedances of the EQS limits.

Table 16. Exceedances measured in drinking water for the years 2016 and 2017 in Bulgaria

Year	Samples taken (sum of surface and groundwater)	Detection of pesticides	Number of exceedances (EQS)
2016	34,374	553	5
2017	41,791	412	12

The implementation and evaluation of the actions related to Article 11 of the SUD heavily rely on the compliance of PPP users. They are therefore provided with instructions drafted in the form of product safety data sheets and legal provisions laid down in the national Plant Protection Act. Nonetheless, the EC's audit criticises that these are not subject to inspection or verification by any of the competent authorities. In addition, it is claimed that there has been no analysis of the effectiveness of PPPs use prohibitions or any further risk mitigation measures in the context of water protection (European Commission, 2018a).

As indicated in the NAP, the action "*improvement of the collection and exchange of information on the types of pesticides used in the specific water catchment areas*" was integrated into the RBMPs 2016-2021. The Ministry of Agriculture, Food and Forestry (bulg. MZKh, engl. MAFF) transmitted relevant information, such as volumes of PPPs used, data on utilised agricultural area and information on pesticide storage facilities. However, the EC's audit criticised that the information provided by the MAFF did not identify specific geographical coordinates, which reduced the possibilities to perform an in-depth analysis and link the risk of specific PPPs with specific geographical areas, and take these into account for the purposes of water monitoring (European Commission, 2018a).

The main criticism of the Bulgarian NAP (2012) is the insufficient exchange of information and the lack of official controls or any other tools for verification. These are considered as limitations for drawing conclusions on the effectiveness of measures and actions implemented. Thus, it is difficult to measure the progress made towards the implementation of Article 11 of the SUD (European Commission, 2018a).

Influencing factors

During the research for this case study, it was difficult to identify the authorities with main relevance for Article 11 of the SUD. The Bulgarian Food Safety Agency which seemed to be responsible for the measures for the protection of the aquatic environment noted that water is the responsibility of the Ministry of Environment and Water. The Ministry of Environment and Water instead – which seems to be responsible for the monitoring of underground and surface water – pointed out that the competent authorities which implement Directive 2009/128/EC are the Ministry of Agriculture, Food and Forestry and the Bulgarian Food Safety Agency.

Discussion of impacts

It seems difficult to discuss any impacts of measures set out in the NAP regarding Article 11 as in Bulgaria there has been no analysis of the effectiveness of PPP use prohibitions or any further risk mitigation measures in the context of water protection (European Commission, 2018a). Moreover, the consultants were not able to arrange any interview with regard to the assessment of impacts with the responsible authorities or to receive any answered questionnaire.

Coherence with the water directives

In Bulgaria, several positive points could be made regarding the coherence of the SUD with the water directives:

- The NAP (2012 and 2020) refers several times to the RBMPs where concrete timelines on specific measures are listed
- The EC's audit report states that preventive measures are included in the river basin management plan (RBMP) as planned in the NAP 2012 (European Commission, 2018a)
- The measures set in the NAP also include timelines "as per Water Act", or as per "plant protection act" showing that the different regulation are connected
- The measure "giving preference to PPPs which do not contain priority hazardous substances" refers to the Bulgarian Water Act listing the hazardous substances

Another factor that enhances coherence is the fact that the MEW is not only responsible for fulfilling the WFD but is also in charge of pesticides. The MEW coordinates water monitoring activities in order to ensure proper quality of surface and ground water to be compliant with the EQS for pesticides and pollutants. Another responsibility of the MEW is to establish measures for water protection, such as the prohibition of pesticide application in specific areas, i.e. belt areas (European Commission, 2018a).

The NAP also mentions that an assessment of the risks posed to groundwater bodies is included in the RBMPs, and explicitly says that that NAP has been developed in line with the RBMPs. Furthermore, certain links and timelines are established and coordinated with the national Plant Protection Act and the Water Act (the national equivalents of the Regulation on PPPs and the WFD). Nonetheless, some challenges with coherence remain especially as relates to the flow of information and inter-institutional exchange. For example, an instance is recorded where MEW required information from MAFF on the types of pesticides used in specific water catchment areas (e.g. volumes of PPPs used), most of the information was provided but it lacked specific geographical coordinates. This reduced the usefulness of the information for conducting an in-depth analysis and establishing a link to the risk of specific PPPs within given geographical areas (European Commission, 2018a).

4.2.3 Netherlands

4.2.3.1 Status of water

The 2019 EC report concerning the assessment of the second RBMP (European Commission, 2019c) concludes the following chemical status for surface and groundwater in the Netherlands:

Table 17. Chemical status of surface and groundwater in the Netherlands

Category	Good	Failing to achieve good	Unknown
Surface water	39%	52%	9%
Ground water	87%	13%	-

Surface water

With regard to failing surface water bodies, it should be noted here that pesticides were not the substances for which the largest share of exceeded values was registered (European Commission, 2019c).³⁷ A report published by the Netherlands Environmental Assessment Agency (Planbureau voor de Leefomgeving, PBL) on pesticides regulated under the WFD indicates a decline in the number of measured exceedances between 2016 and 2018 (van Gaalen et al., 2020). This trend is a perpetuation of a trend identified for the period between 2013 and 2016 (van Gaalen et al., 2020). However, the report indicates that the number of locations in which exceedances have been measured has not declined between 2016 and 2018 (van Gaalen et al., 2020).

Groundwater

The picture is different for groundwater bodies failing to achieve good water status. Here pesticides are recorded among the top-10 contributing pollutants³⁸ and show an upward trend in terms of occurrence (van Gaalen et al., 2020). In 50% of groundwater samples taken in the Netherlands between 2015 and 2016, the presence of pesticides was identified (van Gaalen et al., 2020). Of these samples, 17% contained a concentration of pesticides which exceeded the 0.1µg/l limit value laid down in the EQS Directive (van Gaalen et al., 2020), whereas 7% contained a concentration which exceeded the 0.5µg/l limit value for the sum of pesticides (van Gaalen et al., 2020). The most frequently occurring pesticide substances are bentazon and mecoprop (MCP), as well as the metabolites DMS and BAM³⁹ (van Gaalen et al., 2020).

Drinking water

For drinking water, data from 2013 indicate that the Netherlands has a high level of compliance with the parametric values of the DWD⁴⁰. In terms of the parameter group pesticides, the Netherlands recorded a 100% compliance rate. Very low incidence of concentrations of pesticides in drinking water was also confirmed in reports of the Dutch government for 2016 (ILT, 2017), and 2017 (ILT, 2018). The following table provides an overview of the number of exceedances measured in 2016 and 2017 according to this report.

Table 18. Exceedances measured in drinking water for the years 2016 and 2017 in the Netherlands

Year	Measurements taken for pesticides	Number of exceedances
2016	81.189	2
2017	77.344	1

It should be noted that data collected between 2010 and 2014 covering the occurrence of pesticides and metabolites in the sources for drinking water indicated the presence of pesticides and/or metabolites in two thirds of the sources. In one third of the sources, the identified concentrations of pesticides exceeded the parameters of the WFD (Sjerps et al., 2019). Data collected in the period 2012-2018 on the occurrence of pesticides in groundwater sources indicated the considerable number of exceedances of the WFD parameters for pesticides in analysed sources (Gaalen & Osté, 2020). The following table provides an overview of the measured exceedances.

³⁷ fluoranthene, benzo(a)pyrene, nickel and its compounds and mercury and its compounds were found to be the main causes.

³⁸ Found in 4% of the groundwater bodies.

³⁹ These substances occurred in over 10% of all groundwater samples taken between 2015 and 2016.

⁴⁰ It should be noted that a revised EU Drinking Water Directive was adopted in December 2020.

Table 19. Exceedances measured in drinking water sources for the years 2012-2018 in the Netherlands

Drinking water source	Sources analysed	Number of exceedances
Groundwater	156	47
Surface water	10	9
Bank filtration water	14	8

It is relevant to note that the samples for all drinking water sources did not indicate pesticides as the most prevalent substances which are currently gaining relevance (Galen & Osté, 2020). Only for bank filtration water the substance Pyrazol was identified in 6 out of 14 sources (Galen & Osté, 2020). The disparate outcomes between quality of drinking water and water at the initial source suggests that a considerable part of the pesticides is removed during the drinking water treatment process.

4.2.3.2 Measures put in place

The Dutch NAP on sustainable plant protection was adopted in 2012 and no revisions or updates have been carried out to date. The NAP is based on three main principles. Firstly, *implementation is seen as the joint responsibility of government bodies, the private sector and civil society, with a more pronounced role for the latter two stakeholder groups*. Secondly, *the NAP is based on a supply chain approach*, in which measures are taken throughout the pesticides supply chain. This approach is combined with a regional approach, under which actions, responsibilities and measures are assigned to involved parties if water quality standards and pesticide residue limit values are exceeded on the local level. Thirdly, *the NAP perceives the task of the government as a facilitating one*, refraining from regulatory action until other communication, financial and other options have been exhausted (NAP Netherlands, 2012).

The Netherlands' NAP contains several measures regarding the protection of the aquatic environment and drinking water. These measures aim to achieve the water quality objectives of the WFD in a phased approach, no later than 2027 (NAP Netherlands, 2012):

- Quality of surface water, for 'WFD water bodies (part of the WFD reporting obligations) ': no water quality standards exceeded in 2027; and
- Quality of surface water, specific locations for drinking water production: no drinking water quality standards exceeded in 2027.

The NAP firstly refers to several measures which were already in place before its adoption as follows (NAP Netherlands, 2012):

- General rules on sustainable plant protection in arable farming, market gardening (field crops) and glasshouse horticulture
- Crop-free zones and the use of spray-reducing techniques and nozzles; and
- Measures in the glasshouse horticulture sector, aimed at minimising pesticide use, promoting reuse, and reducing residue levels in water discharge.

The NAP lists the following additional measures through which the Netherlands envisages to realise the abovementioned targets (NAP Netherlands, 2012):

- **Introduction of emission reduction plans (ERP):** such plans are drawn up and implemented by the holders of product authorisations if a link is established between excessive emissions and the use of pesticides.
- **Reducing spray drift to surface water:** commitment by the sector to reduce the drifting of sprays into water, consideration of legislation on the use of best available technologies and further measures.

- **Closed water systems in glasshouse horticulture:** measures such as “coordinating the timing of water discharges” and “pesticide application and using (end of pipe) water purification techniques”; and
- **Banning the use of priority hazardous substances:** prohibition on the use of pesticides containing a priority hazardous substance as defined in the WFD near surface water and groundwater protection areas.

In addition, the NAP lists measures concerning **sound storage of pesticides**. As indicated by the NAP, these measures are also relevant within the context of Article 11 SUD, since storage, and cleaning of pesticide equipment and the mixing of pesticides often takes place near water bodies. Main measures in this regard are (NAP Netherlands, 2012):

- Discharge to surface water or municipal sewers is prohibited. Areas where pesticides are mixed may not, therefore, contain any means of drainage; and
- Water used to clean spraying equipment may be discharged onto non-cultivated land, but not to surface water or municipal sewers.

The measures of the NAP were substantiated further in the Dutch government’s second plan on sustainable pesticides for the period 2013 to 2023. The plan is called “Healthy growth, sustainable harvest” (GGDO) (Dutch Ministry of Economic Affairs, 2013; European Commission, 2020b). The main objective expressed regarding water entails the reduction of exceedances of WFD quality standards concerning pesticides in surface waters to nearly zero by 2023 (Dutch Ministry of Economic Affairs, 2013). The plan envisages measures concerning the following points (Dutch Ministry of Economic Affairs, 2013):

- An emission reduction plan
- Uniform and clear use requirements for pesticides
- Measures concerning glasshouse horticulture:
 - Updated authorisation criteria for pesticides in glasshouse horticulture
 - Obligations concerning new emission mitigation technologies; and
 - Various additional measures such as the management of waiting periods between the application of PPPs and the discharge of wastewater (discharge) and the recirculation of filter rinsing water containing residues of crop protection agents.
- Measures concerning open agriculture:
 - Focus on the reduction of drifting of pesticides to water
 - Measures to reduce level of drift on whole plots of agricultural land
 - Stricter regulations on “cultivation-free zones” near water bodies
 - Measures to promote the extension of “cultivation-free zones” surfaces
 - Enhancing uniformity of etiquettes on pesticidal products on drift-mitigating techniques to enhance compliance and enforcement; and
 - Research on emission mitigation measures at point sources, e.g. on barnyards.

The GGDO provides a tabular overview of the abovementioned measures, including relevant actors and timeframe indications (Dutch Ministry of Economic Affairs, 2013).

In 2016 various authorities signed a declaration of intent concerning cooperation for the improvement of water quality in the Netherland. This “Delta-approach concerning water quality and fresh water” covers, among other things, the issue of pesticides with a focus on the implementation of the national policies described above, the sectoral initiative delta-plan agricultural water management, enforcement and compliance (Delta Approach conference, 2016).

With regard to monitoring, the Netherlands has set up two systems which are respectively linked to the Netherlands’ efforts within the context of the WFD and the national policy laid down in the GGDO (Helpdesk Water, 2021). The WFD-related measuring system is established through:

- The Dutch decree on quality standards and monitoring of water 2009; and
- The Dutch Regulation on monitoring for the WFD 2015.

Based on this legislation, a multi-annual monitoring programme is adopted which consists of various documents (e.g. handbook, measurement protocols) concerning water quality measurement of drinking water sources, groundwater, and surface waters. Highly relevant for the monitoring programme are the WFD monitoring networks (meetnetten) which have been established and which consist of local water authorities, provinces, and the central executive authority for water quality (Helpdesk Water, 2021).

The measuring system related to the national plan on sustainable pesticides consists of a national measuring network for pesticides. This network carries out measurements for all types of active substances in surface water bodies in agricultural regions (Helpdesk Water, 2021). Data on annual measurement values is compiled in a national pesticides atlas (www.bestrijdingsmiddelenatlas.nl) which presents the results in the form of maps (Helpdesk Water, 2021).⁴¹

4.2.3.3 Assessment

The following sections will provide an analysis of the extent to which the measures described in the previous section have been implemented in the administrative and enforcement practices of the Netherlands. In addition, the main impacts of the measures and their coherence with the WFD and its daughter Directives will be discussed. Main sources of the analysis are:

- The 2019 interim evaluation published by the Netherlands Environmental Assessment Agency (Planbureau voor de Leefomgeving, PBL) national policy concerning sustainable use of pesticides;
- its 2019 technical background report; and
- the Audit Report of the EC to evaluate the implementation of measures to achieve the sustainable use of pesticides.

Data from these evaluation reports are combined with other EU and national sources for a more comprehensive picture.

Implementation of measures

The technical background report to the interim evaluation of the *2013 Dutch sustainable pesticides plan* contains an assessment of the way the measures announced in 2013 have been implemented so far. Table 32 (see Annex 0) provides a summary of this assessment (Verschoor et al., 2019) and, where relevant, of additional sources.

Enforcement of measures

Regulatory obligations concerning the use of pesticides near water bodies, as laid down in the Dutch Decree on activities for environmental management (Dutch Official Gazette, 2017) are enforced by the *Netherlands Food and Consumer Product Safety Authority (NVWA)* and by the competent local water authorities (Dutch Ministry of Economic Affairs, 2013).

The NVWA carries out physical and administrative checks with a focus on the following aspects (NVWA, 2021):

- Use of pesticides in accordance with regulatory obligations
- Checks of the stock of pesticides
- Proof of proficiency and spraying permit; and
- Compliance with administrative obligations such as spraying registration and pesticides monitor.

⁴¹ Data on measurement values for plant protection products is compiled on the basis of three year averages (Helpdesk Water, 2021).

With regard to enforcement, the declaration of intent on the "*Delta-approach concerning water quality and fresh water*", which was signed by various Dutch authorities, envisages the application of both "carrots and sticks" and a stronger cooperation between relevant authorities such as the NVWA, the central executive authority and the local water authorities (Delta Approach conference, 2016).

Table 20 provides an overview of the inspection activities of the NVWA concerning users of pesticides. It should be noted that these inspections do not pertain solely to water quality protection.

Table 20. Overview of Inspection activities of the NVWA

Year	Number of inspections	Criminal and administrative procedures	Warnings issued	Source
2018	535	75	68	(NVWA, 2019a)
2017	703	163	119	(NVWA, 2019b)
2016	633	85	72	(NVWA, 2017)
2015	374	69	30	(NVWA, 2016)

Table 21 provides an overview of NVWA inspections during pesticide application, which include an assessment of emission mitigation techniques applied.

Table 21. Overview of NVWA inspections during pesticide application

Year	Number of inspections	Criminal and administrative procedures	Warnings issued	Source
2020	132	30	11	as per stakeholder input
2019	121	29	11	as per stakeholder input
2018	132	34	10	(NVWA, 2019a)
2017	137	32	14	(NVWA, 2019b)
2016	189	30	8	(NVWA, 2017)
2015	269	47	11	(NVWA, 2016)

Specific to water quality protection, the annual inspection reports of the NVWA highlight the following points of attention (Table 22).

Table 22 Points of attention regarding water quality protection according to the NVWA

Year	Point of attention	Source
2018	<ul style="list-style-type: none"> Incorrect or no use of drift-limiting measures. 	(NVWA, 2019a)
2017	<ul style="list-style-type: none"> Incorrect or no use of drift-limiting measures in open cultivation next to surface water. 	(NVWA, 2019b)
2016	<ul style="list-style-type: none"> Need to stimulate the use of drift-limiting instruments in the fruit cultivation sector. 	(NVWA, 2017)
2015	<ul style="list-style-type: none"> Use of specific spraying caps next to surface waters; and Treatment of weeds on canal banks. 	(NVWA, 2016)

In 2019, the NVWA carried out a specific inspection regarding the manner in which spraying is conducted. This inspection focussed on both the techniques “down-spraying” and “up and side spraying”, as well as some alternative techniques. The main findings of this inspection were (NVWA, 2019c):

- A compliance rate with spraying obligations in 2019 of 67% (based on fines and warnings issued); and
- A confirmation of the increasing indications that growers do not possess the techniques necessary for the required 97,5% drift reduction for certain substances.

Based on these findings, the NVWA considered an assessment of the manner in which compliance can be increased (NVWA, 2019c). The infringements of the 2019 and 2020 controls included the application of PPPs without taking the required precaution measures. In a number of cases, these infringements could possibly lead to the contamination of water bodies (as per stakeholder input).

Influencing factors

In terms of drivers, the interim evaluation of the 2013 Dutch sustainable pesticides plan concludes that integrated approaches to awareness raising which are linked to guidance, enterprise-specific monitoring, feedback and linking to subsidies has potential for emissions mitigation (Tiktak et al., 2019). However, it is also noted that such an approach is costly (Tiktak et al., 2019). Another factor which promotes investments in spraying equipment is that land is a scarce and expensive resource in the Netherlands. Therefore, when given the option between buffer zones or improved spraying equipment, the latter option represents the more feasible one for farmers (as per stakeholder input).

In terms of barriers, the interim evaluation of the 2013 Dutch sustainable pesticides plan concludes that the substitution of certain substances did, on balance, not contribute to lower environmental pressures from pesticides (Tiktak et al., 2019). The evaluation notes that this is due to the fact that cultivators do not always switch to less toxic pesticides after substitution (Tiktak et al., 2019).

Requirements (restrictions) for use of pesticides do not per se lead to the improvement of water quality. Substances with a lower toxicity can be used without any requirements. Furthermore, users can switch between different pesticidal products with their own requirements, which could lead to an accumulation overall, higher persistence in water and increased water pollution (Tiktak et al., 2019). This is for instance done by using several PPPs with the same active substance but a different trade name – a method known as “stacking”.

For the use of pesticides outside of the agricultural sector, the Dutch government concluded “Green Deals”, which constitute a package of voluntary commitments by specific sectors or societal actors with public sector facilitation. Three Green Deals pertained respectively to recreational parks, sports fields and private use (Tiktak et al., 2019). Central to the Green Deals was the promotion of alternatives and the use of pesticides as a last resort (Tiktak et al., 2019). However, the evaluation concludes that the instrument of Green Deals may have had a limited effect. For the Green Deals on recreational parks and sports fields, limited monitoring is highlighted. For the Green Deal on private use, it is noted that actors do not seem to follow through on their commitments (Tiktak et al., 2019).

In addition, it was noted that the adoption of regulatory measures concerning drift reduction in open cultivation and water purification in glass horticulture were delayed due to low availability of required equipment (Tiktak et al., 2019).

It was also highlighted that more attention could be afforded to other sources of emissions than the ones currently in focus under the GGDO, such as those occurring during incidents related to unsound use of pesticides (Tiktak et al., 2019). This note makes clear that the current measures may not be comprehensive enough or, at least, may be too focussed on specific emission pathways. In addition,

complex emissions pathways represent a further factor limiting effective enforcement as they make it difficult to determine the root cause of exceedances (as per stakeholder input).

In general, knowledge is considered a key factor influencing the implementation and enforcement of the SUD. Users of PPPs need to take into account various complex aspects such as legal descriptions of pesticides, provisions for water protection (e.g. buffer zones) and the correct application of nozzles. As users often lack this knowledge, they are questioning the effectiveness of measures, e.g. of certain spraying techniques. This hampers effective implementation and enforcement (as per stakeholder input).

Discussion of impacts

The 2019 interim evaluation of the national policy concerning sustainable use of pesticides concludes that since 2013 a 15% reduction in exceedances has been achieved for surface water, falling short of the 50% reduction which was stated as the objective for 2018 (Tiktak et al., 2019).⁴² The evaluation also concludes that, at the current rate, the objective of a nearly complete elimination of exceedances by 2023 is unlikely (Tiktak et al., 2019). Regarding groundwater, the evaluation concludes that the conducted measurements are not systematic enough to draw conclusions concerning the impact of the 2013 measures (Tiktak et al., 2019).

Table 23 provides an overview of identified conclusions regarding the impacts of the specific policy measures envisaged under the 2013 Dutch sustainable pesticides plan.

Table 23. Measures and their impacts in the Netherlands

Measure	Impacts
General measures	
Emission reduction plans.	<p>Currently 16 emissions reduction plans (ERPs) are active. For 11 of 16 pesticides, the ERPs succeeded in reducing the emissions. For 4 pesticides, the emissions stayed the same and for 1 pesticide, the emissions were not reduced (as per stakeholder input). ERPs are criticized as not being sufficiently effective, since they have not been adopted for all problematic pesticides. This is due to the following reasons (European Commission, 2020b; Tiktak et al., 2019):</p> <ul style="list-style-type: none"> • Holders of authorisations are obliged to adopt a plan for only one pesticide per year • Priority substances under the WFD are given priority; and • Several relevant substances which cannot be monitored are not considered for reduction plans.
Uniform and clear use requirements for pesticides.	<p>Requirements (restrictions) for use of pesticides do not per se lead to an improvement of the water quality. Calculations show that emissions of PPPs to surface water from field crops have decreased by 9%. Despite this reduction, the calculated environmental risk (expressed in toxic units) has increased by 3% for outdoor cultivation (as per stakeholder input). Furthermore, users can switch between different products with requirements, which could lead to an accumulation overall (Tiktak et al., 2019). The Ctgb has taken measures against the use of PPPs with the same active substance, where these substances were exceeding the regulatory threshold for authorisation of PPPs. This was done by including a maximum amount of active substance per hectare and year on the label of all PPPs based on such a substance. These measures have been introduced for four active substances (as per stakeholder input).</p>
Measures concerning glasshouse horticulture	

⁴² It should be noted that the number of exceedances of the acute exposure norms was 30%

Updated authorisation criteria for pesticides in glasshouse horticulture.	Impacts are not clear yet. The " <i>Greenhouse Emissions Model</i> " which is included in the guidance document required subsequent testing in practice. The results of a second test are currently anticipated (Verschoor et al., 2019).
Obligations concerning new emission mitigation technologies.	Most cultivators (90%) complied with the regulatory obligations concerning water purification in glasshouse horticulture in 2018 (Tiktak et al., 2019).
Use of alternative sources of irrigation water.	Several promising alternative sources has been identified. It is expected that such sources could limit exceedances until the compliance date for the purification obligations for the sector is reached (Verschoor et al., 2019).
Management of waiting periods between the application of PPPs and the discharge of wastewater.	It is expected that this measure will have limited additional effect on pesticide emissions due to the adopted purification obligation (Verschoor et al., 2019).
Recirculation of filter rinsing water containing residues of crop protection agents.	It is expected that this measure will have limited additional effect on pesticide emissions due to the adopted purification obligation (Verschoor et al., 2019).
Measures concerning open agriculture	
Measures to reduce level of drift on whole plots of agricultural land.	Most cultivators use nozzles with a minimum of 75% drift reduction effect. It should be noted that the level of compliance with the regulatory obligation to use drift-reducing technology with 75% effect is likely to be higher in practice, as such a level of drift reduction can also be reached through the use of less effective technologies under the right circumstances (Tiktak et al., 2019). There is less data available on compliance of cultivators with other drift-limiting regulatory requirements, for example concerning circumstances under which spraying can take place (Tiktak et al., 2019).
Stricter regulations on "cultivation-free zones" near water bodies.	Assessing the impacts, the separate measures have on water quality is challenging as all measures combined cause an overall effect (as per stakeholder input).
Measures to promote the extension of "cultivation-free zones" surfaces.	
Enhancing uniformity of etiquettes on pesticidal products on drift-mitigating techniques to enhance compliance and enforcement.	
Research on emission mitigation measures at point source and regulating such measures where feasible.	

The following points of improvement have been identified in the relevant sources concerning the attainment of the objectives of the SUD and the *2013 Dutch sustainable pesticides plan*:

- A more systematic approach to use requirements which mitigates the risk of unsound use of less toxic pesticides or the accumulation of multiple correctly used pesticides (Tiktak et al., 2019)
- Improving criteria for the selection of substances for which emission reduction plans are required (Tiktak et al., 2019)
- An integrated approach to policies concerning water quality, biodiversity and pesticide authorisations (Tiktak et al., 2019)
- An important cause of exceedances is that the authorisation criteria for pesticides are currently less stringent than the water quality norms of the WFD as it accepts temporary effect on water organisms. The recent EFSA guidance on this matter may provide a solution (Tiktak et al., 2019)
- The authorisation criteria for pesticides currently do not sufficiently consider (Tiktak et al., 2019):
 - The effect of spraying drift and the variations in spraying practices; and
 - The cumulative environmental burden of pesticides per cultivation.

Coherence with the water directives

In the Netherlands, large overlaps exist between the WFD and Article 11 of the SUD. As regards water quality standards, the WFD is the leading directive. The main objective of the measures taken under the NAP and the GGDO is to remove exceedances to the water quality standards outlined in the WFD and its daughter Directives. Therefore, the SUD imposes additional pressure on the WFD. Although Article 11 of the SUD entails duplication of work to a certain extent, the number of exceedances of water quality standards for pesticides in the WFD has been reduced due to the provisions of the SUD (as per stakeholder input).

A main issue of coherence which is identified by the 2019 interim evaluation of the Netherlands Environmental Assessment Agency concerns the lack of alignment between the criteria for pesticide authorisation in the Netherlands and the water quality standards under the WFD. More specifically, the current Dutch criteria accept temporary effect on water organisms, while the WFD standards do not. The evaluation report states that the recent EFSA guidance concerning this matter may provide a solution (Tiktak et al., 2019).

Information related to costs and finances

The financial costs for monitoring activities, analyses of water quality and further measures carried out by the Directorate-General for Public Works and Water Management (Rijkswaterstaat (RWS)) and the Ministry of Infrastructure and Water Management (MIWM) amount to approximately 1.2 million Euro per year (as per stakeholder input).

The investments of waterboards in monitoring and analysing PPPs including the necessary personal costs are roughly estimated to be around EUR 9.5 million per year. Moreover, the costs for purifying drinking water are estimated to be approximately EUR 30 million per year. This includes the costs for the necessary analytical measures and human resources. As around 60% of these costs are estimated to be due to the presence of PPPs, the costs associated with the treatment of water from pesticides and their transformation products corresponds to approximately EUR 18 million year. The costs listed are based on estimates by the waterboards and drinking water companies (as per stakeholder input). According to the Dutch authorities, the need for purification of drinking water poses a particular burden on authorities. The costs are related to the required human resources, buildings, purification equipment, monitoring activities and respective analyses. Although, it should be noted that the need for purification is not exclusively caused by pesticides (as per stakeholder input).

Recommendations and actions for improving the implementation and enforcement of the SUD

According to the stakeholders interviewed, improving the implementation and enforcement of the SUD requires that the authorisation standards for pesticides be harmonised in such a way, that the standards of the SUD do not negatively impact compliance with the WFD. Generally, the SUD should be more specific on how it should relate to the WFD and other relevant directives (as per stakeholder input).

Moreover, the SUD is perceived to be too general. Thus, according to Dutch authorities, the SUD could be further improved by providing more guidance. The SUD should therefore stipulate concrete targets and specify the associated protection goals. Furthermore, MS should be supported with clear guidance on how the targets can be achieved. More specifically, the SUD should specify the kind of measures that could be applied on the national and regional level⁴³. In this context, Dutch authorities highlighted that the way the SUD is implemented might intersect with the authorization process, as a current example in the Netherlands shows. In this case, the Dutch Crop Protection

⁴³ As an example, the Dutch authorities refer for to a paragraph of the SUD, which stipulates that "Member States should take all necessary measures" without providing clear guidance on the kind of measure that could be taken.

Association (Nefyto) stated that the ban of PPPs on hard surfaces interferes with Regulation EC 1107/2009.

At the same time, the authorities highlighted the benefits of flexible implementation. Accordingly, the SUD provides a level playing field for all MS while leaving room for unique measures. In addition, the EC should consider promoting the e-labelling of PPPs. In contrast to paper labels, the use of e-labels could promote the provision of up-to-date information to pesticide users.

4.2.4 Poland

4.2.4.1 Status of water

The EC assessment of Poland's second RBMP concludes the following chemical status for surface and groundwaters (European Commission, 2019a):

Table 24. Chemical status of surface and groundwater in Poland

Category	Good	Failing to achieve good	Unknown
Surface water	59%	26%	15 %
Ground water	Not mentioned	7,8%	-

Surface water

The most significant impact on surface water bodies is unknown (affecting 36% of surface water bodies) followed by nutrient pollution (22%). Diffuse agricultural pressures affected 62% of lakes and 8% of river water bodies (European Commission, 2019i). According to an expert from the Polish Ministry of Agriculture and Rural Development (MARD), nitrates are the biggest challenges in Poland. No major problems relating to pesticides could be identified through monitoring activities. Sporadic exceedances were mainly for DDT, HCH and chlorfenvinphos (input from interview with an expert from the Ministry of Agriculture and Rural Development, June 2021).

Groundwater

Groundwater is mostly affected by abstraction. Most significant pressures on groundwater are diffuse pollution from mining (8% of groundwater bodies) followed by alteration of groundwater level (7%) (European Commission, 2019i).. The status of water has been deteriorating since the first cycle of RBMPs, and the groundwater bodies failing to achieve good status increased from 3.7% to 7.8% of total groundwater body area (European Commission, 2019a).

Pesticides were not the main pollutant affecting groundwater quality, instead nitrates were the key pollutants (European Commission, 2019a). Regarding pesticide residues, the most frequently found substances exceeding limits were very persistent substances used in the past and which have accumulated over time such as DDTs (European Commission, 2017c).

Table 25. Measurements taken for pesticides in surface water and groundwater in Poland (Polish Ministry of agriculture and rural development, 2019)

Measurements taken for pesticides		
Year	2018	2019
Rivers (including dam reservoirs)	1 844 measurement and control points. Substances from the second watch list: measurement started at 20 river gauging and control points	
Lakes	283 measurement and control points.	364 measurement and control points.

	Measurements of pesticide concentrations in biota (fish tissues): at 325 river and 60 lake sampling points	Measurements of pesticide concentrations in biota (fish tissues): at 256 river and 194 lake sampling points
Ground water	154 measurement points to test on the content of organic compounds, including pesticides.	153 measurement points to test on the content of organic compounds, including pesticides
Sediments	422 measurement and control points, including 193 located on rivers, 13 on canals, 9 on groundwaters sediments dam reservoirs and 207 on lakes	423 sampling points, including 247 located on rivers and river channels and 176 on lakes

Table 26. Impact of chemical plant protection products on the state of surface waters (Polish Ministry of agriculture and rural development, 2019)

Impact of chemical plant protection on the state of surface waters		
Year	2018	2019
Surface water	Residues of plant protection products were tested in surface water samples collected at three measurement and control points (ppk) located on the Warta River and in samples from rivers comprising its catchment area. In the case of the Warta catchment, seven monitoring points were designated. 85 surface water samples were collected from Wielkopolska rivers to be tested for residues of plant protection products	452 surface water samples and 9 groundwater samples were tested.
Ground water	6 samples of groundwater samples	See above
Results	Comparing the results of the tests with reference to the Regulation of Minister of Environment of 27 November 2002 on the requirements to be met by surface waters used for supplying the population with water intended for consumption (Journal of Laws, item 1728), only 3 samples out of all samples taken were not compliant with the highest A1 class for raw waters fit for processing for household purposes, which means that 96.5% of analysed samples of waters from the Wielkopolska region met the A1 class requirements	In total 71 substances were detected out of 270 substances tested, including 31 herbicides, 26 fungicides, 12 insecticides and 2 metabolites 429 samples (94.9% of all samples) met the requirements for the highest category of surface water, 17 samples (3.8%) were classified as A2, 2 samples (0.4%) were in category A3 and 4 samples (0.9%) exceeded the requirements for qualification (total residues above 5 µg/L).

Drinking water

Poland reaches very high compliance rates of 100% for the microbiological, chemical and indicator parameters laid down in the DWD (European Commission, 2017a). Pesticide residues in drinking water are controlled by the State Sanitary Inspection (SSI), a control authority under the aegis of the Ministry of Health. In 2015, over ten thousand samples⁴⁴ were analysed for pesticide residues, none of which exceeded the legal limits set out in Directive 98/83/EC (European Commission, 2017c).

⁴⁴ In Poland, water companies and other entities that provide drinking water have to determine the schedule for water sampling, with a frequency determined in the Ordinance of the Minister of Health of 13 November 2015, and in agreement with the SSI.

The following table shows the water monitoring results from 2016 and 2017 including the exceedances of the EQSD limits.

Table 27. Exceedances measured in drinking water for the years 2016 and 2017 in Poland

Year	Samples taken (sum of surface and groundwater)	Detection of pesticides	Number of exceedances (EQS)
2016	Missing	200 (surface water), 150 (groundwater)	Missing

Monitoring

A monitoring programme specific to pesticides was carried out in 2016 in line with the requirements of the Commission Implementing Decision 2015/495 involving, neonicotinoids, other insecticides, and one herbicide. More than 130 samples were taken from fifteen monitoring stations located at rivers over a nine-month period. The result was 29 samples exceeding the limit of quantification (see watch list in Commission Implementing Decision 2015/495) ((European Commission, 2017c).

Detailed regulations for the assessment of the status of groundwater are contained in the Regulation of the Minister of the Environment of 21 July 2016, whereas, for surface water bodies, they are laid down in the Regulation of the same Minister on 21 December 2015. Poland states that these monitoring programmes are in line with the WFD (2000/60/EC) (European Commission, 2017d).

Pesticide Consumption

Since 2009, the use of pesticide has been continuously increasing in Poland but decreased slightly in 2017 (see figure below). The decrease might be explained by a shift from conventional to sustainable agriculture which is observed in Poland (Piwowar, 2021). With an average pesticide consumption of 2.12 kg/ha (2014–2018), Poland still has a relatively low consumption in relation to other European Union countries (Piwowar, 2021). Comparing the share of agricultural area to the total area (around 50% in Poland), Poland ranks third in Europe (after France and Spain). The agricultural production in Poland covered an area of 18.608 million ha in 2018. A characteristic feature of Polish agriculture is the large diversity and fragmentation of farms in terms of area (Piwowar, 2021).

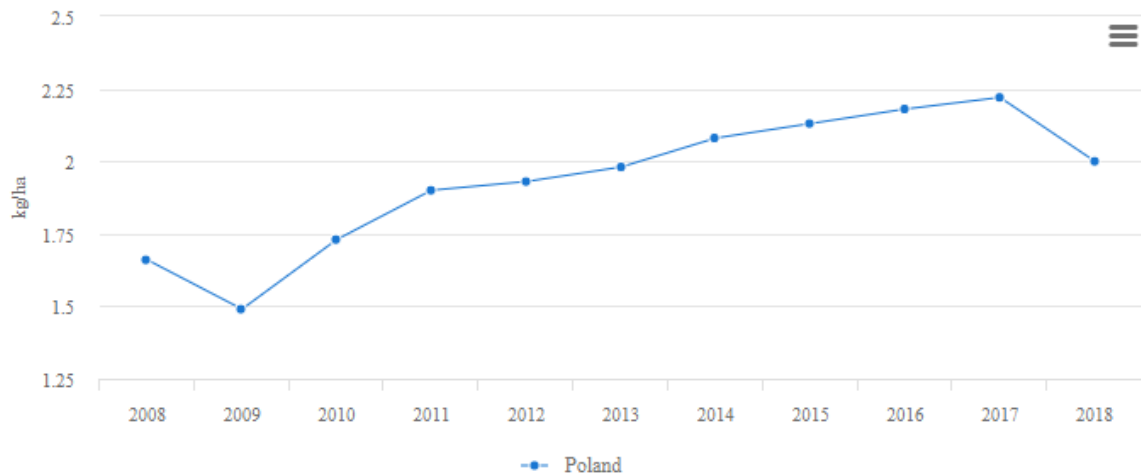


Figure 4 - Pesticides in Poland – Average use per area cropland (2008 – 2018) (Food and Agriculture Organization of the United Nations (FAO), n.d.)

"Herbicides, haulm destructors and moss killers" constituted half of the pesticides sold on the Polish market followed by fungicidal and bactericidal preparations (34.5%). Due to the high share of cereals in arable land and the significant importance of gardening, herbicides and fungicides are used the most. Insecticides and acaricides are much less used. High consumption of pesticides occurs in horticultural production (e.g. apples and pears) as well (Piwowar, 2021).

4.2.4.2 Measures put in place

Poland adopted its first NAP in 2013 to reduce risks and impacts associated with pesticides, and published a revised version in 2018 (European Commission, 2017c).

Both, the NAP and its revision, start off by listing measures already in place prior to their adoption (e.g. inserted in national legislation). Of particular relevance to water protection, are the following:

- National law specifies the minimum distances from reservoirs and watercourses for performing operations that involve the greatest risk of contamination of the aquatic environment (such as PPPs storage and filling and washing of Pesticide Application Equipment (PAE)) (Polish Minister of agriculture and rural development, 2018a)
- The Polish Water Act of 18 July 2001 prohibits the filling of sprayers directly from water courses and the washing of equipment used for spraying in these waters. It also provides for the possibility of restricting the use of fertilisers and PPPs in the vicinity of water supplies (European Commission, 2017c)

In Poland, the obligations arising from the SUD are implemented mainly through the Act on PPPs and the resulting regulations (e.g. the act obliges to maintain the buffer zones specified on the plant protection product label in relation to water bodies and watercourses) (TOPPS, 2013a).

Regarding concrete measures and actions, the first and the revised NAP differ slightly. Whereas goals related to Article 11 (SUD) play only a minor role in the first NAP, the revised NAP dedicates a whole chapter to the protection of aquatic environment and drinking water.

In the first NAP (2013), measures related to Article 11 were only found in the sub-task "Developing, updating and providing methodologies for integrated pest management for individual crops". This task aimed at developing methodologies for better information on pest management and plant protection methods. The NAP states that these methodologies will also take into account the obligations from Article 11(2) points a and b. The methodologies are foreseen as voluntary

guidelines (Polish Minister of agriculture and rural development, 2013). Moreover, monitoring of surface waters and groundwater and of bottom sediments and monitoring of water intended for human consumption is foreseen in the NAP.

In contrast to the first NAP (2013), the revised NAP (2018) contains a separate chapter about “*Measures to protect the aquatic environment and drinking water*” referring to Article 11 SUD. Here, Poland makes the statement that the SUD obligations for the protection of the aquatic environment are fulfilled given that they are included in national law⁴⁵. Thus, only additional actions focusing on monitoring and education are named in the NAP (Polish Minister of agriculture and rural development, 2018b):

- Monitoring of surface waters and groundwater and of bottom sediments
- Conducting monitoring of water intended for human consumption
- Analyses of the impact of chemical plant protection on the state of surface waters
- Supervision over PPPs containing active substances that should be subject to specific monitoring
- Educational and information activities
- Checks to check compliance with laws concerning the protection of the aquatic environment

A key action of the Polish NAP is the monitoring of PPPs. In contrast to other MS (e.g. BE, DE, DK, FR, NL), which did not include the mandatory MRLs and WFD monitoring programmes in their NAPs as they consider them to be independent activities, the Polish NAP opted to include them given the direct link to PPPs impacts (Food Chain Evaluation Consortium (FCEC), 2012).

In accordance with the provisions Article 15 of the SUD⁴⁶, the Polish NAP include a list of indicators to assess the risks of PPPs. This includes aspects of monitoring pesticide residues in drinking, surface and groundwaters (Polish Minister of agriculture and rural development, 2013).

Water Directives

Each of the ten Polish RBDs publishes a RBMP. KTMs related to agriculture were included in all RBDs. From the four KTMs related to pesticides KTM 3 (reduce pesticides pollution from agriculture), KTM 12 (Advisory services for agriculture) and KTM13 (Drinking water protection measures (e.g. establishment of safeguard zones, buffer zones etc.)) applied to all RBDs. KTM15 (Measures for the phasing-out of emissions, discharges and losses of Priority Hazardous Substances or for the reduction of emissions, discharges) is also reported in all RBDs (European Commission, 2019b).

As regards the DWD, the Polish RBMPs include measures for the prevention of nitrogen, phosphorus and pesticides entering drinking water sources. Specific to pesticides, a set of principles of good agricultural practice (including changes taking place in the agricultural sector) was developed. Other measures focussed more on fertilizers in general, or more specifically on nitrates or nitrogen (European Commission, 2019b).

Moreover, drinking water safeguard zones have been established for water bodies from which water is abstracted for human consumption. As per Poland’s Article 54 of the Act of 18 July 2001 - Water Law⁴⁷ (renewed in 2017), the use of fertilizers and pesticides may be prohibited or limited in areas of drinking water safeguard zones (European Commission, 2019b).

⁴⁵ The Water Law of 2017, the Plant Protection Products Act and MARD regulations contain the requirements from the SUD.

⁴⁶ This requires Member States of the European Union to monitor the risks associated with the use of PPP.

⁴⁷ The renewed Polish Water Law includes the following articles that are relevant for pesticides (Water Law (Poland), 2017):

• Art. 117. The minister in charge of water management shall draw up, for each river basin district, an inventory of emissions, discharges and losses of priority substances referred to in regulations issued on the basis of Article 114, taking into account the provisions of the European Union law regarding priority substances in the field of water policy, and shall make it available. The competent authority shall make the list available on the website of the Public Information Bulletin of the office providing its services.

According to an expert from MARD it is not easy to extract costs associated with the implementation of the measures identified for Article 11 of the SUD including follow ups and controls. However, it can be stated that MARD yearly collects about 500 samples of water accounting roughly for 100.000 Euros/year. The financial means are directed to the Institute for plant protection and the Institute for horticulture who take and analyse water samples. Laboratory staff from both institutes collaborate with staff from the inspection of plant protection and the environmental inspection (input from interview with an expert from the Ministry of Agriculture and Rural Development, June 2021).

Other expenses are made on dedicated workshop for farmers. Among others, they are taught how to use PPP properly and how to avoid water pollution and how to prevent pollution of other environmental assets. Thus, it is difficult to allocate the workshop costs only to water. The workshops are carried out by scientists from the Institute for plant protection which is under the supervision of the MARD (input from interview with an expert from the Ministry of Agriculture and Rural Development, June 2021). Costs related to the treatment of water from pesticides and their transformation products do not seem relevant as Poland claims to have few problems with pesticides. However, Poland has schemes for protecting waters from nitrates which are based on EU funds (perspective 2014-2020). Within the next CAP plan, measures to protect water from nitrates are in development. These measures often simultaneously lead to a reduction in pesticides as the kind of use is similar (e.g. connected to tractors, sprayers etc.) (input from interview with an expert from the Ministry of Agriculture and Rural Development, June 2021).

4.2.4.3 Assessment

The following section will provide an analysis of the extent to which the measures described in the previous section have been implemented in the administrative and enforcement practices of Poland. In addition, the main impacts of the measures and their coherence with the WFD and its daughter Directives will be discussed. Main sources of the analysis are:

- EC's audit report on SUD (European Commission, 2017c)
- First Polish NAP (Minister of agriculture and rural development, 2013)
- Revised Polish NAP (Polish Minister of agriculture and rural development, 2018b)

Implementation of measures

The revised NAP (2018) includes a summary on the implementation of the NAP 2013. Regarding goals related to Article 11 of the SUD, Table 33 in Annex 8.4 gives an overview on the status of implementation (Polish Minister of agriculture and rural development, 2018b).

The NAP and its revision reflect partial implementation of the measures relevant to Article 11 of the SUD.

The audit report of the EC states that the monitoring of surface water and groundwater is implemented within the framework of surveillance, operational and research monitoring (European Commission, 2017c). In addition to the State Environment Monitoring, two research programmes for pesticide residues in surface water were commissioned by the Ministry of Agriculture and Rural Development (MARD). These programmes have a wider analytical scope for pesticides (European Commission, 2017c).

However, the EC's audit on the first NAP (2013) concludes that "many of the actions taken do not directly correlate with the targets of the National Action Plan, thus making it difficult to determine

•Art. 118. The competent body of Environmental Protection Inspectorate shall monitor substances particularly harmful to the aquatic environment included in the watch list, for a period of at least 12 months, in at least 15 representative measurement and control points.

