Directive 2009/128/EC on the sustainable use of pesticides

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Directive 2009/128/EC on the sustainable use of pesticides

Study

On 6 November 2017, the European Parliament's Committee on Environment, Public Health and Food Safety requested an implementation report on the 'implementation of Directive 2009/128/EC on the sustainable use of pesticides' (rapporteur: Jytte Guteland, S&D, Sweden). This request was approved by the Conference of Committee Chairs at its meeting of 14 November 2017. Implementation reports are routinely accompanied by European implementation assessments.

This European implementation assessment was drawn up by the Ex-Post Evaluation Unit at the European Parliamentary Research Service's (EPRS) Directorate for Impact Assessment and European Added Value. It aims to contribute to the Parliament's discussions on this topic, improving understanding of the subject and ultimately feeding into the implementation report under preparation by the rapporteur.

The first part of this assessment, prepared within the European Parliamentary Research Service, presents an analysis of the main results of an external study on the implementation of Directive 2009/128/EC establishing a framework for Community action to achieve the sustainable use of pesticides. This part also looks at the position and opinions of the European Parliament.

The second part contains a study prepared by a consortium led by ÖIR GmbH in collaboration with Arcadia International, t33 and external experts, which evaluated the implementation of Directive 2009/128/EC. The study covers the implementation of the directive as a whole. Furthermore, it concentrates on the implementation of the integrated pest management principles in the individual Member States. It also provides an analysis of the development of harmonised risk indicators, the imposition of limits and bans on the use of pesticides in specific sensitive areas, and the impact that the use of pesticides has on drinking water. The analysis is accompanied by recommendations on how to improve implementation.

AUTHORS

The in-house opening analysis was written by **Milan Remáč** from the Ex-post Evaluation Unit in EPRS' Directorate for Impact Assessment and European Added Value.

To contact the author, please email: EPRS-ExPostEvaluation@ep.europa.eu

The external study was written by members of a consortium led by **ÖIR GmbH** in collaboration with **Arcadia International**, **t33** and external experts, at the request of the EPRS' Ex-post Evaluation Unit. The authors of this study are: **Daniel Traon** (Arcadia International), **Silke Dachbrodt-Saaydeh**, **Per Kudsk**, **Sanja Brkanovic**, **Bernd Schuh** and **Helene Gorny** (ÖIR GmbH).

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ADMINISTRATOR RESPONSIBLE

Milan Remáč, Ex-post Evaluation Unit, DG EPRS.

To contact the publisher, please e-mail EPRS-ExPostEvaluation@ep.europa.eu

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eprs@ep.europa.eu
http://www.eprs.ep.parl.union.eu (intranet)
http://www.europarl.europa.eu/thinktank (internet)
http://epthinktank.eu (blog)

Executive summary

The opening analysis presents Directive 2009/128/EC establishing a framework for Community action to achieve the sustainable use of pesticides ('the SUD') and some stakeholders' positions on its implementation. In this regard, it describes the position of the European Parliament on the main issues linked with the SUD, such as integrated pest management and the use of low-risk pesticides. Furthermore, the opening part includes an analysis of the most relevant reports and opinions adopted by the European Commission.

The SUD was adopted in 2009 as part of a package of legislative proposals reacting to the need to improve the placing of plant protection products ('PPPs') on the market and their sustainable use. The SUD has two main aims: 1) establishing a framework for the sustainable use of pesticides by reducing their risks to human health and the environment; and 2) promoting the use of integrated pest management and different techniques, such as non-chemical alternatives.

With regard to the first objective, the SUD introduced various requirements that needed to be transposed into the Member States' national legislation and subsequently implemented by their national authorities. These requirements included, for instance, banning aerial spraying but also reducing or banning the use of pesticides in various specific areas. Furthermore, the SUD required Member States to introduce national action plans setting quantitative objectives and targets for the reduction of risks related to pesticides and their impact on human health and the environment.

Regarding the second objective, the SUD was the first piece of EU legislation to introduce a set of principles for integrated pest management that should lead to a change in the use of pesticides by their users, mostly farmers. This included the application of different (e.g. physical and other non-chemical) techniques and methods for the prevention or suppression of harmful organisms.

The available data show that although all Member States transposed the SUD, there are significant differences in how its provisions are implemented in practice. The occasional vagueness of these provisions has decreased their harmonisation effect to some extent, and led to broad variations in terms of the contents of the Member States' national action plans.

While acknowledging the value of the SUD, the Parliament has called for improvement of its implementation at Member-State level several times and for proper application of its main concept – integrated pest management. In general, the Commission shares similar views to the Parliament regarding the SUD's implementation and the application of its main principle, as reflected in a number of Commission reports on the subject.

The available research shows that 10 years after its adoption, the SUD remains relevant and has EU added value. In general, it is coherent with other related EU legislation. However, the practical implementation of the instruments adopted by the individual Member States, and their impact on achieving the directive's objectives are not always sufficient.

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List of abbreviations and acronyms

AGRI	European Parliament Committee on Agriculture and Rural Development
ENVI	European Parliament Committee on Environment, Public Health and Food Safety
IPM	Integrated pest management
NAP	National action plan
PPP	Plant protection product
SUD	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
External contractor	A consortium led by ÖIR GmbH in collaboration with Arcadia International, t33 and external experts

1. The Sustainable Use of Pesticides Directive

Plant protection products, commonly referred to as 'pesticides',[1] are used to prevent damage to agricultural crops by eliminating insects, weeds and other unwanted organisms harmful to cultivated plants.[2] Despite providing various benefits, such as protection of agricultural crops, plant protection products can be harmful to the environment and human health. For these reasons, they must be produced, sold, stored, used and disposed of in a safe and sustainable manner. Due to the potentially negative effects plant protection products have on human health and the environment, the European Union has established a complex regulatory system to harmonise and monitor their placing on its internal market, and their use.

In 2006, the European Commission adopted a communication addressed to the Parliament, the Council and the advisory committees, on a Thematic strategy on the sustainable use of pesticides.[3] The strategy was a reaction to the gaps in the then existing legal framework, especially regarding 'the use-phase of pesticides at EU level through setting minimum rules for the use of pesticides in the Community'.[4] Accordingly, the Thematic strategy laid out various individual measures that were to be adopted either as non-legislative policy measures or as legislative measures leading to a legislative proposal and the subsequent adoption of new EU pesticides-related legislation. The strategy proposed, among other things: introducing a requirement for Member States to draw up national action plans with the involvement of stakeholders; creating a system for training professional users; raising general public awareness; prohibiting aerial spraying; defining areas of significantly reduced or zero-pesticide use; promoting low-pesticide-input farming; and requiring Member States to create the necessary conditions for the implementation of integrated pest management (IPM) by farmers.[5] The expected outcome of the strategy was to reduce the overall risks involved and negative impact resulting from the use of pesticides on human health and the environment.