•Art.119. The minister competent for water management shall submit to the European Commission a report including monitoring results for substances particularly harmful for the aquatic environment included in the watch list

whether the objective of the plan to reduce the risks associated with pesticide use are being achieved" (European Commission, 2017c).

According to an expert stakeholder interview, the NAP and related activities in Poland aim at giving advice and targets for public institutions only, and not for farmers. Farmers instead are obliged to fulfill the Act of PPP and the legislation of the Ministry of Agriculture. Specific labels for plant protection products PPP which include precise information how to use the PPP in different situations help the farmers to stick to the most important requirements (stakeholder input). This approach might partly explain missing actions related to Article 11 (c) and (d) in the NAP.

Next to legal regulations, initiatives were taken by individuals to raise the awareness of farmers on the proper use of PPPs. An example is the action taken by the Institute of Horticulture in Skierniewice under the project Training the Operators to Prevent Pollution from Point Sources (TOPPS), to reduce pollution from point sources and contamination of waters by PPPs. TOPPS offer tools and trainings which might help to enforce the goals of Article 11 of the SUD:

- Drift evaluation tool
- TOPPS water protection methodology and Decision Support tool
- Different guidelines

Enforcement of measures

- The measures related to Article 11 of the SUD are implemented and enforced by the following ministries: MARD, Ministry of Health, Ministry of the Environment and by units reporting to or supervised by the ministers of the named ministries.
- The authority responsible for monitoring the objectives of the NAP is MARD led by its minister. The results of the monitoring of the objectives as well as a risk assessment associated with the use of PPPs, shall be published online by the minister responsible for agriculture.

The NAP 2013 determines that pesticides in drinking water are only tested in areas where their presence is considered highly probable. The SSI units and other responsible entities conduct the testing. The Central Sanitary Inspection provides guidance on which pesticides should be included in the analyses and the actual scope is determined by the local inspector taking into account local condition (Minister of agriculture and rural development, 2013).

The NAP specifies that tasks related to overseeing compliance with applicable aquatic environment protection measures when performing plant protection treatments should be implemented by the Inspectorates subject to the limits of budget expenditures of their Main Inspectors, and by province governors. Cooperation in this respect is intended to be established with provincial agricultural advisory centres, farmers' self-governing organisations, local governments, and agricultural universities and schools, as well as agricultural organisations (Minister of agriculture and rural development, 2018a). Per the SUD, the measures in the NAP should include quantitative objectives, measurements, and timetables to reduce the risks and impacts of pesticide use to enable progress tracking and evaluation. It was not possible to identify such deadlines or quantitative objectives in the Polish NAP. This makes it difficult to make statements regarding the status of implementation and enforcement of measures. Table 28 gives an overview how existing measures related to Article 11 SUD were enforced.

Table 28. Measures and their status of enforcement in Poland

Actions	Enforcement
Actions contained in both NAPs	
Monitoring of surface waters and groundwater and of bottom sediments	The direct supervision over the realisation of the research programme is exercised by the Chief Inspector of Inspector General for Environmental Protection (Polish Ministry of agriculture and rural development, 2019).
Conducting monitoring of water intended for human consumption	The State Sanitary Inspectorate (SSI) is responsible for drinking water. The SSI is subordinate to the minister responsible for health (Polish Ministry of agriculture and rural development, 2019).
Actions contained in revised NAP	
Analyses of the impact of chemical plant protection on the state of surface waters	Within the framework of multi-annual programmes, monitoring of plant protection agent residues in surface waters was conducted by the Institute of Plant Protection (PIB) and the Institute of Horticulture (INHORT) in cooperation with Voivodeship Inspectorates for Environmental Protection (Polish Ministry of agriculture and rural development, 2019).
Supervision over plant protection products containing active substances that should be subject to specific monitoring	The Polish National Plant Protection Organisation is the civic inspection service which is responsible for the supervision of farmers. If problems are detected, they can make penalties. Supervisions are regular controls based on statistical approach. A specific unit prepares whole-year schedules for controls on the basis of risk analysis and basis of number of crops. Besides the supervision of farmers there is also a percentage of controls which can be done based on accidents stakeholder input).
Educational and information activities	No specific enforcement identified.
Checks to check compliance with laws concerning the protection of the aquatic environment	As part of the action in 2018 and 2019, inspectors of the State Plant Protection and Seed Inspection carried out checks on the safe use of plant protection products and their storage (Polish Ministry of agriculture and rural development, 2019).

Influencing factors

Compared to other MS, Poland still offers artificially low levels of VAT for farmers buying chemical pesticides and fertilisers (PAN Europe, 2017). Moreover, Piwowar states that in Poland an important issue is the lack of information regarding the volume of pesticide use in spatial terms (Piwowar, 2021). Today, aerial spraying has been banned, but derogations have been granted for pesticide use in forests (European Commission, 2017d). Nonetheless, according to a stakeholder interviewed, Poland has no major issues with pesticides. The stakeholder further stated that many requirements set out in Article 11 SUD are already covered by national legislation.

Interesting perspectives are provided by a report published by the ROPPA project in 2013 on the reduction of run-off and erosion. It claims that these challenges are an individual and a collective task which requires the involvement of all actors (farmers, advisors, local administration and experts). Thus, they recommend the development of an action plan to define objectives and to explore funding opportunities. In areas where water pollution is a problem, the units responsible for water quality control should work together with farmers to find suitable compromise solutions. The report claims that the correct application of PPPs begins with periodic inspection and accurate calibration of spraying equipment like it is already done in some MS (TOPPS, 2013b). To date, the Polish NAP tries to address the named challenges.

Discussion of impacts

According to an interviewee, it is not the measures set out in the NAP that have had the greatest influence on pesticide handling but the labels that are attached to the plant protection products (PPP). The PPP labels include precise information on how to use the PPPs in different situations and help farmers to stick to the most important requirements of applicable legislation. Also, the obligation to maintain certain buffer strips are based on the labels (stakeholder input).

The effectiveness of the measures set out in the NAP is mainly assessed on the basis of the results of the Polish water quality study. The water quality was determined on the basis of the study on the impact of chemical plant protection on the condition of surface waters, conducted by the Institute of Plant Protection (PIB) and the Institute of Horticulture in cooperation with provincial inspectorates for environmental protection (Polish Ministry of agriculture and rural development, 2019). Thus, the regular monitoring carried out in Poland enables undertaking such studies and the measurement of the actual chemical status of water.

Coherence with the water directives

In Poland, two systems for monitoring pesticides in water exist. One is carried out by the Ministry of Environment to comply with the WFD, and one by MARD to measure pesticide residues it deems problematic and which it reports within the framework of the NAP. According to stakeholder input, whereas the sampling process is coordinated between the two ministries, the specific pesticides and metabolites each ministry tests for differ. The Ministry of Environment tests pesticide residues as prescribed by the WFD, whereas MARD tests for those it deems of immediate and current relevance and views the WFD list as being outdated. In the interviewee’s opinion, this reveals discord between the two organisations at EU level and requires better coordination and interlinkage between the legislation at that level (stakeholder input). However, the interviewee reports that the Ministries cooperate with each other and that the same analysts take samples for both analyses i.e. the Ministries use the same extraction points. Moreover, the same inspections are involved namely the Inspection of Plant Protection supervised by Ministry of Agriculture and the Environmental Inspection supervised by the Ministry of Environment. According to stakeholder input, they have close cooperation with all inspections for assessing the status of water quality (stakeholder input).

As mentioned, a key action of the Polish NAP is the monitoring of PPPs. Poland has therefore included the mandatory MRLs and WFD monitoring programmes into the NAP (Food Chain Evaluation Consortium (FCEC), 2012). Within a regular report on the enforcement and implementation of the NAP the data of the MARD and the Ministry of Environment is published in a combined way.

4.2.5 Spain⁴⁸

4.2.5.1 Status of water

The EC assessment of the second round of RBMPs concludes the following chemical status for surface and groundwater in Spain (European Commission, 2019b):

Table 29. Chemical status of surface and groundwater in Spain

Category	Good	Failing to achieve good	Unknown
Surface water	87%	6%	6 %
Ground water	Around 69% (own estimation)	31%	1 from 729 groundwater bodies

⁴⁸ Minimal stakeholder input could be gathered for Spain due to overlapping responsibilities within ministries..

An annual report on the pesticides control network published by the Ministry for the Ecological Transition and the Demographic Challenge in 2019 reports an increase in the use of pesticides compared to previous years ((Ministerio para la transición ecológica y el reto demográfico, 2019). The average pesticide consumption in Spain is 3.57 kg per hectare of crop land (for the period 2008-2018) (Piwowar, 2021).

Surface water

Significant progress has been made in Spain in reducing the proportion of surface water bodies with unknown status since the first RBMPs (from 37 to 6%), resulting in a large increase in the proportion of surface water bodies with good chemical status, from 58 % to 87%, and a small increase in the proportion of water bodies with poor status, from 5 to 6% (European Commission, 2019b). Importantly, pesticides like Endosulfan, and hexachlorocyclohexane figure among the top 10 priority substances causing failure to achieve good chemical status in surface water bodies in Spain

(European Commission, 2019b). Measurements from 2019 showed 6 exceedances of individual pesticide measurements for the 1 µg/L threshold (EQSD) and 44 exceedances for the 0.1 µg/L threshold ((European Commission, 2020a).

Groundwater

Overall, 55% of groundwater bodies in Spain were found to be at risk of pollution (European Commission, 2019b). The chemical status situation in ground water bodies has not improved between the first and the second RBMPs and 31 % of the total groundwater body area is still failing good chemical status (European Commission, 2019h). Nitrate was the pollutant causing a risk of failing a good chemical status in the most groundwater bodies (13 of the reported RBDs, 46% of all groundwater bodies), followed by chloride (11%) and pesticides (9%) (European Commission, 2019b). Pesticides represented a risk for only 3 of the 18 reported RBDs (European Commission, 2019b).

Drinking water

In Spain, the quality of drinking water is regulated through the Royal Decree 140/2003. The Ministry of Health, Social Services and Equality (MSSSI) has established a National Information System on Water for Human Consumption, which reports compliance in 99.99% of the cases for the parameters monitored in 2016 (European Commission, 2018b). Regarding pesticide residues in drinking water, the number of non-compliant samples decreased from 68 in 2014 to 16 in 2016 (out of 290,414 and 446,783 samples respectively). The main pesticides in the non-compliant samples included active substances no longer approved in the EU but known to be very persistent such as metolachlor, aldrin, atrazine, dieldrin, heptachlor compounds, lindane or other HCH compounds, DDT, terbutemeton, sebutemeton, and simazine (European Commission, 2018b).

More than 350 authorized and prohibited pesticides are monitored yearly, as well as their metabolites and some of their isomers. For 2019, 308 different pesticides have been reported in 50.7% of all water supply areas. The total pesticides concentration in drinking water for that year was 0.04 µg/L, which was the same value reported in 2018 but constituted a decrease from the value reported for 2017 of 0.06 µg/L (Ministerio para la transición ecológica y el reto demográfico, 2019). All in all, 16 exceedances were reported for total pesticides in drinking water samples from 2019 (Ministerio para la transición ecológica y el reto demográfico, 2019).

4.2.5.2 Measures put in place

The Royal Decree 1311/2012 of 14 September 2012 establishes the framework of action for achieving sustainable use of PPPs. With its provisions, the National Action Plan for The Sustainable Use of Plant Protection Products (NAP) was adopted in 2012 and followed by a revision in 2017 covering the period up to 31st December 2022.

An objective of each of the NAPs relates to the reduction of the risks and effects associated with the use of PPPs, especially for humans and the environment. The achievement of this objective is critical for the protection of the aquatic environment as per Article 11 of the SUD. As such, the first NAP features seven objectives that specifically target the promotion of the sustainable use of pesticides, monitoring programmes on the marketing and use of PPPs, and effective pest management while reducing the risks to the environment. Additionally, the revised NAP includes two specific objectives that focus on the improvement of the use of PPPs. Each of these objectives features at least one measure to be applied throughout the plan's term. These measures address the four categories laid out in Article 11 of the SUD to a greater or lesser extent but do not reference this article.

Royal Decree 1311/2012

In Spain, a regulatory framework for action to ensure the sustainable use of PPPs has been established by the Royal Decree 1311/2012. The most important measures set out in its provisions are as follows:

- Based on a risk assessment of water pollution, if there is a risk, the priority shall be given to the use of PPPs that are not classified as hazardous to the aquatic environment
- To prevent water contamination, the necessary measures include:
 - using as many techniques as needed and feasible to prevent contamination and reduce applications on very permeable surfaces
 - when applying PPPs, a minimum level of safety with a 5-meter buffer zone shall be considered with respect to surface water courses
 - authorisation shall be issued to the competent authorities of communities with regard to the minimum level of safety
 - no treatment in case of wind speed more than 3 meters per second.

Water Directives

RBMPs

Spain has 25 RBMPs corresponding to each of its RBDs in accordance with the WFD. After the first round of RBMPs (2009-2015), the second cycle (2016-2021) has been approved by the Government and published on the websites of the different river basin authorities. In total, 348 measures for the reduction of diffuse pollution have been prepared for the second RBMPs, which amounted to 678.58 EUR million (Directorate general for water, 2017).

In Spain's second RBMP cycle, general binding rules under Article 11(3) (h) of the WFD are applied for nitrates and pesticides in all RBDs (European Commission, 2019b). KTM3 (Reduce pesticides pollution from agriculture) is applied to a lesser extent (European Commission, 2019b). In some RBDs, a few Priority Substances are not covered by a KTM. These are mainly related to pesticides, several polycyclic aromatic hydrocarbons (PAHs) and a few other substances (European Commission, 2019a). The basic measures defined in Article 11(3)(h) for the control of diffuse pollution from agriculture at source are applied uniformly across nine RBDs (European Commission, 2019a). In the remaining 16 basins there are differentiated rules for different parts of the RBDs (European Commission, 2019a).

Measures are reported in the second RBMP cycle for some substances⁴⁹ causing non-compliance. However, no measures have been planned for some substances⁵⁰ which are causing failure of objectives for surface waters in some RBDs (European Commission, 2019b). Moreover, the PoMs do not specify any measures for groundwater bodies related to industrial pollution and do not

⁴⁹ Substances are not specified.

⁵⁰ Substances are not specified

provide clear information about measures addressing River Basin-specific pollutants, including pesticides (European Commission, 2019b). Measures to eliminate or reduce pollution from Priority Substances and other substances are missing from most of the RBDs (European Commission, 2019b). Authorities in Spain have indicated that this is due to the manner in which the information about the measurements has been organised in the Spanish database and the allocation of some measures to different KTMs (European Commission, 2019b). Moreover, it is difficult to tell whether the measures reported in the RBMPs are voluntary or mandatory, making it hard to track implementation and to enforce it (European Commission, 2019b).

DWD

According to an expert's input from the Ministry of Health, General Directorate of Public Health, Spanish government is currently transposing the DWD into national law. In addition to the provisions in the DWD, the following regulations are proposed in Spanish national law:

- At least, pesticides suspected to be present in drinking water in the supply area will be monitored
- At the end of each year, the regional ministries or departments responsible for agriculture will inform the Ministry of Health and the Water Administration (Administración Hidráulica) of the list of pesticides used in their area. With these lists, the health authorities will annually establish a list of pesticides and relevant metabolites, taking into account their possible presence in drinking water.
- The value of 0.1 µg/L shall apply to the controlled pesticides authorised in the previous year and a list of the pesticides authorised in that year shall be provided to operators before 20 December each year.
- If the controlled pesticide is banned, unauthorised or other than authorised, the parametric value shall be below the detection limit of the method. In case of detection, the health authority and the River Basin District Authority shall be notified immediately.

4.2.5.3 Assessment

This section will describe an assessment of the extent to which the measures described in the previous sections have been implemented in terms of administration and enforcement in Spain. In addition, the main influencing factors, impacts of the measures and coherence with the WFD and its daughter directives will be discussed. Data from these assessment reports is combined with other EU and national sources for a more comprehensive picture.

Implementation of measures

After receiving the EC's assessment of its 2012 NAPs, Spain revised its NAP which was then adopted in 2017. Audit reports on the revised NAP have been conducted by public authorities and the EC (see Table 34 Annex 7.5).

Both, the first NAP and its revision list quantitative objectives for each measure related to Article 11. However, the targets are not ambitious or are focused on monitoring rather than a commitment to achieve risk reduction. To better reflect the achievements accomplished and to establish ambitious and achievable targets, the EC recommended the revision of Spain's NAP to set quantitative objectives to reduce the risks and impacts associated with the use of pesticides NAP 2017 (European Commission, 2018b). In response to the evaluation, the Spanish competent authorities commented that Ministry of Agriculture and Fisheries, Food and Environment (MAPAMA) plans a mid-term review which assesses the possibility for each Competent Authority to determine quantitative objectives, goals, timetables and indicators for its achievement.

The audit teams also did not check the implementation of the following measures for users to prevent contamination of waters under the Royal Decree 1311/2012 in the visited regions:

- 5-meter buffer zones at surface water courses during the use of PPPs.
- no spraying, in case of the wind speed is more than 3 meters/second (11 Km/h).
- no direct filling of sprayers tanks by using water from water courses or wells, unless anti-return devices are used.
- Units of Pesticide Application Equipment ("PAE") must be calibrated at a distance of at least 25 meters from water sources.
- a 50-meter buffer zone must be provided at wells or surface water sources used for human consumption NAP 2017 (European Commission, 2018b).

Moreover, the inspectors of the audit team in Andalusia and the Autonomous Community of Valencia did not request specific information on-site regarding the areas used for preparing the pesticide mixtures or for filling the sprayer tanks. The inspection procedure as well as the check list used, developed at national level, did not include these aspects. Therefore, the compliance with some of the aspects of the Royal Decree 1311/2012 to protect water could not be verified on the spot NAP 2017 (European Commission, 2018b).

Enforcement of measures

In Spain, enforcement of measures depends on the type of actions. The first and revised NAP conform to the provision of Royal Decree 1311/2012 stipulating that the national plant protection committee, the autonomous communities, and other departments of the General State Administration have responsibilities for contributing to the NAP. Additionally, according to Royal Decree 140/2003, the municipalities are responsible for ensuring that water supply for human consumption is safe at the point of delivery of water. Thirdly, the MSSSI was designated under the same Royal Decree 140/2003 as the competent authority responsible for establishing a National Information System on Water for Human Consumption (SINAC) NAP 2017 (European Commission, 2018b). The system aims to gather information on the quality of drinking water for any supply to places with more than fifty inhabitants. SINAC was launched in 2003 and revised in 2013.

As concerns enforcement measures for drinking water, there are monitoring programs established by the first NAP for drinking water in order to provide assurance that the water is suitable for consumption. In addition, a Surveillance Programme will be launched from 2018 to 2023 with a budget of 22.5 EUR million, including multi-residue analyses for more than 250 active substances in laboratories accredited to ISO 17025. But the scope of this monitoring programme includes only five out of the more than 65 active substances which have been classified as candidates for substitution. Thus, while legal requirements exist for PPP users to protect the aquatic environment and drinking water supplies, the official controls do not sufficiently check these aspects in order to verify compliance (European Commission, 2018b).

Influencing factors

Several barriers for the effective implementation and enforcement of measures have been identified for Spain. These include delays, governance, lack of finance and lack of quantitative objectives, which are detailed in the following sections. It was not possible to identify some influencing factors relating directly to the implementation of Article 11 of the SUD, however it can be expected that these would be similar to the following ones identified for the WFD and the SUD on general matters.

Delays

NAP 2017 planned an annual report on the result of the application of NAP during the previous year. The National Phytosanitary Committee was created in 1998 and composed of civil servants. The committee is responsible for surveys of the implementation and coordination of the NAP with the developed regional Spanish Autonomous Communities. Delivering the annual reports was also mandatory for the committee. However, only five annual reports have been delivered to date by

the National Phytosanitary Committee. The last date is back to 2017 and is largely outdated (Pablo Alonso González, Eva Parga-Dans, 2021).

As concerns the WFD, despite a deadline in December 2015 specified by the Directive, the seven river basin districts of the Canary Islands adopted the 2nd RBMPs (2016-2021) with a great delay. Moreover, the deadline for public consultation provided by the WFD has been shortened in the case of the Canary Islands (European Commission, 2019h). The seven delayed river basin districts include:

- La Gomera (17 September 2018)
- La Plama (26 November 2018)
- Tenerife (26 November 2018)
- Fuerteventura (26 December 2018)
- Lanzarote (26 December 2018)
- El Hierro (26 December 2018)
- Gran Canaria (21 January 2019)

Governance

MAPAMA was assigned as the competent authority for the drafting the 2012 and 2017 NAPs. The development was also closely aligned with the Business Association for Crop Protection ("AEPLA"). AEPLA comprises companies such as Basf, Bayer, Dow, Du Pont and Syngenta. Although the exact development process of the Spanish NAPs and the structure for AEPLA's involvement remains unknown, it appears that the organization stated clear engagement in the development process for the revised NAP. In AEPLA's 2012 annual report, it was stated that AEPLA presented a basic document and organized a conference to prepare the first draft of the plan. Some of their proposals were included in the final version and AEPLA positively rated the content of the NAP (Pablo Alonso González, Eva Parga-Dans, 2021).

The second key institution in developing the NAP was the Sectoral Committee of Plant Health. The institution was created in 2013, comprising central government representatives, agriculture and exporters' associations and cooperatives, and crop protection companies. However, its role is vaguely described as a forum for exchange and discussion between the administration and the group of organisations related to plant health. It appears that any further public information concerning the role and activities played by the Committee was not identified. The Committee lacks representation from organic agriculture, despite Spain having the most surface area in Europe dedicated to organic agriculture (Pablo Alonso González, Eva Parga-Dans, 2021).

Thus, private sectors actively engaged in the development process of the revised NAP, whereas the involvement from the sector of organic agriculture was limited. The counterbalance may lead to the lack of ambiguous targets and overall quantitative objectives in the revised NAP (Pablo Alonso González, Eva Parga-Dans, 2021).

Another such example relating to governance issues is the River Ebro. The River one of the longest in Spain passing through nine autonomous communities before flowing into the Mediterranean Sea. The nine autonomous communities support unlimited demand to increase water extractions for new irrigation areas, not considering the 2nd cycle RBMP. In addition, the agro-industrial group is highly vested in getting supplies from the River Basins, because a major portion of the water is used for irrigation and the group is interested in further development of irrigation channels to industrial crops and GMOs (European Movement for Water, 2021).

Lack of finance and mechanisms

As concerns financing, the costs offered in the second cycle RBMP in Spain estimated the annual cost of water services at 12,623.02 EUR million (not including the Canary Islands) (Directorate general for water, 2017). Stakeholder input indicated that the General Directorate does not have

data on the cost of drinking water treatment. However, the Directorate is aware of unit treatment processes that are possibly used in addition to common treatment: pre-oxidation, coagulation/flocculation, decantation, filtration and disinfection. Specific methods for removing pesticides include ozone treatment, granular activated carbon filters and, in some cases, membrane technology (reverse osmosis). These methods are much more expensive than standard treatment.

For cost recovery, the General State Administration collects taxes for the use of water services through river basin authorities, whereas regional and local taxes are collected by means of a different mechanism (Directorate general for water, 2017). However, there are some public debates concerning whether these systems actually cover all the costs. Indeed, the extent of recovery of the costs related to water services in Spain ranges between 65% and 96%, depending on the services, users, and river basins (María-Teresa Sánchez-Martínez, Manuel Salas-Velasco, 2012).

Besides the financial challenge, it is unclear, and no data is available whether any of investments for the RBMPs will be considered effective for improving environmental quality in the basin or who benefits from them. For instance, the costs associated with the RBMP of the river Ebro amount to about 800 million Euros over the 6-year of period of the plan. However, no cost-benefit analysis has been conducted. An auditing mechanism to verify if public money is properly used does not exist (European Movement for Water, 2021).

Coherence with the water directives

The measures outlined in Section 4.2.5.2 of the revised NAP make reference to the WFD and the setting up of programmes to monitor the presence of PPPs in surface and ground water. MAPAMA exercises the competencies arising from the application of the WFD, including monitoring and inspection of surface and ground waters. In addition, the revised NAP refers to the SUD as a legal basis in the measures related to the use of PPPs (e.g. measure 7.1. – establishment of monitoring programmes for the use of PPPs), although the measures related to water protection for human consumption under the revised NAP (measure No. 6.6 of NAP 2017) do not refer to the SUD or WFD. Thirdly, as concerns other EU regulations on PPPs, MAPAMA reported that the strategy to prevent water pollution was carried out based on the transposition of the WFD and other related EU legislation such as the EQSD in the field of water policy priority substances (Directive 2013/39/EU), substances included in the watch list (Commission Implementing Decision (EU) 2015/495), or Directive 2006/118/CE on the protection of groundwater against pollution and deterioration (European Commission, 2018b).

Stakeholder input to enhance the coherence and complementarity between the SUD and the EU legislation – “It was proposed a few years ago in Spain that among the tests to be carried out on pesticides for their authorisation, the testing of metabolites and pesticides in water after ozonisation should be requested and the by-products generated should be determined, in order to be sure that they do not generate substances classified as carcinogenic, mutagenic, or toxic for reproduction (CMR substances) or endocrine disruptors”. However, the input does not specify the coherence or complementarity between the proposal on the test for authorisation of pesticides and the SUD or other EU legislations on PPPs.

5. Discussion and conclusions

Article 7 (3) of the WFD states the following “Member States shall ensure the necessary protection for the bodies of water identified with the aim of avoiding deterioration in their quality in order to reduce the level of purification treatment required in the production of drinking water. Member States may establish safeguard zones for those bodies of water”. This gives the imperative

and obligation for MS and, by extension, relevant stakeholders to protect the water at source and reduce pollution as the preferred solution to extensive downstream treatment.

Article 8 of the revised DWD, outlines in detail the obligation to supply safe drinking water including aspects of pollutant monitoring (also pesticides), and prevention and mitigation measures in the catchment area.

Both these Directives, buttressed by the EQSD and the GWD, provide the basis and obligation for the protection of the aquatic environment from pesticides as per Article 11 of the SUD, and highlight its relevance for the protection of the aquatic environment.

Effectiveness

As the previous sections show, despite its high relevance and a clear connection to the WFD's objective of achieving good water status, Article 11 of the SUD still lacks effectiveness. Even in countries like the Netherlands and Germany where ambitious and quantifiable targets are set, implementation and enforcement lag.

Furthermore, there is little evidence to show whether the legislation has been effective, mainly because of limited data on the actual risk from pesticides in surface waters and groundwater at the European level (EEA, 2018a). Also, most samples tend to be taken from drinking water, where the results indicated a high compliance rate (99%) with the EU legal limit established by Directive 1998/83/EC. Nevertheless, these samples are taken after any necessary treatment for the removal of pesticides and are therefore not representative.

In general, the effectiveness of Article 11 of the SUD is impacted by aspects of implementation, enforcement, and coherence at both EU and MS level. Therefore, based on the MS analysis in this case study and a number of interviews with relevant stakeholders, the following section will attempt to analyse and understand the underlying reasons for the weak implementation and enforcement of measures as well as the weak coherence between the SUD and other relevant directives. This understanding should then help inform the process of evaluation and developing recommendations within the wider project scope.

Implementation

The research and interviews conducted throughout the development of this case study revealed several weaknesses in the implementation of Article 11 of the SUD and the corresponding measures in the MS NAPs.

For one, and as per the assessment (also see NAPs case study), most of the submitted NAPs lacked quantifiable objectives and targets for water protection (for instance the Belgian NAPAN), rather citing more vague measures as indicated in the case of Spain above, for example. Furthermore, a direct link between targets and the actions identified to achieve them was often difficult to track; measures were often not developed in a structured way so as to lead back to the targets. Several factors make it difficult to draw conclusions on the effectiveness of certain measures and the degree of their implementation. Relevant factors raised by interviewees include the lack of human, financial and technical resources for assessing the effectiveness of measures (Belgium) or the complex emissions pathways which prevent the identification of the origin of pollution (Belgium, Netherlands).

Nevertheless, the real discord when it comes to implementation lies in the fact that even where authorities draft ambitious and elaborate plans and targets, the actual implementation of measures is with the farmers and the stakeholders applying the pesticides. These often lack the tools, means and knowledge to implement the measures which are often costly and may require training or special equipment (e.g. in the Netherlands or Belgium). Furthermore, they often have no part in formulating or influencing the measures or targets and determining their relevance. Therefore, in

order to ensure better implementation, it is necessary to bridge the gap between what is being decided on the policy level and what is actually done on the ground. One good example comes from Germany where farmers' associations were involved in the development of the national IPM guidelines. According to stakeholder interviews, in contrast to other EU MS, the IPM guidelines in Germany are developed by grower organisations as well as public organisations. This has not only encouraged the associations to actively engage with the guidelines, but has also ensured, that the associations back the guidelines. This has contributed to an effective implementation of the guidelines by the associations and their members. Since the guidelines are subject to a comprehensive recognition process involving the JKI, the Scientific Advisory Board NAP, the CAs of the Länder and relevant federal ministries as well as further independent stakeholder groups, they are based on a broad consensus (stakeholder input) (BLE, 2021).

Transparent and open channels of dialogue between the different stakeholders are often inadequate and functional cooperation models that consider the farmers' needs as well as the environmental wellbeing (win-win case scenarios) remain the exception. Several examples of good practice do nonetheless exist, as shown the box below (EurEau, 2020).

In Germany, regional drinking water suppliers, the Chamber of Agriculture, municipal and county representatives and more than 50 farmers have been part of a collaboration initiative since 1985. The focus lies on the promotion of sustainable agriculture and the protection of the groundwater in the Cologne Region. Efforts and measures within the initiative include advisory services for farmers, the sponsoring of state-of-the-art sprayers, the promotion of the cultivation of catch crops, and the qualification of farmers through regular workshops, among others. A reduction of nitrate levels in groundwaters to less than 25 mg/l has been achieved as a result. Additionally, no pesticides from agricultural use have been detected in groundwater or surface waters after 34 years of cooperation (EurEau, 2020).

Further collaboration initiatives to minimise pesticide pollution have been implemented in countries like the United Kingdom (UK), France, and Luxembourg. Some of the measures applied in these initiatives include the use of better-quality metaldehyde pellets and the use metaldehyde alternatives (e.g. ferric phosphate), spreader calibration; promotion of greater use of cultural controls, research into new treatment processes, awareness raising of farmers towards organic farming, and technical and administrative support to farmers for organic farming conversion. While for most of these no results are there yet, the implementation in the UK has shown a significant reduction of pesticide concentrations in water bodies (specifically metaldehyde) compared to 2008 levels (EurEau, 2020).

Coherence

One of the critical reasons for the reduced effectiveness of the SUD and its weak implementation and enforcement, is the issue of coherence and governance at both EU and national levels. At EU level, the interlinkage between the different relevant legislation (WFD and its daughter Directives, DWD, SUD, Regulation No 1107/2009, and the CAP) needs to be clearly established and relevant Articles adequately cross-referenced while identifying the main governing regulation for the topic. Whereas Article 11 does reference the WFD and Regulation 1107/2009, the thresholds of the DWD, for instance, are not reflected.

Similarly, at the national level, the governance structures need to be clearly established and roles adequately identified to establish efficient implementation, enforcement, and monitoring mechanisms. This means identifying the main institutional bodies responsible for implementation and enforcement, assigning roles and responsibilities between the different governmental institutions, and setting coherent accountability and reporting structures. For instance, water

authorities and utilities are obliged to comply with the water directives, whereas pesticides generally fall under the regulation of agricultural authorities, making it critical to interlink the two as the monitoring example from Poland displays. Due to its cross-cutting nature and the involvement of different administrations, no single entity can be classified as competent authority for Article 11 of the SUD in Flanders (Belgium) Spain or Bulgaria, while this is possible for the WFD.

Enforcement

Improved coherence and clearer accountability and governance structures will, in most cases, lead to improved enforcement. Nonetheless, they are not the only influencing factors. The fact that the NAPs in themselves are nonbinding and that the language of Article 11 is often described as being too “soft”, often leads to deficient political backing for the measures.

Furthermore, Article 44⁵¹ of the Regulation on PPPs stipulates that if the limits of PPPs as stated in the WFD are exceeded, then the authorisation of the chemical in question needs to be revised. The proper enforcement of this Article by the EC is very important, however, clear records of how and if it has been enforced could not be found according to information provided by stakeholders.

Enforcement can be strengthened by a more stringent and elaborate reporting mechanism which the SUD currently lacks. Inspiration can be drawn from the Nitrates Directive and the WFD reporting mechanisms, and some stakeholders also mentioned that the EC can follow the same stringent line of control for the SUD which it employs for the Nitrates Directive, for example, by following up with and pressuring the MS on the targets. Enforcement additionally becomes difficult in the absence of penalties and control mechanisms (at the moment, there are no consequences for not reaching the targets).

The SUD, as well as the MS NAPs, largely lack quantitative targets or concrete reductions, which also makes enforcement difficult. General measures like “establish buffer zones”, without concrete numbers or timetables make enforcement difficult.

One intrinsic limitation of the system of cross-compliance checks is that some requirements are, by their nature, very difficult to check. As an example, one of the requirements refers to the timing and method of use of pesticides. The difficulty here lies in the fact that cross-compliance checks are usually notified in advance, and therefore it is most unlikely that an inspector will come across a farmer spraying a forbidden product in an unlawful manner. Other requirements can only be checked during a certain period of the year or in the absence of certain meteorological conditions (e.g. strong wind, frost), which may not necessarily coincide with the timing of the on-the-spot visit.

Costs and savings

Article 9 of the WFD outlines how the costs of water services are to be recovered and stipulates the following in (1): “*Member States shall take account of the principle of recovery of the costs of water services, including environmental and resource costs, having regard to the economic analysis conducted according to Annex III, and in accordance in particular with the polluter pays principle.*” It also makes it clear that this shall in no way stand in the way or compensate for preventive measures as per Article 7 (3).

In summary, the combination of Articles 7 (3) and 9 of the WFD provides the following main points:

- Pollution prevention at source should be given priority
- Utilities/authorities must recover costs from users
- The polluter pays principle is to be reinforced

⁵¹ “A Member State shall review an authorisation where it concludes that the objectives of Article 4(1)(a)(iv) and (b)(i) and Article 7(2) and (3) of Directive 2000/60/EC may not be achieved.”

The concept of *cost recovery* means that water utilities/responsible authorities have the right to recover the costs of water treatment. This means, for one, that whoever uses more water pays more, but it also means that the more expensive and elaborate the water treatment is (due to pollution by pesticides for example), the higher the cost often is for the consumer.

The *polluter pays principle* seeks to punish polluters by making them pay for the pollution they cause to the aquatic environment, thereby providing capital for mitigation measures and treatment. However, this is where the caveat lies, in the case of diffuse pollution it is difficult to trace back the original polluter responsible for each pollutant. Water utilities often receive water contaminated with pesticides, nitrates, PFAs, pharmaceuticals etc. and are unable to trace where the individual pollutants come from. In the case of agriculture, for example, this would require not only identifying each chemical, but also tracing it back to the individual farmer in the catchment area. Given the impossibility of the mission, the consumer ends up bearing the cost of the additional treatment. Interviews with utilities further showed that it is extremely difficult to quantify the additional costs incurred for treatment by pesticide pollution given the mix of pollutants they receive.

There are also the additional costs related to monitoring and research, for example, that water utilities have to invest in. It therefore proved difficult to get cost estimates in the interviews conducted with water utilities. However, what did become clear is the need for better, transparent, and accessible record-keeping on the side of the farmers that is made available to the responsible authorities and the water utilities as per Article 67 of the Regulation 1107/2009⁵². This requires clear and open communication and reporting channels between the different stakeholders.

Stakeholders noted here, for example, that no standard or model exists for the record-keeping process in there. There is no obligation for professional users of PPP to send the records to the competent authorities, however, the records must be accessible to control services. Third parties, including drinking water companies, can request access to respective data from the Federal Agency for the Safety of the Food Chain (FASFC). Concerning Article 44 of PPP Regulation, in Belgium, there is a Working Group Pesticides which brings together federal and federated entities. Within the scope of this working group, the Regions can report information related to certain PPPs in water. The Federal Government is the CA for placing PPPs on the market and for adaption PPP authorisation acts (stakeholder input). On the other hand, according to an interview with the JRC, the technical feasibility for record-keeping is available, but it is likely the resource intensity on behalf of the farmers that constitutes a roadblock. Good practices come from the Netherlands where e-labelling of pesticides via an application is being pioneered.

Moreover, reducing pesticide pollution requires significant financial investments for the implementation of measures. This often means providing money, training and equipment to farmers and others applying the pesticides. One bottleneck is procuring this financial support. One way of resolving this bottleneck would be tapping into the significant resources contained within the CAP and establishing a clear link between the SUD and the CAP, thereby releasing the resources for use within the framework of the SUD.

Reflections

Asked to reflect on Article 11 of the SUD, a JRC representative noted that the specifications of Article 11, especially section c) and section d) may be considered specific (though with room for more stringent formulation), but 11a) and 11b) are rather weak and very open to interpretation. Concrete ideas for improvement would include specifying minimum performance and characteristics of the buffer strips and eliminating applications on or along roads/ railways/permeable surfaces

⁵² Article 67: „... They shall make the relevant information contained in these records available to the competent authority on request. Third parties such as the drinking water industry, retailers or residents, may request access to this information by addressing the competent authority”, and „... The competent authorities shall provide access to such information in accordance with applicable national or Community law.”

(e.g. the SUD could specify 5 meters provisions of the CAP under certain conditions). Furthermore, a better link to the water safety plans and the water protection areas of the DWD is needed. Here it could be taken out because pesticides in drinking water are more stringently addressed in the DWD. Another aspect is forbidding rinsing equipment in connection with drainage or sewers (e.g. surfaces that could eventually be drained). Enhanced coherence with the WFD could further be achieved by spelling out Article 11 as a basic measure under the WFD.

6. Bibliography

- Bulgarian Council of Ministers. (2012). *National Action Plan for sustainable pesticide use in the republic of Bulgaria*.
https://ec.europa.eu/food/sites/food/files/plant/docs/pesticides_sup_nap_bgr_en.pdf
- Bulgarian Council of Ministers. (2020). *National Action Plan for Sustainable Pesticide Use in the Republic of Bulgaria - UPDATED*.
https://ec.europa.eu/food/sites/food/files/plant/docs/pesticides_sup_nap_bgr_rev_2020_en.pdf
- Bund/Länder-Arbeitsgemeinschaft Wasser. (2019). *Bericht zur Grundwasserbeschaffenheit - Pflanzenschutzmittel*.
- CIW. (2020). *Achtergronddocument Bronbescherming drinkwater* (Issue september).
- Delta Approach conference. (2016). *Intentieverklaring Delta-aanpak Waterkwaliteit en Zoetwater tussen overheden , maatschappelijke organisaties en kennisinstututen* (Issue november 2016). <https://www.parlementairemonitor.nl/9353000/1/j9vviij5epmj1ey0/vk91qed7yuyw>
- Directorate general for water. (2017). *Summary of Spanish river basin management plans, Second cycle of the WFD (2015-2021)*.
https://www.miteco.gob.es/es/agua/temas/planificacion-hidrologica/summaryrbmp2ndcycledraft_tcm30-379040.pdf
- Dutch Ministry of Economic Affairs. (2013). *Gezonde Groei, Duurzame Oogst Tweede nota duurzame gewasbescherming periode 2013 tot 2023*.
<https://www.rijksoverheid.nl/documenten/rapporten/2013/05/14/gezonde-groei-duurzame-oogst-tweede-nota-duurzame-gewasbescherming>
- Dutch Official Gazette. (2017). *Decree of 23 June 2017 to amend the Environmental Management Activities Decree in connection with the reduction of emissions of crop protection products in greenhouse horticulture and field crops*. <https://zoek.officielebekendmakingen.nl/stb-2017-305.html>
- EEA. (2018a). *Chemicals in European waters*. <https://www.eea.europa.eu/publications/chemicals-in-european-waters>
- EEA. (2018b). *European waters. Assessment of status and pressures 2018. EEA Report No 7/2018*. <https://www.eea.europa.eu/publications/state-of-water>
- EEA. (2020). *ETC/ICM Report 1/2020: Pesticides in European rivers, lakes and groundwaters - Data assessment*. <https://www.eionet.europa.eu/etcs/etc-icm/products/etc-icm-report-1-2020-pesticides-in-european-rivers-lakes-and-groundwaters-data-assessment>
- État de l'environnement de Wallonie. (2018). *Pesticides in Groundwater*.
http://etat.environnement.wallonie.be/contents/indicatorsheets/EAU_14.html
- EURACTIV. (2020). *Pesticides banned in EU still in use in Bulgaria*.
<https://www.euractiv.com/section/agriculture-food/news/pesticides-banned-in-eu-still-in-use-in-bulgaria/>
- EurEau. (2020). *Briefing Note-Cooperation projects between water operators and farmers*.
- European Commission. (2003). GUIDANCE DOCUMENT ON THE ASSESSMENT OF THE RELEVANCE OF METABOLITES IN GROUNDWATER OF SUBSTANCES REGULATED UNDER COUNCIL DIRECTIVE 91 / 414 / EEC This document has been conceived as a working document of the Commission Services , which. In *October*.
- European Commission. (2016). *Common Implementation Strategy for the Water Framework Directive and the Floods Directive. WFD Reporting Guidance 2016. FINAL V6.0.6*.
[https://circabc.europa.eu/sd/a/5b969dc0-6863-4f75-b5d8-8561cec91693/Guidance No 35 - WFD Reporting Guidance.pdf](https://circabc.europa.eu/sd/a/5b969dc0-6863-4f75-b5d8-8561cec91693/Guidance%20No%2035%20WFD%20Reporting%20Guidance.pdf)
- European Commission. (2017a). *The Environmental Implementation Review 2017*.
https://ec.europa.eu/environment/eir/pdf/full_report_en.pdf
- European Commission. (2017b). *The EU Environmental Implementation Review Country Report - BELGIUM*.
- European Commission. (2019a). *Second River Basin Management Plans - Member State: Bulgaria*.
<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=SWD:2019:39:FIN&qid=1551205988853&from=EN>

- European Commission. (2019b). *Second River Basin Management Plans - Member State: Spain*. <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=SWD:2019:42:FIN&qid=1551205988853&from=EN>
- European Commission. (2019c). *Second River Basin Management Plans - Member State: The Netherlands*.
- European Commission. (2019d). *Second River Basin Management Plans - Member State: Belgium*. 155.
- European Commission. (2019e). *The Environmental Implementation Review, Country Report: Belgium*. <http://europa.eu>.
- European Commission. (2019f). *The Environmental Implementation Review 2019 - COUNTRY REPORT - BULGARIA*. https://ec.europa.eu/environment/eir/pdf/report_bg_en.pdf
- European Commission. (2019g). *The Environmental Implementation Review 2019 - COUNTRY REPORT POLAND*. https://ec.europa.eu/environment/eir/pdf/report_pl_en.pdf
- European Commission. (2019h). *The Environmental Implementation Review 2019 - COUNTRY REPORT SPAIN*. https://ec.europa.eu/environment/eir/pdf/report_es_en.pdf
- European Commission. (2020a). *Evaluation of Regulation (EC) No 1107/2009 on the placing of plant protection products on the market and of Regulation (EC) No 396/2005 on maximum residue levels of pesticides. Report from the Commission to the European Parliament and the Council.: Vol. COM(2020)*.
- European Commission. (2020b). *FINAL REPORT OF AN AUDIT OF THE NETHERLANDS FROM 05 OCTOBER 2020 TO 14 OCTOBER 2020 IN ORDER TO EVALUATE THE IMPLEMENTATION OF MEASURES TO ACHIEVE THE SUSTAINABLE USE OF PESTICIDES*.
- European Commission. (2020c). *On the experience gained by Member States on the implementation of national targets established in their National Action Plans and on progress in the implementation of Directive 2009/128/EC on the sustainable use of pesticides*. https://ec.europa.eu/food/sites/food/files/plant/docs/pesticides_sud_report-act_2020_en.pdf
- European Commission. (2020d). *Review of the drinking water directive*. https://ec.europa.eu/environment/water/water-drink/review_en.html
- European Commission. (2020e). *Water. EU Water Legislation - Fitness Check*. https://ec.europa.eu/environment/water/fitness_check_of_the_eu_water_legislation/index_en.htm
- European Commission, D. for H. and F. S. (2017c). *FINAL REPORT OF A FACT-FINDING MISSION CARRIED OUT IN POLAND FROM 07 JUNE 2017 TO 14 JUNE 2017 IN ORDER TO EVALUATE THE IMPLEMENTATION OF MEASURES TO ACHIEVE THE SUSTAINABLE USE OF PESTICIDES*.
- European Commission, D. for H. and F. S. (2017d). *FINAL REPORT OF A FACT-FINDING MISSION CARRIED OUT IN POLAND FROM 07 JUNE 2017 TO 14 JUNE 2017 IN ORDER TO EVALUATE THE IMPLEMENTATION OF MEASURES TO ACHIEVE THE SUSTAINABLE USE OF PESTICIDES*. https://ec.europa.eu/food/audits-analysis/audit_reports/details.cfm?rep_id=3913
- European Commission, D. for H. and F. S. (2018a). *FINAL REPORT OF AN AUDIT CARRIED OUT IN BULGARIA FROM 10 SEPTEMBER 2018 TO 20 SEPTEMBER 2018 IN ORDER TO EVALUATE THE IMPLEMENTATION OF MEASURES TO ACHIEVE THE SUSTAINABLE USE OF PESTICIDES*. http://ec.europa.eu/food/audits-analysis/country_profiles/details.cfm?co_id=BG
- European Commission, D. for H. and F. S. (2018b). *FINAL REPORT OF AN AUDIT CARRIED OUT IN SPAIN FROM 23 JANUARY 2018 TO 02 FEBRUARY 2018 IN ORDER TO EVALUATE THE IMPLEMENTATION OF MEASURES TO ACHIEVE THE SUSTAINABLE USE OF PESTICIDES*. https://ec.europa.eu/food/audits-analysis/audit_reports/details.cfm?rep_id=4078
- European Movement for Water. (2021). *Fight for the Ebro River Delta*.
- European Parliament. (2017). *EU policy and legislation on pesticides (Plant protection products and biocides)*. [https://www.europarl.europa.eu/RegData/etudes/IDAN/2017/599428/EPRS_IDA\(2017\)599428_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/IDAN/2017/599428/EPRS_IDA(2017)599428_EN.pdf)
- Executive Environment Agency. (2014). *National report on the state and protection of the environment in the Republic of Bulgaria*. <http://eea.government.bg/bg/soer/2014>
- Executive Environment Agency. (2020). *National Environmental Monitoring System (Bulgaria)*.

- <http://eea.government.bg/bg/nsmos/water>
- Fernsby, C. (2020). Tonnes of dead fish: Unprecedented pesticide pollution in Maritsa river, Bulgaria. *Post Online Media*. <https://www.poandpo.com/agrifish/deat-fish-bularia-martitsa-2812020790/>
- Food and Agriculture Organization (FAO). (n.d.). *AQUASTAT - FAO's Global Information System on Water and Agriculture - Country Profile - Bulgaria*. <http://www.fao.org/aquastat/en/countries-and-basins/country-profiles/country/BGR>
- Food and Agriculture Organization of the United Nations (FAO). (n.d.). *Pesticides indicators*. <http://www.fao.org/faostat/en/#data/EP/visualize>
- Food Chain Evaluation Consortium (FCEC). (2012). *Study on existing monitoring and surveillance activities, communication of the results of these activities to the public and awareness raising programmes put in place by MS on the impacts of use of plant protection products on human health and the environ* (Issue July). https://ec.europa.eu/food/sites/food/files/plant/docs/pesticides_sup_ppp-report_monitoring-study_20120712.pdf
- Gaalen, F. Van, & Osté, L. (2020). *Addendum bij het eindrapport van de Nationale analyse waterkwaliteit. Onderdeel van de Delta-aanpak Waterkwaliteit*.
- Helpdesk Water. (2021). *Public nature of measurements of crop protection products and testing of measurements against the standard*. <https://www.helpdeskwater.nl/onderwerpen/emissiebeheer/agrarisch/gewasbescherming/monitoring-toetsing/>
- Hintze, S., Glauser, G., & Hunkeler, D. (2020). Influence of surface water – groundwater interactions on the spatial distribution of pesticide metabolites in groundwater. *Science of The Total Environment*, 733, 139109. <https://doi.org/10.1016/j.scitotenv.2020.139109>
- ILT. (2017). *De kwaliteit van het drinkwater in Nederland in 2016*.
- ILT. (2018). *Kwaliteit drinkwater van Nederlandse drinkwaterbedrijven 2017*. www.ilent.nl
- Kotal, F., Kožíšek, F., Jelíková, H., Vavrouš, A., Mayerová, L., Gari, D. W., & Moulisová, A. (2021a). Monitoring of pesticides in drinking water: finding the right balance between under- and over-monitoring – experience from the Czech Republic. *Environmental Science: Processes & Impacts*, 23(2), 311–322. <https://doi.org/10.1039/D0EM00389A>
- Kotal, F., Kožíšek, F., Jelíková, H., Vavrouš, A., Mayerová, L., Gari, D. W., & Moulisová, A. (2021b). Monitoring of pesticides in drinking water: finding the right balance between under- and over-monitoring – experience from the Czech Republic. *Environmental Science: Processes & Impacts*, 23(2), 311–322. <https://doi.org/10.1039/D0EM00389A>
- María-Teresa Sánchez-Martínez, Manuel Salas-Velasco, N. R.-F. (2012). Who Manages Spain's Water Resources? The Political and Administrative Division of Water Management. *International Journal of Water Resources Development*, 28(1), 27–42.
- Ministerio para la transición ecológica y el reto demográfico. (2019). *Red de Control de Plaguicidas, Informe Anual*. <http://www.chebro.es/contenido.visualizar.do?idContenido=63577>
- MOEW. (2021). *Ministry of Environment and Water - Bulgaria*. <https://www.moew.government.bg/en/water/>
- NAP Netherlands. (2012). *Dutch action plan on sustainable plant protection* (Issue 2012).
- NAPAN. (2014). *Belgian action plan to reduce the risks and impacts linked to pesticides 2013-2017*.
- NAPAN. (2018). *NAPAN (Nacitonal Action Plan Action National) Programme 2018-2022 - Revised 2018*.
- NAPAN. (2020). *NAPAN (Nacitonal Action Plan Action National) Programme 2018-2022 - Revised on May 2020*.
- NAPAN Task Force. (2020). *2018-2022 NAPAN mid-term report (Belgian report of the NAP for pesticides)* (Issue December 2020).
- NVWA. (2016). *Gewasbescherming 2015 Toezicht op de handel en het gebruik van gewasbeschermingsmiddelen*.
- NVWA. (2017). *Gewasbescherming 2016 Toezicht op de handel en het gebruik van gewasbeschermingsmiddelen*.

- NVWA. (2019a). *Domein gewasbescherming 2018 Beeld van ontwikkelingen op het domein*.
- NVWA. (2019b). *Gewasbescherming 2017 Toezicht op de handel en het gebruik van gewasbeschermingsmiddelen*.
- NVWA. (2019c). *Gewasbescherming Toepassingsinspecties 2019*.
- NVWA. (2021). *How the NVWA checks*.
<https://www.nvwa.nl/onderwerpen/gewasbescherming/hoe-de-nvwa-controleert>
- Pablo Alonso González, Eva Parga-Dans, O. P. L. (2021). Big sales, no carrots: Assessment of pesticide policy in Spain. *Crop Protection*, 141(105428).
<https://doi.org/10.1016/j.cropro.2020.105428>
- PAN Europe. (2017). *PAN Europe reaction to the assessment report on the sustainable use of pesticides Directive*. https://www.pan-europe.info/sites/pan-europe.info/files/PanSUDreport_Nov_2017_Final.pdf
- Piowar, A. (2021). *The use of pesticides in Polish agriculture after integrated pest management (IPM) implementation*.
- Polish Minister of agriculture and rural development. (2013). *National Action Plan to reduce the risk associated with the use of plant protection products*.
- Polish Minister of agriculture and rural development. (2018a). *National Action Plan to Reduce the Risk Associated with the Use of Plant Protection Products 2018-2022*.
https://ec.europa.eu/food/sites/food/files/plant/docs/pesticides_sup_nap_pol-rev-2018_en.pdf
- Polish Minister of agriculture and rural development. (2018b). *National Action Plan to Reduce the Risk Associated with the Use of Plant Protection Products 2018-2022*.
- PROTECT’eau. (2021). *Use of PPPs compatible with sustainable development*.
<https://protecteau.be/fr/activites/doc-12124>
- Quesada, M., & Aubin, D. (2018a). Water Stress and Pollution in Belgium: The Internationalization and Regionalization of a Policy Problem. *Europenowjournal.Org*, December, 13.
<https://www.europenowjournal.org/2018/12/10/water-stress-and-pollution-in-belgium-the-internationalization-and-regionalization-of-a-policy-problem/#>
- Quesada, M., & Aubin, D. (2018b). Water Stress and Pollution in Belgium: The Internationalization and Regionalization of a Policy Problem. *Europenowjournal.Org*, December, 13.
- Sjerps, R. M. A., Kooij, P. J. F., van Loon, A., & Van Wezel, A. P. (2019). Occurrence of pesticides in Dutch drinking water sources. *Chemosphere*, 235, 510–518.
<https://doi.org/10.1016/j.chemosphere.2019.06.207>
- SOERW. (2017). *State of the Environment Report - Wallonia 2017*.
- SPGE. (2018). *How is catchment protection organised*. <http://www.spge.be/en/how-is-catchment-protection-organised.html?IDC=2007&IDD=340>
- Tiktak, A., Bleeker, A., Boezeman, D., van Dam, J., van Eerd, M., Franken, R., Kruitwagen, S., & den Uyl, R. (2019). *GEÏNTEGREERDE GEWASBESCHERMING NADER BESCHOUWD*.
<https://www.pbl.nl/onderwerpen/landbouw/publicaties/ge-integreerde-gewasbescherming-nader-beschouwd-tussenevaluatie-van-de-nota-gezonde-groei-duurzame-oogst>
- TOPPS. (2013a). *Best Management Practices to reduce spray drift (Poland)*.
- TOPPS. (2013b). *Best Management Practices to reduce water pollution with plant protection products from runoff and erosion (Poland)*.
- Trémolet, S., Favero, A., Karres, N., & Toledo, M. (2019). *Investing in Nature for Europe Water Security*.
https://www.nature.org/content/dam/tnc/nature/en/documents/Investing_in_Nature_for_European_Water_Security_02.pdf
- van Gaalen, F., Osté, L., & van Boekel, E. (2020). *Nationale Analyse Waterkwaliteit* (Issue april).
- Verschoor, A., Zwartkruis, J., Hoogsteen, M., Scheepmaker, J., de Jong, F., van der Knaap, Y., Leendertse, P., Boeke, S., Vijftigschild, R., Kruijne, R., & Tamis, W. (2019). *Tussenevaluatie van de nota ' Gezonde Groei , Duurzame Oogst ' Deelproject Milieu*.
- VHRM. (2020). *Environmental Enforcement Report*.
- VMM. (2012). *Pesticiden in het grondwater in Vlaanderen*. 64.
- VMM. (2016). *Pesticiden in de waterketen*.
- VMM. (2018a). *Meersporenaanpak vrijwaring drinkwaterbronnen tegen contaminatie door*

gewasbeschermingsmiddelen.

https://www.vmm.be/water/drinkwater/afsprakenkader_meersporenaanpak_bronbescherming_drinkwater.pdf/view

VMM. (2018b). *Pesticides in Surface Water.*

<https://www.milieurapport.be/milieuthemas/waterkwaliteit/pesticiden/pesticiden-in-oppervlaktewater>

VMM. (2019a). *Kwaliteit van het drinkwater.*

VMM. (2019b). *Monitoring aandachtstoffen kaderrichtlijn Water: campagne 2018-2019.*

<https://www.vmm.be/publicaties/monitoring-aandachtstoffen-kaderrichtlijn-water-campagne-2018-2019>

VMM. (2020). *Pesticides in Groundwater.*

<https://www.milieurapport.be/milieuthemas/waterkwaliteit/pesticiden/pesticiden-in-grondwater>

7. Annex to Case Study III: Measures pertaining to Article 11 of the SUD and the respective implementation

7.1 Belgium

Table 30. Measures and their status of implementation in Belgium

Measure	Implementation
Joint and Federal measures	
<p>Assessing the relevance and practicability of risk mitigation measures to be applied by users. This includes two actions:</p> <ul style="list-style-type: none"> • Review of main risk mitigation measures, their feasibility, relevance, and practicability (e.g. buffer zones, protective equipment) • Reconsideration of policy 	<p>An inventory of the main mitigation measures including the assessment on the relevance and practicability of risk mitigation measures was developed (NAPAN Task Force, 2020).</p> <p>An agreement to reconsider risk mitigation measures and/or the policy for authorisation of PPPs is planned for 2022 (NAPAN, 2020). A new concept for establishing buffer zones as risk mitigation measure is in development (NAPAN Task Force, 2020)</p>
<p>Harmonising the approach to the use of pesticides in maintaining railways and exchanging good practices.</p>	<p>This measure foresees an exchange of information between the three Belgian regions on the use of PPPs for maintaining the rail network, good practices and alternative techniques to reach a common position for Belgium. At least one interregional meeting between public authorities and rail managers is envisaged (NAPAN, 2020).</p> <p>Relevant evolutions, derogations and other issues concerning this subject can be discussed during the meetings of the NTF. When requests for derogations are evaluated, ad hoc meetings among the regional representatives are held if necessary (as per stakeholder input).</p>
<p>Mandatory buffer zones</p>	<p>Buffer zones in Belgium are mandatory and are based on different legislation. The buffer zones vary between 1m and 30m. The larger buffer zones are due to the application standards of PPPs required by national legislation.</p>
Flanders	
<p>Enforcement of buffer zones (SW)</p>	<p>Buffer zones are considered one of the main mitigation measures (NAPAN, 2020). Mandatory buffer zones based on regional legislation in Flanders vary between 1m and 6m. A 1m buffer zone adjacent to a watercourse must be respected by everyone. Furthermore, 6m buffer zones must be respected by non-agricultural users of PPPs, unless there is a derogation. Derogations are rarely granted for the application of herbicides (as per stakeholder input).</p>
<p>Conducting a stricter policy for the presence of pesticides in surface waters and further reducing this presence</p>	<p>This measure is a continuous process and a project in the RBMP. The respective measures can be found in PoM of the RBMP (3rd generation) which is currently under the process of adoption (as per stakeholder input).</p>
<p>Sanctions for incorrect use of PPPs by professional users and their inclusion as a framework condition of the CAP.</p>	<p>The correct use of PPPs was included in the CAP as a cross compliance requirement. During controls on the farms, there is a strong focus on the correct use of PPPs.</p>
<p>Reducing pollution from pesticides</p>	<p>Awareness-raising through the promotion of pesticide-free management among citizens and</p>

<ul style="list-style-type: none"> • through minor private use by citizens; and • on land managed for public or commercial activities 	<p>landowners by means of a website (for citizens and landowners) and workshops, lectures and classes (for landowners). Also, a yearly stakeholder consultation is organized.</p>
<p>Objective: Reducing the contamination of groundwater by pesticides.</p>	
<p>Designating vulnerable areas of groundwater throughout the territory.</p>	<p>A model was developed for calculating vulnerable zones for the most frequently used PPPs. So far it is not clear, how this model can be used for the whole of Flanders, however the drinking water companies will use the model to redefine the protection areas surrounding the groundwater abstraction points (NAPAN Task Force, 2020).</p>
<p>Proposals for extending the ban on the use of persistent pesticides and their degradation products.</p>	<p>The measure is not finalised yet. With regard to groundwater and safeguard zones for drinking water production, certain problematic substances can be banned by the Flemish minister for water policy on the advice of VMM. Therefore, monitoring data are used (as per stakeholder input).</p>
<p>Giving priority to the pesticides to be analysed and an analysis following their use.</p>	<p>The pesticides have been prioritized and the analysis has been carried out. The final report on the analysis is available.</p>
<p>Assessing the current use of pesticides and the possible adaptation of policy to reduce the presence of pesticides in groundwater.</p>	<p>The assessment is available; however, this measure is still ongoing.</p>
<p>Objective: Restoring and protecting groundwater resources in drinking water protection areas.</p>	
<p>Assessment of active substances (pesticides) in the raw water in the groundwater protection areas.</p>	<p>Flanders follows a multi-stakeholder approach which includes the cooperation of the agricultural sector, environmental administration and drinking water companies. The aim of this cooperation is to reduce the risks of pesticides on groundwater used for the production of drinking water (VMM, 2018a). Every year, a report on the quality of drinking water, which contains a section on PPPs is published (NAPAN Task Force, 2020).</p>
<p>Updating environmental-quality standards for surface waters in protected areas of surface waters used for the drinking water supply.</p>	<p>The updated standards were included in the RBMP (as per stakeholder input). This includes assessing whether the existing EQSs for surface water are sufficiently protective to produce drinking water complying with the drinking water quality requirements. Moreover, a list of substances of which might be a concern as regards drinking water production is drawn up based on a risk assessment (CIW, 2020).</p>
<p>Objective: Reducing the contamination of surface waters by PPPs as a result of their professional use in agriculture and horticulture.</p>	
<p>Obligation to use 50%-minimum drift-reducing caps and a ban on the filling and rinsing of dispersers on hard surfaces not provided with an adequate collection system for residual water</p>	<p>At the compulsory inspections of sprayers, 100% of the dispersers checked were fitted with the required drift-reducing caps. Training activities are organized to sensitize users of PPPs. Also, demonstration projects are carried out to inform about the financial support for construction systems for the collection of spray and/or cleaning water and purify systems via the Flemish Environmental Protection Fund (VLIF) (NAPAN Task Force, 2020).</p>
<p>Information, advice and demonstrations of the correct use of PPPs before, during and after the application.</p>	<p>After school training and demonstrations are carried out (NAPAN Task Force, 2020)</p>
<p>Supporting investment in adapted filling and rinsing points for dispersers including remedial systems such as biofilters, Phytobac, Heliosec, etc.</p>	<p>There is a tool which can be used by farmers to receive financial support for construction systems to collect spilled spray and/or cleaning water and for purification systems. The support is financed</p>

	through the Flemish Agricultural Investment Fund (NAPAN Task Force, 2020).
Objective: Studies and research work concerning the pollution of groundwater to support groundwater management and policy.	
Geostatistical analysis of data on groundwater quality.	Geostatistical analyses of groundwater quality are carried out to assess trends of certain substances. The results of the analysis are assessed, and a detailed statistical analysis will be performed in the scope of the RBMPs 2022-2027 which are currently in development (NAPAN Task Force, 2020).
Coming to a good understanding of the presence of potentially problematic, hazardous substances in surface waters, in terms of the most important sources of emissions and the impacts (of measures) on the various biological quality elements.	This measure is a continuous process and is not limited to PPPs. New measurement methods are developed to monitor new substances including microplastics or emerging substances of concern (NAPAN Task Force, 2020) (as per stakeholder input).
Exchange of mandatory information between the drinking water sector, the authorities and manufacturers of PPPs and related agents.	There is a declaration of intent for the mandatory exchange of information between the drinking water sector, the authorities, and producers of PPPs (NAPAN, 2020). The project Waterprotect started in 2017. It provides innovative tools enabling drinking water protection in rural and urban environments (NAPAN Task Force, 2020). Waterprotect aims at improving drinking water protection by following a bottom-up and multi-stakeholder approach for water governance, which involves water companies, farmers, NGOs, producers of PPPs, environmental agencies and ministries.
Wallonia	
Creation of buffer zones in- and outside of crop areas and grasslands	The deadline for the creation of a minimum buffer zone outside crop areas and grasslands and for the creation of agricultural buffer zones was in 2014. Application of PPPs on paved land not suitable for crops (e.g. roads or pavements) which are connected to a rainwater collection system or directly to surface water is prohibited (NAPAN, 2014).
Better protect water bodies (surface and/or groundwater) contaminated by PPPs in order to achieve the objectives of the WFD	In 2015, the draft decree defining modalities for the implementation of areas vulnerable to pesticides had been drawn up. The decree needs to be reviewed and updated according to the regulatory changes since 2015. Especially the list of measures applicable in vulnerable areas should be reviewed in cooperation with stakeholders. The criteria for defining vulnerable zones will be based on the results of the monitoring of the quality of Walloon waters (NAPAN, 2020; NAPAN Task Force, 2020). The review of the order has not started yet due to a lack of time of the people involved. The review still is planned to be finalized by the end of 2022 (as per stakeholder input).
Developing an alternative to PPPs for checks on aquatic plants in aquaculture and fish farming.	This includes developing and implementing the use of herbivorous fish to limit aquatic plants in basins and seeking other alternatives. A research project with the University of Liège and partners from the aquaculture sector will be started in 2021. (NAPAN Task Force, 2020). The research project is planned to start in 2022 (as per stakeholder input)
Protecting surface waters (with permanent vegetation).	Establishment of a 6-meter-wide strip of permanent vegetation (herbaceous and/or woody) along waterbodies. This is defined in Article 3 of the

	<p>Walloon decree of 2 May 2019, which is planned to enter into force in October 2021 (NAPAN Task Force, 2020).</p> <p>As buffer zones currently are cultivated zones without pesticide treatment, the monitor compliance. The above change will facilitate monitoring (as per stakeholder input).</p>
<p>Raising awareness and providing information to professional PPPs users for the application of legal requirements and good practices to reduce the risks of point and diffuse water pollution by PPPs through the organisation of visits and demonstrations.</p>	<p>This action includes the implementation of a demonstration platform ("STEPHY"), which should serve as an instrument for the proper management of washing/ filling areas and effluents from the application of PPPs (NAPAN, 2020).</p> <p>Five sites have been identified by the NGO PROTECT'eau to host a demonstration platform. The plans for three facilities were finalised and the agreements between all partners involved must be drawn up and signed. Also, funding needs to be validated (as per Stakeholder input).</p> <p>PROTECT'eau provides training on the sustainable use of PPPs covering topics such as buffer zones, spray techniques and equipment, filling and cleaning of sprayers and the storage of PPPs (PROTECT'eau, 2021).</p>
<p>Phytosanitary management of public areas</p>	<p>Since June 1st, 2019, managers of public areas have been required to manage the respective areas without using PPPs ("zero phyto") (NAPAN, 2020). Technical sheets covering solutions to the main problems faced by municipalities in "zero-phyto" were designed and are available on the internet (NAPAN Task Force, 2020).</p>
<p>Harmonising and simplifying the various regulations under which buffer zones alongside waterways must be respected.</p>	<p>Information on the different buffer zones applicable to surface water are available on the website of PROTECT'eau.</p> <p>This action is on stand-by and depends on the reinforcement of human resources for the coordination of the PWRP.</p>
<p>Protecting catchment areas used for drinking water production</p>	<p>Survey checks are carried out and measures are implemented if the quality standards for groundwater are exceeded (NAPAN, 2014).</p> <p>The "Cellule Diagnostic Pesticides Captages" (CDPC) can be called upon by drinking water producers in case of contamination of a catchment area by PPPs and/or nitrates. The unit then prepares a diagnosis of the origin of the contamination, notably by consulting the farmers present in the catchment area. The CDPC is included in PROTECT'eau framework (as per stakeholder input).</p> <p>This unit has dealt with about 4 cases of contamination of catchments per year since 2009 (as per stakeholder input).</p>
<p>Obligation of anti-drift nozzles</p> <p>Reducing drift by at least 50% since 1 January 2019</p>	<p>These measures are the result of the adaptation of the Walloon legislation in 2018. As they are included in a decree, they are not part of the measures listed in the PWRP (##stakeholder input).</p>

7.2 Bulgaria

Table 31. Actions of the first and second NAP related to the aquatic environment protection and drinking water control

Actions under measure 8 (NAP)	Implementation
Actions found in NAP 2012 but not in NAP 2020	
Prioritising measures included in the RBMPs associated with the protection of drinking and mineral water sources from pesticide pollution	<ul style="list-style-type: none"> The EC's audit report states that preventive measures are included in the river basin management plan (RBMP) established in consultation with all interested actors and stakeholders in the regions concerned for a period of five years (European Commission, 2018a)
Improving measures to monitor compliance with the requirements for the prohibition and restriction of pesticide use in public health protection zones.	This measure was included in the first NAP, but not in the revised NAP as it was implemented: Concrete actions were integrated in the RBMSs 2016-2022 (European Commission, 2018a)
Updating the legislation on public health protection zones around water sources intended for drinking and domestic water supply, and sources of mineral water	<p>Timeline was 2013</p> <p>In 2019, the information was launched that an "introduction of a new approach for protection of waters intended for drinking and domestic water supply" is planned (MOEW, 2021)</p>
Laying down specific measures to protect the aquatic environment as ordered by the Minister for the Environment and Water and agreed with the Minister for Health: specific measures to protect water used for drinking and domestic water supply from exposure to pesticides	This measure was included in the first NAP, but not in the revised NAP.
Actions found in both NAPs	
Giving preference to PPPs, in accordance with the ecotoxicological assessment carried out when authorising the product and the Authorisation for Placing on the Market and Use of PPPs (CLP classification), which are not classified as hazardous to the aquatic environment, in line with Regulation (EC) No 1272/2008, and which do not contain priority hazardous substances as defined in the Water Act. Addition in revised NAP (2020): Information on the CLP classification can be found on the product's label.	Still included in revised NAP, so probably not fulfilled
Giving preference to the most effective methods of application, such as the use of equipment for the application of PPPs, such as the use of application equipment with reduced spray drift, especially for hop gardens, fruit orchards and vineyards. Addition in revised NAP (2020): "...in line with Regulation No 5 of 3 February 2016 on the periodic inspections of the equipment for the application of plant protection (published in SG No 11 of 9.2.2016)"	Still included in revised NAP, so probably not fulfilled
Minimising the risk of off-site pollution caused by spray drift, drain-flow and run-off, including the establishment of untreated buffer zones of a suitable size to protect non-target aquatic organisms: buffer zones are to	Still included in revised NAP, so probably not fulfilled

be set on an individual basis for each plant protection product during the assessment and authorisation procedure and are to be stated on the product label.	
Reducing or eliminating the application of PPPs on or along highways, railway lines, highly permeable surfaces or other infrastructure close to surface water or groundwater, or on sealed surfaces with a high risk of run-off into surface water or sewage systems.	Still included in revised NAP, so probably not fulfilled
Prohibition of the use of professional-category PPPs in protection zones designated in the Water Act, or other areas designated by order of the Minister for the Environment and Water. If such areas need to be treated, PPPs of the non-professional use category, low-risk PPPs or biological agents are to be used.	Still included in revised NAP, so probably not fulfilled
Ensuring integrated water management in the public interest and to protect public health, along with the conditions needed to reduce the release of priority substances and priority hazardous substances, in line with the Water Act.	Still included in revised NAP, so probably not fulfilled Deadline included in RMBPs
Monitoring surface water, in line with the Order of the Minister for the Environment and Water on water monitoring.	Water monitoring systems are in place in Bulgaria performed by the Environmental Executive Agency (EEA) (European Commission, 2018a).
Monitoring groundwater, in line with the Order on Water Monitoring of the Minister for the Environment and Water, taking into account [information about] the types of plant protection products used, provided by the BFSa for this purpose.	Water monitoring systems are in place in Bulgaria performed by the Environmental Executive Agency (EEA) (European Commission, 2018a).
Additional actions identified in revised NAP (2020)	
Improving controls on compliance with the requirements for the prohibition and restriction of pesticide use in safeguard zones.	In force since 2020, so probably not yet implemented
Farmers and farmers associations must comply with the prohibitions and restrictions on plant protection product use in protection zones for water intended for drinking and household use and mineral water, and in safeguard zones for surface water and groundwater intended for drinking and household use.	In force since 2020, so probably not yet implemented
Development and maintenance of an information system on plant protection products, their production/import, contents, quantity, place of application, type and imported quantities	In force since 2020, so probably not yet implemented
Development and maintenance of an information system on spatial organisation, maintenance and provision of information on agricultural pressure (GIS-based information).	In force since 2020, so probably not yet implemented

7.3 Netherlands

Table 32. Measures and their status of implementation in the Netherlands

Measure	Implementation
General measures	
Emission reduction plans (ERP)	An annual process has been implemented since 2013 by the Ministries of Environment and Agriculture to review the exceedances of WFD standards of pesticides in surface water and to initiate discussions with authorisation holders regarding ERPs. The responsibility to adopt and carry out an ERP ultimately lies with the authorisation holder for a specific pesticide (Tiktak et al., 2019). Although the adoption of ERPs is no regulatory obligation, currently 16 ERPs are active (see Emissiereductieplan – Toolbox Emissiebeperving (toolboxwater.nl)). On request of the authorization holder, the Board for the Authorisation of PPPs and biocides (Ctgb) includes sentences that are necessary for the implementation of an ERP in the instructions for use (as per stakeholder input).
Uniform and clear use requirements for pesticides.	In the Netherlands, there is a standardized format for the legal use instructions. The terms used to describe the application and crops are standardized and are published in lists of definitions (DTW ⁵³ and DTG ⁵⁴ list). In addition, restriction and warning sentences have a standardized format. In case a new sentence is proposed, advice is sought from enforcement on the compliance and enforceability of the sentences (as per stakeholder input).
Measures concerning glasshouse horticulture	
Updated authorisation criteria for pesticides in glasshouse horticulture.	In the period of 2014-2015 a guidance document was adopted with the aim to standardise the way emissions of pesticides in greenhouses is measured. The "Greenhouse Emissions Model" which is included in the guidance document required subsequent testing in practice. The results of a second test are currently expected (Verschoor et al., 2019)-
Obligations concerning new emission mitigation technologies.	A regulatory obligation to purify water before discharge was adopted in 2017 through amendments to the <i>Dutch Decree on activities for environmental management</i> (Dutch Official Gazette, 2017). The purification techniques should remove at least 95% of PPPs in the discharged water. The originally envisaged date of compliance by the sector with such an obligation was 2016. However, due to limited availability of existing purification technologies on the market, the compliance date has been postponed to January 1, 2018 for growers who purify individually and was extended to January 1, 2021 in case of collective purification (Verschoor et al., 2019) (as per stakeholder input).
Use of alternative sources of irrigation water.	Assessment carried out in 2012 for alternative sources of irrigation water to limit the use of tap water in periods of shortage. ⁵⁵ Various sources were identified. However, Verschoor et al. (2019) indicate that it is challenging to objectively assess the merits of every source, due to the variation of the identified sources.
Management of waiting periods between the application of PPPs and the discharge of wastewater.	Due to the adopted purification obligation of at least 95% removal of PPPs in the discharged water, no regulatory obligations concerning waiting periods have been adopted (Verschoor et al., 2019).
Recirculation of filter rinsing water containing residues of crop protection agents.	Due to the adopted purification obligation, no regulatory obligation concerning recirculation have been adopted, due to the adopted purification obligation (Verschoor et al., 2019).
Measures concerning open agriculture	
Measures to reduce level of drift on whole plots of agricultural land.	Regulatory requirements concerning use of at least 75% drift-reducing technologies were adopted in 2017 through amendments to the Dutch Decree on activities for environmental management (Dutch Official Gazette, 2017).

⁵³ Definition List, legal conditions for use

⁵⁴ Definition List, Scope of Permitted Use, Plant Protection Products

⁵⁵ Tap water is discharged faster, due to its high sodium content (Verschoor et al., 2019).

<p>Stricter regulations on "cultivation-free zones" near water bodies.</p>	<p>Regulatory obligations concerning cultivation-free zones were adopted in 2017 through amendments to the Dutch Decree on activities for environmental management (Dutch Official Gazette, 2017). One of the regulated aspects is the breadth of these zones (i.e. the distance between cultivated field and water body).</p>
<p>Measures to promote the extension of "cultivation-free zones" surfaces.</p>	<p>Since 2014, CAP subsidies have been made partly contingent upon the realisation of a percentage of areas with an ecological focus. Such areas can be realised, among other ways, through the creation of field edges. These edges can also function as "cultivation-free zones". In addition, various projects have been conducted to promote the creation of field edges. Activities of farmers' collectives have also been leveraged to this end (Verschoor et al., 2019).</p>
<p>Enhancing uniformity of etiquettes on pesticidal products on drift-mitigating techniques to enhance compliance and enforcement.</p>	<p>Since 2018, the uniformity of etiquettes on PPPs is enhanced by the classification of drift reducing techniques into drift reducing technology (DRT) classes. Protocols were developed for measuring the drift reduction compared to a reference technique. The outcomes of the tests are assessed by the Technical Commission on Technique assessment (TCT) who maintains a list of all techniques classified, including all relevant parameters that are needed to make sure that the required drift reduction is achieved (e.g. type of nozzles, pressure, height and driving speed). In the use instructions of PPPs, DRT classes will be used in all cases in which it is possible to align with the Activity Decree. Individual techniques can only be mentioned in exceptional cases.</p>
<p>Research on emission mitigation measures at point source and regulating such measures where feasible.</p>	<p>No new regulatory obligations have been adopted. Obligations already existed before 2013 concerning the collection and purification of water from the cleaning of sprayers and the sorting of crops (Verschoor et al., 2019). A tool has been developed which provides farmers with insights concerning emission risks on their barnyard (Verschoor et al., 2019). Closed filling systems for filling spraying machines will be an obligation from January 1st, 2024 in order to prevent human exposure and leaching to the environment. More measures will be taken according to the 'Uitvoeringsprogramma Toekomstvisie Gewasbescherming 2030' (as per stakeholder input).</p>

7.4 Poland

Table 33. Measures and their status of implementation in Poland

Actions	Implementation
<p>Actions contained in first NAP (2013)</p>	
<p>Developing, updating and providing methodologies for integrated pest management (IPM) for individual crops.</p> <p>These methodologies will also take into account the following obligations imposed on Member States of the European Union by Directive 2009/128/EC, namely:</p> <p style="padding-left: 20px;">1) Article 11(2) point a) 2) Article 11(2) point b)</p> <p>These methodologies will be voluntary guidelines, the implementation of which will ensure that professional users of plant protection products act in</p>	<ul style="list-style-type: none"> • Several actions to inform on the IPM (including Article 11, SUD) were taken: <ul style="list-style-type: none"> • Pest monitoring website • decision support systems in crop protection, Pest Signalling Guides, integrated pest management programmes, post-registration variety testing • promoting the Integrated Plant Production Scheme • organisation of specialised training (e.g. on the professional use of PPP) • distribution on information material • modification of curricula in agricultural schools • participation in conferences, seminars and trade fairs and exhibitions

accordance with the applicable regulations. Methodologies will be revised and supplemented as new scientific findings come into light.	
Actions contained in both NAPs	
Monitoring of surface waters and groundwater and of bottom sediments	<p>The State Environmental Monitoring system is set up under the Environmental Protection Law of 27 April 2001 and is carried out by the Inspectorate for Environmental Protection. It is in line with the WFD (European Commission, 2017c)</p> <p>Within the research carried out by the Inspectorate Environmental Protection in 2018 and 2019 the following pesticides got monitored in surface waters:</p> <ul style="list-style-type: none"> • Organochlorine pesticides: cyclodiene pesticides (aldrin, dieldrin, endrin, isodrin), total DDT, p,p'-DDT, total HCH, alachlor, dicofol, total endosulfan, heptachlor and heptachlor epoxide, hexachlorobenzene, pentachlorophenol; • Organophosphorus pesticides: chlorfenvinphos, chlorpyrifos, dichlorvos; • Triazine pesticides: atrazine, cybutrin, simazine, terbutrin; • Other pesticides: aclonifen, biphenox, quinoxyfen, cypermethrin, diuron, isoproturon, trifluralin, tributyltin compounds (Polish Ministry of agriculture and rural development, 2019) <p>Please see Table 24 for results.</p>
Conducting monitoring of water intended for human consumption	<ul style="list-style-type: none"> • carried out by SSI • water companies and entities also have monitoring obligations • rules on monitoring are included in national law (European Commission, 2017c) • Within the framework of the monitoring of the quality of water intended for human consumption there were no cases of non-compliance with the water quality norms in the scope of pesticides posing a threat to health, which would result in the State Sanitary Inspection bodies issuing a permission to deviate from the permissible value of pesticides or the sum of pesticides in water intended for human consumption drawn from underground or surface intakes (Polish Ministry of agriculture and rural development, 2019).
• Actions contained in revised NAP (2018)	
Analyses of the impact of chemical plant protection on the state of surface waters	<p>The State monitoring has been supplemented by monitoring covering as many active substances as possible currently contained in plant protection products.</p> <p>For this purpose, within the framework of multi-annual programmes, monitoring of residues of plant protection products in surface waters was carried out by the Institute of Plant Protection in Poznan (PIB) and the Institute of Horticulture in cooperation with Voivodship Inspectorates for Environmental Protection (Polish Ministry of agriculture and rural development, 2019). The MARD is in charge of supervising the additional monitoring.</p> <p>Please see Table 24 for results.</p>
Supervision over plant protection products containing active substances that should be subject to specific monitoring	<p>In the Ministry of Agriculture and Rural Development, work was carried out in 2013-2014 to identify active substances that should be included in the specific monitoring programme. A set of 24 active substances was selected.</p> <p>In 2015-2017, in the framework of the multi-annual programme "Protection of cultivated plants taking into account food safety and reduction of yield losses and threats to the health of humans, domestic animals and the environment", implemented by the</p>

	<p>Institute of Plant Protection - PIB, a set of indicators was developed for the evaluation of sales of plant protection products containing active substances covered by the obligation of special monitoring pursuant to Regulation 540/2011.</p> <p>The sales volume indicator (WSMonit.) and sales structure indicator (WSSMonit.) taking into account the volume of sales of substances requiring monitoring in relation to the total volume of sales were calculated from 2013 onwards. (Polish Ministry of agriculture and rural development, 2019)</p>
Educational and information activities	<p>Farmers' responsibilities and good practices are communicated during training courses related to IPM. The water protection requirements and measures are also part of the mandatory training courses (input from interview with an expert from the Ministry of Agriculture and Rural Development, June 2021).</p>
Checks to check compliance with laws concerning the protection of the aquatic environment	<p>Exact numbers are not available, but checks are performed regularly (input from interview with an expert from the Ministry of Agriculture and Rural Development, June 2021).</p> <p>Regulations have been adopted detailing how to perform of individual activities related to plant protection, including the manner of:</p> <ol style="list-style-type: none"> 1. storage of plant protection products (including health and safety requirements for facilities in which the products are stored); 2. the preparation of the spray liquid (minimum distance of such operations from water bodies and streams); 3. application of plant protection products (including requirements for buffer zones, atmospheric conditions in which treatments may be carried out); 4. cleaning application equipment (minimum distance from water bodies and streams) (Polish Ministry of agriculture and rural development, 2019). <p>The number of irregularities found with regard to the safe use of plant protection products and their storage was 53 respectively 6 in 2018, while 308 respectively 29 in 2019 (Polish Ministry of agriculture and rural development, 2019).</p>

7.5 Spain

Table 34. Measures and their status of implementation in Spain

Measure	Implementation
First NAP covering the period 2013-2017	
Giving preference to pesticides that are not classified as dangerous for the aquatic environment	<p>Measure at section 7.1 of the first NAP prioritised the use of PPPs not classified as hazardous to the aquatic environment or that do not contain substances classified as hazardous. Also, the measure included observation of an untreated safety distance of 5m from bodies of surface water, or 50m if the points or bodies of water are used for human consumption.</p>
Giving preference to the most efficient application techniques such as the use of low-drift pesticide application equipment especially in vertical crops such as hops and those found in orchards and vineyards	<p>The measure at section 7.1 implemented specific requirements on the use of PPPs in sensitive areas and natural spaces subject to special protection.</p> <p>It appeared, however, that the measure did not consider the use of pesticide application equipment in vertical crops.</p>
Use of mitigation measures which minimise the risk of off-	<p>Measure at section 5.5. included training programmes regarding the issues of diffuse pollution caused by spray drift and runoff.</p>

<p>site pollution caused by spray drift, drain-flow and run-off</p>	<p>The first NAP included a measure at section 6.6 to establish monitoring system for the present of PPPs in water destined for human consumption and set reduction targets of the number of warnings due to presence of pesticides in water.</p> <p>The Spanish national information system on drinking water ("SINAC") provides information on individual levels of PPPs, total pesticides, and more than 300 substance checked individually. Total pesticides are an aggregate parameter for pesticide concentrations, including any types of PPPs such as insecticides and herbicides. The parameter value is set at 0.5 µg/L. SINAC notifies healthcare authorities of any water-related alerts in case the value exceeds certain thresholds.</p> <p>MAPAMA has not yet conducted a documented general review of the implementation of the first NAP 2017 (European Commission, 2018b).</p>
<p>Revised NAP covering the period 2018 -2022</p>	
<p>System to monitor the presence of PPPs in water destined for human consumption</p>	<p>The previous measure from section 6.6 of the first NAP has been retained for monitoring the presence of PPPs in water destined for human consumption. Additionally, the revised NAP includes a new measure for monitoring system of the presence of pesticides in surface and ground water.</p> <p>The new monitoring programme measured priority substances and other specific basin contaminants corresponding to PPPs. In the case where surface water bodies become at risk of significant pressure from e.g. drift and outflow, the operative control programme included the obligation to identify monitoring stations of pesticides of agricultural origin (European Commission, 2019h).</p> <p>According to the report by MAPAMA, the strategy to prevent water pollution was carried out based on the transposition of WFD and other related EU legislations such as the EQSD in the field of water policy priority substances (Directive 2013/39/EU), substances included in the watch list (Commission Implementing Decision (EU) 2015/495), or Directive 2006/118/CE on the protection of groundwater against pollution and deterioration (European Commission, 2018b).</p>

Appendix 4: CASE STUDY IV – USE OF PESTICIDE STATISTICS

1. Introduction to the case study

Directive 2009/128/EC on the sustainable use of pesticides (SUD) sets a number of measures for Member States to implement, specifically regarding indicators and monitoring practices. While the SUD does not place explicit requirements on the collection of statistical data on the use of pesticides, it does make reference to the supporting Regulation (EC) No 1185/2009 concerning statistics on pesticides which operates as a policy package along with the SUD. Thus, it is through this Regulation that the collection of statistics regarding the use of pesticides is set out.

Throughout the implementation of the SUD since its inception in 2009, an overarching problem that has slowly emerged is the lack of available data on the use of pesticides at Member State and EU levels. At present, the SUD relies on the use of Harmonised Risk Indicators (primarily HRI 1) and national specific indicators. HRI 1 works by multiplying the quantities of active substances placed on the market in plant protection products by a weighting factor. While HRI 1 presents an overall decreasing trend, it does not specifically show the progress made (particularly by the SUD) in reducing the risk in specific areas as details regarding the use of pesticides (e.g., place, time, way of application) are not available at the EU level.

One crucial aspect which impacts the collection of data is the lack of harmonisation between Member States on the collection of data from users of PPPs. In addition, even where data is collected, the collation of this data and transfer to Eurostat is lacking, resulting in incomplete data at the EU level, particularly for statistics on the use of pesticides.

The purpose of this case study is to develop a better understanding of what constitutes best practice with regards to the collection, monitoring and analysis of pesticide statistics at the national level. In particular through the examination of three Member States. The analysis will seek to look into the design and collection mechanisms put in place to collect statistics on the use of pesticides. This will in turn consider each of the data collection systems' effectiveness, impact on the reporters and data collectors as well as its cost effectiveness. As a result, the case study will look to uncover a set of good practice examples and an overview of key factors that need to be taken into account for similar types of implementation of collection systems in other Member States. To structure the case study, four main questions have been developed:

1. What is the current state of play of the collection and analysis of pesticides statistics in the selected Member States?
2. How effective and relevant have the collection process been for both the reporters and collectors?
3. How cost-efficient have the data collection processes been across each selected country?
4. What contextual factors or unintended effects may hinder the replication of the identified best example approaches in other countries?

2. Methodology

In order to carry out this case study, the following methodology has been developed, with the core aim of gathering sufficient qualitative and (where possible) quantitative data to answer the four research questions mentioned above. As a starting point, it is important to elaborate the selection of case study Member States.

2.1 Member State Selection

To select the three Member States that could be assessed as part of the case study, the following selection criteria were adopted:

- A balanced geographical representation across the EU 27 MS and the UK)
- A balanced split between old Member States and new Member States (the ones that accessed the EU post-2004)
- The level of implementation of the SUD
- The known levels of implementation of data collection processes across MS

From preliminary desk research and consultation with the Commission and Eurostat, the following rationale was used resulting in the selection of: Denmark, France and Portugal:

- **Denmark:** Denmark was noted to currently operate with a relatively advanced collection system. This is backed through assessments of the pesticide statistics which are made available by the Ministry of Environment.
- **France:** Given the data that was provided to Eurostat and the ability for the national authorities to report upon the risks and use of pesticides, it was deemed relevant to analyse the situation and context of pesticide statistics in France. In addition, the regional variations in data collection allow for a more nuanced assessment of collection techniques and their effectiveness.
- **Portugal:** Similarly, Portugal was seen to employ an efficient statistical system that provides recurring and high-quality data. The reporting approaches also vary across the country, thus providing the opportunity to explore possible variations in data collection techniques.

2.2 Data collection

The methodology adopts a stepwise approach covering four distinct tasks, as discussed in the sections below.

Step 1 – Conduct desk research

As a first step, desk research was conducted with the aim of gathering qualitative and quantitative data from national reports and documents from each of the three case study examples. As such, the desk research serves to investigate the state of play with regards to research question one and identify possible factors which have enabled/ limited the collection of statistics on pesticides. The output from the desk research are brief national overviews which will lay the foundation for conducting the interviews with national authorities as well as answering the research questions and determining good practice examples.

Step 2 – Conduct ad-hoc contact/interviews

To gather more in-depth insights and information on the characteristics and functioning of the collection processes and use of pesticide statistics, interviews were conducted with national authorities that are responsible for the collection, monitoring and analysis of pesticide statistics. These interviews were crucial in validating the findings from the desk research as well as investigating available data, particularly on the costs borne by the reporters and collectors.

It should be noted that as part of this case study it was foreseen that a targeted interview with the SUD competent authority in France would be undertaken. However, it was not possible to carry out the interview and, as such, some sections of this study do not present findings from France.

Step 3 – Identify elements of good practice, analyse the information and prepare assessment

Based on the information gathered via desk research and interviews, a set of relevant elements which were pre-defined assesses each of the example countries. The identification of these elements is presented in Table 1 below. To operationalise the data gathered under steps 1 and 2, an overview table presents the information across each of the criterion, of which a SWOT analysis has been conducted to assess the key strengths and weaknesses of each national approach as well as opportunities and threats that could be taken forth in the identification of good practices.

To harmonise the assessment with other assessments conducted by Eurostat, similar criterion has been adopted, with a focus more on the collection processes and mechanisms, as well as the analysis and use of pesticide statistics.

Table 1. Table for the assessment criteria

Assessment criteria										SWOT Analysis			
Type of process/ mechanisms in place	Geographical coverage	Frequency of data collection	Types of statistics collection	Accuracy and reliability of the data collected	Degree of costs borne by reporters and collectors	Degree of administrative burden (both reporters and collectors)	Specific contextual factors that defined the approach	Assessment on the impact of the statistics on reducing risks	Degree to which the SUD played a role in emphasising the importance of pesticide statistics	Strengths	Weaknesses	Opportunities	Threats

Step 4 – Draw conclusions and describe best practice examples

From the evidence collected in steps 1 and 2, and the analysis of information in step 3, step 4 synthesises the evidence collected and input from the assessment table, in order to draw conclusions on the key success factors and good practices, as well as considerations that should be addressed when implementing similar approaches.