The strategy was followed by a package of legislative proposals on the application of pesticides ('the pesticides package'), which resulted in the adoption of four legal acts:

1. Regulation (EC) No 1107/2009 of the European Parliament and of the Council of 21 October 2009 concerning the placing of plant protection products on the market,
2. Regulation (EC) No 1185/2009 of the European Parliament and of the Council of 25 November 2009 concerning statistics on pesticides,
3. Directive 2009/127/EC of the European Parliament and of the Council of 21 October 2009 amending Directive 2006/42/EC with regard to machinery for pesticide application and
4. 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.

Regulation (EC) No 1107/2009 introduced the main instruments for placing effective plant protection products on the market that are safe for humans, animals and the environment, while at

[1] Despite the interchangeable use of the terms 'pesticides' and 'plant protection products', these terms are not identical. The term 'pesticide' is broader than the term 'plant protection product'. For more, see Table 1 on definitions.

[2] See, for instance, A. Dinu and E. Karamfilova, Regulation (EC) 1107/2009 on the Placing of Plant Protection Products on the Market, European implementation assessment, EPRS, 24 April 2018.

[3] COM(2006) 372 final

[4] Expert Group on the Thematic Strategy on the Sustainable Use of Pesticides, mandate, 2009, p. 1.

[5] COM(2006) 372 final, pp. 8-9.

the same time ensuring the effective functioning of the internal market and improved agricultural production.[6] **Regulation (EC) No 1185/2009** adopted rules on the collection and dissemination of statistics on the sales and use of pesticides. These statistics are meant to allow Member States to prepare their national action plans as required by Directive 2009/128/EC. In addition, the statistics are necessary for calculating relevant and accurate risk indicators for health and the environment related to the use of pesticides. **Directive 2009/127/EC** amended Directive 2006/42/EC regarding design, construction and maintenance of machinery for pesticide application; **Directive 2009/128/EC** is the main subject of this study.

In addition, an Expert Group on the Thematic strategy on the sustainable use of pesticides was set up to facilitate the exchange of information and best practices in the field of sustainable use of pesticides and integrated pest management.[7]

The following table provides a clarification of some terms.

Table 1: Definition of terms used throughout the document

Active substance (as applicable to plan protection products)	A chemical, plant extract, pheromone or micro-organism (including a virus), that has action against 'pests' or on plants, parts of plants or plant products (Article 2 (2) of Regulation (EC) 1107/2009)
Biocidal products	Products designed to combat organisms that are harmful to human or animal health and organisms that are detrimental to human activities, including disinfectants, material protection products, rodenticides, insecticides and repellents.[8]
Integrated pest management (IPM)	Careful consideration of all available plant protection methods and subsequent integration of appropriate measures that discourage the development of populations of harmful organisms, 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 (Article 3(6) of the SUD).
National action plan (NAP)	A document adopted by the respective Member State authorities that sets quantitative objectives, targets, measures, timetables and indicators to reduce risks and impacts of pesticide use on human health and the environment, and to encourage the development and introduction of IPM and alternative approaches or techniques in order to reduce dependency on the use of pesticides (Recital 5 of the SUD).
Plant protection products	'Pesticides' that protect crops or desirable or useful plants.[9]

[6] See Dinu and Karamfilova, *op.cit.*

[7] Expert Group on the Thematic Strategy on the Sustainable Use of Pesticides, mandate, 2009, p. 2.

[8] Regarding the definition of biocidal products, the SUD refers to Article 2(1)(a) (of repealed) Directive 98/8/EC that defines biocides as 'active substances and preparations containing one or more active substances, put up in the form in which they are supplied to the user, intended to destroy, deter, render harmless, prevent the action of, or otherwise exert a controlling effect on any harmful organism by chemical or biological means'. Regulation (EU) No 528/2012 concerning the making available on the market and use of biocidal products, which repealed Directive 98/8/EC, provides a different definition. See Article 3(1)(a) of Regulation (EU) No 528/2012.

[9] A comprehensive definition is included in Article 2(2) of Regulation (EC) No 1107/2009.

Pesticide	A plant protection product as defined by Regulation (EC) No 1107/2009 or a biocidal product as defined by Directive 98/8/EC[10] (Article 3(10) of the SUD).

Source: author, based on the definitions provided in EU legislation.

The following sections provide a legal analysis of the SUD, an analysis of the Parliament's resolutions on the sustainable use of pesticides, and the Commission's evaluations of the SUD in its policy context.

1.1. Policy context

Directive 2009/128/EC (the SUD) is part of a broader EU pesticides policy, and it was adopted as a part of the abovementioned 'pesticides package'. The following table provides an overview of various kinds of technical information applicable to the SUD.

Table 2: Directive 2009/128/EC – additional information

Parliament's committee responsible at the time of adoption of the SUD	The Committee on Environment, Public Health and Food Safety (ENVI)
Procedure and rapporteur	2006/0132(COD), Christa Klaß (EPP, Germany)
Report from the responsible committee on the legislative proposal	Report of 26 September 2007 on the proposal for a directive of the European Parliament and of the Council establishing a framework for Community action to achieve a sustainable use of pesticides (PE 386.502v04)
Date of adoption of original legislation in plenary	13 January 2009
Deadlines for transposition of legislation	26 November 2011[11] (Article 23 of the SUD)
Planned dates for review of the SUD	By 26 November 2014, the Commission had to submit to Parliament and the Council a report on the information communicated by the Member States in relation to the national action plans (Article 4(3) of the SUD).[12] By 26 November 2018, the Commission has to submit to Parliament and the Council a report on the experience gained by Member States on the implementation of national targets in order to achieve the objectives of the SUD (Article 4(4) of the SUD).[13] Furthermore, the Commission is required to regularly submit to Parliament and the Council a report on progress in the implementation of the SUD (Article 16).[14]

[10] Directive 98/8/EC was repealed with effect from 1 September 2013 by Regulation (EU) No 528/2012 concerning the making available on the market and use of biocidal products.

[11] Originally, Article 23 and Article 4(3) and (4) of the SUD contained the date 14 December 2011, which was subsequently changed to 26 November 2011 through a corrigendum to the SUD.