2.3 Limitations

Over the course of this case study several limitations were encountered which are summarised below:

- Selecting appropriate Member States to examine that would provide fruitful information on data collection systems proved to be challenging. Given the differences between Member States in the way in which they collect data regarding pesticide sales/ use, only a limited number of Member

States offered a basis in which to analysis possible best practices regarding the collection of statistics.

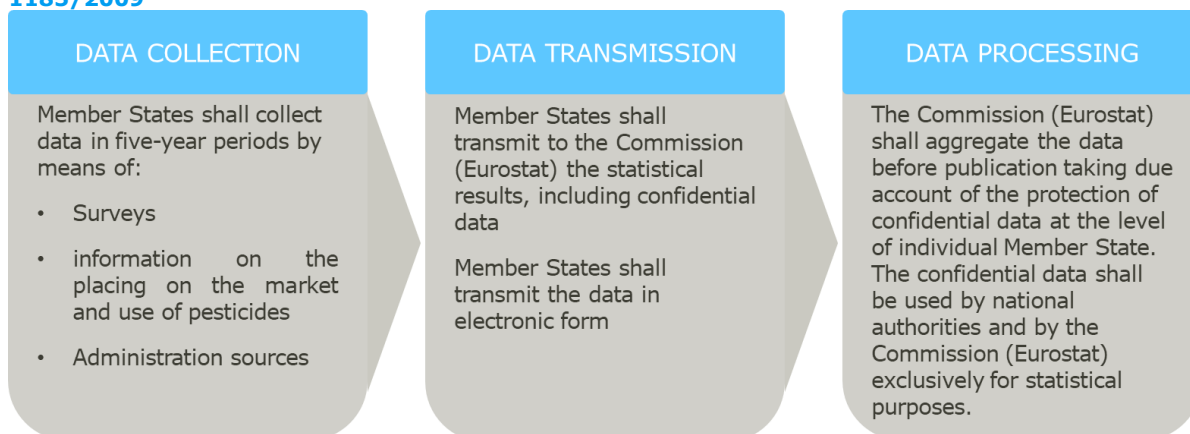
- As the case study was carried out over the summer period, it resulted in difficulties in contacting and setting up interviews with national authorities thus hindering the drafting of the report.
- As documented by Eurostat in their quality reports of sales and use data across all Member States, the amount and quality of data available is sparse, particularly on the impacts of reporting obligations on users of PPPs. This thus limited the extent to which the case study could meaningfully analyse the extent to which the examined collection systems have been effective and could be applied in other Member States.
- It was not possible to conduct an interview with the SUD competent authority in France. Publicly available information has been used to the extent possible in order to present the approach adopted in France regarding the system for collecting and using data on pesticide use.

3. Situation analysis in the EU

This chapter provides a background and analysis to the use and adoption of statistics to monitor the risk and use of pesticides across the EU.

Contextually, under the SUD, the explicit mention of statistical data and/or indicators that should be gathered by Member States are not provided. Crucially, the SUD operates as a policy package, encompassing Regulation (EC) No 1185/2009 concerning statistics on pesticides, thus it is through this Regulation that the collection of statistics regarding the use of pesticides is set out. The figure below provides a summary of the main mechanisms under the Regulation.

Figure. 5. Data collection, transmission and processing under Article 3 of Regulation (EC) No 1185/2009



Under Regulation 1185/2009, it stipulates that for the statistics on agricultural use of pesticides, each Member State shall choose the crops to be covered during the five-year reference period so that the selection is representative of the crops cultivated in the Member States and of the substances used. The reference period shall be a period of a maximum of 12 months covering all plant protection treatments associated directly or indirectly with the crop, during the five-year period. Member States may choose the reference period at any time during the five-year period, and the choice can be made independently for each of the crops reported.

While the SUD does not lay down specific provisions regarding statistics on pesticides, Article 15 of the Directive states that Member States shall calculate Harmonised Risk Indicators (HRIs) by using

statistical data collected in accordance with the Community legislation concerning statistics on plant protection products together with other relevant data (Art 15(2.a)). This is outlined in more detail in the quote from the Directive below.

[...] calculate harmonised risk indicators as referred to in paragraph 1 by using statistical data collected in accordance with the Community legislation concerning statistics on plant protection products together with other relevant data;(b) identify trends in the use of certain active substances;(c) identify priority items, such as active substances, crops, regions or practices, that require particular attention or good practices that can be used as examples in order to achieve the objectives of this Directive [...] The Commission shall calculate risk indicators at Community level by using statistical data collected in accordance with the Community legislation concerning statistics on plant protection products and other relevant data, in order to estimate trends in risks from pesticide use.

Directive 2009/128/EC, Indicators, reporting and information exchange; Article 15; Indicators

3.1 General overview in the EU

Building upon the context provided above, it is important to set out the specific types of statistics which are required under Regulation (EC) No 1185/2009, and by virtue, the SUD. Each of the following sub-sections will provide a summary of the statistic type and the main hindering factors which limits their use.

Data on placing on the market of pesticides and agricultural use of pesticides

Firstly, EU Member States and EEA countries⁵⁶ are obliged to provide data on placing on the market of pesticides and agricultural use of pesticides to the Commission (Eurostat). These statistics are to be collected annually and published on the Commission's database. The unit of measurement is the number of pesticides (in tonnes) sold across the EU, and are more commonly referred to as available sales data, as shown in the figure below.

⁵⁶ With the exemption of Switzerland

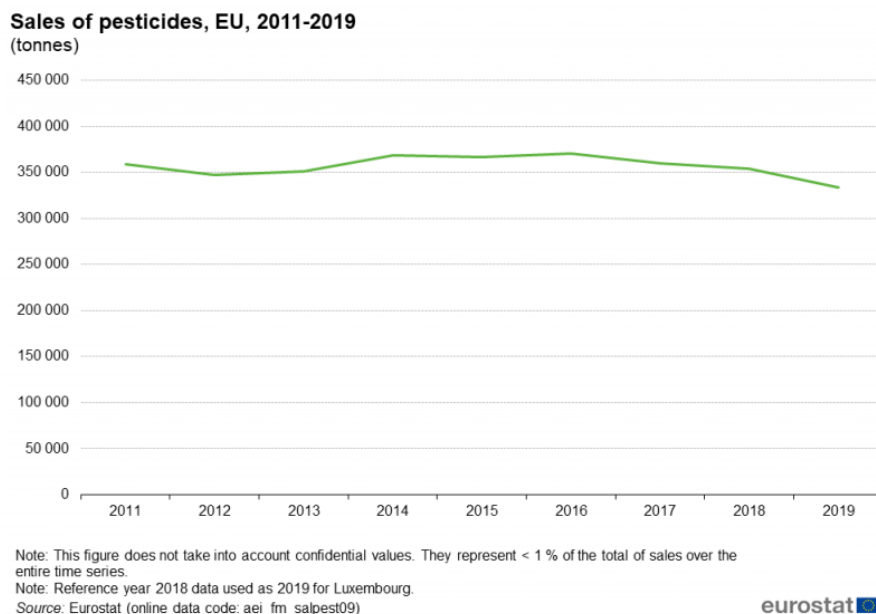


Figure 6. Sales data provided under Regulation 1185/2009

An important aspect of this data is that it represents one of the few data sources which are complete (to a usable extent) and follow the partial form of time series data. As such, this data is currently used under the SUD in the HRI 1. This indicator is calculated by multiplying the quantities of active substances placed on the market in plant protection products (PPPs) by a weighting factor. A weighting factor is applied through grouping active substances into four categories:

- **Group 1:** Low-risk active substances, comprising of micro-organisms (Category A) and chemical active substances (Category B)
- **Group 2:** All approved active substances, other than those in Groups 1 and 3, comprising of micro-organisms (Category C) and chemical active substances (Category D)
- **Group 3:** More hazardous active substances⁵⁷, which is divided into Categories E and F based on the classification of the active substances as regards their carcinogenic, repro-toxic and endocrine disrupting properties
- **Group 4:** Active substances that are not approved, also categorised as Category G

These weightings are applied across the categories in each group and are intended to encompass and reflect the overarching objective of the SUD in reducing the risk and impact of pesticide use and promoting alternative approaches or techniques. While the categorisation helps in understanding the trends in the number of pesticides per group, thus enabling the establishment of HRI, there are a number of areas which hinder the use of sales data in this regard.

As reported in the 2019 review by Eurostat⁵⁸, harmonisation of data is an important factor which hinders the use of sales data. Considering that Regulation 1185/2009 requires the transmission of data for a variety of crops, it enables Member States to select the crops to report upon, based on whether they are representative of the crops cultivated in the Member State over the five-year reference period. Given the different climates and crops grown across all Member States, this

⁵⁷ Active substances that meet the cut-off criteria as set out in points 3.6.2. to 3.6.5 and 3.8.2 of Annex II to Regulation (EC) No 1107/2009 or are identified as candidates for substitution in accordance with the criteria in point 4 of that Annex

⁵⁸ Eurostat (2019). Research paper; Statistics on agricultural use of pesticides in the European Union

approach to the selection and transmission of data can create problems at the EU level in terms of harmonisation.

This is further complicated by the fact sales data only provides an indication on the volumes of pesticide being used and does not take into account the concentration of where pesticides have been used, the toxicity of the pesticides nor the environmental behaviour determining human and environmental exposure. These areas combined creates added complications in the ability of statistics on the use pesticides to be fully used and understood. Thus, the collection of consistent and thorough data at the national level, especially on the actual use of pesticides is of great importance in better understanding not only the impact of the SUD, but also the reduction in risk and use on the environment and human health.

Data on placing on the market of pesticides and agricultural use of pesticides

In comparison to sales data, data on the use of pesticides is notably lacking. Again, Member States are required to provide data over a five-year period, as stated under Regulation No 1185/2009. Compared to sales data, the main hindering factor of use data is the lack of systematic reporting between the EU and Member States and from the lack of harmonisation in the aggregated dataset that would allow an analysis of trends overtime at the EU level. As Regulation No 1185/2009 also enables Member States to gather data though the use of surveys, it can lead to variations in the amount and quality of data transmitted. This data thus frequently represents indirect or estimated information compared to sales data.

It should be caveated that the usability of use data to assess its effects on the environment and human health is impacted by the lag time between the cause and effect. Therefore, unless systematically collated spatial data on the use of pesticides was gathered, the lag time effect would persist and impact the ability for the statistics to be used in a meaningful way.

It is in this context in which the following sections should be understood, in order to examine the crucial areas of data collection, transmission and use.

3.2 Discussion on the research questions

This section presents the context and findings of the research questions in each of the selected Member States. To structure the discussion, the following subsections will first present an analysis per research question.

3.2.1 State of play of the collection of pesticides statistics in the selected Member States

The aim is to understand the current processes and means in which national statistics on the use of pesticides are gathered in Denmark, France and Portugal. Considering that Regulation No 1185/2009 primarily requires the submission of data on pesticides sales and use, the following sections will assess each per Member State.

Denmark

Denmark operates within rigorous national legislation with respect to the purchase, storage and use of pesticides. Contextually, it is important to note that the sale of biocides and plant protection products has changed dramatically over the last decade in Denmark. For instance, a reformed pesticide tax was introduced in 2013, which increased the cost of the pesticides causing the highest load and encouraging farmers and users to reduce their use and load. Considering that approximately 93% of pesticide use in Denmark is agricultural, this tax has an important influence

on the use and purchase of pesticides⁵⁹. This pesticide tax along with other Danish pesticide policies previously mentioned collectively aim to reduce the so-called Treatment Frequency Index (TFI).

On the basis of this, **monitoring the impact of the tax as well as the impacts of pesticide use on the environment and human health was seen to be crucial**. Two central pieces of legislation have an impact upon the collection of statistics on the use of pesticides: [1] Statutory Order on Pesticides under the Danish Chemicals Act and the [2] Executive Order on spraying logs for all professional users of plant protection products (PPPs). These two pieces of legislation work in tandem to ensure that products for which a company has an authorization from the Environmental Protection Agency should be included in the submission of data electronically⁶⁰.

Prior to the implementation of Regulation 1185/2009, Danish authorities did collect some data on the use of pesticides however the uptake of Regulation 1185/2009 provided a reinforced mandate for authorities to develop a data collection system as well as put in place legislation to ensure the collection of data. To assist the transition into the new system post 2009, Danish authorities enabled farmers to continue to submit data in paper format while moving towards an obligatory system to submit data digitally. The system was fully implemented in 2010 with data being available from 2011. Since then, the Danish Environment Protection Agency (EPA) noted continual improvements in the quality of the data provided over the years. The table below provides an overview of the data requirements in Denmark.

Table 2 Overview of data requirements in Denmark

Category	Statistical process in sales data	Statistical process in use data
Frequency of collection	Once a year	Once a year
Enforcement of data collection	Statutory Order on Pesticides under the Danish Chemicals Act	National legislation ("Sprøjtejournalbekendtgørelsen") ⁶¹ farmers are obliged to report their pesticide use yearly. The legislation covers all farmers with a yearly turnover at approximately 6600 euro or more, or farmers with a total of 10 acres or more.
Type of data reported	Annual sales in kilograms or litres sold to the Danish market.	Quantity of each active substances listed in Annex III of Regulation 1185/2009 contained in plant protection products used on a selected crop, expressed in kg. The area treated with each substance are expressed in hectares.
Method of reporting	Danish authorisation holders must submit data electronically and foreign authorisations by email.	
Population (i.e. No. of Authorised holders of pesticides)	Number of agricultural workers: 300,300 ⁶² Number of authorised holders of pesticides: 68 ⁶³	
Number of available PPPs	Total: 538 Product quantity in tonnes: 7947 Tonnes of active substances: 2664	

⁵⁹ IEEP (2019). Pesticide Tax in Denmark

⁶⁰ Eurostat (2018). Sales of pesticide, Denmark – Quality report

⁶¹ Danish environment ministry (2017). Executive Order on spray logs for all professional users of plant protection products and reporting obligation for some agricultural companies and horticulture, etc.

⁶² Eurostat (2021). Farmers and the agricultural labour force – statistics. Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Farmers_and_the_agricultural_labour_force_-_statistics#Agriculture_remains_a_big_employer_within_the_EU.3B_about_9.7_million_people_work_in_agriculture

⁶³ Danish environment ministry (2020). Control-means statistics 2019; Treatment frequency and pesticide load based on sales and consumption

Practically, consultation with relevant Danish authorities working in this area noted that a specialised IT system was put in place which contains information on the authorised pesticides available on the market. At the farm level, farmers are required to keep records both on the purchase of pesticides (in kilograms or litres) as well as the quantity of each active substance contained in PPPs used on a selected crop (in kg). While there is no data on the variations of systems which are used by farmers to submit data, the most common approach is for advisory services working with farmers to submit the data to the Danish environmental protection agency (EPA).

Crucially, it was noted that there was already a system in place for data exchange between the advisory services and the Danish EPA. Farmers are able to directly upload data onto the system, however it was noted by the Danish authorities that farmers have a preference for the use of advisory services to submit the data. This was primarily seen to be due to the possible risks involved in submitting “wrong” or inaccurate data that could possibly lead to fines being imposed on the farmer. Thus, the use of advisory services added an additional layer of quality assurance for both the farmer and the Danish EPA. The main types of data which are provided include the total area of cultivation per farm, amount of pesticides purchased as well as their use (in kg) per hectare, per crop type.

The output from this system of data collection is a reliable source of data with approximately 90-95% data coverage across Denmark. This information is collated into an annual report, published by the EPA, on total annual sales figures for authorised pesticides as well as data on their use. The statistics also identify plant protection products used in agriculture and contains the Treatment Frequency Index (TFI) and sales of specific active substances.

France

Like Denmark, France operates with several stringent policy measures to try and reduce the use and risks of pesticides. These policies include national bans on the use of unauthorised substances, as well as specific taxes for farmers who use synthetic pesticides, depending on their toxicity (maximum 5%). From a research and development point of view, France also has in place research programmes to develop alternatives with the introduction of the Ecophyto 1 plan⁶⁴ in 2008 and reformed into Ecophyto 2+⁶⁵ which includes new taxes for pesticide retailers unless pesticide retailers are able to justify a decrease of their sales. Crucially, these plans put in place a target of a reduction in the use of plant protection products under a two-phase timeframe; The first phase with a 25% reduction by 2020 (through mainstreaming and optimising currently available techniques) while the second phase aims for a 50% reduction by 2025. The table below provides an overview of the data requirements in France.

Table 3 Overview of data requirements in France

Category	Statistical process in sales data	Statistical process in use data
Frequency of collection	Once a year	Once a year
Enforcement of data collection	Since 2009, distributors of plant protection products have been obliged to declare to the water agencies the sales of these products to end-users.	

⁶⁴ Ministry of Agriculture, Food and Forestry (2008). Plan Ecophyto 2018, de reduction des usages de pesticides, 2008-2018. Available at: <http://temis.documentation.developpement-durable.gouv.fr/docs/Temis/0082/Temis-0082750/22141.pdf>

⁶⁵ Ministry of Agriculture, Food and Forestry (2015). ECOPHYTO PLAN II. Available at: https://ec.europa.eu/food/system/files/2019-03/pesticides_sup_nap_fra-ecophyto-2_en.pdf

Type of data reported	Annual sales in kilograms or litres sold to the French market.	Quantity of each active substances listed in Annex III of Regulation 1185/2009 contained in plant protection products used on a selected crop, expressed in kg. The area treated with each substance are expressed in hectares.
Method of reporting	The data are from a compulsory declaration system which is controlled. Until 2010, compulsory declarations only concerned distributors selling certain categories of the most dangerous products. Since 2010, declaration has been compulsory for all distributors, regardless of the classification of the product.	
Population (i.e. No. of Authorised holders of pesticides)	Number of agricultural workers: 2 848 000 ⁶⁶ Number of authorised holders of pesticides: unknown	
Number of available PPPs	Total: 2694 Product quantity in tonnes: 56,837,721 ⁶⁷	

Since 2009, the National Bank for Sales of PPPs by approved distributors has been in place, with the provision of declarations of annual reports of sales of phytosanitary products by approved distributors to the water agencies. This operates within the framework of the provisions relating to the fee for diffuse pollution defined in the framework of the law on water and aquatic environments (LEMA) of December 2006⁶⁸. This database is also triangulated by comprehensive administrative data from a national database of pesticide sales recorded in units of active substances (kilograms and litres) by the Ministry of the Environment.

The principal method for data collection stems from administrative data which is collected via the use of surveys to distributors of PPP. As part of these surveys the respondents are required to report on quantity of each PPP sold. Then, by using the active substance composition of PPP, the quantity of product sold is converted into the quantity of active substance (kg) sold. Crucially, a compulsory declaration system controls the provision of data, with changes in 2010 making it compulsory for all distributors, regardless of the classification of the product to report. It should be noted however that this form of enforcement is progressive in that regulatory reform has occurred since its inception in 2010. For example, 2012 saw the requirement for distributors of seeds treated with PPPs and farmers buying products from abroad to report. In addition, the declaration system covers sales to end-users (or purchases abroad by end-users), which prevents double counting linked to authorisation transfers or intermediaries in the sale chain from occurring. While this data primarily provides information on the quantities sold, use data is calculated through other means.

For the collection of use data, each active substance listed in Annex III of the Regulation (EC) No 1185/2009, has to be reported with regards to the quantities used in kg and the area treated in hectare per crop in one reporting year. This data is collected via a number of surveys to farmers, collecting information such as cultivation practices (broken down by thematic areas and crop type) as well information on pesticide use. To assess the data, which is provided, data is checked and validated against previous survey cycles. Data entry software also has controls to check the dose provided by each phytosanitary product in comparison with the reference dose at the time of

⁶⁶ Eurostat (2021). Farmers and the agricultural labour force – statistics. Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Farmers_and_the_agricultural_labour_force_-_statistics#Agriculture_remains_a_big_employer_within_the_EU.3B_about_9.7_million_people_work_in_agriculture

⁶⁷ Eurostat (2021). Sales of pesticides. Available at: <https://ec.europa.eu/eurostat/web/products-eurostat-news/-/DDN-20200603-1>

⁶⁸ OIEau (2006). France : The 30th December 2006 - Law on Water and Aquatic Environments

registration thus allowing for the check of the consistency between the targets and the crop protection products used.

Portugal

Pesticide policies in Portugal primarily stem from legislation for the Regulation of Pesticides, namely Law No 26/2013⁶⁹, which regulates the distribution, sale and application of PPPs for professional use and their adjuvants and defines procedures for monitoring the use of such products. In addition, requirements on the reporting of sales data are enforced through Decree No.145/2015 which implements the Regulation (EU) No. 1107/2009 with regard to the list of approved active substances, the uniform principles applicable to the evaluation and authorization of PPPs and the data requirements for active substances and PPPs. The following table provides an overview of the main data requirements in Portugal.

Table 4. Overview of data requirements in Portugal

Category	Statistical process in sales data	Statistical process in use data
Frequency of collection	Once a year	Once a year
Enforcement of data collection	Decree-Law n.º 145/2015 of 31 July	No national legislation is in place.
Type of data reported	Annual sales in kilograms or litres sold to the Portuguese market.	Quantity of each active substances listed in Annex III of Regulation 1185/2009 contained in plant protection products used on a selected crop, expressed in kg. The area treated with each substance are expressed in hectares.
Method of reporting	All authorisation holders of plant protection products report the quantity of all active substances that are placed on the market nationally (incl. import and export data).	
Population (i.e. No. of Authorised holders of pesticides)	Number of agricultural workers: 459 221 ⁷⁰ Number of authorised holders of pesticides: 200 (around 1700 licenced distributors)	
Number of available PPPs	Total: Unknown Product quantity in tonnes: 9 865 810 ⁷¹ Tonnes of active substances: Unknown	

As described in the summary box above, for sales data, there is a legal obligation under Decree-Law n.º 145/2015 for authorisation holders to provide sales data (in kg) of active substances as well as PPPs to their competent authority. Each competent authority is required to distribute an excel template to all authorisation holders and consultants for which they are required to fill out the form or face possible infringement procedures. Once the data has been collected, it is then aggregated by the national authorities and sent to the national Statistical Office which validates the data and also implements secondary confidentiality. The accuracy of the data is checked, particularly for sales data where checks are carried out for duplications between authorisation holders and distributors. The reliability of the data is also checked through examining trends for outliers in the data that may be caused by reporting mistakes. It is under these checks that confidentiality is also ensured.

⁶⁹ Portugal national authorities (2013). Law No. 26/2013 regulating distribution, selling and application of pesticide products for professional use.

⁷⁰ Eurostat (2021). Farmers and the agricultural labour force – statistics. Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Farmers_and_the_agricultural_labour_force_-_statistics#Agriculture_remains_a_big_employer_within_the_EU.3B_about_9.7_million_people_work_in_agriculture

⁷¹ Eurostat (2021). Sales of pesticides. Available at: <https://ec.europa.eu/eurostat/web/products-eurostat-news/-/DDN-20200603-1>

The approach regarding use data is noticeably different. To calculate the national levels of pesticide use, the combination of eight separate data sources is combined to produce an estimate of the pesticide use. These include pesticide sales data and a variety of surveys to farmers and users of PPP, including vegetable surveys, farm structure surveys and orchard and olive groves surveys. As such, there is no specific collection of data on the use of pesticides in Portugal, however it was noted by the National Authorities that this would likely be revised upon the revision of the EU Statistics Regulation.

3.2.2 Effectiveness and relevance of the collection process for both the reporters and collectors

This section presents information pertaining to the costs that are incurred in reported data on the sales and use of pesticides. It will examine both the costs for competent authorities, as well as (where possible) indications of the costs for users and reporters. In a similar format to the previous sections, the following will be divided across Member State.

Denmark

From consultation with Danish authorities, information was uncovered regarding the effectiveness and relevance of the implementation and collection of statistics on pesticide sales and use. Firstly, in comparison to previous practices in data collection, it was noted that there was strong push back from farmers on the implementation of the new mechanism put in place following the implementation of Regulation No 1185/2009.

This was based on a number of factors. For example, there was fear from farmers on the repercussions of reporting the use of unauthorised substances that they may have purchased prior to a ban being put in place or by mistake. Despite there being process in the data collection system to account for this, there was a lack of awareness/ apprehension on the use of the collection system. In addition, the collection system operates with a series of warning messages which are triggered when a user attempts to upload the use of any non-authorised pesticides.

As a result, only approximately 10% of the data uploaded is directly imputed by farmers. The remaining 80% of data is reported via advisory services which inserted the data on behalf of the farmers. This approach was found to help to reduce errors and common mistakes being submitted into the system which were primarily found to originate from smaller farm dwellings. Common types of data error included mistakes in the naming of PPPs which created added complications in the results.

Contextually it is important to note that the implementation of greater data collection was put into legislation as a political agreement. Thus, while there were concerns from farmers on the burden such a system would impose, it was deemed necessary in order to monitor and report on pesticide use.

With regards to the usefulness of the data provided, consultation with the Danish authorities uncovered that **one of the main uses of the statistics was to report on the effectiveness of the pesticide tax which was put in place in 2013.** Crucially, indicators as part of the tax require the use of the data collected in order to understand the impact of the decisions made at both the political and governmental levels.

Interestingly, it was acknowledged by Danish authorities that while they are not directly aware of the views of farmers on the subject matter, **there is sense that farmers do not see any benefits in reporting data to the EPA.** Prior to the implementation of the new system in 2009, farmers were required to report data as part of a treatment frequency indicator which was calculated per crop and set indicators on the index level at which farmers need to abide by. Thus, under this system, farmers were able to monitor their pesticide use within the permitted index. In moving

away from this system, farmers reportedly did not see what benefits additional reporting would have on their daily practices.

Despite this, results and effects from having this data was clear from the point of view of the Danish authorities. While caveating that the collection of data does not have a direct link to a reduction in risk from the use of pesticides, the “on-demand” data on the amount of pesticides used and its application across crop types provides a powerful evidence base on which to base future political decisions and policies.

Portugal

From consultation with Portuguese authorities, information was collected regarding the effectiveness and relevance of the implementation and collection of statistics on pesticide sales and use. When asked about the degree to which the gathered statistics proved to be useful, particularly in informing policy decisions, the Portuguese authorities noted that the statistics are indeed useful. This was particularly the case for the development and use of indicators as the current system uses sales data to estimate the use of PPPs, however it is only used as a proxy. The statistics that are gathered provide useful information on plant health issues throughout Portugal and offer trends over time that can be validated and tracked. This information is of importance in providing data for the indicators on pesticide use which were published as part of the National Action Plan.

The use of statistics was found to be particularly relevant in policy making decisions, specifically towards risk and use reduction policies on PPPs. The level of information for decisions has increased at the policymaking level where it could be seen that this indirectly has an impact on farmers on the use of the best available product.

In addition, the data on pesticide sales was noted to be very important to evaluate the market and its connection with the sales authorization by the national authority. With regards to the benefits that the gathered statistics provide to the reporters of the data, the national authorities noted that users of PPPs have raised an interest in accessing and using statistics more. However, the level at which they would like to access the data would preferably be at the regional and local levels, providing more granular level data for users. Displaying the information at these levels can be challenging and the intended benefits for users are unclear. Indeed, it was noted that the collection of data at the regional levels is particularly challenging as the distribution networks are often very complex and can be difficult to track.

With respect to other stakeholders, other public administrations were noted to be using the data, particularly the Ministry of Environment which uses the collected data to support indicators on the quality of the environment.

When asked what effects the statistics had on reducing the risks and potentially the use of pesticides in Portugal, the National Authority highlighted that the collection of statistics is not connected to the reduction of risk per se. However, the collected statistics do allow for the observation of sales of PPPs and by virtue an estimation of the reduction of risk (as used under HRI1). In this respect, the national authority noted a steady decline in these levels.

3.2.3 Cost efficiency of data collection processes across the Member State

This section presents information pertaining to the costs that are incurred in reported data on the sales and use of pesticides. It will examine both the costs for competent authorities, as well as (where possible) indications of the costs for users and reporters. In a similar format to the previous sections, the following will be divided across Member State.

Denmark

Following a review of the estimations of costs and burdens imposed in the collection and monitoring of pesticide sales and use data by Eurostat quality reports, the following estimations were provided by the Danish authorities (see table below).

Table 5. Estimations of costs and time spent in Denmark

Cost category	Estimation of cost/ time spent on sales data	Estimation of cost/ time spent on use data
Time spent by the national competent authority	Around 20% of one FTE	Not available
Time spent by authorisation holders/ users	Approx. 1-7 hours	Not available
Costs for the national competent authority	EUR 26 896.25 (for EPA time) EUR 20 172.19 (for IT solutions)	Not available
Costs for the authorisation holders/ users	Approx. EUR 67.24 per product.	Increased digitalization caused additional burden

From consultation with Danish authorities, a more detailed picture was provided regarding the costs and burdens in the implementation and collection of statistics on pesticide sales and use. As mentioned under Section 3.2.2, farmers were seen to oppose the requirements on data to be recorded and provided to the Danish EPA. However, evidence on the direct costs/ burdens placed on farmers was found to be minimal if advisory services were used to upload the data. The main requirement for farmers is to keep records on the pesticides they use, and which crops they are applied to, thus in this respect the time taken is comparable to the system which was in place previously.

France

Similarly, estimations of costs and burdens imposed on the collection and monitoring of pesticide sales and use data reported in Eurostat quality reports, uncovered the following estimations which were provided by the French authorities (see table below).

Table 6. Estimations of costs and time spent in France

Cost category	Estimation of cost/ time spent on sales data	Estimation of cost/ time spent on use data
Time spent by the national competent authority	Around 0.1 FTE (Use of the sales database and ensured consistency with Annex III to Regulation)	Spread over the reference period (5 years): National level, 4 FTEs for one survey, at Regional level 15 FTE for one survey.
Time spent by authorisation holders/ users	Unknown	Approx. 1 – 1.5 hours per survey.
Costs for the national competent authority	Unknown	Cost of the 5 surveys carried out totalled approx. EUR 6,400,000
Costs for the authorisation holders/ users	Unknown	Unknown

Portugal

Finally, estimations of costs and burdens imposed on the collection and monitoring of pesticide sales and use data reported in Eurostat quality reports, uncovered the following estimations which were provided by the Portuguese authorities (see table below).

Table 7. Estimations of costs and time spent in Portugal

Cost category	Estimation of cost/ time spent on sales data	Estimation of cost/ time spent on use data
Time spent by the national competent authority	0.1 FTE per year	Not available as the processes haven't ended yet
Time spent by authorisation holders/ users	Unknown	Not available as the processes haven't ended yet
Costs for the national competent authority	Unknown	Not available as the processes haven't ended yet
Costs for the authorisation holders/ users	Unknown	Not available as the processes haven't ended yet

From the limited information that was possible to gather from desk review and interviews, national authorities noted that there is one dedicated person that works on the collation of data, however it was highlighted that this work is usually organised around one period, thus it is estimated to only accumulate around 0.1 FTE per year. With the current available national resources, it is not possible to add additional workload onto this position, however if resources were to increase it was noted that a more concerted effort would be placed in developing more indicators that could be used.

3.2.4 Contextual factors or unintended effects that may hinder the replication of the identified best example approaches in other Member States

This final point aims to explore the main contextual factors that were in place in each Member State for their reporting system to be put in place as well as the any areas which may hinder the replication of best practices in other countries. The following sections will explore each country in turn.

Denmark

Evidence from the Eurostat quality reports and consultation with Danish authorities uncovered several key contextual areas that were in place for the data collection system to work effectively. Firstly, clear political decisions to implement and legally require the reporting of data on pesticides which are sold and applied was crucial to enact any form of change. Secondly, the role of advisory services proved to be invaluable in supporting the provision and quality of data provided. Interestingly, this aspect was not foreseen in the inception of the collection system but was rather something which developed according to the needs of farmers.

Portugal

While only a small amount of evidence was provided with regards to contextual/ unintended effects from the interview with national authorities in Portugal. An unintended effect was seen to be through the increase in the quality of the data submitted since 2015, allowing the national authority to be able to rely on the data more than before.

4. Analysis of results

Based on the information gathered via desk research and interviews, a set of elements have been collated and presented in the table below. This summary overview is complemented by a SWOT analysis which has been conducted for both Denmark and Portugal. As such the following sections will be structured according to the SWOT analysis and look to identify areas of good practice that could be taken into consideration by other Member States in the collection of statistics on pesticide use.

Strengths

One of the core strengths of each of the data collecting systems was their connection to national legislation which often obliges users of PPPs to report data on their use or by distributors on the number of sales. In addition, the role of advisory services in the case of Denmark in supporting users to report data was seen to be a crucial driver in securing the transfer of high-quality data, while at the same time limiting the administrative burden of users to report.

The strong enforcement of the collection systems through national legislation provided clear results for both Member States (Denmark and Portugal), primarily through the increase in the quality and standard of data provided to the national authorities. This proved to be crucial in informing future policy decisions on the use and provision of pesticides at the national level, as well as providing data that could be used to measure the country performance against the indicators that were developed in each NAP.



Suggested Good Practice

Strong implementation and enforcement of legislation on the collection of statistics on the use of pesticides proved crucial. Where data collection/ reporting can cause increased burdens for reporters, the case of Denmark highlighted the possible role of farm advisory services to assist with the input and quality check of data being transferred to national authorities. An approach which was seen to be appreciated by both users of PPP as well as national authorities.

Weaknesses

While strong implementation of national legislation was seen to be a core strength of collection systems, this approach was also seen to produce weaknesses, primarily in the impact this has on reporters of data. In the case of Denmark, the strong political agreement which pushed the need for users of PPPs to report was met with strong opposition from farmers, thus creating a situation in which farmers felt disengaged in the reporting process. This is coupled with the issue of incentives where in both Member States (Denmark and Portugal) no clear incentives were given to farmers to report such data, further aiding the disengagement of farmers to report which could be seen to hinder cooperation between farmers and national authorities.

While providing incentives to report was not seen as a useful option by both Member States, one area that could be enhanced in future reporting systems is to make the reported data more accessible and useful to farmers to use. This was seen to be the case in Portugal where users expressed an interest in using data at the regional and local levels, however this was not possible due to reporting complexities.



Suggested Good Practice

Engagement with users of PPPs and working together on reporting statistics on the use of pesticides is an important and often overlooked aspect that could improve data in the future. While incentives to report may not be politically feasible, making use of the reported data and providing it in a useful format to give back to reporters can help to outline the usefulness of reporting such data and aid the collaboration between national authorities and users of PPPs in reducing the use of pesticides.

Opportunities

One of the main opportunities for national authorities in the rigorous collection of data is the enhanced evidence base that it provides for future policy decisions. This was found to be the case across both consulted national authorities, particularly in Denmark where the enhanced data quality provided greater opportunities for the development of a tax on pesticides. Crucially, increases in the quality of data can enable a more prescriptive approach to future policy decisions across a variety of thematic areas (i.e. with regards to the environment, human health and market changes).

As Denmark set clear provisions on the collection of use data, it acted as an example of what can be achieved through the collection and use of such data. While caveating that the collection of data does not have a direct link to a reduction in risk from the use of pesticides, the “on-demand” data on the amount of pesticides used and its application across crop types provides a powerful evidence base in which to base future political decisions, measures, initiatives and policies.



Suggested Good Practice

Despite the increased level of detail which is required for users to report, collecting data on the use of pesticides poses an important opportunity not just for national authorities but also for policy making at the EU level. Thus, in developing future collection systems, national authorities should prioritise the collection of use data to further the evidence base in which future political decisions, measures, initiatives and policies can be made at the national and EU levels.

Threats

Organisational capacity poses a threat to other national authorities which may look to adopt more stringent reporting requirements. This aspect primarily refers to the increased burden which could be placed on reporters to report data to national authorities and there being insufficient support to aid the transfer and quality assurance of data. The case of Denmark, as previously mentioned, highlighted the possible role of advisory services which could support users in reporting data. Thus, the overarching threat with such collecting systems is undoubtedly trying to find a balance between collecting data which is useful against the degree of burden which is imposed on users.



Suggested Good Practice

In the development of a data collection system, ensuring that system operates efficiently is of great importance to ensure that data can be provided with the least amount of impact on reporters. Utilising the role of advisory services poses as an option for additional support.

Table 8. Overview table and SWOT analysis

Country name	Type of process/mechanisms in place	Geographical coverage	Frequency of data collection	Types of statistics collected	Accuracy and reliability of the data collected	Degree of costs borne by reporters and national authorities	Degree of administrative burden (both reporters and collectors)	Specific contextual factors that defined the approach	Assessment on the impact of the statistics on reducing risks	Degree to which the SUD played a role in emphasising the importance of pesticide statistics	Strengths	Weaknesses	Opportunities	Threats
Denmark	Digital Data Collection System	Approx. 90-95% data coverage	Annual	Data on sales of pesticides on the market and use (in kg) per crop type	Progressively accurate and on-demand data since 2011	Minimal costs for reporters Medium costs for the Danish EPA	Administrative burden was shifted onto advisory services.	Need for national legislation to enforce the data collection Crucial role for advisory services in reporting the data and supporting farmers	Indirect impacts were observed - The collection of data did not lead to a reduction risk, but rather the data plays an important role in future policy decisions that can be tailored to specific trends.	The SUD helped to reaffirm the need of statistics and supported the role of regulation 1185/2009	Effective and efficient system which has enabled the Danish authorities to oversee in detail the purchase and use of pesticides across Denmark. Results have shown increased in data quality since its implementation.	Political agreement pushed through the reporting system against opposition from farmers, and failed to provide clear incentives for farmers	The data provided provides greater opportunities for the Danish authorities with regards to their tax on pesticides as well as a more prescriptive approach to future policy decisions	The lack of incentive for reporters could create significant problems for implementation of this approach in other countries. Countries with less advisory services could find this approach overly burdensome for farmers
Portugal	Digital reporting platform and use of surveys	At the national level only	Annual	Data on sales of pesticides on the market and use (in kg) per crop type	Progressively accurate since 2015	Minimal costs for Portuguese authorities. Costs to users unknown	Unknown	The enforcement of national legislation helped to increase the quality of data produced.	The impact of the statistics on reducing risk was seen to be more indirect, yet an important tool in measuring and following trends in the risks associated with pesticide use.	The SUD was seen to have an indirect effect on the changing statistics at the national	The current system, supported by the obligatory legal provision, meant that data quality and standards were increased since the legislation came into force in 2015.	The current system does not currently include any measurement of the actual use of pesticides and instead only collects data on pesticides sales. Data is also only available at the national level, not allowing for use at the regional or local levels.	The data provided was seen to boost policy making at the national level, primarily through the provision of a higher quality of data. The future also posed opportunities to expand the gathered statistics to include use data.	There is no clear evidence on the degree to which the obligation to report poses a burden to the users of PPPs, thus there is a threat that the current system could be currently overburdensome.

5. Conclusions

This case study aimed to examine four key questions on the use of pesticide statistics in three EU Member States. It included a review of the current state of play in each Member State, the effectiveness and relevance of collecting statistics on pesticide use, the cost efficiency of collection systems and the wider contextual factors which can hinder the replication of collection techniques.

At its core, the collection of statistics on the use of pesticides across the EU (or a lack thereof) is an important aspect in ensuring that national and EU level strategies to reduce the use and risk of pesticide use are well informed and evidence based. From the assessment of available information in each of the three selected Member States, a SWAT analysis uncovered four main areas of best practice that could be taken into consideration by other respective Member States that may not have in place similar collection systems. These four areas are summarised in the figure below.

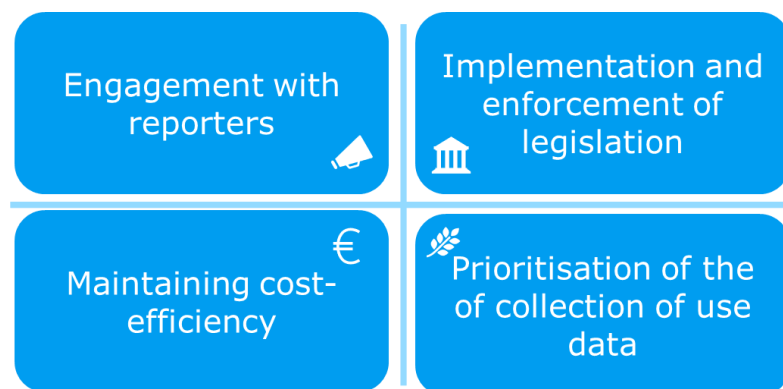


Figure 7 - Overview of key areas of best practice

In sum, while some Member States have made a concerted effort in the collection of data on the use of pesticides, the lack of harmonised and reliable data at an EU level continues to persist since the adoption of the SUD in 2009. Central to this is the level of ambition by Member States in collecting and utilising the potential of such data in working towards risk reduction in the use of pesticides.

6. Bibliography

Danish Environment Agency, 2017. Executive Order on spray logs for all professional users of plant protection products and reporting obligation for some agricultural companies and horticulture, etc.

European Commission. 2009. DIRECTIVE 2009/128/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 21 October 2009 establishing a framework for Community action to achieve the sustainable use of pesticides.

Eurostat. 2018. Pesticide sales (aei_fm_salpest09)- National quality reports. [online] Available at: https://ec.europa.eu/eurostat/cache/metadata/en/aei_fm_salpest09_esms.htm

Eurostat. 2018. Pesticide use in agriculture (aei_pestuse) - National Quality Reports. [online] Available at: https://ec.europa.eu/eurostat/cache/metadata/en/aei_pestuse_esms.htm

Eurostat, 2019. Research paper; Statistics on agricultural use of pesticides in the European Union.

Eurostat. 2021. Farmers and the agricultural labour force - statistics - Statistics Explained. [online] Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Farmers_and_the_agricultural_labour_force_-_statistics#Agriculture_remains_a_big_employer_within_the_EU.3B_about_9.7_million_people_work_in_agriculture

Eurostat. 2021. Pesticide sales. [online] Available at: https://appsso.eurostat.ec.europa.eu/nui/show.do?query=BOOKMARK_DS-382683_QID_-43E65BDE_UID_-3F171EB0&layout=PESTICID,L,X,0;TIME,C,X,1;GEO,L,Y,0;UNIT,L,Z,0;INDICATORS,C,Z,1;&zSelection=DS-382683UNIT,KG;DS-382683INDICATORS,OBS_FLAG;&rankName1=UNIT_1_2_-1_2&rankName2=INDICATORS_1_2_-1_2&rankName3=PESTICID_1_2_0_0&rankName4=TIME_1_0_1_0&rankName5=GEO_1_2_0_1&rStp=&cStp=&rDCh=&cDCh=&rDM=true&cDM=true&footnes=false&empty=false&wai=false&time_mode=ROLLING&time_most_recent=true&lang=EN&cfo=%23%23%23%2C%23%23%23.%23%23%23

French Ministry of Agriculture, Food and Forestry, 2008. Plan Ecophyto 2018, de reduction des usages de pesticides, 2008-2018.

French Ministry of Agriculture, Food and Forestry, 2015. ECOPHYTO PLAN II.

OIEau, 2006. France : The 30th December 2006 - Law on Water and Aquatic Environments.

Pedersen, A., 2020. Pesticide Tax in Denmark. Aarhus University-DCE/ IEEP,

Portugal national authorities, 2013. Law No. 26/2013 regulating distribution, selling and application of pesticide products for professional use.

Appendix 5: CASE STUDY V – GOVERNANCE OF THE SUD IN MEMBER STATE

1. Introduction to the case study

The Directive 2009/128/EC⁷² (henceforth SUD) is a transversal policy that spans economic, social, health and environmental fields as well as a broad range of different levels of governance and stakeholders. Prior to its introduction by the European Commission, the main body of legislation governing pesticides was Directive 91/414/EEC concerning the placing of plant protection products (PPPs) on the market, which is the predecessor of Regulation (EC) 1107/2009⁷³. The SUD was introduced to establish a framework to achieve a sustainable use of pesticides by reducing the risks and impacts of pesticide use on human health and the environment and promoting the use of integrated pest management and of alternative approaches or techniques such as nonchemical alternatives to pesticides.

The SUD itself is largely based on actions taken at Member States (MS) level, given the variation in agricultural land and practices. Moreover, MS had their own legislation in place that governed the use of pesticides even before the SUD was introduced (European Court of Auditors, 2020).

Due to these factors, and the general differences between the MS in terms of governance, the implementation of the SUD can drastically differ between MS. The differences between MS do not only concern the means by which MS have anchored the implementation of the SUD, but also the level of cooperation between institutions (inter-institutional cooperation) and organisations (inter-organisational cooperation). Furthermore, MS might show differences with respect to the level of cooperation at different governance levels. Analysing these aspects might shed light on interesting lessons learned and future policy options. The following figure from the European Court of Auditors (2020) lays out the a high level overview of the different responsibilities that arise from the European plant protection policies, including the SUD, at different levels and further highlights the importance of close coordination to effectively fulfil them.

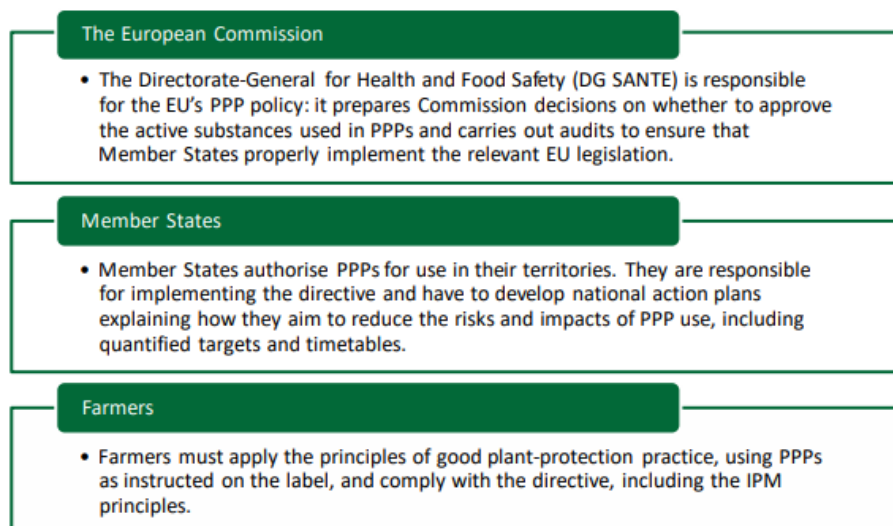


Figure 8: Key responsibilities for the European plant protection policy.

Source: (European Court of Auditors, 2020)

⁷² Directive of the European Parliament and of the Council of 21 October 2009 establishing a framework for Community action to achieve the sustainable use of pesticides. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32009L0128>

⁷³ Regulation (EC) No 1107/2009

At national level, further responsibilities could potentially be differentiated between different authorities as well as regional and local authorities for the implementation of the SUD. As such, responsibilities for the SUD can lie with different institutions such as the agricultural or environmental ministry, which in turn may have implications for the implementation and enforcement of the legislation within a given MS. In most MS, the SUD is led by the Ministry of Agriculture, Food and Forestry (e.g. Luxembourg, Italy, Germany, etc.), but with varying levels of involvement of the Ministries of Environment and/or Health. In a few cases, it is led by the Ministry of Environment (Denmark) or the Safety and Chemicals Agency (Finland). Additionally, fragmentation of responsibilities such as on the federal and regional levels can be observed in some cases (e.g. in Germany, Austria and Belgium). These different approaches and the distribution of responsibilities highlight the need to further consider possible governance issues which may arise. In order to identify these issues, it needs to be assessed how the governance of the SUD is implemented within the different MS. Moreover, by analysing the distribution of responsibilities as well as the extent of cooperation, interesting insights can be gained concerning specific challenges faced and good practices applied by the MS to overcome these challenges.

2. Research theme for the case study

The purpose of this case study is to analyse how different MS have implemented the SUD. In this regard, the focus is drawn to aspects of governance including inter-institutional cooperation and the level of cooperation at different governance levels, as this might entail interesting lessons learned or best practice examples for future policy options but also might highlight possible problems in the enforcement of the SUD.

The intention of the case study is therefore to answer how different “governance approaches” in the selected MS, Denmark, Germany, Greece and Italy may influence how SUD performs, e.g. to look into examples of division of responsibilities, collaboration, and consultation in the MS. The case study will therefore seek to answer the following questions:

- How are the administrative structures in the selected MS built up and which administrative or institutional bodies are in charge of transposing and implementing the SUD?
- What are relevant strategies/activities regarding the implementation of the SUD on the national, regional and local level?
- Which authorities are involved in the planning and implementation of relevant strategies and how are corresponding responsibilities distributed (e.g. per SUD article or monitoring- and reporting responsibilities)?
- What is the level of consultation and cooperation between relevant authorities and/or policy fields and to which extent are further stakeholders involved? Do certain governance models or working groups exist?
- Which financial and human resources must be taken into account and what are the relevant administrative burdens?
- How is the support from the European Commissions (EC's) side perceived by the MS and which possible improvements on the governance of the EC regarding SUD were identified by MS?

The main means of assessment will be a literature research of governance documents available in English as well as in-depth interviews with the regulating authorities within the selected MS.

In conclusion, based on the research questions above and the analysis of governance aspects in the selected MS, this case study intends to identify and assess obstacles in the implementation and cooperation and to provide examples of identified best practices on different institutional and administrative levels (EU, national, regional and local level).

3. Methodology

The starting point for this case study was identifying the key research questions and, based on that, proposing criteria for the selection of the MS. The means for data collection were then selected (literature review and interviews), and the interview questions drafted.

3.1 Data collection

Data collection was based on two pillars. Firstly, a targeted literature review, which consisted of analysing the relevant fact-finding missions and audit reports, the NAPs for each of the selected MS, and other relevant sources e.g. national ministry website. This was followed by conducting semi-structured interviews with the selected MS with national and regional authorities as well as non-governmental actors involved such as grower organisations.

3.2 Member State Selection

For this case study, the following MS have been selected: Denmark (DK), Germany (DE), Greece (EL) and Italy (IT). The selection criteria were as follows:

- variation of relevant responsible authorities and possible cooperation in place;
- evolution of the harmonised risk indicator for pesticides (HRI1);
- percentage of EU PPP sales, considering the countries at the lower end and the higher end of the spectrum and
- the result of the report and the annex of the report on the experience gained by the Member States on the implementation of national targets under the SUD directive (European Commission, 2020b, 2020a).

Lastly, the availability and responsiveness of the MS was critical for the final selection as some MS did not respond to our inquiry thus not being further considered for the case study. For contacting regional and non-governmental actors, the national authorities were asked for contact details of relevant stakeholders during the interviews. The respective stakeholders were contacted via e-mail.

3.3 Limitations

It was originally planned to conduct field trips to enhance the case studies but, given the ongoing COVID-19 pandemic at the time of drafting this case study, this could not take place. It must therefore be noted that a large part of the assessment is dependent on a sample of interviews and therefore potentially reflect individual statements. This applies to relevant authorities on the national and regional level and also to non-governmental stakeholders. At the same time, the available scientific literature on governance structures in the MS is limited. Therefore, any extrapolation of the results must be considered with care.

Another limitation was that audits and fact-finding missions are often outdated due to political changes within the MS (example Denmark). Additionally, the extent to which MS reported internal problems and hurdles during the interviews regarding the governance and cooperation on the SUD might vary. To combat this, interviews with other relevant stakeholders within the MS were planned, however could not in all cases be conducted.

4. Situation analysis in the EU

4.1 General overview in the EU

The design of the SUD goes back to 2006 and was originally drafted, adopted and coordinated by DG Environment. Since then, the coordination of the SUD has been transferred to SANTE E4 in 2012 and is currently with SANTE F3 since 2016.

In terms of governance of the SUD, the EC was required to submit a report on the experience gained by the MS on the implementation of national targets established in their NAPs to the European Parliament and the Council in accordance with Article 4(3) once in November 2014 and in November 2018. Moreover, the EC has to report regularly⁷⁴ to the European Parliament and Council on the progress in the implementation of the Directive under Article 16 (European Commission, 2020b).

Generally, it was noted by the EC that, based on the trends in HRI1 and HRI2 and the Farm to Fork targets, that through the provision of the SUD there seems to be a reduction of pesticide use. But it remains difficult to concretely evaluate the progress under the SUD. For instance, it is difficult to trace back improvements in water quality over time to the SUD.

Given the current data limitations on pesticide use and impacts, EC audits and fact-finding missions are probably the most important tool for monitoring the implementation of the SUD. Nonetheless, working on the governance case study has shown that these are outdated in some cases e.g. due to frequent political changes within a MS. The current back-to-back evaluation of the SUD has further decreased the number of audits which can be performed by SANTE according to the EC. It was however noted by the EC, that doing more audits could lead to incremental improvements in the enforcement of the SUD over the years.

Coordination and cooperation within the EC

Within the EC, DG SANTE is in charge of the coordination with the different DGs and European institutions (e.g. AGRI, ENV, ESTAT, JRC and CLIMA) covering a multitude of relevant topics including PPPs, Farm to Fork, international affairs, water protection etc.

For the SUD back-to-back assessment, an additional EC inter-service steering group was set up representing 19 DGs⁷⁵ further highlighting the cross-cutting nature of the topic and possible overlaps with other legislation such as the Regulation (EC) No 1107/2009 concerning the placing of PPPs on the market. Even though the various DGs have different foci of work, the general cooperation within the inter-service steering group was described as very good by the EC. Sustaining such a platform as a permanent exchange mechanism between the different relevant DGs could potentially further improve the efficiency of implementing and regulating the SUD.

Coordination and cooperation with MS between the EU and the MS

In terms of support and oversight of the transposition and implementation of the SUD by the MS, the EC has established a SUD Working group (WG) with regular meetings, audits and fact-finding missions, regular surveys and questionnaires as well as Better Training for Safer Food (BTSF) Events. Additionally, the EC provides guidance, legal clarifications, and training where necessary to further support the implementation.

⁷⁴ Regularly is not further elaborated

⁷⁵ Including ENV, AGRI, JRC, ESTAT and CLIMA

The main modes of cooperation are regular exchanges as well as trainings. Moreover, platforms for ad hoc exchanges are provided. The main cooperation plan allowing to EC to coordinate and collaborate with MS as well as MS with each other are outlined below.

SUD Working Group

The SUD WG constitutes of the nominated competent authorities (CA) from the MS (including IS, NO and CH). Moreover, other DGs and relevant stakeholders are invited on a case-by-case basis if a particular agenda topic is discussed.

The WG meetings thereby present the core strategy for coordination and cooperation with the MS, and meetings taking place once a year. The main aims of the WG are for MS to share and exchange good practices and experiences in the implementation of the SUD as well as to provide a platform to discuss ongoing SUD-related activities. This also allows the EC to gather firsthand information on the SUD implementation in the MS and possible issues as they arise and provide legal interpretation on specific aspects. Moreover, the WG provides room for the EC to share updates and ongoing work at EU level, including on related policy aspects such as the CAP, biodiversity, statistics, etc. It further allows relevant stakeholders to present their work during these meetings. This working group also allows for cooperation with other working groups such as the PPP Enforcement Working group and the Agro-Environmental Statistics working group. To foster this cooperation a joint meeting was organised by the EC in 2019 (European Commission, 2020b).

Due to the pandemic as well as the back-to-back elevation of the SUD, the frequency of the WG meetings has further increased as costs for travelling can be reduced by remote participation. It was noted by the EC and several MS that these more frequent meetings are appreciated as they can be used as a chance for MS to explain their viewpoint, share their experience and exchange information on certain topics. This, however, does not necessarily lead to a common solution suitable for all since local conditions vary. Nonetheless, some have also voiced their desire for less frequent meetings due to busy schedules.

Better Training for Safer Food

Additional means of cooperation and coordination include the BTSF which is used to support MS to implement the SUD. The courses provide MS with the knowledge to implement their obligations e.g. relating to testing of pesticide application equipment or the implementation of Integrated Pest Management (IPM) (European Commission, 2020b). However, the effectiveness of BTSF trainings can be questioned because they were never assessed. Training/information is usually provided for one person per MS per course session. This person is requested to disseminate the information within the MS. Thus, the effectiveness also depends on the proper dissemination of information within the MS. This is not always the case according to the EC. It does however allow the EC to bring people from different MS together.

Despite the training, MS voiced the need for crop specific IPM guidance and inquired if those could be prepared by the EC. However, the EC has indicated that it may not have sufficient resources or expertise to prepare them and offered the MS the opportunity to do so themselves. These also cited insufficient resources and expertise as a reason for not developing them. This raises the question of who would be best suited to develop such guidance.

SUD-Web-Portal

Lastly, the EC established and maintains the SUD-Web-Portal⁷⁶ to facilitate the exchange of information between MS and other stakeholders in the SUD and IPM, which was proposed by the expert group on sustainable plant protection set up under the Dutch Presidency in 2016. The portal

⁷⁶ https://ec.europa.eu/food/plants/pesticides/sustainable-use-pesticides_en

is used by MS to facilitate sharing of relevant information among interested parties (European Commission, 2020b).

Coordination and cooperation with other stakeholders

No regular form of cooperation is established with stakeholders. However, there is the basis for irregular cooperation or on an ad hoc basis. Examples for irregular cooperation would be the EC partaking in relevant conferences in order to hear the view of certain stakeholders on relevant topics. Moreover, NGOs such as Pesticide Action Network PAN Europe and stakeholders from the industry, are invited to present their standpoint within the WG meetings. As such, PAN, the European Crop Protection Association (ECPA) and SPISE (Standardised Procedure for the Inspection of Sprayers in Europe) and many others have had the chance to present their work in past meetings of the WG (European Commission, 2020b). The involvement of different stakeholders does however depend on the topic to be discussed.

Article 18 stipulates that "The Commission shall put forward as a priority for discussion in the expert group on the thematic strategy on the sustainable use of pesticides the exchange of information and best practice [...]", however, according to the EC currently no such expert group is established (Directive 2009/128/EC of the European Parliament and the Council of 21 October 2009 Establishing a Framework for Community Action to Achieve the Sustainable Use of Pesticides, 2009).

Moreover, the EC has in the past been contacted regularly by different stakeholders and it was stated that the EC is open to this form of communication.

4.2 Selected MS

As described by the EC (2001), different governance approaches can offer greater flexibility as to how MS implement EU legislation on the ground, so that regional and local conditions can be taken into account. In the following, approaches applied by the selected MS are examined and bottle necks and good practices described.

4.2.1 Denmark

4.2.1.1 Overview

In Denmark the SUD is implemented via the Chemical Act⁷⁷ and a series of orders covering specific aspects of the Directive (European Commission, 2017a). The Ministry of Environment is the competent authority (CA) with regards to the SUD.

The Ministry of Environment was established in 1971 and was historically tasked with the authorisation and other activities concerning pesticides (e.g. health effects, environmental effects, groundwater, etc.). Between 2015 and 2020 (4.5 years) the Ministry of Environment the Ministry of Food Agriculture and Fisheries were fused. As regards the implementation of the SUD, the merge changed the responsibility between the ministries, as during this time the enforcement, IPM, and spraying journals⁷⁸ were all located within one ministry.

Next to the Chemical Act, the NAP presents the primary strategic instrument for the implementation of the SUD in Denmark, which was established even before the SUD came into force in 1986. The NAPs, also in their early form prior to the SUD, contain specific and detailed funding of activities from the government. Currently, the NAP is funded by the government, however, some parts of the

⁷⁷ <https://www.retsinformation.dk/eli/lt/2017/115>

⁷⁸ <https://www.retsinformation.dk/eli/lt/2015/1229>; <https://www.retsinformation.dk/eli/lt/2020/1946>

actions outlined in the NAP are paid by the users (e.g. spraying authorisations by farmers, pesticide approvals, supplementary courses).

Besides the NAP, Denmark has established a pesticide tax. This allows the taxation of individuals who sell and use pesticides depending on the load on the environment and human health of the pesticides used. In the past, there was a direct link between the governmental income from the pesticide tax and the governmental financial support of the NAP. This link was not continued as farmers would pay for the use but also receive agricultural subsidies from the government (promille- og produktionsafgiftsfonden⁷⁹) which did not serve the overall goal to reduce the use of pesticides. As this link has ceased, governmental income generated from the tax is used to support activities under the SUD.

4.2.1.2 Administrative structures and distribution of responsibilities among involved authorities

The lead ministry for the SUD including the NAP in Denmark is the Ministry of Environment. There is however close cooperation with the Ministry of Food, Agriculture and Fisheries considering they were merged between 2015 and 2020. Other ministries and agencies entrusted with different tasks related to the SUD or the NAP are indicated below:

- The Ministry of Health;
- Agencies of the Ministry of Food, Agriculture and Fisheries:
 - Danish Agricultural Agency (DAA);
 - Danish Veterinary and Food Administration (DVFA);
- The Danish Ministry of Taxation, specifically:
 - Danish Tax Agency (DTA);
- Ministry of Education.

National level:

Until recently, most of the responsibilities for implementation resided with the Danish Environmental Protection Agency (DEPA). The responsibilities of the agency and the Ministry have however changed. Thus, the main responsibility has been moved to the Ministry of Environment. The DEPA however is still responsible for a multitude of tasks concerning the implementation and enforcement of the NAP.

All responsibilities which touch on food and feed (e.g. residues or health effects) lie with the Ministry of Food, Agriculture and Fisheries, particularly the DVFA. Moreover, the DAA is responsible for the control of farmers. The reason as to why these responsibilities lie with the DAA is that they also check for the CAP cross-compliance at the same time. To reduce the administrative burden on farmers and to minimise the number of agencies tasked with carrying out controls on the farms, inspections are bunched together. A benefit indicated by Denmark arising from this, is that the agricultural agency while on the farm also specifically check farmers' compliance with the SUD.

Regional level

Denmark has around 100 municipalities and 5 regions, but they do not have many tasks under the NAP and the SUD. The main responsibilities of the municipalities concern the determination of appropriate land management conditions around wells used for public water supplies and the implementation of the buffer zones. Despite that, municipalities are only involved with a few activities relating to green houses, handling of wastewater and waste with pesticide residues.

Table 9 highlighted the institution bodies in charge of implementing and enforcing the SUD per article.

⁷⁹ <https://lbst.dk/om-os/tilsyn-med-fonde/promille-og-produktionsafgiftsfonde/#c6427>

Table 9: Administrative or institutional bodies in charge of transposing, implementing and enforcing the SUD in Denmark

Article of the SUD	Implementing authorities	Enforcing authorities
Lead Ministry	Ministry of Environment	
Article 4 (NAP)	Ministry of Environment and Inter-ministerial steering group consisting of representatives from: <ol style="list-style-type: none"> 1. Ministry of Environment, 2. DEPA, 3. Ministry of Food, Agriculture, and Fisheries of Denmark, 4. DAA, 5. DVFA, 6. DTA. Nine sub-steering groups, consisting of relevant authorities, report to the inter-ministerial steering group.	See individual articles
Article 5 (Training)	Ministry of Environment, DEPA (education and certification of operators), and Ministry of Education (training).	Not legally required for advisors to undertake training – no enforcement. DAA is responsible for the control at farm level and the control of other professional users of pesticides and DEPA will enforce violations. DEPA is responsible for the control and enforcement of distributors of pesticides that need to have a training certificate.
Article 6 (Sales of pesticides)	DEPA and Ministry of Environment	DEPA carries out control of distributors to check if they sell pesticides to customers that do not have the required certificates
Article 7 (Information and awareness-raising) & Article 10 (Information to the public)	National Poisons Centre under the Ministry of Health (Data collection on acute and chronic poisoning), DEPA (Website and campaigns), DVFA (quarterly and yearly reports on pesticide residues in food and campaigns)	This article confers no control obligations and therefore there is no enforcing authority.
Article 8 (Inspection of equipment)	Ministry of Environment and DEPA	DAA carries out control at the farm level and DEPA enforce violations
Article 9 (Aerial spraying)	Ministry of Environment and DEPA	DEPA – aerial spraying including drones is prohibited. One derogation has been granted for the application of pesticides with drones in July 2021. No other derogations have been given for the application of pesticides by air in the last twenty years
Article 11 (Aquatic environment and drinking water)	Ministry of Environment and DEPA, Municipalities are responsible for delineating and determining appropriate land management conditions around wells used for public water supplies.	DAA controls farmer practices regarding sprayer filling and washing during controls on farms. Compliance with buffer zone requirements are controlled by DAA and DEPA enforce violations.
Article 12 (Reduction of pesticide use or risks)	Ministry of Environment and DEPA.	DEPA, DAA.
Article 13 (Handling and storage)	Ministry of Environment, DEPA. Municipalities (waste)	DAA carries out control and DEPA carries out the enforcement in case of violations. The municipalities are responsible for waste management.
Article 14 (IPM)	Ministry of Environment and DEPA.	There is an IPM point system consisting of 14 questions that the individual growers have to fill in each year. During the control at the farm level, the DAA will control if the questions have been answered or control either at the

		individual grower level or at a national level
Article 15 (HRI)	DEPA	This article confers no control obligations and therefore there is no enforcing authority.

4.2.1.3 Stakeholder engagement and cooperation

The following section will elaborate on the level of consultation and cooperation between relevant authorities and further stakeholders in Denmark. Due to the distribution of tasks, the focus will be on both, the national levels as well as the structures for engagement with municipalities and other stakeholders.

Cooperation structures and forms of engagement on the national level

As described above, there is a multitude of national ministries and agencies involved in the implementation and enforcement of the SUD, highlighting the need for close cooperation. In order to facilitate this coordination, Denmark and especially the Ministry of Environment coordinate with the relevant ministries and agencies on a regular basis within structured meetings. There were however no strategies or plans for stakeholder engagement identified for Denmark. The following describes the means to guarantee regular and meaningful exchange between relevant authorities.

Steering group:

A previous evaluation by the Danish national auditor's institution (Rigsrevisionen) of the steering of the NAP has uncovered that there was a need for further steering. Based on this evaluation, a steering group and associated subgroups were established. The overall goal was to optimise the organisation and communication between the different agencies.

The steering group (SG) is responsible for the planning of the next NAP period (meaning the next year of e.g. a five-year NAP period) and the follow-up on the NAP. It focuses on how the initiatives described in the NAP are progressing and the communication between agencies and ministries is conducted. Meetings are held biannually. Each year the agencies are responsible for describing the activities in the NAP that have been carried out during the past year and for planning the next one. On this basis, a yearly report for the Parliament is drafted.

The Ministry of Environment is the head of the SG. Other members involved are listed below:

- The DEPA;
- The Ministry of Food, Agricultural and Fishery;
- The Danish Veterinary and Food Administration;
- The Danish Agriculture Agency (formerly known as Agrifish) and
- The Danish Ministry of Taxation, specifically the Danish Tax Agency

The Ministry of Education is not part of the SG as it only has a minor role in the implementation.

Additionally, there are several subgroups responsible for the implementation of activities and the reporting on these activities covering different issues. In total there are 7 subgroups. Their main focus issues and members are highlighted in the table below.

Table 10: Subgroups of the steering group for the NAP

Subgroup	Involved authorities
Approval of plant protection products	DEPA, DVFA
Controls and enforcement	DEPA, DAA, DTA
Greenhouses	DEPA, DAA
IPM (DEPA)	DEPA

The warning system for pesticide leaching	DEPA, GEUS - Geological Survey of Greenland and Denmark, the Faculty of Agricultural Sciences
Groundwater	DEPA
Statistics and status for golf courses	Not specified

The subgroups report back to the main SG. Moreover, each subgroup prepares 10 status reports per year containing information on the activities carried out and their results. A short resumé of these is sent to the parliament. The political parties are involved in agreeing on strategies for the NAP and are made the final decision on what is prioritised in the NAP. At the moment, there is very broad political agreement in Parliament.

Cooperation structures and forms of engagement with municipalities

Within Denmark, there is the association of local governments (Kommunernes Landsforening, KL), which allows the municipalities to communicate with the government in one voice. This further makes it necessary for municipalities to coordinate before approaching the ministry.

In terms of cooperation strategies, no specific strategy could be identified. According to the Danish authorities, there is communication between the DEPA and the municipalities on groundwater protection with regards to the protection of buffer zones. It was however not specified if these are a regular occurrence or rather ad hoc and on need basis. Moreover, there are structured meetings taking place, which involve relevant stakeholders dealing with water and water protection. This panel is described below.

Danish water panel

The Danish water panel was implemented to support the coordination of measures taken by the farming industry, the municipal authorities, and water companies, and foster cooperation between those entities. Its main goal is not steering the cooperation but rather providing a panel for dialogue and communication.

The water panel consists of:

- Danish water and waste water associations;
- Danish Water Treatment facilities (DVA);
- KL;
- Danish Regions;
- Danish Patient Safety Authority;
- DEPA and
- GEUS - Geological Survey of Greenland and Denmark, the Faculty of Agricultural Sciences.

Cooperation structures and forms of engagement with stakeholders

Private stakeholders are not directly involved in the governance or implementation of the SUD, there is however the expectation that stakeholders such as farmer organisations aid in the enforcement by informing their members of violations and to discuss possible improvements or contribute to possible new measures/highlight areas they struggle with. In order for these stakeholders to do so, close cooperation is necessary, which is primarily led by the DEPA and the Ministry of Environment. This is achieved by regularly and structured meetings to promote dialogue and provide a platform providing information and guidance on the correct implementation of legislation. Additionally, cooperation is sought in a less structured way or on a smaller scale during regular or ad-hoc meetings as a way to bring up certain aspects which stakeholders might not want to address in front of a larger audience. The means for achieving this regular exchange are described next.

Dialogue Forum:

Besides the water panel, where relevant stakeholders are represented, there is also the dialogue forum for communicating with different stakeholders. Participants are from different types of stakeholder groups including authorities, NGOs, pesticide authorisation holders, farmer associations (Danish Agricultural and Food Council), water works associations, universities, etc. These meetings take place four times a year and topics discussed concern the implementation of measures, the controls, different issues concerning the Action Plan, cooperation with the EU to name but a few.

Other workshops/ stakeholder meetings:

Another form of cooperation is provided through special workshops consisting of different stakeholders, which focus on what could be improved or what could be important issues within the next 5-year period in a new NAP. Before these workshops, input is collected. The workshops are split into several groups either individual meetings or several stakeholders within one workshop additionally there is a public hearing planned for the new NAP.

Besides the workshops, DEPA and the Ministry hold regular meetings with e.g. the agricultural food council, the industry for the authorisation of pesticides, the Agricultural Advisory Service, HortiAdvice Scandinavia, the Golf Union and with NGOs (Beekeeper Association, The Danish Society for Nature Conservation).

It was further noted, that this close dialog is of great importance and that stakeholders are involved throughout the implementation process. For this reason, relevant stakeholders and farmers are also part of the subgroups of the SG.

4.2.1.4 SUD associated financial and human resources

Costs for the SUD are almost exclusively covered by the government (with the exceptions previously mentioned where users and producers of PPPs pay a fee for specific services and farmers have to pay for their training and certificates). Employees undertake responsibilities related to the SUD in addition to other tasks, but in time use, the workload would equate to around nine full-time employees with assignments concretely relating to the SUD. The implementation of the NAP mandated by the SUD involves the workload for at least 23 full-time workers at the national level. This does not include leadership and support staff. The use of time at the regional and municipal level is limited and would likely not amount to a full-time worker.

Administrative costs emphasised by stakeholders as burdens of the SUD related to the approval of PPPs, the pesticide tax and the requirement of submitting data to the DEPA on farmers' record-keeping on the use of pesticides are often.

In terms of better financing of the SUD, Denmark recommended to further encourage other MS to adopt a pesticide tax to reduce the use of pesticides and finance activities under the SUD. In the following assessment, the strengths and weaknesses, as well as challenges and best practices identified within Denmark, are highlighted.

4.2.1.5 Assessment

Within Denmark, the SUD is largely transposed and implemented at the national level, and very little incorporation of regional bodies is seen there. Generally, within the European Implementation Assessment of the SUD (2018), a high level of engagement among the social partners and the public concerning reducing the risks posed by pesticides was noted and significant efforts were made to promote IPM among growers were found, which indicates a high level of communication and integration of relevant partners. To achieve high levels of cooperation, several groups, panels, and forums have been established to enable different stakeholders to discuss aspects of the SUD and be involved in the governance of the SUD as described in the previous sections.

Strengths and Weaknesses

The central organ for the coordination and cooperation of the SUD is the steering group and its associated subgroups. These seem to allow the monitoring of progress made on the activities described within the NAP and allows for effectively coordinating with the relevant ministries. Moreover, the subgroups allow splitting the activities set in the NAP into relevant topics and assign relevant government bodies which might lead to a more targeted assessment and more flexibility. The required status reports further guarantee that all relevant bodies are informed about the results of the individual subgroups.

In terms of cooperation with the regional level, Denmark has the KL which allows municipalities to communicate with the government in one voice. This can possibly reduce the time needed for coordination at the ministerial level as not all 100 municipalities have to be consulted by the national authorities and they can maintain their impartiality. On the other hand, the coordination is possibly just transferred to the regional level. The KL could not be interviewed for this case study, assessing whether this approach reduced the burden or if it rather transfers it to a different level and how the KL perceives the cooperation would be of interest.

Involving other stakeholders besides the authorities on the national and regional level in forms such as the dialog forums and the SG subgroups allows to foster cooperation between the involved entities and encourages open communication. Further cooperation with said stakeholders is possible during individual ad-hoc meetings or smaller workshops and allows stakeholders to bring aspects to the attention of the relevant authorities in a smaller setting. On the other hand, providing this opportunity for individual or smaller meetings with stakeholders might rob the opportunity of wider stakeholders getting informed or involved.

Challenges and best practices

Within Denmark, the Danish national auditor's institution (Rigsrevisionen) audits the Danish public accounts based on the provisions of the Danish Auditor General Act. Through the assessment of specific policy areas such as the SUD and its governance, the Danish national auditor's institution can uncover areas with the need for improvement such as the need for more steering of the SUD. These assessments can be seen as a best practice to uncover bottlenecks and provide a starting point for overcoming them.

Another best practice identified is the limitation of farm visits to one authority to reduce the administrative burden for farmers but also for authorities. Combining compliance checks not only minimises the number of agencies tasked with carrying out controls but also allows assessing cross-compliance at the same time.

4.2.2 Germany

4.2.2.1 Overview

In Germany, the SUD is transposed into national law via the Plant Protection Act of February 6th 2012 (PflSchG) and other relevant national ordinances⁸⁰ (European Commission, 2017b). Legislation in the field of plant protection is coordinated by the Federal Ministry of Food and Agriculture (BMEL) in cooperation with the Länder⁸¹ (federal states) authorities. As regards the SUD, the BMEL is the CA at the federal level. Respective responsibilities associated with the SUD are defined in the PflSchG. Furthermore, the NAP has been established for transposing several – but not all – articles of the SUD. This distinction is necessary as several measures of the SUD are transposed through relevant national ordinances such as the "Pflanzenschutz-

⁸⁰ Examples of relevant national ordinances include the "Pflanzenschutz-Sachkundesachverordnung" (Regulation on Professional Knowledge in Plant Protection), the "Pflanzenschutz-Geräteverordnung" (Regulation requiring checks on Plant Protection Equipment), the "Verordnung über die Anwendung von Pflanzenschutzmitteln mit Luftfahrzeugen" (Regulation concerning the aerial spraying of Plant Protection Products)

⁸¹ In Germany, the federal states are called "Länder"

Sachkundesachverordnung" (Regulation on Professional Knowledge in Plant Protection) or the "Pflanzenschutz-Geräteverordnung" (Regulation requiring checks on Plant Protection Equipment). According to stakeholder interviews, Germany had already implemented measures relating to the reduction of the use of pesticides in conventional farming even prior to the transposition of the SUD, as a result of the "Reduktionsprogramm chemischer Pflanzenschutz" (Programme to Reduce the use of Chemical Pesticides) which came into force in 2005.

In general, it should be noted, that no strategies or plans for stakeholder engagement could be identified for Germany. For the governance of measures related to the SUD, Germany relies on regular meetings with relevant stakeholders. For this purpose, different cooperation structures and forms of stakeholder engagement exist. These will be described and analysed in the following sections. Also, relevant examples of existing cooperation structures are presented. In a first step, the administrative structures and the distribution of responsibilities among the involved authorities is outlined.

4.2.2.2 Administrative structures and distribution of responsibilities among involved authorities

In Germany, the BMEL is the lead ministry for the coordination and management of the NAP. Other relevant ministries involved in the NAP are (BLE, 2021):

- The Federal Ministry for Environment, Nature Conservation, Building and Nuclear Safety (BMU);
- Federal Ministry of Education and Research (BMBF);
- Federal Ministry of Health (BMG);
- Federal Ministry of Economic Affairs and Energy (BMWi);
- Federal Ministry of Labour and Social Affairs (BMAS);
- Federal Ministry for Economic Cooperation and Development (BMZ);
- Federal Environment Agency (UBA).

Further authorities entrusted with different tasks related to the NAP which are falling under the jurisdiction of the BMEL are:

- the Federal Office for Agriculture and Food (BLE);
- the Federal Office of Consumer Protection and Food Safety (BVL);
- Federal Research Centre for Cultivated Plants Julius Kühn-Institute (JKI);
- Federal Institute for Risk Assessment (BfR).

All listed authorities participate in the Forum NAP and take on several other tasks related to the SUD. Table 11 shows the involvement of authorities in the implementation and enforcement of the SUD per Article. Germany's federal structure must be taken into account when analysing its administrative structures related to the SUD.

National level:

On the national level, the involved ministries have fewer tasks, while the subordinate federal authorities take on several functions as regards to the implementation and enforcement of the SUD. This can be seen, for instance, in the organisation of the Forum NAP, the central organ of the German NAP. There the BMEL is responsible, but it is supported by the BLE and the JKI. The BLE organises the Forum NAP while the JKI focuses on risk reduction related to the use of PPPs, IPM and the development of risk indicators (BMEL, 2017)(as per stakeholder input).

Länder level:

On the Länder level, the authorities of the 16 Länder are assuming several tasks related to plant protection. This mainly concerns the ministries of environment and/or the ministries of agriculture. Table 11 highlights the involvement of the CAs of the Länder and the respective institutions, which

have a key role in the enforcement and control of SUD-related measures and in reaching out to the farmers (as per stakeholder input).

Table 11: Administrative or institutional bodies in charge of implementing and enforcing the SUD

Article of the SUD	Implementing authorities	Enforcing authorities
Lead Ministry	BMEL	/
Article 4 (NAP)	NAP was drafted by BMEL and coordinated with the respective Ministers of the Länder and other relevant stakeholders	See individual articles
Article 5 (Training)	The Länder authorities provide initial training; follow-up training is provided by Länder authorities or approved bodies	CA of the Länder
Article 6 (Sales of pesticides)	BMEL in coordination with BMG, BMAS and BMU	CA of the Länder
Article 7 (Information and awareness-raising) & Article 10 (Information to the public)	Webpages of the BMEL, the NAP webpage operated by the BLE and many other webpages of the federal and Länder authorities serve as platforms for information and awareness raising. BfR is developing a national poisoning reporting system; information on poisoning cases is recorded at Länder level	Art. 7: PflSchG, Chemical Act (ChemG), CA of the Länder, BfR Art. 10: (measures of the NAP and CA of the Länder)
Article 8 (Inspection of equipment)	BMEL	CA of the Länder The Plant Protection Services of the Länder are responsible for training, certifying, and supervising the PAE testing operators List of authorised PAE provided by JKI
Article 9 (Aerial spraying)	Länder authorities can grant exemptions BVL authorises PPP exemptions in cooperation with BfR, UBA and JKI.	CA of the Länder; derogations and controls by CA of the Länder
Article 11 (Aquatic environment and drinking water)	CA of the Länder The BMU is the CA for surface and ground water The BMG is the CA for drinking water	CA of the Länder
Article 12 (Reduction of pesticide use or risks in specific areas)	BVL is CA for the authorisation of pesticides Länder authorities support the identification of sensitive areas	CA of the Länder (for water and conservation law)
Article 13 (Handling and storage)	CA of the Länder ⁸²	CA of the Länder
Article 14 (IPM)	IPM implemented through PflSchG guidelines for integrated plant protection ⁸³ were developed by grower organisations ⁸⁴ with the support of the JKI	Compliance with the specific goal "Compliance with the necessary minimum" is determined based upon the examination of spray records from a network of 146 reference farms. This is a project of the BMEL and Länder authorities for plant protection and coordinated and analysed by JKI Checks of CA of the Länder
Article 15 (HRI)	BVL collects and transmits the annual sales data to ESTAT, JKI	BVL

⁸² Structural requirements for storage areas of PPPs are not regulated in the PflSchG

⁸³ In Germany, the term integrated plant protection (Leitlinien des integrierten Pflanzenschutzes) is used instead of IPM.

⁸⁴ Anbauverbände

conducts scientific analysis and interpretation of national sales data

4.2.2.3 Stakeholder engagement and cooperation

The following section will elaborate on the level of consultation and cooperation between relevant authorities and further stakeholders in Germany. Due to its federal structure, the focus will be on both, the structures for stakeholder engagement on the federal level as well as on the Länder level.

Cooperation structures and forms of engagement on the national level

The most relevant cooperation structures and forms of stakeholder engagement in Germany are

- the Forum NAP;
- the Working Groups (WGs) and
- the Scientific Advisory Board NAP⁸⁵.

In the subsequent paragraphs, these cooperation structures will be described as regards their purpose, the involved authorities or stakeholders and their associated roles. Also, the form of cooperation will be specified.

Forum NAP

The **Forum NAP** represents a panel for the coordination of the activities of all stakeholders involved in plant protection including federal authorities, Länder authorities and different associations. The Forum meets once a year. The BMEL is the responsible authority for the Forum NAP and is supported by the BLE and JKI. The BLE organises the Forum NAP. Overall, the Forum NAP represents the most important cooperation structure for stakeholder engagement in Germany.

Besides the representatives of the involved federal ministries, higher federal authorities and the Länder, representatives of relevant federal associations and organisations are invited to the Forum. This covers organisations and associations of the following activity fields (BMEL, 2017):

- consumer protection;
- environment protection and nature conservation;
- water management and protection of water bodies;
- agriculture, horticulture and forestry incl. contracted services;
- organic farming;
- the food-processing industry;
- manufacturers of PPP and of plant-protection equipment;
- traders of food, feed and PPP;
- associations representing non-agricultural users of PPP (e.g. home gardens and allotments, railways, cities, towns and municipalities, including the conference of heads of the official service for garden-related matters);
- plant-protection research.

The Forum NAP reviews the progress made towards achieving the goals set out in the NAP. Another primary task of the Forum is the discussion of recommendations forwarded by the WGs. If approved, the recommendations are adopted and published as "recommendations of the Forum NAP"⁸⁶ and forwarded to the federal government (BLE, 2021).

Working Groups (WGs)

⁸⁵ Wissenschaftlicher Beirat des Nationalen Aktionsplans zur nachhaltigen Anwendung von Pflanzenschutzmitteln

⁸⁶ Empfehlung des Forums NAP

Within the framework of the NAP and the Forum NAP, several **Working Groups**⁸⁷ (WG) have been established. They support the Forum NAP as technical advisory bodies (BLE, 2021). Currently, there are three WGs: i) WG Plant protection and Water protection, ii) WG Plant protection and Biodiversity and iii) WG Forest (BLE, 2021). The WGs comprise different types of stakeholders (producing and grower organisations as well as environmental stakeholders) and authorities. For instance, the WG Plant protection and Biodiversity comprises representatives from federal authorities such as the BfN, BVL, UBA and BLE, representatives from the federal level such as the Länder advisory services on plant protection (PSD) of North-Rhine Westphalia (NRW) or the Chamber of Agriculture of Lower Saxony as well as representatives from the "Deutscher Imkerbund e.V." (German Professional Beekeepers Association), the "Deutsche Bauernbund e.V." (German Farmer's Association) or the "Zentralverband Gartenbau e.V." (Central Horticultural Association)⁸⁸.

Within the WGs, the involved stakeholders identify and discuss relevant subjects related to measures associated with the SUD. Further tasks of the WGs include the assessment of the NAP indicators and the formulation of recommendations concerning further fields of action or measures. These recommendations are forwarded to the Forum NAP. Moreover, the WGs evaluate the latest scientific developments (BLE, 2021).

Scientific Advisory Board NAP

The Scientific Advisory Board represents an independent committee, and its main tasks are the provision of scientific advice and the development of criteria for the evaluation of crop or sector-specific guidelines for integrated plant protection (IPM guidelines). Another task of the Scientific Advisory Board concerns the development of proposals for the further development of the NAP. The Scientific Advisory Board comprises members of several institutions and organisations including, amongst others, universities, the Helmholtz Centre for Environmental Research (UFZ), The Research Institute of Organic Agriculture (FiBL), the State Seed Breeding Institute, State Institute of Bavaria for Forestry and Silviculture (LWF) and the Agricultural Chamber of Lower Saxony (Wissenschaftlicher Beirat zum Nationalen Aktionsplan Pflanzenschutz, 2018).

Cooperation structures and forms of engagement on the Länder level

As outlined above, the Forum NAP and the WGs also involve relevant authorities from the Länder level. On the Länder level, the **Länderreferentenbesprechung** represents a relevant cooperation structure for institutionalised exchange between federal ministries and the ministries of the Länder. Within this framework, the respective contact persons on plant protection of the Länder discuss current topics concerning plant protection including the SUD. If common decisions are necessary, resolutions can be passed during these meetings. This ensures that the BMEL decides in consultation with the Länder. The Länderreferentenbesprechung takes place twice a year (as per stakeholder input).

Examples of forms of stakeholder engagement in Germany

While the previous section outlined the existing cooperation structures and forms of stakeholder engagement on the national and the federal level in Germany, the following section elaborates on how different stakeholders are involved in the governance process of the SUD by describing concrete examples of their involvement.

Länder advisory services on plant protection (PSD)

The PSD of the Länder take on an important role in consulting growers and gardeners on the sustainable use of pesticides and are therefore substantially involved in the implementation and

⁸⁷ Arbeitsgruppen des Forums NAP

⁸⁸ An overview of the different members of the WGs can be found here: <https://www.nap-pflanzenschutz.de/gremien/arbeitsgruppen-des-forums-nap/>

enforcement of the SUD. They have a special function in advising farmers and gardeners about plant protection utilising brochures, digital media, training events, field days and personal consultation (BLE, 2021). The advisory services on plant protection offered by the PSD are financed by the Länder and provide independent research and advice to growers and gardeners on the sustainable use of pesticides, especially on alternative techniques including non-chemical plant protection techniques (BMEL, 2017).

Their involvement can be illustrated by the example of the PSD NRW, which is responsible for the following tasks and responsibilities related to the SUD (as per stakeholder input)⁸⁹:

- The PSD is involved in the NAP and in the WG Plant protection and Biodiversity and contributes to the indicators of the NAP and to the development of IPM guidelines (Article 4).
- The PSD is the CA for the training and certification of distributors, advisors and professional users of PPPs (Article 5).
- The PSD is the CA for controlling the proper sale of PPPs (Article 6).
- The PSD is responsible for the inspections of the pesticide application equipment in use (Article 8).
- The PSD controls the national requirements implemented in accordance with Article 11, 12 and 13 of the SUD.
- The PSD offers advice on water protection to growers and farmers (Article 11)
- The PSD focuses on the introduction and development of IPM and alternative methods and techniques and their practical transfer and testing.

Moreover, the PSD are involved in various forms of cooperation and stakeholder engagement involving federal authorities as well as authorities of the Länder. For instance, the PSD of the Länder regularly coordinate on overarching subjects concerning the professional knowledge on plant-protection matters⁹⁰ or on the annual inspection program on the import, manufacture, storage, sale and application of PPPs⁹¹. The PSD are also involved in IPM in Germany. For example, the ISIP portal (Information System for Integrated Plant Production) was developed by the PSD to serve as a common platform providing information on pest monitoring and offering growers guidance in applying proper plant protection measures (as per stakeholder input) (European Commission, 2017b). As regards IPM, the PSD NRW is involved in relevant projects carried out in coordination with the JKI, other Länder and federal authorities, research institutes, universities, the Zoological Research Museum Alexander Koenig (ZFMK) and the Institute for Sugar Beet Research (IfZ). According to feedback from the PSD NRW, there is a regular exchange between the Federal authorities and the authorities of the Länder. This includes, inter alia, regular meetings of the PSD with the BVL, BMEL, BfR and the JKI as well as meetings with educational institutes. There is little cooperation with the UBA although there have been attempts for improving the cooperation. Moreover, the PSD NRW points out, that there is a very good cooperation and regular exchange between the PSD of the Länder. In addition, there is a good cooperation with relevant authorities in NRW and further relevant stakeholders such as water supply companies or regional agricultural and horticultural associations.

According to stakeholder input, in order to improve the involvement of NGOs, an improved basis for discussion between NGOs and other stakeholders would be required. Moreover, it was emphasised that the trade industry represents a further stakeholder which should be better integrated into the overall SUD governance to improve the implementation of the SUD. Growers need to consider the requirements of the trade industry (e.g. maximum residue levels), while at

⁸⁹ The PSD NRW was used as an example since it was the only PSD which responded to the questionnaire.

⁹⁰ as part of the "Sachkundekonferenz der Länder"

⁹¹ as part of the "Arbeitsgemeinschaft Pflanzenschutzmittelkontrolle (AG PMK)"

the same time being exposed to price pressure from trade and competition with lower-priced products. Therefore, a stronger involvement of the trade industry is necessary.

Development of IPM-guidelines and the involvement of grower organisations:

The development of IPM guidelines constitutes a special feature within the German implementation of the NAP. In contrast to other EU MS, the IPM guidelines in Germany are developed by grower organisations as well as public organisations. Moreover, the JKI has a supporting role in the development of new guidelines. The guidelines are subject to a recognition process, which involves, amongst others, the Scientific Advisory Board and federal as well as Länder authorities (as per stakeholder input) (BLE, 2021).

According to stakeholder input, grower organisations are strongly involved in the development of crop- or sector-specific IPM guidelines. This involvement is described next using the example of the Union for the Promotion of Oil and Protein Plants (UFOP)⁹²⁹³. From 2017 – 2018, the UFOP funded a project on the development of IPM guidelines on canola cultivation and on the cultivation of fava beans, grain peas, soybeans and sweet lupins. In 2020, both IPM guidelines were acknowledged by the BMEL and included in Annex 1 of the NAP. As regards both IPM guidelines, the following activities have been carried out by the UFOP:

- The UFOP has commissioned the preparation of the guidelines;
- Inclusion of the guidelines in the recognition process;
- The UFOP has been in charge of the necessary revisions of the guidelines resulting from the coordination process with Federal and Länder authorities;
- Publication of the guidelines as “UFOP-guidelines” via press releases, newsletters and technical articles in agricultural journals;
- Implementation of a webinar with more than 350 participants on the topic “Canola – pest and beneficial insects” from the IPM guideline on canola cultivation.

The UFOP cooperates and coordinates with several federal and Länder authorities. Thus, there is an exchange with the BMEL, the JKI and representatives of the PSD on technical subjects. There is a very close and trustful cooperation with the stakeholders listed (as per stakeholder input). Moreover, the UFOP participates in the Forum NAP.

According to the UFOP, there is a strong interest of farmers concerning IPM. However, the possibilities for implementing IPM measures are limited. Innovative IPM measures based on digital tools are often developed by the PPP industry and might be connected to the marketing of chemical PPPs. On the other hand, there is a lack of digital tools offered in combination with independent advice from the advisory services on plant protection of the Länder. Moreover, biological PPPs for arable crops are rare and those available tend to be much more expensive than the chemical alternatives. Also, farmers often lack respective knowledge of biological PPPs and the advice offered by the advisory services of the Länder on biological PPPs and further alternative techniques is limited.