[12] This report was submitted to Parliament in October 2017 (COM(2017) 587 final). For more information, see Section 2.2 of the introductory analysis.

[13] It seems that with the exception of the 2017 report (COM(2017) 587 final), the Commission has not submitted to the Parliament any other report on progress in the implementation of the SUD.

[14] See comment in footnote 13 above.

Guidelines	To enhance the comparability of information, the Commission, in cooperation with the Member States, was obliged to develop a strategic guidance document on monitoring and surveying the impacts of pesticide use on human health and the environment (Article 7(3) of the SUD).[15]
Committee	With regard to the SUD, the Commission is assisted by the Standing Committee on the Food Chain and Animal Health.[16]
Amendment of the SUD	Regulation (EU) No 652/2014 of 15 May 2014 laying down provisions for the management of expenditure relating to the food chain, animal health and animal welfare, and relating to plant health and plant reproductive material, deleted the original Article 22 of the SUD dealing with the financing of measures by the Commission.

Source: author, based on the information included in the EUR-Lex database.

However, no concrete timeline has been established for this extension. Furthermore, the review obligations of the Commission do not cover biocidal products in any way.[17]

SUD goals and targets

The SUD has two main goals:

- to establish a framework for the sustainable use of pesticides by reducing the risks the latter pose to human health and the environment; and
- to promote the use of integrated pest management and different techniques, such as non-chemical alternatives (Article 1 of the SUD).

The directive had to be transposed into the national legislations of the individual Member States. To achieve the directive's goals, they were obliged to adopt various measures, such as:

- adopting national action plans;
- ensuring proper training of professional users, distributors and advisors;
- providing information to and raising the awareness of the general public;
- setting requirements for the sale of pesticides;
- setting requirements for the inspection of pesticide application equipment;
- banning aerial spraying;
- setting specific requirements for the protection of the aquatic environment and drinking water;
- reducing or banning the use of pesticides in various specific areas; and
- promoting low-pesticide pest management.

Article 15 of the SUD requires establishing harmonised risk indicators, which were to be referred to in Annex IV of the directive. Once established at EU level, the indicators were meant to be used by the Member States. The article entrusted the Commission with the task of calculating these indicators and evaluating progress in applying them. So far, however, no such indicators have been established at EU level.

[15] In October 2017, the Commission published its Guidance on monitoring and surveying of impacts of pesticide use on human health and the environment under Article 7(3) of the SUD.

[16] The committee was established by Regulation (EC) No 178/2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety.

[17] Presently, rules applicable to biocidal products are included in Regulation (EU) No 528/2012 of the European Parliament and of the Council of 22 May 2012 concerning the making available on the market and use of biocidal products.

Furthermore, Member States are required to set penalties for breaches of the national provisions implementing the SUD and subsequently to notify them to the Commission.

Biocidal products

Presently, the SUD applies to pesticides that are plant protection products. While Recital 2 of the SUD envisaged extending the scope of the directive to include biocidal products, no specific timeline has been established for this move. Furthermore, the review obligations of the Commission do not cover biocidal products, should the scope of the directive be expanded to include them. Presently, rules applicable to biocidal products are included in Regulation (EU) No 528/2012 of the European Parliament and of the Council of 22 May 2012 concerning the making available on the market and use of biocidal products.[18] However, neither any amendments to the SUD nor Regulation (EU) No 528/2012 have subsequently extended the scope of the SUD to these products.[19]

1.2. Integrated pest management principles

The SUD provides incentives for integrated pest management, one such example being the set of rules it introduced with regard to the sustainable use of PPPs. Since 1 January 2014, professional users of PPPs have had to apply eight general principles of integrated pest management (IPM), listed in Annex III to the SUD. The principles are considered to be a cornerstone of the directive.[20] Their implementation is expected to lead to a decreased dependency on pesticide use and to generally promote low-risk products.

Below are the eight general principles of integrated pest management, as listed in Annex III to the SUD:

1 The prevention and/or suppression of harmful organisms should be achieved or supported among other options especially by:

- crop rotation;
- use of adequate cultivation techniques (e.g. stale seedbed technique, sowing dates and densities, under-sowing, conservation tillage, pruning and direct sowing);
- use, where appropriate, of resistant/tolerant cultivars and standard/certified seed and planting material;
- use of balanced fertilisation, liming and irrigation/drainage practices;
- preventing the spreading of harmful organisms by hygiene measures (e.g. by regular cleansing of machinery and equipment);
- protection and enhancement of important beneficial organisms, e.g. by adequate plant protection measures or the utilisation of ecological infrastructures inside and outside production sites.

2 Harmful organisms must be monitored by adequate methods and tools, where available. Such adequate tools should include observations in the field as well as scientifically sound warning, forecasting and early diagnosis systems, where feasible, as well as the use of advice from professionally qualified advisors.

[18] Regulation (EU) No 528/2012 is the equivalent of Regulation (EC) No 1107/2009 for PPPs. It sets the procedures for placing biocidal products on the market, but does not include provisions on their sustainable use.

[19] For more information about biocidal products, see D. Bourguignon, EU policy and legislation on pesticides: Plant protection products and biocides, in-depth analysis, EPRS, April 2017.

[20] See, for example, Integrated Pest Management, European Commission 2018.

3. Based on the results of the monitoring the professional user has to decide whether and when to apply plant protection measures. Robust and scientifically sound threshold values are essential components for decision making. For harmful organisms threshold levels defined for the region, specific areas, crops and particular climatic conditions must be taken into account before treatments, where feasible.
4. Sustainable biological, physical and other non-chemical methods must be preferred to chemical methods if they provide satisfactory pest control.
5. The pesticides applied shall be as specific as possible for the target and shall have the least side effects on human health, non-target organisms and the environment.
6. The professional user should keep the use of pesticides and other forms of intervention to levels that are necessary, 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.
7. 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 products. This may include the use of multiple pesticides with different modes of action.
8. Based on the records on the use of pesticides and on the monitoring of harmful organisms the professional user should check the success of the applied plant protection measures.

The IPM principles are to be implemented by professional users, whom the SUD defines as any persons who use plant protection products in the course of their professional activities.

With regard to the IPM principles, the SUD obliges Member States:

1. to take measures to promote low-pesticide input pest management, giving wherever possible, priority to non-chemical methods; and
2. to establish or support the establishment of necessary conditions for the implementation of IPM, including ensuring that professional users have information and tools for pest-monitoring and decision-making at their disposal.

Member States were required to report to the Commission on the implementation of these two obligations by 30 June 2013.[21] An assessment of the integrated pest management principles is included in Part 2 of this study.[22]

1.3. National action plans

Directive 2009/128/EC requires Member States to adopt national policy documents, known as national action plans (NAPs), which set quantitative objectives, targets, measures and timetables in order to reduce risks and the impact of pesticides on human health and the environment. NAPs generally set out a framework for targets and actions to achieve the sustainable use of pesticides.

Besides saying that NAPs should be adopted by the respective Member State authorities, the SUD does not specify what they should look like, which authorities should adopt them, or whether the

[21] Based on the available data, it is unclear to what extent Member States have fulfilled this obligation.

[22] In this regard, see Part 2, sections 2, 3 and 4.

NAPs of the individual Member States should be comparable. However, the directive requires Member States, when drawing up their NAPs, to take into account the health, social, economic and environmental impacts of the measures envisaged; the specific national, regional and local conditions; and all relevant stakeholder groups.

Although the SUD is not very keen on specifying the contents of the NAPs in detail, it requires them to at least include:

- indicators for monitoring the use of plant protection products 'containing active substances of particular concern, especially if alternatives are available' (Article 4(1) of the SUD);
- timetables and (intermediate or final) targets for reduced use of plant protection products (Article 4(1) of the SUD);
- timetables and inspection intervals for pesticide application equipment not used for spraying pesticides; for hand-held pesticide application equipment or knapsack sprayers; and for additional pesticide application equipment that represents a very low scale of use (Article 8(3)a) of the SUD);
- provisions on informing persons who could be exposed to the spray drift (Article 10 of the SUD);
- provisions on how Member States intend to ensure that the general principles of integrated pest management are implemented by all professional users by 1 January 2014 (Article 14(4) of the SUD); and
- crop or sector-specific guidelines for integrated pest management drawn by public authorities and/or organisations representing particular professional users, if these are considered relevant and appropriate (Article 14(5) of the SUD).

According to Recital 19 of the SUD, NAPs must also describe how Member States would ensure that the IPM principles are being implemented. Member States are also instructed to give priority to non-chemical methods of plant protection and pest- and crop management. Recital 5 of the SUD provides that NAPs 'should be coordinated with implementation plans under other relevant EU legislation and could be used for grouping together objectives to be achieved under other EU legislation related to pesticides'. Recital 6 asks Member States to exchange information on the objectives laid down in the NAPs. In this regard, Member States should regularly report to the Commission and other Member States on the results achieved through their NAPs and on their practical experience. The Commission should then feed this information into its reports to the Parliament. While drafting their NAPs, Member States should also take into account the plans existing under other EU pesticides-related legislation (Recital 5).[23]

The SUD sets deadlines for Member States concerning the NAPs. Member States were obliged to communicate their NAPs to the Commission and to the other Member States by 26 November 2012. The Commission had to submit a report on the NAPs to the Parliament and the Council by 26 November 2014. The Commission's deadline for submitting a report to the Parliament and the Council on the Member States' success in achieving their national targets with regard to sustainable pesticide use is 26 November 2018.

NAPs have to be **reviewed at least every five years** and any substantial changes to them have to be reported to the Commission without undue delay (Article 4(2) of the SUD). Since the deadline for

[23] In this regard, the SUD refers to Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy, which *inter alia* requires Member States to prepare river basin management plans.

communicating the adoption of the first NAPs to the Commission was in November 2012, Member States had an obligation to review their NAPs by November 2017.

Furthermore, the SUD notes that rules concerning public participation also apply to the preparation and the adoption of NAPs. Namely, it refers to Article 2 of Directive 2003/35/EC of the European Parliament and of the Council of 26 May 2003 providing for public participation in respect of the drawing up of certain plans and programmes relating to the environment.[24]

The national action plans of all 28 Member States are published on the respective website of the Commission. A comprehensive assessment of the NAPs' contents, strengths and weaknesses is included in Part 2 of this study.[25]

[24] This article *inter alia* requires Member States to ensure that 'the public is given early and effective opportunities to participate in the preparation and modification or review of the plans or programmes'.

[25] See Part 2, Section 3.

2. Selected EU documents

2.1. Selected evaluations of the directive

This section provides an analysis of the most relevant evaluations of the SUD by the European Commission.

1) In October 2017, the Commission submitted its first report on the implementation of the SUD to the Parliament and the Council.[26]

The Commission based this report on the following sources of information: its 2015 assessment of the NAPs; audits of the implementation of the SUD (carried out in 2012-2014 and in 2015-2016); a survey and a questionnaire sent to the Member States in 2016; and fact-finding missions in Germany, the Netherlands, Italy, Denmark, Poland and Sweden (see more on the fact-finding missions outcomes further down in this section). In the first part of the report, the Commission focuses on the state of play regarding the national action plans, noting that all Member States have them. However, it observes that there is 'huge diversity in their completeness and coverage', thus acknowledging that they lack harmonisation. The Commission further states that Member States need to significantly improve their NAPs and address theirs shortcomings. These shortcomings are briefly described below:

- only two Member States had produced a revised NAP;
- NAPs differed considerably on how the Member States planned to implement measures included in the SUD;
- not all aspects of the SUD were covered by the NAPs or were covered in scant detail;
- NAPs were inconsistent regarding the establishment of quantitative objectives, targets, measurements and timetables for the various action areas (e.g. measures to protect the aquatic environment from pesticides);
- approximately 80 % of NAPs did not specify a method for measuring the achievement of targets or objectives,
- only five NAPs included measurable targets; and
- NAPs did not specify methods for assessing how farmers apply the IPM principles or how the implementation of these principles is ensured.[27]

The Commission draws the conclusion that despite having contributed to substantial progress in the sustainable use of pesticides, NAPs have significant gaps in many areas and their quality needs improving.

In the second part of the report, the Commission focuses on the implementation of individual articles of the SUD by the Member States. The report's main findings in this regard are as follows:

1 Despite a high level of compliance in the area of training and certification of professional users, distributors and advisors, it is not possible to claim that all users have been trained.[28]

[26] COM(2017) 587 final

[27] ibid., pp. 4-5.

[28] ibid., p. 5.