4.2.2.4 SUD associated financial and human resources

Financial and human resources on the national level

As regards costs, there is no specific funding program financing the SUD- or NAP-related measures. The funds come from the budgets of the federal state and the Länder and are thus borne by both.

⁹² The aim of the „Union zur Förderung von Oel- und Proteinpflanzen eV.“ (UFOP) is the promotion of oil and protein crops in every aspect while taking into account the technical progress. (as per stakeholder input).

⁹³ Interview partners from federal authorities were asked whether they could provide contact details of representatives from grower organisation which were involved in the development of IPM guidelines. UFOP was recommended by the interview partners and therefore taken as an example.

Furthermore, there are no concrete figures available for the administrative or financial costs associated with the implementation and enforcement of the SUD. Calculating these costs would – if possible at all– require intensive exchange with the Länder authorities and involve a considerable amount of work. Since the SUD and many of its provisions have been transposed through national ordinances, the resulting tasks are considered administrative tasks of the Länder. Therefore, the associated costs are not recorded. Given that Germany had already started introducing measures prior to the transposition of the SUD, it might be the case that the financial and human resources associated with SUD were lesser than in other MS. However, according to stakeholder input, a revision of the SUD could lead to higher costs due to an increased bureaucratic burden.

Financial and human resources on the Länder level

It should be noted that the information on the costs associated with the SUD on the Länder level in the following paragraphs is based on the information provided by the PSD NRW. Therefore, the information presented is intended to give only an approximate overview of the costs incurred at the Länder level and represent one single region or Bundesland. Corresponding costs result from the following:

- Financing the PSD by the Feder State of NRW;
- Financing projects at the Chamber of Agriculture NRW⁹⁴ on special issues;
- Financing joint projects on special issues with various institutions;
- Membership fee for the ISIP portal;
- Financing the water protection advisory service of the Chamber of Agriculture NRW;
- Costs for the provision of personnel at the Ministry for Environment, Agriculture, Conservation and Consumer Protection of the State of NRW (MULNV).

Moreover, the Table 12 provides an overview of the amount of full-time employees involved in the implementation and enforcement of the SUD at the Länder level of NRW.

Table 12: Overview of costs associated with the SUD (estimated by the PSD NRW)

Description	FTEs
Personnel working at the Chamber of Agriculture NRW for the PSD	70 FTEs
Advisors for crops and plant protection supporting the monitoring, surveys and further tasks in the Chamber of Agriculture NRW	10 FTEs
Advisors for crops and plant protection working in the fee-based advisory on plant protection	12 FTEs
Personnel working for the advisory on water protection	5 FTEs
Personnel working on projects for the MULNV	Low and varying number of FTEs
Personnel working at the MULN	< 1 FTEs
External personnel e.g. for providing professional training courses or advanced training courses	/

In Germany, the Regulation on Professional Knowledge in Plant Protection requires farmers to complete trainings and acquire certificates. These trainings and certificates are associated with costs. The PSD NRW pointed out, that in NRW, these costs are relatively high in comparison to other Länder. Therefore, no further costs should be passed on to farmers. The PflSchG states that the provision of advisory services should be free of charge and available to all farmers. In NRW, the consultation of farms by the advisors of the Chamber of Agriculture is already fee-based (as per stakeholder input). It is generally seen as problematic by the PSD NRW if the additional costs for implementing integrated measures are not compensated by the trade industry or the consumer (as per stakeholder input).

⁹⁴ Landwirtschaftskammer NRW

In its Final Report of a Fact Finding Mission carried out in Germany, the EC (2017b) concluded that the advisory service in Rhineland Palatinate is fully financed by public funds and therefore could be considered a good practice example for the provision of independent and high-quality information to growers. However, the advisory services are limited by financial constraints in the Länder. This is also confirmed by the comments of the PSD NRW described in the paragraph above. According to stakeholder input, the PSD of the Länder should receive the financial resources necessary to hire the personnel required for the provision of qualified advisory services on the implementation of the SUD. This includes funds for field trials on biological PPP and further alternative techniques. In this way, the advisory services for practical agriculture should be improved (as per stakeholder input).

4.2.2.5 Assessment

When comparing the governance structures of Germany with those of other countries, it should be taken into account, that Germany already had a relatively advanced status concerning the sustainable use of pesticides before the implementation of the SUD (as per stakeholder input). Nevertheless, due to the cross-cutting nature of the SUD provisions and the NAP there is a need for coordinating the interests and concerns of different stakeholders. For this purpose, Germany has established the following cooperation structures and institutions:

- the Forum NAP
- the Working Groups (WGs)
- the Scientific Advisory Board NAP
- the Länderreferentenbesprechung
- the Länder advisory services on plant protection (PSD)

Strengths and Weaknesses

The central organ for bringing together the stakeholders involved is the Forum NAP. The Forum does not only ensure cooperation and coordination between involved federal ministries, federal authorities and the Länder, but also guarantees the involvement of grower and industry organisations and other relevant stakeholders. The authorities interviewed emphasised that the Forum NAP and the WGs bring together a wide range of stakeholders from different sectors with different viewpoints enabling an intensive exchange and controversial discussions. This is perceived very positively by the authorities. In this context, they emphasised that SUD-related measures can only be effectively implemented if all stakeholders support the decisions. According to stakeholder input, the Forum NAP and the IPM guidelines have ensured the strong integration of farmers and other relevant stakeholders into the overall SUD governance. Consequently, the stakeholders interviewed do not see much potential for improved stakeholder engagement. Moreover, according to stakeholder input, cooperation and coordination do not only take place within a regular framework but also in the context of ad-hoc questions. This ensures a flexible exchange between involved stakeholders on the national as well as the Länder level.

On the other hand, the relatively high number of stakeholders present in the Forum NAP could make discussions less effective. It should also be noted that there are no environmental organisations (NGOs) present in the Forum NAP. According to the authorities interviewed, the basis for discussion would have to be improved for enabling a better involvement of NGOs⁹⁵.

Challenges and best practices

There is a strong involvement of grower organisations within the SUD implementation in Germany given their role in developing the crop- or sector-specific IPM guidelines. This has not only encouraged the associations to actively engage with the guidelines but has also ensured, that the associations back the guidelines. In addition, the associations must represent the guidelines to their

⁹⁵ There have not been any interviews with NGOs. Thus, their viewpoint cannot be described here.

members. This contributes to the effective implementation of the guidelines by the associations and their members. Since the guidelines are subject to a comprehensive recognition process involving the JKI, the Scientific Advisory Board NAP, the CAs of the Länder and relevant federal ministries as well as further independent stakeholder groups, they are based on a broad consensus (as per stakeholder input). Consequently, the development of IPM guidelines could be considered as a best practice for the involvement of growers and grower associations.

On the level of the Länder, the PSD have an important role in the consultation of growers and gardeners on the sustainable use of pesticides. As outlined by the EC (2017b), the advisory services are limited by financial constraints but could be considered a best practice example. Therefore, further financial support could help to improve the quality of advisory services of the Länder as regards the advice on biological PPP and further alternative techniques. At the same time, it was highlighted, that further financial burdens for farmers should be avoided (as per stakeholder input).

It should be noted that only a limited number of relevant parties could be interviewed or were available for the verification of information (see also section 3.3). Different opinions or perceptions on certain SUD-related aspects might exist depending on the respective parties. This becomes clear taking into consideration a letter of a Member of the European Parliament (MEP), who points out that there is no sustained reduction in the use of pesticides in Germany, particularly referring to a lack of appropriate measures for implementing Article 11,12 and 14 of the SUD is highlighted.

4.2.3 Greece

4.2.3.1 Overview

In Greece, the SUD is implemented by Law 4036/2012 (Republic, 2020). Moreover, the NAPs are published as common ministerial decisions (No. 8197/90920/22-7-2013 amended by No. 6669/79087, and NAP revision No 9269/246316) (Republic, 2020; The Minister of Rural Development and Food; the Minister of Environment Energy and Climate Change and the Minister of Health, 2013). The Ministry of Rural Development and Food (MRDF), and within this, the Directorate of Plant Produce Protection (DPPP) under the General Directorate of Agriculture is the CA for to the SUD.

Measures for the implementation of the SUD, outlined in the NAP are all implemented on the national level with no involvement of the regions. The measures are partially funded by the CAP (e.g. Crop guidelines).

4.2.3.2 Administrative structures and distribution of responsibilities among involved authorities

As mentioned, the lead ministry for the SUD is the MRDF and the DPPP within the MRDF. Additionally, the Ministry of the Environment and Energy and the Ministry of Health are involved.

Generally, based on the Greek legislation, all decisions have to be unanimously agreed upon by these three ministries. Moreover, the ECs audit report (2019) mentions the Ministry of Internal Affairs (regional level) as an additional Ministry of relevance however, no mention of the Ministry or its role came up during the stakeholder interviews.

The distribution of responsibilities between the administrative and institutional bodies is outlined in the table below. It was noted during the interviews, that the local/municipal level has very limited involvement when it comes to the implementation or enforcement of the SUD or NAP.

Table 13: Administrative or institutional bodies in charge of transposing, implementing and enforcing the SUD in Greece⁹⁶

Article of the SUD	Implementing authorities	Enforcing authorities
Lead Ministry	DPPP in the MRDF	-
Article 4 (NAP)	DPPP	
Article 5 (Training) + Article 6 (Sales of pesticides)	MRDF approves providers of training (both public and private) DPPP for online exam for professional users (provides training and test material) DREV approve & register agronomists	Regional Directorates of Rural Economy and Veterinary (DREV)
Article 7 (Information and awareness-raising) & Article 10 (Information to the public)	DPPP & Ministry of Rural Development and Food in cooperation with the Benaki Phytopathological Institute. DPPP in cooperation with the Poisoning Center of the Ministry of Health, Local Directorates of Agricultural Economy and Veterinary of Regional Units and Regional Centers of Crop Protection and Quality Control in cooperation with DPPP	-
Article 8 (Inspection of equipment)	Institute of Agricultural Machinery of the Hellenic Agricultural Organisation "Dimitra" (Inspection Reference Laboratory (IRL) issuing) DREV + IRL (authorise inspection stations) Directorate for Land Reclamation and Soil and Water Resources + DREV (manage register of PAE)	Directorate for Land Reclamation and Soil and Water Resources of the MRDF (PAE), "Dimitra" (inspections) Public or private inspection stations
Article 9 (Aerial spraying)	MRDF	Prohibited
Article 11 (Aquatic environment and drinking water)	Ministry of Rural Development and Food & Natural Environment and Water under the Ministry of Environment and Energy, The State Chemical Laboratory & Hellenic Authority for Geological and Mineral Exploration, Hellenic Authority for Geological and Mineral Exploration, The Environmental Health and Sanitary Control, Departments (regional)	Not specified
Article 12 (Reduction of pesticide use or risks)		Ministry of Environment, Energy and Climate Change, DPPP but official controls do not include systematic checks on the use of PPPs in specific areas.
Article 13 (Handling and storage)	DPPP	
Article 14 (IPM)	DPPP	There are no official controls in place in Greece to assess the implementation of the IPM principles specified in Annex III of the SUD

4.2.3.3 Stakeholder engagement and cooperation

The following section will elaborate on the level of consultation and cooperation between relevant authorities and further stakeholders. Generally, it was noted, that there is very little coordination and cooperation in place currently, however efforts are underway to improve the situation.

⁹⁶ This table is based on the information reported within the Greek audit report (European Commission, 2019). This table was forwarded to the responsible personnel in Greece; however, no information or correction was provided.

Cooperation structures and forms of engagement on the national level

The responsibility for the implementation of the various elements of the SUD as highlighted above lies with different ministries. Cooperation with the MRDF and other authorities such as with the Ministry of Health regarding drinking water monitoring and training on treatment of incidents of acute poisoning caused by pesticide use, or with the Ministry of Environment & Energy for storage containers for PPP) was mentioned by the DPPP. However, no mention was made about the form of this cooperation or how often it occurs.

Within the audit report, it was stated by the CA that there is a lack of continuous coordination, as they had not always been informed of staff changes in the other ministries and therefore struggled to contact the relevant staff from time to time. It was also found that no coordination meetings took place between the authorities involved in the NAP (European Commission, 2019).

Nonetheless, Greece has recognised this shortcoming, which was once again highlighted during the amendment of the NAP and therefore intends to form standing committee as per the interview. The goal and relevant stakeholders who will be present in the committee are outlined below.

Standing Committee:

The main goal and tasks of the committee will be the monitoring the actions under the NAP as well as overseeing its proper implementation. Moreover, it is planned as a forum for discussion and coordination between the ministries with meetings taking place on a bi-monthly basis.

As stated by the DPPP, the relevant stakeholders from the different ministries will participate and take part in meetings, namely:

- Ministry of Interior;
- MRDF;
- Ministry of Health and
- Ministry of Environment and Energy.

However, no information was available as how the relevant stakeholder within the ministries will be selected.

It was further noted that many public bodies could be involved in the support of the implementation of the SUD due to the broad range of issues it covers. This means that the committee can also be the platform where various stakeholders partake and exchange information and best practices.

It was furthermore elaborated that in the cases where cooperation was established prior to the implementation of the SUD, such as with the Ministry of Health, fewer problems seemed to occur as compared to cooperations' that were established a later stage. An example of the latter is with the Ministry of Environment & Energy on the aspects of recycling of containers where coordination and cooperation issues were mentioned.

Cooperation structures and forms of engagement with municipalities

Based on the information provided, the engagement with the local level seems to be very limited. It was stated that the coordination and cooperation e.g., with the regional crop protection officers is good as these used to be part of the MRDF. However, no information was provided regarding other authorities on the local level and what measures are taken to uphold this "good communication".

Cooperation structures and forms of engagement with stakeholders

In terms of involvement and engagement with other stakeholders apart from the national and local level, the Greek national Law (No. 4048/2012 and 4002/2011) requires a public consultation procedure of the revised NAP including the publication of the posed texts at www.opengov.gr.

Comments received are then considered in the amendment of the proposal (fact finding). The Greek authorities noted, however, that not many comments were received (around 60 comments), which possibly indicates the public's lack of interest in participation.

Next to the consultation, Greece also sends out an anonymous questionnaire-based survey bi-annually to around 100 selected professional PPP users per region (European Commission, 2019). The survey aims to monitor the level of implementation of the NAP and to identify key areas and targets requiring further action, thereby providing the authorities with useful insights.

In terms of other possible engagement, the Greek authorities highlighted the absence of a diverse field of stakeholders. The only stakeholders currently involved in the SUD according to the authorities are ICPA/Crop Life and beekeepers. ICPA/Crop Life are authorisation holder which are actively involved in e.g. the recycling of packages and have therefore made suggestions regarding recycling in the past. Especially the absence of (environmental) NGOs was discussed. The MRDF has tried to engage with the NGOs in the past, but they did not respond. Farmer associations are also not typically present or involved in the SUD according to the Greek authorities. However, it was pointed out, that if they are engaged with farmers e.g. on such topics as IPM (false seedbed technique, pheromone traps) the cooperation is reported to be good. No means to uphold continuous efforts to cooperate were outlined.

4.2.3.4 **SUD associated financial and human resources**

In terms of costs associated with the SUD, the main ones incurred arise from the need for human resources. The main burdens highlighted were the costs from monitoring and teaching. Many of the costs incurred are however distributed along the pesticide chain (e.g. authorisation holders, sellers). It was further noted that a large share of costs is passed down to the farmers as they have to pay for training, application equipment and packing recycling. Up to this point, there seems to be no funding for farmers to compensate them for their expenses. Thus, it was pointed out that the Greek authorities would like to have the means to fund the efforts made by farmers such as risk mitigation investments. The means to do so could come from CAP funding which, in the interviewees' opinion, should be concretely coupled with the SUD. According to the stakeholder input, the previous CAP did not make it clear which funding-specific activities regarding the implementation of IPM should be used. It was pointed out, that this was made more transparent within the new CAP. It was additionally pointed out that clearly indicating appropriate tested methodologies (e.g. for IPM) and funding the related equipment by the EC would be greatly appreciated.

An overview was provided of the number of full-time employees involved in the implementation and enforcement of the SUD. Considering that very few tasks are passed down to the regional level according to the interviews, the estimation for the regions seems rather high in comparison. Table 14 outlines the FTEs associated with the SUD at the national and regional level

Table 14: Overview of FTEs associated with the SUD at the national and regional level

Description	FTEs
Total Central level	9.5
Ministry of Agriculture - Central office in the directorate (not considering the people in the CAP)	4 (should be 5)
Ministry of Agriculture - Directorate of machinery	2
Ministry of Health – Poisoning department	1(-2)
Ministry of the Environment and Energy – Water surveying	1
Ministry of the Environment and Energy – Recycling	1
Ministry of Education – Training of farmers	0.5
Regional offices – at least 3 people per region as a mean	52

4.2.3.5 Assessment

Strengths and weaknesses, challenges and best practices

In Greece, no central body for the coordination with other ministries or relevant stakeholders is assigned as of the time of writing. As stated in the EC Audit report (2019), even though responsibilities for the implementation of the articles of the SUD have been assigned to the ministries, the lacking coordination and the insufficient cooperation of the responsible authorities has led to inefficiencies in executing the provisions of the SUD. To combat these issues, a standing committee is planned for the coordination and cooperation of the different ministries involved. As this standing committee has not been formed yet, its effectiveness cannot be judged. As per the interviews, the current cooperation with the Ministry of the Environment and Energy seems to be inefficient.

Further challenges might arise due to the lack of interest from the general public and relevant NGOs in Greece. This deficiency means that there is no one advocating for topics that would normally be addressed by environmental NGOs. It was stated that, within Greece, the authorities struggle to explain to farmers what they should do and what developments are happening on the European level. In the absence of NGOs, means of engaging farmers and the general public seem to be of essence and could be integrated within the planned standing committee or a subgroup thereof.

4.2.4 Italy

4.2.4.1 Overview

In Italy, the SUD is transposed into national law by the Legislative Decree No 150 of 14 August 2012. Depending on the specific institutional competencies, the responsibility for implementation is distributed among three ministries:

- Ministry of Health (MH);
- Ministry of Agricultural Food and Forestry Policies (MIPAAF);
- Ministry of Environment and Protection of Land and Sea (MATTM).

Decree (150/2012) established a Scientific Council on the sustainable use of PPPs (CTS). The CTS is an inter-institutional body for coordinating the activities under the SUD (see section 4.2.3.3). Furthermore, the Decree (150/2012) laid down ground rules for the cooperation in the Regions and Autonomous Provinces⁹⁷. The rules stipulate that the regions should establish a structure similar to the CTS for coordinating the three main sectors associated with the SUD (agriculture, environment and health) on the regional level (see section 4.2.3.3). As these coordination structures have not been implemented by all Regions, the implementation is made mandatory in the revised NAP.

4.2.4.2 Administrative structures and distribution of responsibilities among involved authorities

In Italy, there is a separation of competencies between national and regional administrations. On the regional level, there are Regions and Autonomous Provinces.

Relevant authorities involved in the implementation of the SUD at the national level include (European Commission, 2017c) :

- Ministry of Health (MH);
- Ministry of Agricultural Food and Forestry Policies (MIPAAF);
- Ministry of Environment and Protection of Land and Sea (MATTM);
- Ministry of Ecological Transition (MITE)

⁹⁷ For a better readability, in the following sections, the term "Regions" will be used for both, Regions and Autonomous Provinces.

- Ministry of Education, University and Research (MIUR);
- Ministry of Economic Development (MISE);
- Institute for Environmental Protection and Research (ISPRA);
- National Institute of Health (ISS);
- Centre of Policy and Bio-Economy of the Council for Agriculture, Research and Agricultural Economy Analysis;
- Agricultural Paying Agency (AGEA);
- SIN-SHEAP (Italian National System for Surveillance of Hazardous Exposures and Acute Poisoning).

The implementation in the regions and the verification of compliance with the provisions of the SUD is the responsibility of the Regions and Autonomous Provinces. Thus, most of the measures associated with the SUD are implemented at the regional level. Furthermore, the coordination of the SUD with other relevant regional or local legislation is ensured at the regional level (as per stakeholder input).

Table 15: Administrative or institutional bodies in charge of implementing and enforcing the SUD

Article of the SUD	Implementing authorities	Enforcing authorities
Article 4 (NAP)	CTS MIPAAF, MATTM, MH Regional and provincial CAs	Regions and provincial CAs Regions need to submit reports to MIPAAF and MITE
Article 5 (Training)	Regional or provincial CAs (planning, organisation, delivery of training and certificates) Provision of training by approved external bodies (under supervision of regional CAs)	CAs at regional or provincial level must report to the MIPAAF Regional/provincial CAs responsible for assessing the knowledge acquired by training participants (exams)
Article 6 (Sales of pesticides)	Regional or provincial CAs (planning, organisation, delivery of training, certificates)	MIPAAF, MH Regional/Provincial CAs
Article 7 (Information and awareness-raising)	Central and Regional or Provincial CAs perform measures to inform the public Central CAs based on SIN-SHEAP which is a database operated by the ISS (analysis of poisoning cases)	data for SIN-SHEAP is reported by ASLs (and further stakeholders) to the PCC and then from the PCC to the ISS.
Article 8 (Inspection of equipment)	MIPAAF approved "Programme to co-ordinate checks on PAE" with the technical support of ENAMA (National Agency for Agricultural Machinery); ENAMA coordinates a Working Group in which all the Regional and Provincial CAs are represented. The Technical Working Group (TWG) produces a series of recommendations for harmonising inspections of PAE.	Regular inspections of PAE by authorised test centres; regional and provincial CAs are responsible for the authorisation of test centres, training and certification of technicians and organisation of inspection services
Article 9 (Aerial spraying)	Regional or Provincial CAs are responsible for collecting information in order to submit the request for the authorization of aerial spraying; Authorisations are granted by the MH only.	ASLs and municipalities are in charge of monitoring compliance with the requirements
Article 10 (Information to the public)	The Central CAs define the criteria to deliver the information to the public	Regional or Provincial Cas on the basis of NAP provisions issue guidelines to define in details the measure to adopt.
Article 11 (Aquatic environment and drinking water)	MITE, MIPAAF and MH were responsible for developing guidelines. Regional and provincial CAs in charge of establishing the respective measures. MITE is CA responsible for policies, legislation and providing technical support to regions/provinces with regard to environmental aspects of the SUD	Drinking water monitoring is the responsibility of the MH Surface and groundwater monitoring are the responsibility of regional/provincial CAs Samples taken by ARPAs every year (Regional Agencies for the safeguard of the environment)

		including protection of the aquatic environment	Data collected by ARPAs are processed by IPRA that issue a bulletin on the status of surface and underground water, every two years
Article (Reduction of pesticide use or risks)	12 of	The three Ministries have adopted in 2015 the Guidelines in order to point out the measures oriented to the safeguard of the N2000 areas, natural protected areas (parks, natural reserves, etc.) Criteria for the definition of measures at local level concerning areas used by the general public or by vulnerable groups, are defined within the NAP; MITE, together with the other two Ministries, has adopted specific measures to define the Minimum Environmental Criteria (CAM) to respect in case of contracting the use of herbicides along railways, roads and motorways	Regional/provincial CAs establish and implement measures concerning PPP use in specific areas, including N2000 areas, natural protected areas and areas used by the general public or by vulnerable groups
Article (Handling storage)	13 and	The good practices of handling and storage of PPPs, are included within the provisions of both NAP and Legislative decree 150/2012 MITE is CA responsible for policies, legislation and providing technical support to regions/provinces with regard to aspects relative to treatment of used packaging and remnants Companies dealing with waste storage, processing and disposal need to be authorised by MITE	MITE and MIPAAF define Guidelines and technical protocols aimed to set up procedures for handling and storage of PPPs, as well as the treatment of remnants and empty packages; Regional/Provincial CAs adopt the guidelines and monitor their implementation
Article 14 (IPM)		CA is MIPAAF; MIPAAF is in charge of several responsibilities in the context of IPM, e.g. setting up a guidance document in cooperation with Regions and Autonomous provinces. Regional and provincial CAs in charge of implementing measures to ensure a better understanding and implementation of IPM by growers Regional CAs and universities are involved in the publication of specialised magazines and newspapers	Relevant CAs check awareness of growers with regard to IPM during routine inspections (Article 68 of Reg. 1107/2009). Besides that, no general monitoring or verification system for IPM in place Pest monitoring networks are established nationwide and operated by regional/autonomous provinces (based on surveys and on-spot checks)
Article 15 (HRI)		Indicators HRI1 and 2 have been elaborated and published following the adoption of Directive (EC) 782/2019. The transposition of the Directive in the national legislation has been done with the Inter-Ministerial Decree 7 November 2019 (issued jointly by MITE, MIPAAF and MH) Indicators are published, nationwide, on ISPRA website	Calculation of HRI1 is performed by ISTAT (National Institute for Statistics); Calculation of HRI 2 performed by MH

4.2.4.3 Stakeholder engagement and cooperation

The following section will focus on the level of consultation and cooperation between relevant authorities and further stakeholders in Italy. Due to its federal structure, the cooperation structures and forms of stakeholder engagement on the federal level as well as on the level of the Regions will be assessed.

Cooperation structures and forms of engagement on the national level

As regards the SUD, the CTS represents the most relevant cooperation structure on the national level in Italy. The main tasks of the CTS are the coordination of activities under the SUD and the evaluation of the efficacy of the measures taken. Thus, the CTS monitors the progress made towards

the implementation of the NAP. Moreover, relevant SUD-related strategies are defined within the framework of the CTS. In Italy, the CTS represents the governance structure for coordinating the SUD with other legislation on the national level (European Commission, 2017c) (as per stakeholder input).

All relevant competent central administrations as well as representatives from the Regions are represented in the CTS. The CTS also includes representatives from research institutions supporting the national and local administrations. The CTS is composed of 23 members and the same amount of deputy members. The specific composition is as follows (European Commission, 2017c) (as per stakeholder input):

- 4 representatives of the MIPAAF;
- 4 representatives of the MATTM;
- 4 representatives of the MH;
- 1 representative of the MIUR;
- 1 representative of the MISE;
- 9 representatives of Regions and Autonomous Provinces.

Since most aspects of the SUD are related to agriculture, the MIPAAF assumes the presidency of the CTS as “primus inter pares” (first among equals) and therefore takes on a coordinating role. This includes, for instance, presenting the agenda points and moderating the discussion. The agenda points are determined prior to the meetings of the CTS. For the determination of agenda points, there is a regulation. Accordingly, members can vote the agenda points if no common position can be found. However, so far there has not been a need for establishing a voting procedure. Until now, no voting procedure has been necessary since the members have always been able to find a common position regarding the agenda points. The contents discussed during the CTS meetings are of a technical and scientific nature. If certain aspects are of political relevance, the CAs are addressed so that they can contribute to resolving the issue (as per stakeholder input).

The CTS meets regularly on a monthly basis (approximately) and requires the availability of most members to take place. Meetings are summoned at least five days in advance (as per stakeholder input).

The members and deputies of the CTS are designated by the Standing Conference State-Regions following a request by the MIPAAF. The Standing Conference is a central body of the governance mechanism for the relations between the state and the regions. Thus, within the framework of the conference, political negotiations among the central and regional administrations take place. This includes for instance the exchange of views regarding the competencies of the central government or the regions concerning certain policy targets. The meetings of the Standing Conference take place every two weeks (as per stakeholder input).

Cooperation structures and forms of stakeholder engagement on the regional level

As outlined above, the Regions and Autonomous Provinces are represented in the CTS. Normally, the regions are structured in the following way: There is the Presidency of a Region and several Departments which are broken down into General Directorates with different competencies. Concerning the SUD, the relevant Directorates include the Directorates for Agriculture, Environment, and Health.

Relevant cooperation structures on the regional level include:

- the structure for the coordination of the involved General Directorates and
- the Permanent Conference of the regions.

These are elaborated next.

Structure for coordinating the involved General Directorates

The Decree (150/2012)⁹⁸ requires the Regions to establish a body for the coordination of the respective Directorates in order to ensure close collaboration for the SUD implementation.

It should be noted that these coordination structures have not been implemented by all Regions. According to stakeholder input, the Regions show differences concerning the level of governance. For instance, in some regions (Emilia Romagna, Lombardy or Apulia) the involved stakeholders have already established strong cooperation, whereas other regions (mainly Southern Regions) tend to be less organised.

A good example of cooperation comes from the Piedmont Region, where the requirements of the Decree (150/2012) have been implemented through the establishment of a Working Group in 2012. This Working Group provides a cooperation basis for experts from different functional areas (Environment, Agriculture and Health) and is seen as key to a successful communication and an effective implementation of the SUD (as per stakeholder input).

The differences between the Regions also concern the sensitivity of stakeholders to environmental themes and the level of extension of monitoring networks causing variations in the amount of monitoring information available per Region (as per stakeholder input). According to stakeholder input from the region Emilia-Romagna, the existing differences between the Regions can be traced back to the different organisational methods. Therefore, a governance approach or coordination structure for the regional level must be formalised in the new NAP. To ensure the effective implementation of the coordination structure in the Regions, awareness campaigns and other support activities must be carried out. Generally, the involvement of public institutions and stakeholders should be increased both at national and regional level (as per stakeholder input).

Permanent Conference of the Regions

The Permanent Conference of the Regions is a regular meeting between the representatives of the CAs of the Autonomous Provinces and the Regions. Only nine representatives of the Regions participate in the CTS. The purpose of the Permanent Conference is to ensure that the representatives of the Regions represent the common position of the regional CAs (European Commission, 2017c).

Depending on the aspect of the NAP implementation in question, e.g. agricultural or environmental aspects, different Regions take on the leading role in the Permanent Conference of the Regions (European Commission, 2017c). According to the input of the MIPAAF, taking a leading role in the Permanent Conference enables regional CAs to gain relevant experience as regards governance and leadership. Another stakeholder interviewed evaluated the discussions between the representatives of the agricultural sector of the Regions positively but highlighted that discussions with relevant stakeholders at the national as well as at the regional level are limited.

Examples for forms of stakeholder engagement in Italy⁹⁹

Stakeholder involvement during the consultation phase of the NAP and the organisation of "back-to-back meetings"

According to stakeholder input, NGOs are consulted at various stages of the implementation of the SUD. The consultation phase for drafting the new NAP can be taken as an example. During the consultation phase, there have been meetings with NGOs and other relevant stakeholders at least weekly. Main NGOs involved include environmental associations as well as grower and consumer organisations. Thus, as per stakeholder input, the opinions of the NGOs can be included and are

⁹⁸ LEGISLATIVE DECREE No 150 of 14 August 2012 for the Implementation of Directive 2009/128/EC establishing a framework for Community action to achieve the sustainable use of pesticides

⁹⁹ Since stakeholders from the Regions of Piedmont and Emilia-Romagna have responded to the questionnaire, many of the following examples on stakeholder engagement are from these regions.

reflected in the provisions of the NAP. Furthermore, NGOs take on an important role in the surveillance of the implementation of the NAP measures and in informing the public or relevant administrations in case of non-compliance or deviations.

In addition, back-to-back meetings are organised with different ministries, NGOs or other private stakeholders if necessary. These meetings can be implemented at different phases of the SUD implementation, such as the launch of the public consultation on the draft of the NAP (as per stakeholder input).

Coordination tables with different stakeholders

Furthermore, coordination tables with different stakeholders including NGOs take place. However, there is no regular framework or timeframe for conducting the coordination tables. According to the feedback of the stakeholders from the MIPAAF, this kind of meetings is often requested by the NGOs or other private stakeholders, and the MIPAAF is generally open to these requests.

Involvement of external bodies for organising trainings

Regional administrations sometimes hire contractors to provide SUD-related trainings. However, according to stakeholder input, the contractors only play a role in organising the courses. Apart of this, no other form of cooperation with private stakeholders could be identified.

Protocol for rice management in the Piedmont Region

Another example for stakeholder engagement on the regional level is the development of the Protocol for rice management. For this protocol, several public institutions including the regional administration, universities, research centres, the Regional Environmental Agency and the Po River Basin District as well private stakeholders such as grower and industrial organisations cooperated for defining managements strategies towards the targets of the SUD in rice ecosystems were involved. This also included the implementation of formation and information activities towards the SUD goals (as per stakeholder input).

Relevant projects in the Piedmont Region

The stakeholders of the Piedmont Region pointed out that – besides the NAP – there have been other opportunities for contributing to the implementation of the SUD on the national level. For instance, the Environmental Directorate of Piedmont has been involved in the project CreIAMO PA. The project was organised by the MITE and the SODESID SPA¹⁰⁰, It aimed at defining minimum environmental criteria for the use of PPPs in non-agricultural environments such as highways and railways.

As regards the cooperation with NGOs, the Environmental Directorate of Piedmont was involved in the VisPO project (Volunteer Initiative for a Sustainable Po) organised by the NGO Legambiente. However, no specific link to the provisions or goals of the SUD could be identified for this project.

4.2.4.4 SUD associated financial and human resources

In Italy, the implementation of the SUD provisions entails financial and personnel costs on the national and regional level. The associated costs are described subsequently.

Financial and human resources on the national level

In Italy, there is no dedicated budget for the NAP. According to stakeholder input, the lack of dedicated financial resources resulted in an incomplete application of the SUD during the first phase of the NAP. The first NAP phase was carried out referencing to existing structures and financial resources at the national and regional level. For improving the financing of measures, in the second

¹⁰⁰ <https://www.sogesid.it/index.php/it>

NAP, Italy aims at linking the provisions of the NAP with the CAP and the Rural Development plans (as per stakeholder input).

The main costs associated with the SUD are personnel costs. At the national level, there are approximately 6 FTEs working on the SUD¹⁰¹. However, the costs and the administrative burden is mainly borne by the Regional and Provincial Administrations which have to effectively implement and enforce the provisions of the SUD (as per stakeholder input). In this regard, one aspect where the lack of financial resources is particularly evident is the implementation of inspections and controls.

Financial and human resources on the regional level

As outlined above, the Regions bear the main costs for the implementation of the SUD-provisions. In terms of FTEs, there are approximately 80 FTEs for working on the SUD¹⁰¹. For instance, in the Piedmont Region, there are approximately 10 employees involved in the SUD implementation. However, as these employees fulfil non-SUD-related tasks as well, the exact amount of FTEs specific to the SUD could not be indicated (as per stakeholder input).

Stakeholders from the Region of Emilia Romagna estimated that approximately 5 FTEs are spent working in the regional administration of Emilia Romagna on the implementation of the SUD (as per stakeholder input).

According to stakeholder input, in the Piedmont Region additional funding should be devoted to the development of demonstration sites for better educating farmers, public technicians and private users as well as to information and awareness raising events for the general public. Moreover, it is necessary to allocate specific funds for the implementation of the SUD (as per stakeholder input).

4.2.4.5 Assessment

Strengths and Weaknesses

In Italy, the central body for the coordination of relevant stakeholders is the CTS and the meetings take place regularly on a (an almost) monthly basis. They can also be organised on short notice (ca. 5 days in advance) which entails a certain degree of flexibility, e.g., if urgent decisions need to be made. Additionally, members have the possibility to make suggestions for the issues to be discussed during the meetings. Despite its obvious benefits, the CTS represents a rather limited number of stakeholders (representatives of 5 ministries and the regions) and no NGOs or other stakeholders such as grower or industry organisations.

According to stakeholder input, there has been regular and intensive exchange with NGOs and other relevant stakeholders during the consultation phase of the new NAP. Further cooperation with the said stakeholders is possible through back-to-back meetings or coordination tables. However, it should be noted, that there is no regular framework for this kind of stakeholder engagement. Moreover, based on the analysis of stakeholder feedback, the following points of potential improvement regarding stakeholder engagement and cooperation could be identified:

- There is a lack of an effective involvement of farmers and the public.
- The involvement of the various public institutions and stakeholders on the national and the regional level should be increased.

Challenges and best practices

As outlined in section 4.2.4.3, the new Italian NAP aims at introducing a mandatory governance structure for coordinating the main General Directorates (Agriculture, Environment, Health)

¹⁰¹ The stakeholders interviewed highlighted, that this is a very rough estimation. They further outlined, that it could be an underestimation.

involved in the SUD on the regional level. In some Regions, this structure has already been implemented and is considered key for the effective implementation of the SUD provisions at regional level. In this regard, a major challenge is the prevailing differences between the regions in terms of the level and extent of cooperation between the relevant stakeholders. The formalisation of governance structures in the new NAP could be seen as a first step towards overcoming this difficulty.

The different projects described for the Piedmont Region (see section 4.2.4.3) can be taken as examples for the involvement of various stakeholders such as universities, NGOs as well as grower and industry organisations on the regional level.

5. Discussion and conclusions

In general, for the MS analysed in this case study, the governance structure of the SUD hinges on one ministry which coordinates the cooperation with other involved authorities. This coordination is mostly achieved through regular fixed meetings (Forum NAP, CTS, Steering Group) to ensure cooperation and coordination between involved authorities on the national and in some cases regional level, depending on the national conditions. In certain cases, this also offers the opportunity to include further stakeholders. Depending on the national historical context, regional levels are involved to a larger (Germany) or lesser (Denmark) extent.

In terms of human resources costs for the implementation and enforcement of the SUD, the availability as well as the associated FTEs differ greatly depending on the degree of involvement of the regional levels.

It became apparent in the analysis of this case study that providing a centralised structure for the cooperation of the involved parties on the national level can contribute to efficient implementation. Furthermore, this kind of cooperation structure can facilitate effective communication between the involved parties as regards possible bottlenecks and hindrances in the implementation of the SUD. In the absence of these structures, struggles in the coordination were reported but these are also seen as opportunities for improving the coordination of SUD provisions in the future by the affected MS.

Another aspect that was often indicated is that stakeholder inclusion in an organised and fixed form can guarantee the involvement of farmers, industry organisations and other relevant stakeholders and ensure that their feedback is channelled. It can also serve as an information platform to update relevant stakeholders on activities within the country and the EU. A possible downside for these fixed forms with many stakeholders is that they might be perceived as too time-intensive and might discourage some participants from speaking up in such a wide platform. To overcome the latter hurdle, some MS provide the possibility for subgroups or ad-hoc meetings.

In addition to fixed forms of cooperation, MS noted that cooperation and coordination can also take place in ad-hoc form and on need basis. This was viewed favourably as it ensures flexible exchange between involved stakeholders on the national as well as the regional levels. The case study and associated interviews were however unable to evaluate how often ad-hoc meetings took place and whether they were organised on demand in a flexible way and which stakeholders were involved.

In the absence of such measures (structured or ad hoc meetings), MS have reported that communication with stakeholders is challenging. This particularly concerns informing and making stakeholders aware of the developments taking place at the national- and the EU level regarding the SUD. Moreover, stakeholders – if not actively involved – have criticised the lack of effective involvement of relevant stakeholder groups such as farmers. Therefore, it seems that a mixture of fixed structures with a regular schedule with the additional possibility to involve relevant

stakeholders on an ad-hoc basis might be the way forward to provide a platform for the effective governance of the SUD not only at national but also at municipal/regional level.

Some measures for improving collaboration and coordination and for supporting the identification of bottlenecks were applied in Denmark and Germany. For example, Denmark has an internal review of its policies and cooperation mechanism which provides the opportunity to uncover hurdles in the implementation. Whereas Germany's approach for developing the IPM guidelines displays the strong involvement of grower organisations using the available know-how and encouraged the associations to actively engage with the guidelines. This approach further ensures that the associations back the guidelines and garner the support of their members. However, one should be careful when trying to apply best practices from one MS to another as the agricultural and governmental structure can differ drastically and what works in one MS might not necessarily be applicable in another. This also applies to different regions or states within one MS, as the example of Italy shows. Here, the national legislation requires the regions to establish a governance structure for the coordination of the SUD. These structures have not been implemented in all regions. This indicates that different circumstances can hinder the implementation of governance structures or best practice examples. Furthermore, Belgian authorities pointed out¹⁰², that the complex governance structures of Belgium might pose a challenge to the implementation of the SUD due to differing definitions at the national and regional level. As per stakeholder input, the development of guidance documents for the MS might be supportive.

Another aspect that was discussed with the MS related to the support from the EC. It was indicated here that the efforts to improve information sharing and regular meetings and hearings with other MS are viewed favourably by the MS. However, other MS view the EC as being engaged and doing a lot in the field, however, at the same time, leaving limited room and space for MS to act. Moreover, the present top-down character and the lack of "freedom" in proposing measures themselves were criticised.

In terms of implementation of the SUD and the current back-to-back evaluation, it was noted that rather than introducing a stricter regulation, firstly all countries should be brought to the same level. One way of doing this would be by increasing the exchange of information and good practices between the MS via workshops or similar for example. Generally, according to stakeholder input, the EC should take a leading role e.g. by presenting ideas and different scenarios on the SUD revision and actively asking MS to participate. This was further substantiated by the wish for the EC to provide more specific instructions/guidelines on what the SUD wants MS to do. For example, the European Commission of Agriculture (ECA) requested crop specific IPM guidance, however, the EC noted that they neither have the resources nor expertise for this, and therefore tried to pass it on to MS, who noted similar issues.

Generally, the absence of "carrots", as opposed to "sticks", has been criticised. MS expressed their desire to have more recognition of what has already been achieved and for more incentives, especially for farmers. One suggestion for doing this according to the stakeholders would be to couple the funding of the CAP with the implementation of the measures under the SUD. Furthermore, MS voiced their concern that the introduction of annual reporting on the status of implementation, as suggested by the EC, would increase their burden. In this context, the EC pointed out that certain additional requirements like record-keeping would not pose much additional burden as they are already required for the Regulation on PPPs, for example.

¹⁰² Belgian authorities were interviewed for the case study on the water provisions of the SUD.

6. Bibliography

- BLE. (2021). *NAP-Pflanzenschutz*. <https://www.nap-pflanzenschutz.de/>
- BMEL. (2017). *Nationaler Aktionsplan zur nachhaltigen Anwendung von Pflanzenschutzmitteln*.
- European Commission. (2001). *European Governance - A White Paper*.
- European Commission. (2017a). *Final Report of a Fact-Finding Mission Carried Out In Denmark from 03 May 2017 to 10 May 2017 in Order to Evaluate the Implementation of Measures to Achieve the Sustainable Use Of Pesticides*.
- European Commission. (2017b). *FINAL REPORT OF A FACT-FINDING MISSION CARRIED OUT IN GERMANY FROM 06 MARCH 2017 TO 15 MARCH 2017 IN ORDER TO EVALUATE THE IMPLEMENTATION OF MEASURES TO ACHIEVE THE SUSTAINABLE USE OF PESTICIDES*.
- European Commission. (2017c). *FINAL REPORT OF A FACT-FINDING MISSION CARRIED OUT IN ITALY FROM 03 TO 11 MAY 2017 IN ORDER TO EVALUATE THE IMPLEMENTATION OF MEASURES TO ACHIEVE THE SUSTAINABLE USE OF PESTICIDES*.
- European Commission. (2019). *FINAL REPORT OF AN AUDIT CARRIED OUT IN GREECE FROM 26 MARCH 2019 TO 04 APRIL 2019 IN ORDER TO EVALUATE THE IMPLEMENTATION OF MEASURES TO ACHIEVE THE SUSTAINABLE USE OF PESTICIDES*.
- European Commission. (2020a). *ANNEX to the REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND TO THE COUNCIL on the experience gained by the Member States on the implementation of national targets established in their National Action Plans and on progress in the implementation: Vol. COM(2020)*.
- European Commission. (2020b). *Report from the Commission to the European Parliament and the Council - On the experience gained by Member States on the implementation of national targets established in their National Action Plans and on progress in the implementation of Directive 2009/*
- European Court of Auditors. (2020). *Sustainable use of plant protection products: limited progress in measuring and reducing risks*. <https://www.eca.europa.eu/en/Pages/DocItem.aspx?did=53001>
- Directive 2009/128/EC of the European Parliament and the Council of 21 October 2009 establishing a framework for Community action to achieve the sustainable use of pesticides, 309 Official Journal of the European Union 1 (2009).
- European Parliamentary Research Service. (2018). *Directive 2009/128/EC on the sustainable use of pesticides; European Implementation Assessment* (M. Remáč (ed.); Issue October). Ex-Post Evaluation Unit. [https://www.europarl.europa.eu/RegData/etudes/STUD/2018/627113/EPRS_STU\(2018\)627113_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/STUD/2018/627113/EPRS_STU(2018)627113_EN.pdf)
- Republic, G. G. of the H. (2020). *DECISIONS No 9269/246316*.
- The Minister of Rural Development and Food; the Minister of Environment Energy and Climate Change and the Minister of Health. (2013). *GR National Action Plan on Sustainable Use of Pesticides (Plant Protection Products). Common Ministerial Decision Num 8197/90920/22-7-2013*.
- Wissenschaftlicher Beirat zum Nationalen Aktionsplan Pflanzenschutz. (2018). *Forschungsagenda des Wissenschaftlichen Beirats des Nationalen Aktionsplans zur nachhaltigen Anwendung von Pflanzenschutzmitteln* (Issue April).

Appendix 6: CASE STUDY VI - Additional measures to strengthen the SUD

1. Introduction to the case study

The Directive 2009/128/EC on the sustainable use of pesticides, short SUD, defines a set of measures that Member States (MS) need to implement to reduce the risk associated with pesticide use. These measures include, among others, the establishment of National Action Plans (NAPs), training of professional pesticide users and inspection of pesticide application equipment. Some of these measures are assessed in detail in other case studies.

In the process of revising the SUD, the European Commission (EC) is also considering introducing additional measures. Those include:

- The setting of legally binding targets by EU legislation,
- The targeted taxation of pesticides, and
- The requirement of a prescription for the purchase or use of a pesticide.

These measures are already implemented in other policy areas of EU policy or in some MS or EEA/EFTA countries which can provide important insights for their potential application in the legislation on pesticide use. Because of the role they play in these countries, the instruments can be considered to complement or replace elements of the existing SUD. In that case, detailed information on the instruments is needed. This case study compiles this information for the three aforementioned measures.