2 The accuracy of the data on acute pesticide poisoning gathered by Member States can be questioned. Information on chronic poisoning is not gathered, as the information-gathering systems remain largely unimplemented.[29]

3 In general, Member States have put systems in place requiring that pesticide application equipment is inspected at regular intervals. However, data about the overall rate of compliance differ among Member States.[30]

4 Aerial spraying is banned and derogations are only granted under strict conditions. The proportion of areas sprayed is small, diminishing and effectively controlled.[31]

5 The provision related to information and awareness-raising is used inconsistently among the Member States.[32]

6 Despite a range of measures to protect the aquatic environment from pesticide use, measurable targets are missing in the majority of NAPs.[33]

7 There is a positive effect from the extensive measures put in place by the Member States for reducing the use of pesticides in specific areas. However, there is an absence of measurable targets in the majority of NAPs.[34]

8 Nearly all Member States have systems for controlling the handling and storage of pesticides. However, their effectiveness is decreased due to a lack of measurable targets.[35]

9 Member States have no criteria for assessing the implementation of the integrated pest management principles, nor have they adopted enforcement measures to apply in case these principles are breached.[36]

10 The Commission intends to start discussions on 'whether a consensus can be reached on the development of harmonised risk indicators', given that such are missing from the NAPs.[37]

11 Regarding low-risk pesticides, the Commission notes that it is 'taking measures to accelerate the[ir] availability'.[38]

The Commission furthermore notes that it has reminded Member States of their obligations and the importance of the implementation of the SUD. The Commission intends to carry out an audit of the implementation of the SUD in the Member States. If necessary, it also considers taking infringement action. Furthermore, the Commission intends to produce a further report as soon as Member States adopt revised NAPs.[39]

2) In 2017, the Commission's Directorate-General for Health and Food Safety (DG SANTE) also produced an Overview report on the implementation of Member States' measures to achieve the sustainable use of pesticides.[40] The overview report provides a summary of the main findings of the

[29] ibid., p. 6.

[30] ibid., p. 7.

[31] ibid., p. 8.

[32] ibid., p. 9.

[33] ibid., p. 10.

[34] ibid., p. 11.

[35] ibid., p. 12.

[36] ibid., p. 13.

[37] ibid., p. 15.

[38] ibid., p. 16.

[39] Member States were required to have adopted their revised NAPs by November 2017 (Article 4(1) of the SUD).

[40] DG(SANTE) 2017-6291

results of the Commission's questionnaire and its fact-finding missions to six Member States, as mentioned above. These main findings include:

1. NAPs were adopted in all Member States, though in many cases with delays. There was great diversity in terms of the NAPs' coverage and completeness.
2. 21 Member States had set risk reduction objectives and nine had set use reduction objectives.
3. Only five Member States had set high-level measurable targets, of which four related to risk reduction and one to use reduction.
4. Compliance with the IPM principles was not systematically checked by Member States. They often lacked clear criteria about implementing these principles.
5. Inspection systems for spraying equipment had been set up in 26 Member States. There was however a lack of reliable data on the total number of sprayers to be tested.
6. A training and certification system had been set up in all Member States. However, there was a lack of reliable data on the total number of operators who needed to be trained and certified.
7. There was a high level of compliance with the SUD regarding prohibition of aerial spraying. Derogations from this prohibition were granted under strict conditions.
8. There were various discrepancies regarding the systems used for gathering information on acute pesticide poisoning and those used for gathering information on chronic poisoning.
9. Despite the existence of measures on the protection of the aquatic environment, the majority of Member States had not established measurable targets and it was therefore difficult to assess progress in this regard.

To support its conclusions, the overview report provides a lot of practical examples from different NAPs and from the audits of the six chosen Member States.

3) Between March 2017 and June 2017, the Commission published six audit reports from its fact-finding missions carried out in the same year, which investigated the implementation of the SUD in Germany, the Netherlands, Denmark, Italy, Poland and Sweden.

a) Germany

The audit report noted that there was clarity in the German NAP regarding targets to further reduce risks and impact of pesticides, and the relevant timelines. The report also noted progress in the continued reduction of the environmental risks associated with pesticides. It however pointed out that financial constrains were limiting the effectiveness of public advisory services and were thereby posing an emerging risk to the sustainable use of pesticides. That said, the report highlighted the existence of various good practices, such as publicly funded advisory services. The report however observed that 'the production of field crops in Germany continues to depend on pesticides'.

b) The Netherlands

The audit report found that the Dutch NAP did not include quantitative objectives, targets, measures or timetables as these were included in another 'higher level policy document on sustainable plant protection'. It observed that the priority focus in the Netherlands was on reducing the impact of PPP use on water quality. Furthermore, the report found several good practices, such as the approach taken with regard to the authorisation of low-risk PPPs. The report concluded that there was significant progress in the development and implementation of IPM measures, achieved in part through the introduction of public and private tools and the

assumption of a common commitment by the social partners to make further progress in the field of IPM.

c) Denmark

The audit report noted a high level of engagement among the social partners and the public with regard to reducing the risks posed by pesticides. Furthermore, it found 'significant efforts to extend the range of non-chemical pesticides and to extend the range of advisory services provided to growers in order to promote integrated pest management'. According to the report, Denmark has achieved its primary goal of reducing the impact of pesticides on human health and the environment by 40 % by 2015. In addition, the report found a significant reduction in the volumes of pesticides in public areas. Last but not least, the report identified good practices including a number of incentives to broaden the range of non-chemical pesticides. It however also observed a lack of a system to determine compliance with the IPM principles.

d) Italy

The audit report noted that the Italian NAP did not include quantitative objectives and specific targets as required by the SUD. The report also mentioned a delay of 14 months in the adoption of the first NAP, which resulted in subsequent delays in its implementation. Several examples of good practices were found, such as a surveillance system for cases of acute poisoning. Furthermore, the report also noted the existence of an extensive nationwide pest monitoring network. However, it found that control to determine compliance with the IPM principles was given to growers 'who receive financial support for participation in voluntary schemes'.

e) Poland

The audit report observed that the main objectives of the Polish NAP were linked with the implementation of the IPM principles and the actions taken to promote their use or monitor their implementation. Here it found that some of these actions did not correlate with the NAP's targets, making it difficult to assess whether the goals had been achieved or not. The report noted improvements in the sense that there were systems in place for training operators and for inspecting spraying equipment. Nonetheless, the report observed that there had been a low number of applications for the authorisation to use low-risk and non-chemical PPPs, which had a limiting effect on the development of IPM strategies.

f) Sweden

The audit report noted that in Sweden, pesticide risks to human health and the environment were low, while remaining stable. It observed a range of measures taken to implement the SUD, including systems for training professional users and distributors. Furthermore, it found that aerial spraying was prohibited, with no derogations granted. Similarly, it observed high levels of compliance with drinking-water-quality standards. It also noted that there was publicly-funded information available to guide professional users of IPM. The report finally noted the existence of good practices, such as an extensive pest monitoring system. It however found that there was no systematic assessment of the implementation of the IPM principles.

4) In June 2016, the Expert Group on Sustainable Plant Protection[41] adopted an implementation plan on increasing low-risk plant-protection-product availability and accelerating integrated pest

[41] Temporarily set up by the Commission in 2015, the expert group was made up of representatives of 19 Member States.

management implementation in Member States. The plan was endorsed by the Council[42] and welcomed by the Parliament[43]. Both institutions invited the Commission and Member States to confirm their support for the implementation plan.

The implementation plan acknowledged the progress made regarding the availability of low-risk PPPs and recommended taking action in the following directions:

1 Increasing the availability of low-risk products by
   - (i) accelerating approval and authorisation procedures in general;
   - (ii) accelerating procedures for low-risk active substances and products (such as expediting the renewal of low-risk substances, exploring ways to assign low-risk status to already approved substances and meeting the 120-day legal timeline for authorising a low-risk product);
   - (iii) adopting measures to support businesses to apply for low-risk approval and authorisation (including reducing fees for low-risk products and providing guidance to applicants); and
   - (iv) providing clarification and guidance on regulatory requirements (such as amendment of low-risk criteria, guidance on the zonal evaluation and mutual recognition of low-risk products, and guidance on the efficacy assessment of low-risk products);

2 Accelerating the implementation of IPM in Member States through:
   - (i) on-farm or experimental station research;
   - (ii) the establishment of demonstration farms and the provision of advice on IPM;
   - (iii) the facilitation of information-sharing on IPM between Member States; and
   - (iv) further development of indicators to monitor IPM.

3 Supporting the research and development of alternative methods.

The annex to the implementation plan included an overview of the actions, main actors and timelines that had been identified. With regard to the IPM principles, in the majority of the cases the main actors identified were Member States, with other stakeholders and the Commission also considered as being involved.

2.2. Selected European Parliament resolutions and opinions

The Parliament has, on several occasions, emphasised the importance of the sustainable use of pesticides, including integrated pest management. Since the adoption of Directive 2009/128/EC,[44] the Parliament has adopted several resolutions calling for improvements with regard to the sustainable use of pesticides and implementation of the SUD. The following resolutions present some examples related to the sustainable use of pesticides and the IPM principles.

[42] See the Council's endorsement of the implementation plan of 16 June 2017 (10041/1/16 REV 1).

[43] See Parliament's resolution of 15 February 2017 on low-risk pesticides of biological origin (P8_TA(2017)0042), point 7.

[44] Prior to the adoption of the SUD, Parliament adopted several resolutions acknowledging the need for a better legal framework relating to the sustainable use of pesticides, for example, the resolution of 24 October 2007 on a Thematic strategy on the sustainable use of pesticides (P6_TA(2007)0467).

In its **resolution on honeybee health and the challenges of the beekeeping sector** of 15 November 2011 (2011/2108(INI)),[45] Parliament called on the Member States 'to transpose and fully implement, as soon as possible, Directive 2009/128/EC on the sustainable use of pesticides'. Parliament called, in particular, for the full implementation of Article 14 of the SUD, 'which highlights the fact that it will be mandatory for all farmers in the EU to apply integrated pest management as of 2014'. Parliament also called on Member States to 'pay particular attention to the use of those pesticides that may have an adverse effect on bees and colony health' (all in point 29). Parliament also called on the Commission to 'pay special attention to the use of specific pesticides that have had an adverse effect on bee and colony health under certain circumstances' (point 30).[46]

In its **resolution on the future of Europe's horticulture sector – strategies for growth** of 11 March 2014 (2013/2100(INI)),[47] Parliament called on the Member States and the Commission to promote integrated pest management. In this regard, Parliament also called upon them to support innovation and development of non-chemical alternatives and to use the Horizon 2020 Framework Programme. As in the previously mentioned resolution, Parliament highlighted the need for proper implementation of Article 14 of the SUD, which requires Member States to 'take all necessary measures to promote low pesticide-input pest management, giving, wherever possible, priority to non-chemical methods' (point 18).[48]

In a **resolution on technological solutions for sustainable agriculture in the EU** (2015/2225(INI)) of 7 June 2016,[49] Parliament regretted 'the slow progress of the Member States and the Commission in respectively implementing and evaluating the implementation of IPM and Directive 2009/128/EC' (point 43). It also considered important to 'reduce farmers' dependence on pesticides as much as possible' (point 32). Furthermore, it welcomed the latest Integrated Pest Management – European Research Area Network (IPM-ERANET). In this regard, Parliament considered that this platform should 'cover research and innovation with a view to addressing the lack of crop protection solutions for minor use and speciality crops' (point 36). The Commission's DG SANTE was called upon to ' establish clear criteria for defining low-risk active substances for the development and use of low-risk pesticides' (point 38). Parliament also took a view that low-risk substances should be given priority for evaluation in order to help meet the aims of the SUD (point 39).[50]

In a **resolution on the draft Commission implementing regulation renewing the approval of the active substance glyphosate** (2016/2624(RSP)) of 13 April 2016,[51] Parliament called on the Commission 'not to approve any agricultural uses of glyphosate where integrated pest

[45] (P7_TA(2011)0493).

[46] The Commission, in its follow-up of March 2012 (SP(2012)55), noted that it is 'strictly monitoring the process of transposition and implementation by the Member States'. The Commission mentioned that it had organised several expert meetings focused on sharing best practices on integrated pest management and on advising on proper transposition. It also mentioned that it was planning on taking technical supportive measures to ensure harmonised implementation.

[47] P7_TA(2014)0205.

[48] In its reply to its follow-up of August 2014 (SP(2014)457), the Commission did not respond to this specific request of the Parliament.

[49] P8_TA(2016)0251.

[50] In its November 2016 follow-up (SP(2016)612), the Commission noted that it had strictly followed up on the implementation of the SUD, including through audits carried out in each Member State by DG SANTE. The Commission also informed that in 2016 it 'supported a dedicated temporary expert group to identify priority actions for the availability of low risk PPP and application of IPM' while working together with Member States on implementing actions recommended in the 'Implementation Plan on increasing low-risk plant protection product availability and accelerating integrated pest management implementation in Member States'.