The purpose of this case study is to analyse each of the additional measures to assess their possible role in a revised SUD. For this, the case study summarises publicly available information on the measures and supplements this with additional data from national authorities and other stakeholders.

The key themes are therefore:

- Describing the design and implementation of the measures in different policy areas or countries, including scope, process and enforcement,
- Understanding the effects on pesticide use and the related risk that have resulted from the measures, and
- Understanding the costs related to the measures for authorities and stakeholders such as pesticide users, distributors and advisors.

For the case of EU targets, experiences from the policy field of energy and climate legislation, in particular the Renewable Energy Directive (RED), have been collected. This legislation provides a relevant point of comparison as it sets national targets in EU legislation in its first version (RED I) from 2009. In this case, a key theme is to assess the lessons learned and determining factors that can inform the design of targets for pesticide use and risk.

For details on taxation and prescription systems, evidence originates from the MS and European Economic Area (EEA)/European Free Trade Association (EFTA) countries in which such measures are in place.

2. Methodology

For this case study, a stepwise approach for the assessment of additional measures to those in the current SUD has been used.

1. First, the relevant measures have been identified in exchange with the EC. Due to the high political relevance following the presentation of the Farm-to-Fork strategy¹⁰³, targets of legally binding nature are included in the scope of this case study. While some MS have defined quantitative reduction targets in different ways, this case study investigates the applicability of a system of targets defined at the EU level with shared indicators, rather than different national systems. Therefore, the set-up of targets and their follow-up or reporting represents the key interest in this comparison. The high attention that taxation of pesticides has received already at the stage of the thematic strategy on the use of pesticides (European Communities Commission, 2006)¹⁰⁴, as well as strongly differing positions from stakeholder groups and Member States warrants a close assessment of the experiences with existing systems. Finally, the option of prescriptions for pesticide purchase and use is considered because it is a potential option for reducing pesticide use, on which stakeholders and Member States make highly differing claims on the effectiveness in comparison to the administrative burden it generates.
2. Second, as a result of the selection of measures, the examples to assess and compare were taken based on previous implementations of such instruments. For targets, the EU climate and energy legislation since the EU Energy and Climate Package in 2009 has provided the main object for comparison. Out of this the RED I, which was in place from 2009 to 2018 set nationally binding targets for EU Member States, which is one key option to assess for the SUD as well. For taxation and prescription systems, several Member States and EEA/EFTA countries have such measures in place, which have been assessed. These are
 - a. For prescriptions: Hungary, Greece and Switzerland
 - b. For taxation: Denmark, Sweden, France, and Norway
3. Third, data for these implementation examples has been collected in desk research and expert interviews. As a first step, existing studies and reports on the mechanisms was reviewed. A focus was set on ex-post evaluations of the measures in order to understand the effects and implications. However, the literature on pesticide prescription systems is scarce, as a result of only few such systems being in place. For this reason, most information on this instrument was collected is interviews and from documents shared by the respective national authorities.

All Member States and countries targeted by this case study have been contacted with an invitation for an interview. To this date, two Member States (France, Sweden) have not responded with availabilities for an interview. Therefore, the description of cases is based on information available in literature. All other countries were interviewed in order to understand practical details, impacts and estimations of costs.

The description and analysis in this case study is based on a small number of cases for each instrument. Some of the implementations of pesticide taxation or prescription systems vary substantially from one another. This limitation and the differences need to be considered in case extrapolations for the entire EU and EEA are made.

¹⁰³ European Commission, 2020. COM(2020) 381 final. A Farm to Fork Strategy.

¹⁰⁴ European Commission, 2006. COM(2006) 372 final. A Thematic Strategy on the Sustainable Use of Pesticides.

Moreover, the instruments are not established in isolation and are affected in their effects by other policies and external factors such as weather events or input and output prices for agricultural products. Assessing the effects of the measures, therefore, is not unambiguously possible.

Additionally, the data sources mentioned under point 3 of the methodology provide grounds for limitations. Not all cases can be based at the same breadth of information.

3. Legally binding targets for pesticide reduction

Targets are in principle already a part of the SUD as it is currently in place. Article 4 of the SUD requires MS to set up NAPs that include quantitative objectives and targets to reduce the risks and impacts related to the use of pesticides. However, since the entry into force of the SUD only a few MS have established quantitative targets on for reducing the risk or the use of pesticides.

The Farm-to-Fork strategy(European Commission, 2020a) confirms the ambition of the EU to reduce pesticide risk and use, and defines targets of 50% reduction, also for the use of the more hazardous pesticides. These targets set quantitative goals for the sustainable use and also widen the scope by including a target on the reduction of use. The confirmed and increased ambition requires action by all Member States to achieve the targets.



Figure 9 - Pesticide targets of the Farm to Fork Strategy.

So far, the pesticide targets in the Farm-to-Fork strategy are of political and strategic nature. Creating legally binding targets could be a way to create stricter and ambitious measures at Member State level. This part of the case study analyses previous and existing approaches to binding targets at the EU level in the area of energy and climate legislation.

3.1 General overview on RED targets

The current EU climate and energy legislation has been developed in several policy packages, notably 2009 and 2018. The packages, together with the EU Emissions Trading System (EU ETS), aim at achieving a trio of targets that result from negotiations between the EU Commission, the European Parliament and the Council. The targets set in 2008 were formalised in EU legislation in the "2020 EU Climate and Energy Package" of 2009. Updated targets for 2030 were formalised in the "Clean Energy for all Europeans" package of 2018. The RED and the Effort Sharing Regulation as central pieces of these packages are introduced in the following paragraphs.

The 2009 Renewable Energy Directive, RED I (Directive 2009/28/EC), was one of the key pillars of the 2009 energy and climate policies. It has driven the growth of renewable energy between 2010 and 2020 in many of the EU's member states and facilitated these developments through several supporting provisions. Key policies in the RED I were binding national targets for the overall share of renewable energy in energy consumption, separate targets for renewable energy in transport and provisions on sustainability criteria for biofuels and biogas.

In 2018, the recast of the RED, RED II (2018/2001/EU), which focuses on the period until 2030, was adopted as part of the EU's energy and climate policy framework towards 2030 and beyond, the Clean Energy Package. The recast directive reflects the higher target for 2030 and takes a

different approach in creating a legally binding target at the EU level, rather than at Member State level.

3.2 Design of important elements of the RED targets

3.2.1 Monitoring and reporting

As a first important element, the Trinomics RED I evaluation of 2016 finds that the monitoring and reporting mechanisms are key to ensure and track compliance, which has helped to increase the RES share in the Member States. The energy legislation relies strongly on Member State reporting to ensure the effective implementation. The RED I requires Member States to develop National Action Plans, similar to the SUD. These National Renewable Energy Action Plans (NREAP) contain the policy instruments chosen at national level to reach the target set out in the Annex to RED I. In the following, Member States report on the progress and on changes to the actions. These reports had to be submitted biennially to the Commission who reviews them (see Art 22 of RED I). Article 4 of the directive provides that Member States have to update their plans to return back on track to the pathway of reaching the target.

Second, the ability to collect data that captures progress in an accurate and widely accepted way is determined as a key factor. The fact that installed capacity and output of renewable electricity can be captured relatively unambiguously, efficiently and in a robust manner, helped the acceptance and implementation of these data points. Areas such as research and innovation with less accurate and accepted indicators were more strongly contested and reporting of the target has had less effect on achieving the target, for which solid understanding of the progress and effectiveness (Trinomics, 2016).

Related to this, the perception of the need to monitor progress in the policy field is an important factor. The shared impression found for the RED context was that more data and knowledge was needed to evolve policies. In a mature area such as energy policy, the introduction of new technologies and objectives are found to be a stimulus to monitor developments (Trinomics, 2016). This point is furthermore connected to the perceived importance of progress and accurate data on progress in the policy area, from both the EU and the Member States. Urgency and broad political relevance of the topic create a need to be able to show progress that supports the interest in having accurate data.

3.2.2 Distribution of efforts between Member States

A further lesson that can be learned from the definition of targets for the share of renewable energy is the distribution of efforts between the Member States. On the other hand, the role enforcement plays, is less clear from this example. Lastly, the nature of the RED targets as positive, increasing targets, needs to be taken into account.

First, the distribution of efforts to achieve the overall EU target among the Member States is an important point to consider. The RED sets differing targets for all Member States reflecting different factors. Recital 15 of the RED presents these factors, while the impact assessment of the energy and climate package (European Commission, 2008) provides further details on the rationale behind these.

- The potential for development of RES generation and therefore to achieve the target is one main element. This helps reflecting cost-effective development opportunities, which was one key principle for the implementation.
- The starting point of the energy mix, considering the past efforts in the area is a second element that ensures buy-in from forerunner countries

- The economic ability to perform the transition, measured by the GDP is the final weighting factor to create fairness of the national targets in respect to differing levels of prosperity. This was set as another key principle for the implementation of RED targets.

An evaluation of this approach is not undertaken in any of the evaluation reports. However, it is found that effectiveness of the RED to achieve the targets at an intermediate stage has been highest in countries with low initial ambition, while some frontrunner countries have seen high increases in absolute RES capacity.

3.3 Effects

The 2009 targets for renewable energy generation in the Member States have led to an increase in renewable energy sources (RES) share. According to the latest available figures published in 2020 on data up to 2018, the overall EU renewable energy target and most of the national targets for 2020 are likely to be met (EEA, 2020). Evaluations of the RED I confirm an important contribution of the directive overall on the increased uptake of renewable energy sources (European Commission, 2016; Trinomics, 2016). The targets set and the National Renewable Energy Action Plans form the central element of the RED I and can therefore be credited with a large part of this achievement.

3.4 Lessons for SUD from the RED

The experiences and results show that a system of frequent reporting on monitored data would be key to the success of legally binding pesticide reduction targets in the SUD as well. Currently, sales data and the information for the calculation for HRI1 is submitted annually by Member States, while the National Action Plans generally do not take the form of reporting on progress towards reduction targets, as most Member States have not defined such targets (European Commission, 2020b). Reporting in the current form or in an adapted format with national progress reports to the EU Commission can be envisaged and would likely play an important role in ensuring successful achievement of the targets.

Here, a key challenge for the inclusion of legally binding targets in the SUD can be found. The Harmonised Risk Indicators (HRIs) are relatively easy to monitor based on data on sales of pesticides that has been collected for a long time. However, the use of the HRIs is contested from different sides. Stakeholders from both pesticide industry and environmental NGOs, as well as Member State authorities express in interviews on the evaluation of the current SUD that the HRIs, in particular HRI1, are not accurately capturing the sustainability of the use of pesticides. The fact that several Member States have continued to use their own indicators suggests that limitations of the harmonised EU ones may exist.

As a result, reporting on the HRIs in the context of legally binding targets could be highly contentious, as factors such as volumes of low-risk pesticides or productivity gains in some Member States may lead to misleading HRI1 figures, while the practices around the use of the sold pesticides are not captured in the indicator. This contention does not make the monitoring of targets impossible, but the already existing criticism may be expanded on the developments of (non-) achievement of the targets.

For the SUD this indicates that legally binding targets could be a useful instrument to initiate efforts in Member States that have so far made little progress towards reducing the risk associated with pesticide use. For this, however, a consideration of feasibility and capability in each Member State may be helpful in order to distribute the efforts rather than having the same target for all Member States. The consideration of cost effectiveness in achieving the reduction targets may give strength to the notion of setting higher targets for those Member States that have made fewest progress so far. Here, smaller adaption costs can be expected in comparison to Member States that have

introduced the cost-effective measures for pesticide use reduction. However, considering the criterion of fairness and capability may still require additional actions even from countries with high ongoing reductions.

3.5 Costs of EU target setting and reporting

This section investigates the costs related to the definition of targets and planning of policies. It does not consider the costs of achieving the targets, as these will vary significantly between policy areas and depend on the instruments chosen.

Legally binding targets create costs for Member States on developing the policies needed to achieve them as well as report on the progress towards the targets. The Commission on the other hand bears costs for the assessment of policies and reports submitted by Member States. Additionally, the initial work on the distribution of efforts between Member States can be considered a cost, which is however highly dependent on the political process and the negotiations with the Council and the Parliament of the EU.

The Fitness check of the Reporting, Planning and Monitoring Obligations in the EU energy acquis (Trinomics, 2016) surveyed Member States about their costs for policy planning and reporting in relation to several obligations, including those of the RED. The results presented in the study are

- median costs of 10 309 EUR per Member State and year (resulting in a total of 278 343 EUR) for the policy planning obligation of Article 4 and Annex VI of the RED, and
- median costs of 4 407 EUR per Member State and year (resulting in a total of 118 989 EUR) for the biennial progress report provided for in Article 22 of the RED. The biennial nature of the report needs to be noted, which would lead to a doubling of costs for an annual reporting frequency.

These costs are low for the specific obligations of the RED but found to be much higher for all energy-related planning (ca. 6 million EUR per year for all MS) and reporting (ca. 13 million EUR per year for all MS) obligations. In particular, the Energy Efficiency Directive¹⁰⁵ creates much higher planning and reporting costs for Member States because of the higher complexity of data collection and a higher diversity of national approaches to increase energy efficiency as described in that Directive. In general, the fitness check was conducted for all the planning and reporting obligations of energy-related policies as there is overlap between them.

The relatively low costs of Member State obligations are additionally largely driven by a standardised template provided by the Commission, which was also found to increase the compliance of Member States with the reporting obligations (European Commission, 2016).

Quantifying the costs for the Commission is more challenging. Data on the costs of processing Member States reports is not available.

3.6 Conclusions

The Renewable Energy Directive (RED) has proven that legally bindings targets for Member States can be a successful option of reaching a target set at the EU level at relatively low costs directly connected to the compliance with the obligation. However, this main finding needs to be considered in light of contextual factors and parameters that enabled the success and low costs. A high support and interest in data on the general topic of renewable energy shares, important developments of

¹⁰⁵ Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC

renewable energy technologies, and widely accepted monitoring indicators that can easily be reported have paved the way of the success of the RED.

For the topics covered by the SUD, some of these elements like a widely accepted indicator have been a challenging topic in the past and will likely remain a contentious one in the future. The distribution of effort between Member States would also need to be based on broadly accepted basis. These elements would need to be reflected in the target design process in order to obtain similar success and see reductions in risk and use in the Member States, in line with the overall EU target.

4. Pesticide prescription system

A prescription system introduces a barrier to the purchase or use of pesticides, as these have to be confirmed by an issuer of a prescription similar to many pharmaceuticals which require a prescription in order to purchase them. Thus, in this context, policies that require an expert approval for the purchase or use of a specific pesticide (i.e. not general requirements like training and certification for users) are considered a prescription system.

In the case of pesticides, a key rationale is to require justification from the user for applying certain active substances in specific situations. The details of existing prescription systems in Europe, in place in Greece, Hungary and Switzerland, are presented below. In these countries, prescription systems have been in place since before the entry into force of the SUD. Other Member States or countries in the EU have not decided to introduce prescription systems, while outside of the EU, the Canadian province Québec provides a further example of such a system.

4.1 General overview

The three European systems take different approaches to prescriptions or permissions for the purchase or use of pesticides. Table 16 summarises the main points for the three systems.

Table 16 Comparison of pesticide prescription systems in Europe.

Member State or EFTA country	Substances needing a prescription	Issuer of prescription	Basis of the prescription decision	Duration of prescription	Controls/ enforcement	Numbers	Costs	Effects
HU¹⁰⁶	Category I (more hazardous pesticides according to health and environmental risk assessment) substances need prescription; for Category II, non-trained users need a prescription	Members of the chamber of doctors of plant protection, which can be either <ul style="list-style-type: none"> - Holding an MSc degree in plant protection - Holding a university degree in agricultural, nursery, forestry or biology engineering with specialization on plant protection - Equivalent degree recognized by the Ministry 	Contracted plant doctors monitor developments of pests in the fields of a farmer Based on their assessment, prescriptions are issued which also provide information to the user	Purchase must be within 30 days from issuance of the prescription, no limit on use of the product	Controls are part of pesticide inspections (which also include other tasks) Controls at pesticide distributors, users and plant doctors Need to keep prescription for 5 years	100k-150k prescriptions per year 4300 plant doctors Around 170 pesticide inspectors	Plant doctors: 5 minutes per prescription Farmers: Contracts with plant doctors ca. HUF 3000-6000 (EUR 9-18) per hectare Authorities: checks are part of the daily work but not specifically measured	Plant doctors are employed by private service providers in a free market General contribution to pesticide awareness and risk reduction but not directly measurable
EL	All pesticides authorised for professional users	Authorised distributors of pesticides: Agronomists with relevant university degree	Authorisation of the pesticide for the crop in question	For immediate purchase	Registered in national electronic system together with intended use	2500 authorised distribution points	Main cost is setup and maintenance of the electronic system No extra costs for farmers or distributors	No reduction in pesticide use Intention is record keeping of pesticide sales and uses
CH¹⁰⁷	Substances (nematicides, molluscicides and insecticides) not contained on a list for a selected number of pests, also use of all pesticides in certain condition (e.g. winter, pre-emergence)	Plant protection services of the Cantons	User needs to request remission before use, Request made by phone Decision made based on description of the situation and insights from continuous pest monitoring by the authorities	Permission for a specific application, possibility to have regional prescriptions in case of epidemics	Spot checks in which plant mass is collected by authorities and analysed to see if AS are found on fields without permissions for application	Ca. 4000 permissions per year ¹⁰⁸ Ca. 95% approval rate Controls find violations in around 10-15% of the spot checks	Time needed for issuing permission: 20 minutes for authorities 10 minutes for farmer In addition: careful monitoring of pests In total about 30 FTEs ¹⁰⁹	Not possible to determine direct effect In place since before current statistics are recorded, part of policy package Main effect: sensitizing users

¹⁰⁶ Decree 43/2010 on plant protection

¹⁰⁷ Legal document: Swiss Ordinance on Direct Payments for Agriculture

¹⁰⁸ Calculated based on information from the largest Canton, Bern, and share of agricultural land

¹⁰⁹ Calculated based on information from the largest Canton, Bern, and share of agricultural land

4.2 Important elements and differences of the national instruments

4.2.1 The action for which a prescription is needed

Two key actions of the use of pesticides may require a prescription. First, the purchase can only be possible with a prescription. Or second, the use of the pesticide in the field can require a permission.

The **Swiss** system requires a permission for the application, whereas the purchase of pesticides is open to any certified person. In **Hungary** on the other hand, a prescription is needed for the purchase of the pesticide. Similarly, in **Greece** an authorisation is needed at the time of purchase, which can be obtained from the selling distributor.

4.2.2 Pesticides requiring a prescription

As Table 16 illustrates, in all three countries, prescriptions are necessary for certain pesticides, while others are allowed for use without prescriptions. The risk profile and prescription status for the pesticides are based on their active substances and defined during the national approval of the specific formulation of the pesticide. However, the specific connection between pesticide and prescription varies slightly between the existing systems.

In **Greece**, all pesticides require the authorisation at purchase, which is considered the prescription. In this approval it is checked if the pesticide is authorised for the crop and purpose which the user intends to treat.

In **Switzerland**, the use of pesticides is limited by different parameters in the Ordinance on Direct Payments for Agriculture¹¹⁰. Seasonal timing, pre- or post-emergence spraying and type of active substance, all imply restrictions on the use of pesticides. Exemptions from these restrictions require a permission to do so, which equates to the prescription.

The main area for application is the use of initially restricted AS. Under normal circumstances only AS on a positive list for nematicides, molluscicides and insecticides may be used¹¹¹. These have been selected based on their low risk for beneficial species as the main criterion. Other pesticides in these categories require the prior permission.

In **Hungary**, environmental and human health risks are the basis for declaring a pesticide as category I, II or III, with category I, which contains the more hazardous pesticides. The categories are nationally determined based on the classes of active substances as authorised under Regulation (EU) 1007/2009. The need for a prescription for the three categories is illustrated in the Table 17 below.

Table 17 Need for prescription for pesticide purchases in Hungary

User category	Pesticide category		
	Category I	Category II	Category III
Person with higher education degree in plant protection	<ul style="list-style-type: none"> May purchase and use May issue prescription for other users 		
Person with certified participation in 80-hour training on pesticide use	<ul style="list-style-type: none"> Purchase and use only with prescription 	<ul style="list-style-type: none"> May purchase and use 	

¹¹⁰ <https://www.fedlex.admin.ch/eli/cc/2013/765/de>

¹¹¹ See Annex 1 of the Ordinance on Direct Payments for Agriculture

Person not having special qualifications	<ul style="list-style-type: none"> • Purchase and use only with a prescription 	<ul style="list-style-type: none"> • May purchase and use
-------------------------------------------------	-----------------------------------------------------------------------------------------------	--------------------------------------------------------------------------

4.2.3 **Issuing person or body**

A key element of a prescription system is the person or organization issuing the prescriptions or permissions. In the existing cases, these have to have a specific training and are generally in close contact with the situation on the fields in order to assess the need for treatment quickly.

In **Switzerland**, public authorities, the plant protection services of the local canton, are the issuing bodies of prescriptions, while in **Hungary**, members of the national Chamber of Professionals and Doctors of Plant Protection can prescribe pesticides. To become a member, a master level university education in plant protection or selected fields of engineering is required (see Table 16). Farmers and plant doctors need to be in a contractual relationship for the cropping season, in order to ensure that understanding of the crops and condition is available from the beginning rather than calling any doctor at signs of infestation. Farmers have to pay for these services, which are provided by private advisory and plant protection providers on a free market. This means that plant doctors can have an incentive to issue prescriptions relatively freely to their clients. Otherwise, farmers may risk incurring yield losses and based on this decide for another provider for the next cropping season. Similarly, in **Greece** a university education is needed to become an authorised distributor and be able to approve the use of pesticides.

4.2.4 **Basis for prescription decision**

The basis for a prescription describes how the presence of a pest is assessed in order to decide if an application of pesticides is needed.

The systems in both **Switzerland and Hungary** are designed so that issuers of the prescriptions follow the development of the crops and pests over a longer time horizon of at least one cropping season (Hungary). The frequent checking of pests on different fields enables the issuers to quickly decide if and which pesticides are needed. This means that the process of requesting and obtaining a prescription does not take a long time but that considerable efforts/costs arise from the frequent monitoring.

In **Greece**, only the authorisation of the pesticide for the specific crop and purpose is considered.

4.2.5 **Duration of the prescription**

The duration of the prescriptions issued is only defined in Hungary. In Switzerland, the prescription is for the application of a certain pesticide, which will normally take place directly after receiving the permission. In Greece, the purchase follows immediately to the prescription/approval. In Hungary, prescriptions for purchasing the pesticide are valid for a maximum of 30 days.

4.2.6 **Controls**

Controls are undertaken in Switzerland and Hungary to make sure the laws underlying the prescription systems are respected. These controls are part of wider checks on the implementation

of plant protection laws, such as the illegal use of unauthorised substances. **Greece** relies on an IT system to which all approvals are reported for the main purpose of recording keeping of sales and use of pesticides in the country.

In **Hungary** the controls are check if the necessary documentation is available and amounts and applications can be supported with the correct prescriptions. To this end, pesticide distributors, users and plant doctors are subject to controls. All these parties have to keep a copy of the prescription for five years.

In **Switzerland** the controls are based on analyses of plant biomass that is collected in spot checks. The substances found in the analysed samples are compared with the pesticides that had been approved for a that area, which reveals potential violations.

4.3 Effects

It is difficult to assess the direct effects of the prescription systems in place. One reason for this is that they have been in place for a long time, which makes a comparison to the situation before the introduction impossible. A second reason is that the instrument forms part of a larger mix of EU and national policies that regulate the approval and use of pesticides.

Greek authorities indicate that a reduction of the use of pesticides is not the main objective of the prescription system. Record keeping on the sales and use of pesticides is the intention behind the instrument. Advice on the most appropriate pesticide can be given during the selling process and only in cases where a pesticide is not authorised for a specific crop, the distributor is not allowed to sell the pesticide.

In both **Switzerland and Hungary** direct changes in the use of pesticides are not reported from the national authorities. According to the interviewees, some key trends can be observed:

- A key contribution of a prescription is the increased awareness of pesticide users. Both Switzerland and Hungary connect the prescriptions to advice on the correct use of pesticides. The requirement to obtain a prescription means that advice from the issuing bodies, then is a mechanism to ensure farmers receive advice.
- A prescription system does not ban the use of pesticides. In Hungary the number of prescriptions issued per year amounts to 100 000 to 150 000. In Switzerland the approval rate of prescription requests is 95%. Both numbers indicate that some pests require the use of the prescription pesticides. In particular, if alternatives which do not require a prescription are not available, a reduction in use of cannot be expected.

Sensitisation of farmers is therefore the only major effect a prescription system is achieving. This is also an objective of other policy instruments such as training and advisory. For an increased uptake of IPM, advice prior to the emergence of the pest is crucial. This is connected in both the Swiss and the Hungarian system to the issuing of prescriptions but in a less formal manner. As farmers can expect to obtain a prescription in almost all cases, the concrete incentives to prioritise integrated ways of preventing and controlling pests are not strongly increased.

4.4 Costs

The costs for the systems in Switzerland and Hungary are calculated based on information provided by the national authorities during the interviews. For monetising time spent on activities related to the prescriptions, the EU average for the hourly wage is assumed, which is 28.5 EUR.

Switzerland:

Based on numbers obtained for the biggest canton Bern, plant protection services employ about 30 FTEs for the monitoring of pests in fields and issuing of prescriptions. Around 4000 prescriptions are issued each year which on average takes 20 minutes for authorities and 10 minutes for the farmer.

For authorities, these numbers result in costs of around EUR 37,000 for the time needed to issue prescriptions. Additionally, and more importantly, the monitoring, advice and controlling activities account for EUR 1.6 million per year.

For farmers, the costs are low with EUR 19,000 per year for all Swiss farmers.

Hungary:

Based on numbers obtained during the interview with the national authorities, between 100,000 and 150,000 prescriptions are issued every year. These take about 5 to 10 minutes for the issuing plant doctors. Costs for farmers result from the contract that is needed with a plant doctor or service provider. The prices for these are based on hectares and are estimated by the interviewee to lie between EUR 9 and 18 per hectare and year. Finally, authorities are performing controls at pesticide distributors, farmers and plant doctors. 400 inspectors are working on pesticides in Hungary. However, the prescription controls are part of a large number of tasks that also involve sampling and pesticide application equipment inspections. Therefore, the specific costs of the controls for prescriptions cannot be estimated.

The costs for farmers depend on the farm size. As the FAO describes a strongly bipolar farm structure¹¹², company-run farms are separated from individual-run farms. For the former, an average size of 486 ha is presented by the FAO, for the latter, only 3.4 ha on average. Thus, the plant doctor service costs between EUR 4374 and 8748 per year and company-led farm and between EUR 30 and 60 per year and individual-run farm.

Greece:

Concrete data on the costs of the Greek system were not available. According to the national authorities, the main cost factor is the IT system to which sales are reported. The costs are covered under the main budget of the Ministry for Agriculture and could not be obtained specifically.

Farmers or distributors are reported to face no additional costs as the approval takes place during the normal purchase procedure and is completed within instants.

4.5 Conclusions

A prescription system provides a policy instrument to require advice for farmers when they want to buy or use certain pesticides. As has been mentioned, the systems in place in Switzerland and Hungary can be related to increased sensibilization of farmers to when and how they use pesticides, as well giving priority to the low-risk pesticides that are available. However, the prescription systems are not a barrier to pesticide use and can therefore not reduce the overall amount applied or the dependency.

Monitoring of pests is essential in order to be able to assess the need for pesticide application quickly. Depending on the current set-up in Member States, connecting a prescription system to such monitoring may be a notable additional burden in the period in which the system is introduced and developed. In addition, the analysis shows that a prescription system requires support from advisors

¹¹² According to FAO website: Large farms above 100 ha use 72.2% of all areas, while they constitute only 1% of all farms. Whereas 93.4% of individual farms are below 10 ha, and account only for 25% of the land used (70% of them own less than 1 ha). The majority of individual farms serve as a supplementary income source. <http://www.fao.org/family-farming/countries/hun/en/>

prior to the request of a prescription to be an effective instrument for reducing pesticide risk and use. The sensitisation achieved by a prescription system provides fruitful ground for integrated pest management (IPM) advice. This could effectively lead to less need for prescriptions and thus reduced risks.

5. Pesticide taxation

Economic instruments like taxation play an important role in many policy areas. In general, taxes and excise taxes, that is taxes based on the quantity on consumption or use of a certain product, in particular can rely on two key underlying mechanisms (UNDP, 2017):

Create a price signal for the desired behaviour

Increase the public budget to balance social costs from non-desired behaviour

As an example, tobacco consumption is subject to an excise tax that aims at disincentivising smoking and raises means for public budgets to address public health costs related with smoking.

Similarly, a tax on pesticides can account for the costs related to negative impacts on the environment and human health by introducing price incentives to decrease the use of pesticides or lowering the risk profile. If tax revenues are used for relevant projects of e.g. biodiversity restoration or water quality, a pesticide tax support the polluter pays principle as stipulated in the Treaty on the Functioning of the EU¹¹³. Many stakeholders concerned about the negative environmental and public health effects are arguing for an introduction of a pesticide tax in the EU¹¹⁴, while a majority of Member States object to the introduction of such a tax on the EU level. Professional users and the pesticide industry also do not support the idea of a tax, giving lost competitiveness on international markets as a main reason in position papers and comments on such a possible option.

Taxation of pesticide use assumes that professional users will find the optimal balance between the costs for pesticide application and the loss of income from yields. This optimum would be at a lower level of pesticides use. However, some studies suggest that pesticide demand (and thus use) is not very responsive to price changes and farmers may place secure yields above the additional costs for pesticides (Falconer & Hodge, 2000; Pedersen et al., 2012).

5.1 General overview on pesticide taxation in Europe

In Europe, specific taxation of pesticides is in place in only a few countries with Sweden, Denmark and France as EU Member States and Norway as an EEA country. In other countries, taxes such as value added tax (VAT) apply to pesticides but only in the same way as they do to other products. In some MS, even reduced VAT rates apply to pesticides. This is also not considered pesticide taxation in the context of this case study.

Table 18 provides an overview of the main characteristics of the pesticide taxes in European countries.

¹¹³ Article 191 TFEU

¹¹⁴ E.g. PAN Europe website, Mahler & Runkel, 2018

Table 18 Comparison of pesticide taxes in Europe

Member State or EFTA country	Tax base	Tax rate	Imposition point	Revenue generated	Use of revenue	Costs	Effects
DK	Excise duty Volume of active substances sold according to categories of environmental risks, expressed as the pesticide load indicator: Human health risk Environmental degradability and accumulation Environmental toxicity on non-target organisms	Fixed base tax per kg of active substance: DKK 50 Differentiated tax based on criteria: DKK 107 (multiplied by the compiled load indicator)	Pesticide distributor or importer	DKK 520 million (EUR 70 million) per year on average between 2014 and 2017	Fully reimbursed to the agricultural sector through lowering of agricultural land property tax, support of organic farming, administrative services, green growth measures as defined in NAP	High initial costs due to complex system of determining the tax rates Small regular costs because of highly digitalized infrastructure and integration in other processes Minimal efforts needed for holders of pesticide authorization because of digitalization and overlap with sales records	Has helped DK to meet its target in relation to sales every year since 2015 Substitution of high load pesticides with low-load ones No reduction trend in use of pesticide More frequent treatment Decrease in load after the introduction of new tax system, stable since then Effect differs on types of pesticide: fungicides stable, insecticides strongly decreased Extra financial burden for farmers, which results in lower competitiveness within EU
FR	Excise duty Volume of active substances sold, grouped according to their risk profile: Carcinogenic, mutagenic or impact on human reproduction Ecotoxicity Aquatic toxicity	Rates depending on risk category between EUR 0.9 and EUR 9 per kg of active substance	Pesticide distributor and importer	EUR 400 million	Used for agricultural measures including NAP and promotion of organic farming and balancing costs of water operators		No continuous decrease of pesticide sales High peaks of sales because of storage before introduction or raising of tax rate Increases budget for NAP measures
	Price-based tax, similar to VAT Value of pesticide sale	0.9% of the selling price without VAT 0.1% for biocidal products	Pesticide distributor and importer	EUR 18 million	Mainly for compensation fund for pesticide victims		
	VAT reduction for PPPs used in organic production	10% VAT rate instead of 20% VAT for regular products	Along the value chain, payable by final consumer				
SE	Excise duty Volume of active substances sold	Fixed for all active substances SEK 34 (ca EUR 3.4) per kg of active substance sold	Pesticide distributor or importer		State budget	Easier to calculate and enforceable	
NO	Excise duty Volume of active substances produced or imported, grouped into categories according to human health and environmental risks (low, medium, high)	NOK 25 per hectare multiplied by a category weighting factor and a standard area dose for the pesticide Higher factors for pesticides sold to non-professional consumers Parameters are defined at the approval of a pesticide	Pesticide producer or importer	NOK 50-65 million (EUR 5-6.5 million)	Part of the overall state budget	For authorities: Ca. 25 days per year for administration of yearly tax calculation and collection Additionally, risk category and SAD are determined during approval, minimal additional time For businesses: Reporting 2x per year A few days for each reporting External accountant for approving the declared numbers	No clear trend in relation to pesticide use or risk since the introduction of the tax Small number of pesticide approved in Norway means that alternatives are limited

Sources: Böcker & Finger, 2016; OECD, 2017; Ørsted Nielsen et al., 2020; Sud, 2020, interviews

5.2 Important elements and differences of the national instruments

5.2.1 Tax base and rate

The tax base describes the unit used for calculating the tax. All Member States and countries analysed in this part of the case study have at least a pesticide excise duty, which is based on the volume of active substance, rather than their price. In France additional taxes and reductions are in place that are based on the VAT or a similar mechanism.

In all cases, except for Sweden, the pesticides are classified into risk profiles, which determine the tax rate. The more detailed tax base helps to set price signals according to the properties of the product. The Member States and countries apply different parameters for the determination of the risk profile and have varying numbers of categories. The Danish pesticide tax does not rely on categories at all but set specific tax rates for each approved pesticide. In all cases of categories or specific tax rates, the risk profile is determined during the national approval of a pesticide.

The Danish system also has the most comprehensive set of parameters to determine the risk profile, considering human health, environmental degradability and accumulation as well as effects on non-target species. This ensures that final pesticide prices including the tax reflect the risks in a very detailed and comprehensive manner.

As mentioned, Sweden on the other hand does not differentiate between pesticides according to risk parameters. They are all subject to the same tax. As a result, the system is much simpler for all actors involved, but also does not provide incentives to replace hazardous pesticides with less hazardous ones.

The tax rate defines how much tax needs to be paid on the production/import or purchase of pesticides. The approaches to determine the rates differ between the Member States and countries and as a result, also the applicable tax can vary substantially. In Sweden, a relatively low tax of EUR 3.4 per kg of active substance is fixed. The tax rates for French pesticide categories start even lower at EUR 0.9 for pesticides with low environmental risks up to EUR 9 for pesticides with high public health risks (carcinogenic, mutagenic or reproductive effects). In Norway and Denmark, a base tax rate is multiplied by the corresponding risk factor or load indicator.

Because of the differences in tax base and tax rates, specific pesticides can be subject to very different amounts of tax when comparing the Member States and countries.

5.2.2 Process of tax determination and collection

The tax rate or its defining parameters are set during the approval process of a pesticide. Norway and Denmark explain that as part of the approval of pesticides produced or imported into the countries, the risk profile is determined and thus the basis for calculation of the tax. In Denmark, the tax for a specific pesticide is determined at that time, while in Norway the pesticide is grouped into one of the categories which forms the multiplying factor for the base tax. The number of different rates and the parameters used to determine the applicable rate have an impact on the complexity of the administration process. While Denmark, Norway and France have different groups and this step is necessary, Sweden's fixed tax rate does not require efforts for the determination of the tax base.

The collection of the tax in both Norway and Denmark occurs at the level of the companies holding the approval of a certain pesticide for either production or import. These companies have to report the pesticide sales and surrender the corresponding tax.

In both Norway and Denmark, the responsibilities are thus split between the plant protection authorities, which set the tax base and administer data on sales, and the tax authorities, which collect the tax.

5.2.3 Controls

Controls are necessary to ensure compliance with any tax and therefore also the pesticide tax. Normally tax and customs authorities are in charge of checking if the correct amounts have been paid and that no illegal products are used, that have not been subject to the tax. As in both Norway and Denmark pesticide producers and importers are liable to pay the tax, the number of taxpayers is very low in both countries, with only between 10 and 20 organisations holding the authorities to place their pesticides on the national market. Controls of pesticide users are carried out on a risk-based approach, depending on proximity to the border, business connections to companies in other countries, or the value of a crop.

5.2.4 Generation and use of revenues

The revenue generated by the different tax systems by nature differs between countries depending on the tax rate and on the amount of pesticides sold. The national revenues range from EUR 5-6.5 million in Norway to EUR 400 million in France, illustrating the vastly different characteristics of the agricultural sectors in the countries. An estimation for revenue from a potential EU-pesticide tax was carried out as part of a study on an environmental fiscal report in 2016. For 2030 the revenue was estimated at EUR 4.01 billion (Eunomia et al., 2016).

The use of the revenue also differs between the countries. In Norway and Sweden, the revenues are allocated to the general state budget. In Denmark, the use of revenues on the other hand is earmarked for the agricultural sector and redistributed through lowered tax rates for agricultural land, administrative services related to pesticide reduction and support of organic farming. France takes one step further on the polluter pays principle by allocating part of the revenues to balancing costs of water operators, while a large part is financing the actions of the French NAP (Plan Ecophyto).

5.3 Effects

The effects of pesticide taxes are assessed differently in various studies and by stakeholders and interviewees. Again, taxation is in all countries one of several instruments in a policy mix, which makes it difficult to attribute developments directly to tax application. Several studies (Böcker & Finger, 2016; Pedersen, 2016) investigating the design and impact of European pesticide taxes find that a lasting effect on pesticide use cannot be observed.

A change in risk profile of the applied pesticides can only be expected if differentiating tax rates reflect the environmental and public health risks (Böcker & Finger, 2016). Interviewees from national authorities with such differentiating tax systems mention that substitutions to lower risk alternatives take place, if such alternatives are available. For example, in Denmark the pesticide load (based on risks) decreased, while the frequency of treatment increased. This can also be seen in the HRI 1 for Denmark (see Figure 10), which shows a sharp drop after the introduction of the most recent tax design in 2013 and stayed stable since then. Similarly, the HRI 1 for Sweden drops after the most recent increase in the tax rate in 2014. In both cases, a peak can be observed in the year prior to the changed tax. This can be explained with stockpiling by farmers (Böcker & Finger, 2016; Pedersen, 2016). While such behaviour could account for the sudden drop after the increase in tax rate, the continuously decreasing developments in both countries indicate a lasting effect. In

France, new and increased rates were introduced in 2019, which provides context for the increased data point in 2018 in

This is in large parts attributed to the low price elasticity of demand for pesticides. Also the Danish tax was repeatedly found to have only small effects up until 2013 when its design changed (Pedersen, 2016). The decline of HRI1 following this change indicates that a higher tax rate does provide sufficient incentives to reduce the risk profile of the pesticides that are applied. France increased the tax rates in 2019 to the current levels. An assessment of the effectiveness of this revised tax rate is not possible yet and will have to be evaluated in the future.

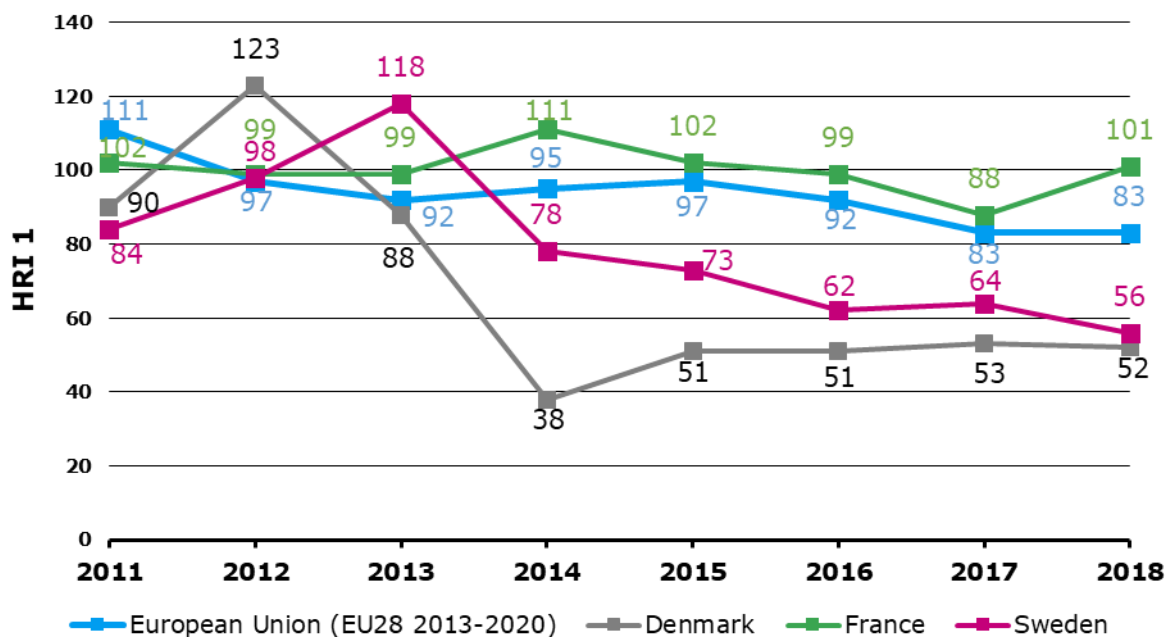


Figure 10 - Development of HRI 1 in Denmark, France and Sweden, plus the EU28

Political considerations have likely caused the lower level of tax rates in the past (OECD, 2017). Raising revenue for the state budget and public expenses on pesticide reduction campaigns as well as water treatment have to be balanced with political acceptability of the tax in the sector and the society as a whole. This political context differs strongly between the EU Member States, which is underlined by the fact that pesticide taxes are only in place in countries with a strong and longstanding history of action on pesticide risk reduction, and all predate the entry into force of the SUD.

The political considerations are furthermore an important consideration for all taxation instruments on the European level is the required unanimity between Member States, as formulated in the TFEU¹¹⁵. In the past as well as in current discussions on the SUD, several MS have expressed clear objection towards an EU-wide pesticide tax. This political context is acknowledged also by stakeholders supporting such a tax, which see higher potential in national initiatives to introduce taxation (IFOAM, 2018). In this context, a proposal for a pesticide tax cannot be considered politically realistic.

¹¹⁵ Article 113 TFEU

5.4 Costs

Costs of pesticide taxation systems can be caused by different factors such as determining the tax level, paying/collecting the tax, or checking the compliance with it.

In all Member States and countries with which interviews have been conducted, the determination of the tax rate, i.e. what tax is described as the costliest activity. However, also in all countries, the determination of the tax rate happens during the authorisation of a pesticide by the national authorities. Therefore, costs are described as high during the introduction of a tax or change of the tax calculation method. The continuous work in this respect does not create additional costs for authorities, as the authorisation would be necessary even without a tax. The costs at the initial stages of a tax also depend on the complexity of the tax rates. As described above, Sweden and its simple tax system are reported to create lower administration costs than more complex ones such as Denmark or France (Böcker & Finger, 2016).

Further activities required by national authorities are the collection of data on the amount of tax due as well as the tax itself. Authorities from Norway and Denmark point out that the number of importers or producers which are ultimately paying the tax is low, with 10 to 20 companies from which data is needed. Bigger Member States may need more efforts and therefore higher costs in this context.

The companies that import or produce pesticides have to submit data on the sales yearly in Denmark and twice per year in Norway. This results in small costs for these companies, but electronic submission is mentioned as a simplification factor in recent years.

Overall, all of the interviewed national authorities agree that the administration and compliance costs for a tax are low, except for the initial stage in which new definitions are applied to a long list of pesticides which had already been authorised.

5.5 Conclusions

Pesticide taxes are aimed to provide incentives for pesticide users to apply less or lower-risk substances. Their effectiveness depends strongly on the design and in particular on the level of differentiation between products and on the level of the tax rate. The existing taxation schemes differ in respect to these elements, showing that the introduction of pesticide taxes in other Member States could take a range of forms and thus a range of effects.

As the first key determining factor, the differentiation between risk profiles ensures that high risk pesticides are taxed higher than low risk ones. The definition of parameters to determine the risk can result in many aspects to be considered and weighed. France, Denmark and Norway all apply such differentiation. However, the parameters vary between toxicity for non-target species, longevity in environmental systems, carcinogenic or mutagenic properties and more. The exact definition and determination are highly political and accounts for a large portion of administrative costs. A flat rate tax system such as the Swedish one risks – depending on the profile of the agricultural sector and the list of approved pesticides – to incentivise low volume pesticides, which may have higher risk profiles.

In terms of the tax level, high rates are necessary in order to have an effect on the risk profile. However, depending on the differentiation approach, high rates can also lead to de-facto bans of certain pesticides which reduces the number of pesticides available for certain pest pressures and may increase the risk of resistances. The tax rate is also the main factor that drives the additional costs for pesticide users. These have not been considered in this case study, as they depend strongly on political realities, but the impacts on political acceptability, profitability of farming and food prices, amongst others, are highly relevant for the overall assessment of a pesticide tax.

Because of the different tax systems and other policy measures in place in the applicable Member States, it is difficult to conclude on the overall effectiveness. In order to achieve a lasting risk reduction, complementary instruments are necessary.

6. Overall conclusions

The range of instruments to increase the sustainable use of pesticide is large. The three measures discussed in this case study are currently not prescribed by the SUD but are in place in relevant policy areas or certain EU Member States or European countries. As such they can be considered options to complement the current set of instruments.