[51] P8_TA(2016)0119.

management systems are sufficient for the necessary weed control' (point 6).[52] Similarly, in its **resolution on the draft Commission implementing regulation renewing the approval of the active substance glyphosate** (2017/2904(RSP)) of 24 October 2017,[53] Parliament reiterated its call on the Commission and the Member States 'not to approve any agricultural uses of glyphosate after 15 December 2017 where integrated pest management systems are sufficient for the necessary weed control' (point 4).[54]

Finally, in a **resolution on low-risk pesticides of biological origin** (2016/2903(RSP)) of 15 February 2017,[55] Parliament stressed the need to increase the availability of low-risk pesticides without delay (point 1). It emphasised the importance of offering farmers a bigger choice of tools to protect their crops 'including low-risk pesticides of biological origin, following the principles of integrated pest management' (point 2). In this regard, Parliament welcomed the Implementation Plan on increasing low-risk plant protection product availability and accelerating integrated pest management implementation in Member States, and called on the Commission and Member States to implement it (point 7). Member States were invited to 'include the use of low-risk pesticides of biological origin in their national action plans on the protection of the environment and of human health' (point 10). In addition, Parliament called on the Commission 'to identify gaps in the implementation of the SUD by Member States and to include robust recommendations to Member States to take immediate action in order to reduce the risk and impact of pesticide use on human health and the environment and to develop and introduce alternative approaches or techniques with the aim of reducing dependency on the use of pesticides'. The Commission was supposed to include all of these points in its report on the evaluation of the NAPs as required by the SUD (both point 17).[56]

The resolutions of the Parliament show that it is interested in the proper functioning and application of the legislation on sustainable pesticide use and integrated pest management. Furthermore, Parliament's calls and requests to the Commission and the Commission's follow-up documents reveal the fact that these two institutions agree that the implementation of the SUD, including the proper application of the IPM principles, needs to be improved and that Member States should pay more attention to their SUD-based obligations as transposed in their national laws.

In addition to Parliament's resolutions, Members of Parliament have addressed various questions to the Commission concerning Directive 2009/128/EC and the sustainable use of pesticides.[57]

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[52] The Commission, in its follow-up of September 2009 (SP(2016)484), pointed to its own research that 'aim[s] at the development of bio-pesticides, the development of alternative control strategies for important pests and diseases but also on horizontal aspects such as the development of integrated pest management tools'.

[53] P8_TA(2017)0395.

[54] The 2018 Commission follow-up (SP(2018)7) noted that Member States need to ensure that certain elements are being taken into account when assessing applications for and making decisions on granting authorisation to plant protection products containing glyphosate, such as the elements that are included in the SUD (Article 12a).

[55] P8_TA(2017)0042.

[56] The Commission reacted to this resolution in its follow-up of August 2017 (SP(2017)358). It supported the common objective to increase the availability of low-risk plant protection products. With regard to the SUD, the Commission noted that Member States needed to take responsibility for its implementation. The Commission reaffirmed its intention to review Member States' NAPs including through fact-finding visits. The Commission furthermore noted its intention to prepare a report on the implementation of the SUD in the autumn of 2017. For more about this report see Section 2 of this opening analysis.

[57] See, for example, questions E-002529-18, E-001224-18, E-000431-18, E-002463-17, O-000147/2016 and E-008770-16.

3. Implementation of the directive: state of play

All Member States have officially transposed the directive[58] through various legal acts and measures.[59]

As noted in the previous section, in October 2017, the Commission submitted a report to the Parliament and the Council, which focused on the national action plans and progress in the implementation of the SUD. From March to September 2018, the EPRS, carried out an independent assessment of the implementation of the SUD with the help of an external contractor.[60] While focusing on the implementation of the SUD in general, the assessment pays special attention to the implementation of the IPM principles and several other points, such as the development of harmonised risk indicators, the imposition of limits and the ban on the use of pesticides in sensitive areas.

Among the sources of the general assessment of the implementation of the SUD are two targeted surveys carried out by the external contractor in May 2018: one among the Member States' national competent authorities,[61] and another among 'other' stakeholders.[62] Their purpose was to assess the implementation of the SUD against a standard set of evaluation criteria, namely relevance, coherence, effectiveness, efficiency and EU added value. In this particular case, this translates as follows:

- **relevance** – whether the set of policy objectives laid down by the SUD (as transposed in national legislation) reflects current needs to a sufficient extent;
- **coherence** – whether the implementation of the SUD (as transposed in national legislation) is in line with other related EU policies and legislation;
- **effectiveness** – whether the practical implementation of the SUD (as transposed in national legislation) underpins or goes against the achievement of the set objectives;
- **efficiency** – whether the existing policy results could have been achieved with fewer costs/resources; and
- **EU added value** – whether Member States could have achieved existing results better if acting alone (i.e. without policy-making at EU level).

Relevance

This evaluation criterion looks at whether the set of policy objectives laid down by Directive 2009/128/EC sufficiently reflects the current needs. As noted before, the directive has two main objectives with regard to relevance:

- to establish a framework for the sustainable use of pesticides by reducing the risks they pose to human health and the environment, and

[58] See document 32009L0128 on the status of national transposition and national transposition measures communicated by Member States, published on EUR-Lex. All Member States, with the exception of Croatia, had transposed the SUD into their legal systems by 26 November 2011. Croatia did this by 1 July 2013, the date of its accession to the EU.

[59] The amount and type of measures through which the SUD was transposed into national law depend on the Member States' individual legal and constitutional traditions.

[60] Consortium led by **ÖIR GmbH.** See Part 2.

[61] National competent authorities included the authorities dealing with the sustainable use of pesticides.

[62] The 'other' stakeholders included three categories: 1) the users of PPP; 2) the producers of PPP; and 3) other NGOs, whose activities are related to health and environmental safety and/or the productions of foodstuffs.

- to promote the use of integrated pest management and different techniques such as non-chemical alternatives.

It appears from the surveys that overall, the objectives of the SUD are still relevant to the current needs. The stakeholders, Member State authorities and other stakeholders alike consider that at this stage there is no need to modify the SUD. Nonetheless, some health and environmental NGOs noted that an additional objective aimed at reducing dependency on pesticide use should be added, and that all of the objectives should be rearranged so that more priority is given to the IPM principles.

Coherence

Coherence is assessed to check whether the objectives established by Directive 2009/128/EC and their practical implementation in the Member States are in line with other related EU policies and legislation.

The stakeholders, national authorities of Member States and other stakeholders alike are generally of the opinion that the SUD objectives are highly coherent with other policy areas, such as the environment, public health, the PPP Regulation, agriculture, and food and feed safety. However, some issues were raised by the other stakeholders with regard to the coherence of the SUD with the internal market, biocides and chemicals. Moreover, some Member State authorities questioned the coherence of the SUD with the legislation on fertilisers and chemicals.