In this context, and after what has been discussed under each of the three measures of this case study, no policy can be or will be established in isolation. Rather, a package or mix of policies is always required. As the most prominent examples, legally binding targets for Member States would only provide the framework in terms of objectives for pesticide risk reduction, but not include provisions on how such improvements could or should be achieved.

Taxation and prescription systems could be options to pursue the targets, but they can also be introduced independently from targets. However, also for taxation and prescription, complementary measures are required to provide pesticide users with the capacity to perform changes towards lower risk profiles. As such, trainings and advice mechanisms as already in place under the SUD, or other awareness campaigns (e.g. demonstration farms) are relevant elements of a larger policy mix on sustainable pesticide use.

An important factor for the reduction of risk related to pesticide use, and therefore for all three measures, is the availability of alternatives with lower risk profiles. Member State authorities as well as other stakeholders¹¹⁶ representing users, NGOs or research institutions, all mention the importance of alternatives to the effectiveness of pesticide use policies. As yields are the main source of income for farmers, the need to ensure high quality and quantity is of key interest to farmers and producers of plant products. For other professional users (e.g. along railways and airports) safety of operations has an overriding importance. As confirmed by stakeholders and Member State authorities, for this reason, pesticide users will always treat pests and weeds. Only if alternatives such as non-chemical or low-risk pesticides are available, can users make a change towards a reduction of use and risk. Therefore, measures such as a prescriptions system or taxation, as well as defined objectives such as a legally binding target, can frame and support the sustainable use but the foundation needs to be laid by ensuring that alternatives are available.

As a result, none of the measures presented and discussed in this case study will be effective on its own. As presented initially, analysing their effects in isolation can only difficultly capture the potential for other policy settings but provides an indication of the crucial parameters, trade-offs, and implications. Considerations of coherence with the other instruments and policies are essential for the introduction of any of the measures.

In summary, all three measures are possible and have their advantages and disadvantages for the regulation of pesticide use at the European scale.

¹¹⁶ Input collected for other activities of the study.

7. Bibliography

- Böcker, T., & Finger, R. (2016). European pesticide tax schemes in comparison: An analysis of experiences and developments. *Sustainability (Switzerland)*, 8(4), 1–22.
<https://doi.org/10.3390/su8040378>
- EEA. (2020). *Trends and projections in Europe 2020* (Issue 10). eea.europa.eu
- Eunomia, IEEP, Denkstatt, Aarhus University, & ENT. (2016). *STUDY ON ASSESSING THE ENVIRONMENTAL FISCAL REFORM POTENTIAL FOR THE EU28* (p. 1496). European Commission. <https://doi.org/10.2779/86822>
- European Commission. (2008). *SEC(2008) 85/3. Package of Implementation measures for the EU's objectives on climate change and renewable energy for 2020.*
- European Commission. (2016). *SWD(2016) 416 final. REFIT evaluation of the Directive 2009/28/EC of the European Parliament and of the Council.* European Commission.
- European Commission. (2020a). *A Farm to Fork Strategy for a fair, healthy and environmentally-friendly food system* (Issue COM(2020) 381 final).
- European Commission. (2020b). *On the experience gained by Member States on the implementation of national targets established in their National Action Plans and on progress in the implementation of Directive 2009/128/EC on the sustainable use of pesticides.*
https://ec.europa.eu/food/sites/food/files/plant/docs/pesticides_sud_report-act_2020_en.pdf
- European Communities Commission. (2006). *A Thematic Strategy on the Sustainable Use of Pesticides: Vol. COM(2006).*
- Falconer, K., & Hodge, I. (2000). Using economic incentives for pesticide usage reductions: responsiveness to input taxation and agricultural systems. *Agricultural Systems*, 63(3), 175–194. [https://doi.org/10.1016/S0308-521X\(00\)00007-X](https://doi.org/10.1016/S0308-521X(00)00007-X)
- IFOAM. (2018). *Taxation as a tool towards true cost accounting. December.*
https://www.organicseurope.bio/content/uploads/2020/06/ifoameu_final_study_on_taxation_as_a_tool_towards_true_cost_accounting.pdf?dd
- OECD. (2017). *The Political Economy of Biodiversity Policy Reform.* In *The Political Economy of Biodiversity Policy Reform.* OECD Publishing. <https://doi.org/10.1787/9789264269545-en>
- Ørsted Nielsen, H., Pedersen, A. B., Konrad, M. T., & Gyldenkerne, S. (2020). *Evaluering af den omlagte pesticidafgift Betydningen af beslutningsadfærd for pesticidanvendelsen.* Miljøstyrelsen Denmark.
- Pedersen, A. B. (2016). *Pesticide Tax in Denmark. IEEP Policy Paper.*
https://ieep.eu/uploads/articles/attachments/504788d7-db01-4dd8-bece-ee7b9e63979e/DK_Pesticide_Tax_final.pdf?v=63680923242#:~:text=Denmark implemented a pesticide fee in 1972%2C at 3%25 of,or 1 kilogram was implemented.
- Pedersen, A. B., Nielsen, H. Ø., Christensen, T., & Hasler, B. (2012). Optimising the effect of policy instruments: a study of farmers' decision rationales and how they match the incentives in Danish pesticide policy. <https://doi.org/10.1080/09640568.2011.636568>, 55(8), 1094–1110. <https://doi.org/10.1080/09640568.2011.636568>
- Sud, M. (2020). *Managing the biodiversity impacts of fertiliser and pesticide use.* OECD.
<https://www.oecd-ilibrary.org/content/paper/63942249-en>
- Trinomics. (2016). *Preparatory study for the Commission's Fitness Check Evaluation of Planning and Reporting Obligations in the EU Energy acquis and support for an Impact Assessment in view of legislative proposals on streamlining of Planning, Reporting and Monitoring.*
http://publications.jrc.ec.europa.eu/repository/bitstream/JRC105642/methodology_jrc_final_identifiers_pdf.pdf
- UNDP. (2017). *Taxes on Pesticides and Chemical Fertilizers* (pp. 1–3). UNDP.

Appendix 7: CASE STUDY VII - Inventory and analysis of new technologies and alternative techniques that have the potential to reduce the use and risk of chemical pesticides, better achieve the objectives of the SUD and achievement of the pesticide reduction targets set out in the farm to fork and biodiversity strategies

1. Introduction to the case study

The objective of this case study is to present an inventory and analysis of new technologies and alternative techniques that have the potential to reduce the use and risk of chemical pesticides, better achieve the objectives of the SUD and achievement of the pesticide reduction targets set out in the farm to fork and biodiversity strategies.

This case study also presents the main barriers to the use of the most promising new technologies and alternative techniques.

2. Research theme for the case study

The case study is composed of two main components as follows:

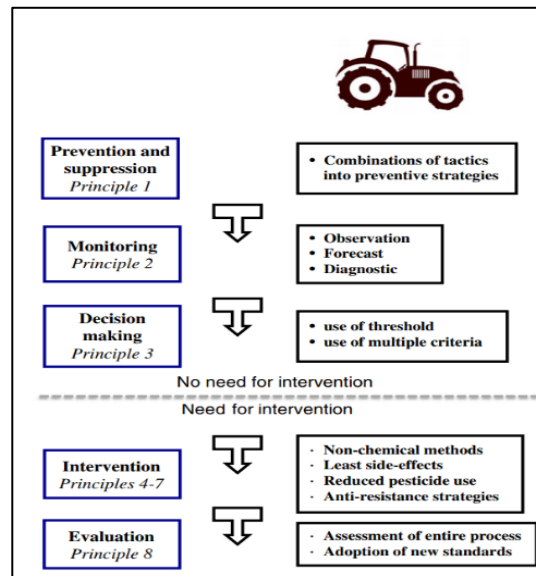
- An inventory and description of the main techniques, practices and technologies that could help reducing the dependency of pesticide use, including the main barriers for the adoption of each of them, when relevant;
- An analytical section analysing the most promising technologies and techniques that have each the potential to significantly reduce the dependency of pesticide use. For each of them the main drivers and barriers for their use at farm level (by farmers) are described.

The inventory follows the structure of the eight principles of IPM as listed under Annex III of the Sustainable Use Directive 2009/128/EC (the "SUD"). IPM is defined under Article 3 (6) of the SUD as *"careful consideration of all available plant protection methods and subsequent integration of appropriate measures that discourage the development of populations of harmful organisms and keep the use of plant protection products and other forms of intervention to levels that are economically and ecologically justified and reduce or minimise risks to human health and the environment. 'Integrated pest management' emphasises the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms"*.

IPM hence combines the use of cropping, biological, and chemical practices to control pests¹¹⁷ in agricultural production. It seeks to use natural mechanisms, predators, or parasites to control pests, using selective pesticides as a last resort option, when pests cannot be controlled by natural or non-chemical means. IPM should not be confused with organic farming. It does not exclude spraying of synthetic/chemical pesticides; it promotes spraying with selective pesticides based on monitoring and threshold values, but only when needed, which aims altogether at reducing dependency of pesticide use, meaning reducing the volumes of pesticides used by farmers.

¹¹⁷ Pests include weeds, diseases, insects, or any species harmful to plants or plant products, as defined by the International Plant Protection Convention (2010) International Standards for Phytosanitary Measures No. 5, Food and Agriculture Organization of the United Nations, Italy.

Figure 11 - The eight principles of IPM



Source: Barzman et al. Eight principles of integrated pest management¹¹⁸

3. Methodology

The methodological approach entails three steps:

- Step 1: Data collection: Targeted literature review. The literature review has consisted of analysing the literature on IPM at European and Member State levels.
- Step 2: Data collection: Conducting semi-structured interviews experts, researchers and technical advisors involved in the development and implementation of novel techniques and technologies.
- Step 3: Analysis and reporting: Writing-up of the case study report.

4. Inventory of techniques, technologies and practices that could lead to reduction of pesticide use (descriptive part)

This section lays the basis for the creation of background knowledge on the most promising ways to reduce dependency of pesticide use in EU agriculture by providing a list of the most important practices, technologies, and techniques to be used by farmers. As mentioned above already, this inventory of practices; technologies and techniques is based on the eight IPM principles which numbering originates from a logical sequence of events.

¹¹⁸ Barzman, Marco & Bàrberi, Paolo & Birch, A. & Boonekamp, Piet & Dachbrodt-Saaydeh, Silke & Graf, Benno & Hommel, Bernd & Jensen, Jens Erik & Kiss, Jozsef & Kudsk, Per & Lamichhane, Jay Ram & Messean, Antoine & Moonen, A.C. & Ratnadass, Alain & Ricci, Pierre & Sarah, Jean-Louis & Sattin, Maurizio. (2015). Eight principles of integrated pest management. *Agronomy for Sustainable Development*. 35. 10.1007/s13593-015-0327-9.

Principle 1: Prevention and suppression. The overall goal of reducing reliance on pesticides emphasises the importance of growing healthy crops. The principle of prevention is paving the ground for resilient cropping systems and is the backbone of IPM. Increasing spatial and temporal diversity in terms of e.g. number of crops in the rotation, together with the introduction of spring crops, legumes or under sowing in arable crop rotations dominated by winter crops, can reduce weed pressure; intercropping or cultivar mixtures are also very effective measures to reduce pest pressure. Combining these preventive measures with other non-chemical crop protection tactics can significantly reduce the need for pesticides. However, the trends observed in recent years in many MS – increasing farm specialisation and mixed farming becoming less common – are in contrast with the implementation of Principle 1.

The prevention and/or suppression of harmful organisms should be achieved or supported among other options especially by:

- Selecting suitable site conditions (area not infested by pest, diseases, or weed; suitable soil types and climatic conditions);
- Applying crop rotation to reduce the pressure of diseases, pests, or/and weed. If the same crop is planted year after year on the same fields (monoculture), populations of certain pests and diseases can gradually increase. Growing the same crop repeatedly will also cause the fertility of the soil to diminish rapidly. For example, Rotation of cereal crops with legumes is often very useful. These crops are very different so that insects and diseases which attack the first one will not attack the other. The legumes in the rotation will also help to improve the soil fertility through fixation of nitrogen. Over the last 50 years, crop rotation length has decreased significantly moving from a long crop rotation of 6-7 years to a shorter one (2-3 years). Crop rotation can be an interesting tool for reducing pest/disease pressure only when long crop rotations are applied (>5 years). In addition to significantly decrease pest pressure, crop rotation has to be planned at a larger scale than just individual fields as pest/diseases easily move from one field to another. Therefore crop rotation must be reasoned at the level of the farm or the area of production by considering the farming systems present under such area.
- Use of adequate cultivation techniques (e.g. stale and sterile seedbed techniques, sowing dates and seeding rates, under sowing, reduce ploughing and tillage, mulching, pruning, and direct sowing). Each of these different cultivation techniques must be analysed carefully to identify their usefulness depending on the crops to grow and considering the most important pests and diseases present in the region. For example, the sterile seed bed technique involves cultivating the soil, and then leaving it for a period until an initial flush of weeds has germinated. The grower will then lightly cultivate the soil to destroy the weed cover before the desired crop is planted/sown. Decompaction of the soil also contributes to reducing pest/disease pressure as soil structure also has an impact on biological activity and processes, root development and seed germination and emergence. An early or late sowing date can also contribute to reduce pest pressure and competition as the biological cycle of the pests and diseases is shifted and, therefore, the pest pressure less strong.
- Use, where appropriate, of resistant/tolerant cultivars and standard/certified seed and plant propagating material. Use of resistant varieties to pest and diseases is a very efficient way to protect the crops. Plant breeding has been supporting the development of cultivars with tolerance or resistance to key pests, with an ultimate goal of reducing reliance on conventional pesticides. New genetic methods will certainly help developing new adapted resistant varieties not yet present on the market as traditional breeding techniques do not allow creating such cultivars. The use of certified seed is also recommended as such seed lots have been inspected by official bodies to secure a minimum level of varietal purity, seed germination and vigour.

- Use of balanced fertilisation, liming, and irrigation/drainage practices based on soil analysis. Soil analysis allows to adapt quantities of fertilisers applied to crop requirement for an optimum crop production. Such approach allows to reduce nutrient losses and leaching to the environment and therefore participate to farm profitability. In addition, a balanced nutrition reduces the risk of crop lodging (for example in cereals) and therefore reduces the use of plant growth regulators that farmers are spraying to avoid any crop lodging in their cereals.
- Preventing the spreading of harmful organisms through hygiene measures (e.g. regular cleaning of machinery and equipment). Machinery can often be responsible for the transport of pests or seed of weeds from field to field or farm to farm. Examples of this are situations like potato cyst nematode or beet cyst nematode being carried from one field to another on soil particles on machinery. Another example is where a combine harvester/baler transports wild oat seeds from one location to another. In addition, good growing and storage hygiene is important to minimise the spread of many pathogens injurious to many crops. Pathogens such as *Erwinia spp.* in potatoes, can be transmitted by debris etc. on boxes. Steam cleaning can eliminate such possibilities. Similarly, cleaning and/or disinfecting growing trays, remains a useful way to reduce the initial source of inoculum. The same principle holds true for storage boxes and trays for all types of crop.
- Protection and enhancement of important beneficial organisms, e.g., through adequate plant protection measures or the utilisation of ecological infrastructures inside and outside production sites. A beneficial organism is any living organism that benefits the growing process, including insects, pollinators, fungi, viruses, microorganisms, bacteria, other plants than the cultivated one, and nematodes. By securing the presence of beneficial organisms in the fields by providing suitable living conditions, plants are better protected against pests and diseases. For example, research has demonstrated that low ploughing and limited cultivation is reducing the development and proliferation of aphids in vineyards.

Principle 2: Monitoring is the basis of the actual decision-making process. Monitoring for pests either by scouting individual fields or through regional or national warning/forecasting systems is a prerequisite for making informed decisions. Harmful organisms must be monitored through adequate methods and tools, where available. Such adequate tools should include:

- Observations in the field to identify and monitor pest, beneficial organisms, diseases and weed. In order to decide to spray its crops or not, farmers should monitor their crops on a regular basis by visiting each individual plot to assess whether or not diseases, pests and weeds are present to a sufficient threshold that requires a treatment. Farmers should also take an interest in neighbouring fields to assess the sanitary situations as pests and diseases easily move from one field to others, from one farm to others. Therefore it is not enough for a farmer to only monitor its fields. Some countries such as France have set-up collective monitoring processes ('Réseau d'épidémiologie')¹¹⁹ in order to analyse the situation at area of production level.
- Use of scientifically sound warning and forecasting and early diagnosis systems, where feasible. The short to medium term weather forecast influences the rates of pesticides application in cases of protective approaches. For example, the only efficient solution to protect its potatoes against mildew is to protect the crop before the disease appears (preventive treatment). Such approach leads to e.g. a treatment frequency of 12-13 in Belgium on an annual crop. In order to reduce such frequency, an early diagnosis system called Vigimap has been developed. It relies on whether forecasting. When a risk of mildew is identified, an email is sent to farmers to indicate them to spray. A range of disease forecasting systems are available and can be quite useful to supplement observations made during site visits, but their number is rather limited.

¹¹⁹ <https://agriculture.gouv.fr/le-reseau-depidemiologie-decophyto>

The additional issue is that such forecasting systems do not fully consider the farming practices of individual farmers but provide recommendation at area of production level. Forecasting systems can also take the form of traps and sticky pads which are used, mainly in fruit and vegetable productions, to identify the presence of a pest (e.g. *Psila spp.* traps in fruits).

- Use of advice from professionally qualified advisors. Agronomic advisors are usually monitoring crops in different fields and farms under different growing conditions and therefore can bring interesting information to farmers on the overall pest pressure in a given region and in predicting what way an individual disease or insect pest may develop. Such anticipation may help reducing the number of applications on a given field.

Principle 3: Decision-making based on monitoring and thresholds. Based on the results of the monitoring professional users (farmers and agronomic advisors) have to decide whether and when to apply plant protection measures. Robust and scientifically sound threshold values are essential components for decision-making. Such monitoring activities are costly as frequent visits to the fields and the crops have to be done all over the cropping season. The threshold levels for harmful organisms defined for regions, specific areas, crops, and particular climatic conditions must be considered before treatments, where feasible.

For many pests, thresholds are not available or not very reliable because they were developed many years ago in a different cropping context. Prognosis and decision support systems (DSS) are the most elaborated tools to support the decision-making process of growers, but they are only available for major weeds, pests, and diseases, and only for a number of regions. In addition, thresholds are very context-specific and should be revised and updated regularly to be of value to farmers. A new H2020 research project called IPM decisions has the objective to develop new DSS in key crops in which such systems have not been developed yet.

The decision to treat (or not treat) is of the responsibility of individual farmers that could be supported by advisors and/or regular plant health bulletins (see the example of the "Bulletin de Santé du Végétal" en France) make it possible to assess the risk associated with the presence of pests, and to reason the technical itineraries for plant protection, including spraying and other potential techniques, with the aim of reducing the use of pesticides.

Principle 4: Non-chemical methods. If a treatment is necessary, based on thresholds and/or the results of DSS, growers should prefer non-chemical methods (e.g. bio-pesticides, macro-organisms, mechanical, physical, or bio-technical methods) if they provide sufficient pest control. In recent years, there has been an increased interest in developing and implementing non-chemical methods partly triggered by the loss of chemical pesticides and lack of alternatives creating orphan and minor uses. These alternatives can be grouped in several categories as follows:

- Biological control and biopesticides (use of natural enemies, application and release of beneficial organisms, natural substances, use of plant strengtheners/biostimulants of which micro-organisms).
- Physical measures (mechanical, thermic, optical). Mechanical weed control is certainly a promising practice that can be used in many crops and in particular in permanent crops and annual crops which are seeded/planted in rows. Such techniques can achieve moderate levels of weed control in other crops. New technologies and robots are currently being developed for such mechanical weeding. Such new tools seem to be efficient and allow multiple passes in the same field. The main issue with such tools is their costs which is far too high for a high level of adoption by farmers unless several farmers decide to buy equipment collectively. Manual weeding is often used in conjunction with mechanical methods for weed control in specialty and high value crops such as vegetables. In orchards/vineyards etc., topper/mower for weed control are being used where there is usually a grassed area between each row of trees/vines etc. Crop fleeces can serve to warm up the soil and vegetation thus encouraging and enhancing growth,

then strengthening plants against pests and diseases. However, in some situations the use of a fleece can have a negative impact as it may create conditions for the development of new diseases due to the micro-climate created under the fence at soil level. The use of nets is another physical measure that can be used to protect high value crops, mainly F&V, to prevent entry of insect pests (e.g. flies in cabbages and carrots, birds etc.). However, as with the crop fleeces, new diseases under the net can appear and such nets can't be used in windy areas. Use of optical and sound generating devices such as bangers and kites are primarily used to deter birds from crops. Birds can become accustomed to such devices and so use of such devices requires a change from one method to the other within often a short period of time limiting the usefulness of such approach.

- Biotechnical measures (pheromones traps, mating disrupting, food traps and attractants). In recent years, considerable progress has been made using pheromones for mass-trapping, mating-disruption and attracticide methods for beetle and moth pests associated, mainly, with stored products. Such use of pheromones for stored products can lead to a drastic reduction of chemical treatments during storage, with economic advantages and improvement of food quality. Mating disruption technologies use pheromones in large amounts to confuse males and limit their ability to locate calling females since the goal is to "disrupt" rather than "attract". Such sex pheromones have been successfully used for decades to monitor insect activity patterns e.g. in the insect order *Lepidoptera spp.* (moths and butterflies).
- Precision agriculture – Smart agriculture. Smart agriculture is a fairly new term which is being perceived as being the future of farming. The term refers to the use of several technologies like internet of things, sensors, location systems, robots and artificial intelligence on the farm. The ultimate goal is increasing the quality and quantity of the crops while optimising the human labour used of which reducing the use of pesticide use. A more detailed description of smart agriculture is provided under Chapter 5 below.

Many of the non-chemical methods are less effective and/or more expensive than pesticides and the adoption has been slow, except e.g. greenhouse cultivation.

Principle 5, 6 & 7: Pesticide selection, reducing pesticide use, and preventing pesticide resistance. Target-dependent selection and dosage of pesticides is crucial for a successful control and the least side effects to the environment. The right choice of pesticides and of their mode of action, appropriate dose rates and proper timing of their application also mitigate the risk of resistance development or of the adaptation of harmful organisms.

The professional user should keep the use of pesticides and other forms of intervention to necessary levels, e.g., by reduced doses, reduced application frequency or partial applications, considering that the level of risk in vegetation is acceptable and they do not increase the risk for development of resistance in populations of harmful organisms. The use of new types of sprayers (drones, robots) should be privileged and spraying techniques optimised (pressure, nozzles, drift, and row application). For many years now, agricultural spraying drones have been tested in Europe. Preliminary results suggest that drones could provide farmers with a very precise tool to further reduce volumes of pesticides used and increase safety, both for the environment and operators, in comparison to traditional sprayers or aerial sprayers (planes and helicopters). Drones seem to be an interesting tool for precision farming, particularly in vineyards and orchards in steeply sloped areas, where the use of conventional technologies is difficult or impossible. According to literature¹²⁰, new pesticide spraying technologies could lead to about 40% reduction of spray consumption, up to 80% less airborne drift for an equal quality of protection for the crop. However

¹²⁰ peer review published research conclusions

such arguments of e.g. reduced risks are not shared by all stakeholders and more evidence needs to be collected to prove (or not) that such equipment are safer than the classical sprayers.

The combination of all means should provide sufficient control of pests and ensure the quality of products. If effective non-chemical methods are not available, farmers can use pesticides to protect their crops against pests but should choose the most environmentally and toxicologically benign pesticides and not use higher doses than required to achieve satisfactory control.

At the same time, farmers should adopt anti-resistance strategies to prevent the development of pesticide resistance. Where the risk of resistance against a plant protection measure is known and where the level of harmful organisms requires repeated application of pesticides to the crops, available anti-resistance strategies should be applied to maintain the effectiveness of the PPPs. This may include the use of multiple pesticides with different modes of action. In some situations, however, reduced pesticide use and preventing pesticide resistance are conflicting goals.

Principle 8: Evaluation. The soundness of the crop protection strategy adopted by the farmer should be assessed, e.g. at the end of the growing season, and adjusted for the next growing season if required. The challenge here is how to assess the strategy: in terms of e.g. yield, economic benefit, or pesticide use? annually or over several cropping seasons? Experience shows that the evaluation of adequate pest control should use more criteria than the sole yield. The post-assessment of the pest control measures is equally important, as it evaluates the tactical (were pests sufficiently controlled without yield reduction) as well as the strategic component (e.g. does crop rotation result into lower pest pressure?) of crop protection in one cropping season, or the rotation over several cropping seasons. Additionally, post-assessment encourages farmers to critically evaluate the annual measures and thus contributes to knowledge development and evaluation of crop management not only from an economic perspective.

The following table summarises the potential contribution of the technologies, practices and techniques described above to the objective of reducing dependency on pesticide use. It highlights the potential of each of these in the future and doesn't state the actual situation. By doing so this table identifies the most promising future technologies which are then discussed in the next chapter.

Notes to read the table:

Criterion "Potential reduction of risk and use" (scale: low, medium, or high) assesses the potential of the measure to reduce either risk or use of pesticides and doesn't differentiate between risk and use as (risk and use) is used as a single indicator in the F2F strategy.

Criterion "Cost of implementation" (scale: low, medium, or high) estimates the cost for implementing the measure at both industry and farm levels.

Criterion "current level of implementation" (scale: low, medium, and high) indicates whether the methodology or practice is already widely used at farm level or if it is still at a development level.

Criterion "long-term sustainability" (scale: low, medium, and high) informs about the long-term sustainability of the method and technology.

Table 1 – Assessment of the main technologies and techniques described above as regards their future potential of reducing dependency on pesticide use

Techniques, technologies, practices	Potential reduction of pesticide use and risk	Cost of implementation	Current level of implementation	Long term sustainability
-------------------------------------	-----------------------------------------------	------------------------	---------------------------------	--------------------------

Principle 1 – Prevention and suppression				
Site conditions	Low	Low	Medium	High
Crop rotation				
Crop diversity (crop rotation/sequence)	Medium	Low to high	Low to medium	High
Intercropping	Low	Low to medium	Low	High
Undersowing	Low	Low	Low	High
Others (companion cropping)	Low	Low	Low	High
Cultivation techniques				
Stale seedbed	Low to medium	Low	Medium	High
Sowing time	Low to medium	Low	Medium	High
Seed/plant density	Low	Low to medium	Medium	High
Superficial ploughing	Low	Low	Low	High
Non-inversion tillage	Low	Low	Medium	High
Conservation tillage/direct sowing	Low	Low	Medium	High
Mulching	Low	Low	Low	High
Resistant/tolerant cultivars and standard/ certified seed and planting material				
Weed competitive cultivars	Medium	Low	Low	Medium to high
Disease or pest resistant and tolerant cultivars	High	Low	Medium	High
Use of certified seed	Medium	Low to medium	High	High
Genetic engineering & new genomic techniques	High	High	Low	High
Balanced fertilisation, liming and irrigation/drainage practices				
Balanced fertilisation	Low to medium	Low	Low to medium	High
Irrigation	Low	Medium	Medium	Medium
Preventing the spreading of harmful organisms by hygiene measures				
Hygiene measures: cleaning of machinery	Low	Low	Medium	High
Protection and enhancement of important beneficial organisms				
Habitat conditions: hedges, field margins	Medium	Medium	Low	High
Habitat conditions: Enhancing beneficials by improved management	Medium	Medium to high	Low	High
Protection and enhancement of important beneficial organisms	Medium	Medium to high	Low	High
Principle 2 – Pest monitoring				
Identification of pests, beneficial, diseases and weeds	Medium	Low to medium	Medium	High
Monitoring	Medium	Low to high	Low to medium	High
Diagnostic tools	Medium	Low to medium	Low to medium	High
Principle 3 – Decision-making				
Thresholds (wherever this makes sense - can be in conflict with low-dosage application)	Medium	Low	Low to medium	High
Warning systems (may be associated to Principle 2: monitoring)	Medium	Low to medium	Low	High
Forecast/prognosis systems	Medium	Low to medium	Low	Medium
Modelling	Low	Low to medium	Low	Medium
Principle 4 – Biological, physical and other non-chemical methods				
Biological control: application and release of beneficials and microbials	High	Low to medium	Low	High
Biological control: other natural substances	High	Low to medium	Low	High

Biological control: use of plant strenghteners/biostimulants	Medium	Low to medium	Low	High
Physical measures: mechanical	High	Low to medium	Medium	High
Physical measures: thermic	Medium	Medium to high	Low	High
Biotechnical measures: pheromone traps	Medium	Low to medium	Low to medium	Medium to high
Biotechnical measures: mating disrupting	Medium	Low	Low	Medium to high
Biotechnical measures: food traps, use of attractants	Low	Low	Low	Medium to high
SMART agriculture	High	High	Low	Medium to high
Principle 5 – Pesticide selection				
Pesticide selection	Low to medium	Low	Low to medium	Low
Principle 6 – Reduced pesticide use				
Pesticide timing	Low	Low	Low to medium	High
Pesticide mixtures	Low	Low	Medium to high	High
Precision agriculture and spraying	Medium to high	Medium	Low to medium	Medium
Spraying techniques: pressure, nozzles, drift, row application	Medium	Low to medium	Low to medium	Low
Principle 7 – Anti resistance strategies				
	Low	Low	Low	Medium
Principle 8 – Evaluation by farmers				
Economic assessment (e.g. profit maximising)	Medium	Low	Low	Medium
Societal assessment	High	Low to high	Low	High
Environmental assessment	Medium	Low to high	Low	High
Post treatment monitoring	Medium	Low	Low to medium	Medium

5. Most promising technologies and practices that could lead to reduction of pesticide use (analytical part)

The table 1 above summarises and assesses the different agronomic measures, practices and technologies that could impact the use of pesticides in the future. From such assessment, the following four ones seem to be the most promising ones in order to reduce the dependency of pesticide use:

- Crop rotation;
- Use of alternative products and solutions;
- Further development of resistant varieties using new genomic techniques/new breeding techniques;
- The use of adequate pesticide application equipment (PAE); and,
- The development of precision farming and smart agriculture.

Each of these are further discussed below.

Crop rotation and crop diversification are important farming practices with most significant impacts in the short and long term. They can clearly have a role in improving soil conditions, water quality, weed management and plant protection systems, biodiversity, and more. Crop rotation is a very old practice. Many different crop rotation schemes have been introduced in the past centuries, to make the crops better adapted to local pedoclimatic conditions. This was done by increasing the number and the complexity of the crops in the rotation cycle, including fallow. During the last decades the diffusion of such practices has been considerably reduced and the length of the crop rotations have significantly decreased to range between monoculture to 4 years maximum, which leads to more pest and disease pressure on the cropping systems. The reduction of crop

rotation length was searched for the best economic return by cultivating the two-three most profitable crops for individual farmers. If monoculture of maize is largely implemented in Alsace in France, it is simply because there are no other crops that could bring the same level of revenue for farmers as other crops are less profitable. For the last ten years the agronomic values of implementing longer crop rotations of 6-7 years have been highlighted and longer crop rotations have gained considerations. It is largely agreed by agronomists that crop rotation can help the control of weeds, diseases, and pests. This is also the case with a reduced application or without the use of pesticides, due to an increased crop resistance to pests. Long crop rotations bring other including reduced runoff and soil erosion, improved water conservation, more efficient use of water, enhanced soil carbon sequestration, reduced nitrogen in water (using intermediate crops that can be sold) and increased above-and below-ground biodiversity.

When it relates to reducing the pest pressure, crop rotation has to be considered at several levels, as follows:

- The farmer's individual fields that each have a different history in term of agronomic practices being used on such plot. Therefore e.g. weed pressure is field specific;
- Crop rotation has also to be considered at farm level to adapt to specific farming and cropping practices considering that pests and diseases are moving across individual fields; and
- The area of production has also to be included in the reflexion and development of strategies related to crop protection as the pests and diseases pressure can be largely different from one area of production to the other due to their biological characteristics that make that they are present or not in a given area of production. For example, the European corn borer is not present in all maize production areas but is mainly present in South-Europe rather than in the North.
- These three components have to be considered by farmers when building their crop rotation strategy.

The main issues for farmers to change their crop rotation practices, moving from monoculture to long rotations, are mainly economic as such changes of practices involves significant costs:

- It is likely that farmers will have to grow new crops on their farms, meaning that they will have to buy specific equipment for such new crops (seeders, harvesters, etc.), leading to significant investment in material;
- Existing market opportunities have to be considered when selecting crops to be introduced in the crop rotation. When market opportunities are not immediately present, farmers are reluctant to grow a crop they will not be able to sell at high price;
- Introducing new crops on their farm may be perceived as an agronomic risk for farmers that are not used to cultivate such new crops; and therefore do not have all agronomic expertise for an optimal cultivation leading to an optimal revenue; and,
- Short-term the introduction of new crops in the rotation will lead to decrease of revenue for farmers that have optimised their rotation for the most valuable crops, and complexity in managing long crop rotations. Flexibility is also required.

These are the main reasons explaining why farmers have difficulties to adopt such long crop rotations. In addition, the importance of crop rotation is still highly underestimated for some researchers, and it proves challenging to create awareness among stakeholders and practitioners, as well as the general public.

Use of alternative products and non-chemical solutions. Pesticides include a large array of chemical types that exhibit many different biological effects (modes of action). By their nature, pesticides are designed to negatively impact various life processes and therefore have hazardous properties which may lead to risks to the environment and human health. The EU legislation addressing to the placing to the market of PPP is addressing such issue during the risk assessment

of individual active substance and commercial products leading to a drastic reduction of the number of active substances approved at the EU level (moving from more than 1,000 in the early 2000s to about 450 in 2021). However a significant number of active substances with one or several hazards are still approved, and corresponding commercial products sold widely in the EU.

The easiest solution for farmers will be to replace such hazardous substances, being of chemical nature or not, by non-hazardous ones (the so-call "biopesticides"). According to the OECD, the term groups four different types of products:

- Microbials e.g. bacteria, algae, protozoa viruses and fungi;
- Pheromones and semi chemicals;
- Macrobials/invertebrates such as insects and nematodes, and
- Plant extracts/botanicals.

However, the biopesticide market is still at an infant stage even if the European biopesticides market is expected to grow by 10-12% during the forecast period (2020-2025). Over the last decade, the major pesticide companies have invested in R&D efforts to develop and market biopesticides and more products and active substances are being approved at the EU level. Before the market was dominated by smaller companies acting mainly at national level.

Side-by-side another group of products shows large interest in the farming community; these are the plant biostimulants which are products which are re-enforcing the strength of the plants to make them more resistant and resilient to biotic and abiotic stresses.

The progress of the organic industry, the rising cost of chemical pesticides, concerns issues by the civil society, and the increase in awareness about hazards caused by chemical pesticides are the major driving factors for the biopesticides market. It is therefore expected that there will be a shift from chemical pesticides to biopesticides and plant biostimulants in the future. However, the speed of the shift remains unknown.

For the time being, the alternative products suffer from the situation that their spectrum to control pests and diseases is more narrow than chemical pesticides and that, in most of cases, their agronomic efficacy is lower. Such a situation is decreasing the adoption rate by farmers and producers.

Further development of resistant varieties created by using new genomic techniques/new breeding techniques.

Another easy solution for farmers will be to grow varieties resistant to pests and diseases developed through plant breeding. Resistance breeding is an important strategy for reducing crop losses caused by diseases, viruses, and bacteria. Such resistant varieties are already existing in a majority of crops, but resistant cultivars do not cover all pathogens in all crops. Breeding for crop resistance is an environmentally sound method for managing disease and minimising these losses but was, to date, limited to use of the conventional plant breeding techniques which do not often allow to breed varieties with resistance that is effective, stable and broad-spectrum.

Recent advances in genetic and genomic technologies have contributed to a better understanding of the complexity of host-pathogen interactions and have identified some of the genes and mechanisms that underlie resistance. In addition, such advances have led to the development of new breeding methods and techniques, such as the CRISPR technology in 2012, to overcome the current issues highlighted above. This new knowledge may benefit crop improvement through better-informed breeding strategies that utilise diverse forms of resistance at different scales, from the genome of a single plant to the plant varieties deployed across a given region. Therefore, effectiveness of plant breeding will certainly increase soon with the adoption of recent developments in large-scale phenotyping, genome sequencing, analysis of gene expression, and

protein/metabolite abundance even if additional research is needed to increase our understanding of the biology and epidemiology of the causal agents, including host status and virulence, as these have major implications for any breeding program. Only after significant input in improving existing knowledge on both pathogen virulence and plant resistance, resistance breeding will be efficiently accelerated through such novel techniques. Consequently, such plant breeding innovations are rapidly being developed and utilised internationally and across the seed sector, public and private research, plant species and markets.

However, the regulatory burden on such new techniques is high in Europe. Regarding mutagenesis breeding the ruling of the European Court of Justice (2018) confirmed that 1)organisms obtained by all means of mutagenesis must be considered to be Genetically Modified Organisms (GMOs) as defined in article 2(2) of Directive 2001/18/EC (GMO Directive), and 2)the mutagenesis exemption only applies to methods of mutagenesis which have conventionally been used in a number of applications and have a long safety record. Organisms obtained by applying exempted methods are considered GMOs exempted from GMO regulation. Therefore, the EU legislation on biotechnologies is perceived as a major hurdle for investments in new breeding methods -related R&D by the seed industry. Such legal framework may limit the R&D efforts in plant breeding in the EU for developing new disease resistant cultivars.

The development of precision farming and smart agriculture.

Smart farming is becoming a key component of modern agriculture. The concept was first emerged in the United States in early 1980s. Smart farming means application of precise and correct amount of inputs like water, fertiliser, pesticides etc. at the correct time to the crop for increasing its productivity and maximising its yields at lowest costs. The term "smart agriculture" refers to the usage of technologies like internet of things, sensors, location systems, robots and artificial intelligence on farms with the objective to increase the quality and quantity of the crops while optimising the costs. Examples of technologies used in smart agriculture are:

- Precision irrigation and precise plant nutrition;
- Climate management and control in greenhouses;
- Sensors that provide solutions where mapping for the disease incidences can be carried out. Once mapped, the experts can actually understand the causes which led to the crop infestations;
- Software platforms;
- Location systems – geographic information systems (GIS) - GPS, satellite, etc;
- Communication systems – based on mobile connection, etc;
- Robots; and
- Analytics and optimisation platforms.

The connection between all these technologies is called "the Internet of Things" – this is a mechanism for connectivity between sensors and machines, resulting in a complex system that manages farms based on data received. Farmers can monitor the processes and take strategic decisions remotely – from their tablet, phone or other mobile device – without being on the open fields, in their greenhouse, orchard, vineyard, etc.

When it relates to crop protection, smart agriculture and precision agriculture can be used to give crops the correct treatment as precisely as possible. Technology offers assistance in a number of stages in the operational procedure: detection, decision-making, execution and evaluation. Among others, the following technologies are being developed for crop protection purposes:

- Vision technology (image analysis) for the location-specific detection of illnesses, pests, weeds and crop conditions, and for monitoring over time;

- Molecular techniques for the detection of diseases and pests;
- Decision support systems: computer models that translate the detection of diseases, pests, weeds and crop conditions into management advice and cultivation measures;
- Application techniques: for precise use of preventative and curative measures against diseases, pests and weeds;
- Satellite technology: produces accurate images of plots of land and crops;
- Autonomous navigation: such as drones that make crop observations with cameras or autonomous tractors/robots that make observations or spray individual weed plant with herbicides at very low quantities as they drive around the field;
- Farm management information systems which use geo-data from satellites and other observation systems.

Most of times, several of these techniques have to be combined in smart agriculture, for new and improved applications.

All in all, the overall approach of smart agriculture is 1) to capture data at an appropriate scale and frequency, 2) to interpret and analyse that data, and 3) to implement of a targeted management response at an appropriate scale and time.

To date the main barriers that limit the uptake of smart agriculture technologies by farmers read as follows:

- High prices of technologies: setting up farms for a more technological approach, buying special equipment, and implementing various precision farming techniques are undoubtedly expensive and prohibitive;
- Lack of education and qualification to use such modern techniques;
- Age of farmers. In the EU in 2013, 31 percent of the farm managers were older than 64 years. Meanwhile, only six percent were 30 years younger than that. Such farmers are not prepared to use such technological innovations; and
- Telecommunication infrastructure not always present in all agricultural areas in the EU. As a result, farmers in further located areas struggle with implementing new technologies and tools; and,
- Lack of trust in new technologies by a large proportion of farmers that limits its uptake.

The barriers mentioned above are specific to the users of smart agriculture technologies. Providers of smart technologies are also suffering from existing barriers as well. These can include financial barriers, such as inadequate funding to support their R&D and marketing efforts.

6. Conclusions

In conclusion we present a SWOT analysis of the most promising technologies and techniques as presented under Chapter 5 which summarises the main strengths and weaknesses of each of them while considering the potential opportunities and threats to be faced during their development and implementation.

Table 2 – SWOT analysis of the most promising techniques and technologies for reducing the risk and use of pesticides

Strengths	Weaknesses
<ul style="list-style-type: none"> • Easy uptake by farmers (new resistant cultivars, economically viable alternatives) • The use of less hazardous PPPs leads to restoring public confidence in their use. 	<ul style="list-style-type: none"> • More knowledge intensive technologies (all) • High costs of implementation (crop rotation, smart ag.) • Long time to market (alternatives, new resistant varieties) • Perceived lack of agronomic efficacy of alternative by farmers (alternative products) • Lack of framework of incentives or disincentives (all) • Regulatory issues (NBTs)
Opportunities	Threats
<ul style="list-style-type: none"> • Establishing more diverse and resilient rotations benefiting crop production as a whole and not only crop protection • Economic assessment can have win-win effects for farmers and society • Establishing a package of “alternatives”, i.e. supporting beneficial organisms, adopting rotations etc. can further have long-term economic benefits for farmers as well. • Continuing current practices could lead to lower yields and reinforce environmental and health risks (also for farmers). 	<ul style="list-style-type: none"> • Lack of acceptance from the public (NBTs) • Lack of effective alternative products • Often difficult to assess effects of technologies and new practices (environmental, health, long-term yields/productivity) for farmers/on farm level • The reliance of some measures might not be very high (high variability/risks) – threatening long-term commitment of farmers (all)

7. Bibliography

Baerselman, F. 2001. The Dutch Multi-Year Crop Protection Plan (MJP-G): A contribution towards sustainable agriculture. In: Proceedings of an IOBC conference, "Biological control and integrated crop protection: towards environmentally safer agriculture", Van Lenteren, J.C. and O.M.B. de Ponti (Ed.), pp. 141-147

Barzman, Marco & Bàrberi, Paolo & Birch, A. & Boonekamp, Piet & Dachbrodt-Saaydeh, Silke & Graf, Benno & Hommel, Bernd & Jensen, Jens Erik & Kiss, Jozsef & Kudsk, Per & Lamichhane, Jay Ram & Messean, Antoine & Moonen, A.C. & Ratnadass, Alain & Ricci, Pierre & Sarah, Jean-Louis & Sattin, Maurizio. (2015). Eight principles of integrated pest management. *Agronomy for Sustainable Development*. 35. 10.1007/s13593-015-0327-9

Briolini, G. 2001. IPM in Italy with particular reference to the Emilia-Romagna region. In: Proceedings of an IOBC conference, "Biological control and integrated crop protection; towards environmentally safer agriculture", Van Lenteren, J.C. and O.M.B. de Ponti (Eds.), pp. 76- 97

C-IPM, PURE websites available at www.C-ipm.org and www.pure-ipm.eu

ECOPHYTO website available at <https://agriculture.gouv.fr/ecophyto>

ENDURE website available at <http://www.endure-network.eu/>

Finger, R., & El Benni, N. (2013). Farmers' adoption of extensive wheat production—Determinants and implications. *Land Use Policy*, 30(1), 206-213

Hossard, L., Guichard, L., Pelosi, C., & Makowski, D. (2017). Lack of evidence for a decrease in synthetic pesticide use on the main arable crops in France. *Science of the Total Environment*, 575, 152-161

Kogan, M. 2008. Integrated pest management: Historical perspectives and contemporary developments. *Annual Review of Entomology* 43: 243-270

Kudsk, P., Jørgensen, L. N., & Ørum, J. E. (2018). Pesticide Load—A new Danish pesticide risk indicator with multiple applications. *Land use policy*, 70, 384-393

Melander, B., Munier-Jolain, N., Charles, R., Wirth, J., Schwarz, J., Van der Weide, R., . . . Kudsk, P. (2013). European Perspectives on the Adoption of Nonchemical Weed Management in Reduced-Tillage Systems for Arable Crops. *Weed Technology*, 27(1), 231-240. doi:10.1614/WT-D-12-00066.1

Möhring, N., Gaba, S., & Finger, R. (2019). Quantity based indicators fail to identify extreme pesticide risks. *Science of the total environment*, 646, 503-523

Möhring, N., Ingold, K., Kudsk, P., Martin-Laurent, F., Niggli, U., Siegrist, M., Studer, B., Walter, A., & Finger, R. (2020). Pathways for advancing pesticide policies. *Nature Food* 1, 535–540. 15 <https://doi.org/10.1038/s43016-020-00141-4>

Möhring, N., Wuepper, D., Musa, T., & Finger, R. (2020). Why farmers deviate from recommended pesticide timing: the role of uncertainty and information. *Pest Management Science*

Progress report on the implementation plan to increase the availability of low-risk plant protection products and accelerate implementation of integrated pest management in Member States - Note from the Commission (2019) Available at https://www.consilium.europa.eu/register/en/content/out/?&DOC_LANCD=EN&typ=ENTRY&i=ADV&DOC_ID=ST-10238-2019-INIT

Xia, Y., Maarey, R., Suiter, K., & Stinner, R. (2007). Applications of information technology in IPM. In *General concepts in integrated pest and disease management* (pp. 209-226). Springer, Dordrecht

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