Effectiveness

In terms of effectiveness, the aim is to assess whether the objectives of Directive 2009/128/EC are being achieved. The available evidence, however, shows that the practical implementation of the instruments existing in individual Member States and their impact on the directive's objectives are not always sufficient.

a) Reducing the risks and the impact of pesticides on human health and the environment

The effectiveness of the SUD in reducing the risks and the impact of pesticides on human health and the environment can only be assessed indirectly; it is difficult to quantify and/or measure, because the SUD is not the only piece of European legislation dealing with (and managing the impact of) pesticides. This point was raised by the majority of respondents to the surveys. They noted missing indicators (what to measure and how to measure it), high expenses related to monitoring the impact and presence of pesticides in the air, and overlap with the measures already included in the NAPs.

The evidence at hand shows that the actions included in the NAPs have had a somewhat positive effect on the environment. However, respondents occasionally pointed out the need to set more ambitious goals regarding environmental protection and nature conservation in the NAPs. In particular, these goals would translate into actions such as carrying out mandatory trainings, placing a ban on aerial spraying, and practising correct storage and disposal of PPPs help reduce the risks on the environment and human health. In addition, based on the accessible evidence, one can assume that an increase in the use of alternative solutions to pesticides decreases the risks and effects of pesticides on human health and the environment.

b) The IPM principles and promotion of the use of alternative approaches and techniques

The available evidence shows that despite the fact that the SUD has been transposed into national law, farmers usually have limited knowledge about the IPM principles and their application, or about alternative approaches and techniques, which limits the impact of the IPM principles and renders them only partially effective. Furthermore, the principles' vagueness and general character seem to pose a considerable challenge. In this regard, the evidence shows a

need to further develop and disseminate guidelines and management practices that would be specific for each crop or crop category.

Some actions, such as the promotion of alternative approaches and techniques, are in general considered effective, despite some stakeholders (other than Member States authorities) calling them ineffective. Incentives for growers to change their practices regarding the use of pesticides are generally considered insufficient. There is also a limited involvement of advisory services and academia in the search for alternative methods. Furthermore, proactivity is required to initiate and to implement the necessary changes leading to the development of alternative methods. This seems to be one of the main issues that can influence users' behaviour towards pesticides.

Efficiency

The assessment of the efficiency of Directive 2009/128/EC addresses the question whether the existing policy results could have been achieved with fewer costs/resources.

The available evidence shows that Member States occasionally lack the resources – financial and personal – to properly implement the directive. This makes it rather challenging to implement all of the activities envisaged under the SUD (as transposed in national law) and to obtain the expected results. At the same time, higher costs for implementing the directive were noted, especially those related to developing alternative methods and implementing the IPM principles. Furthermore, there is evidence that a reduction of resources may negatively impact the implementation of some of the SUD provisions, including those related to training or the provision of direct advice to farmers.

In some Member States, no specific national budget is foreseen for implementing the SUD following its transposition into national law.

EU added value

In the context of Directive 2009/128/EC, the question of EU added value refers to whether Member States could have achieved the same or better results without this directive and its implementation in their national law.

The available evidence shows that there is an overall positive perception of the EU added value of Directive 2009/128/EC as it adds value to national efforts in achieving the relevant health, environment and market objectives. None of the stakeholders taking part in the survey considered that Member States would do better without the SUD.

There is broad consensus that the SUD has been considered key in ensuring that the use of pesticides and methods for risk reduction are discussed among the stakeholders. Furthermore, the SUD contributes to achieving a level playing field to further reduce risks from pesticide use, as well as diminishing the discrepancies of the approaches followed across Member States.

4. Key findings

- At the time of its adoption, Directive 2009/128/EC was welcomed; almost 10 years later, it is considered an important tool that sets general rules for the sustainable use of pesticides.
- The directive introduced into EU law the concept of integrated pest management and its principles for the first time.
- The directive still does not have specific provisions applicable to biocidal products.
- All Member States transposed the directive into their national legislation.
- Some provisions of the directive are rather general and vague, allowing Member States a lot of discretion. Though Member States may use this discretion to adapt the directive's provisions to their national legislation, too broad a discretion might limit the intended harmonisation impact of the directive. For example, this has led to a large variety in the content of national action plans across Member States.
- Some of the directive's provisions, especially Annex IV on harmonised risk indicators, still do not have any substantive content.
- The Parliament has called for improving the implementation of the directive on several occasions. It has similarly acknowledged the value of the directive and called for the correct application of its core concept, the integrated pest management principles.
- The Parliament and the Commission agree that the implementation of the SUD, including the proper application of the integrated pest management principles, needs to be improved and that Member States should pay more attention to their SUD-based obligations as transposed into their national laws.
- The directive remains relevant and has EU added value. In general, it is coherent with other related pieces of EU legislation. However, the practical implementation of the instruments in the individual Member States and their impact on the directive's objectives are not always sufficient.

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Part II:

Evaluation of the implementation of Directive 2009/128/EC on the sustainable use of pesticides

Study

This study assesses the implementation of Directive 2009/128/EC on the sustainable use of pesticides (SUD). A special focus has been given to the practical implementation of the general principles of integrated pest management (IPM).

The study presents the results of various data-collection processes that will allow the European Parliament to evaluate the progress made to date in achieving the objectives of the Directive, as well as to establish whether the Directive has delivered the expected benefits and results. The study assesses in particular the relevance, coherence, effectiveness, efficiency as well as the EU added value of the implementation of the Directive. The analysis identifies potential problems of compliance and underlines factors that hinder the achievement of the objectives of the Directive. Based on the conclusions of the study, recommendations for future actions are outlined.

AUTHORS

This study has been written by members of a Consortium led by ÖIR GmbH, in collaboration with Arcadia International, t33 and external experts at the request of the Ex-Post Evaluation Unit of the Directorate for Impact Assessment and European Added Value, within the Directorate-General for Parliamentary Research Services (EPRS) of the General Secretariat of the European Parliament. The authors of this study are: Daniel Traon (Arcadia International), Silke Dachbrodt-Saaydeh, Per Kudsk, Sanja Brkanovic, Bernd Schuh (ÖIR GmbH), Helene Gorny (ÖIR GmbH).

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ADMINISTRATOR RESPONSIBLE

Milan Remáč, Directorate-General for Parliamentary Research Services (EPRS), Directorate for Impact Assessment and European Added Value, Ex-Post Evaluation Unit

To contact the publisher, please e-mail EPRS-ExPostEvaluation@ep.europa.eu

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eprs@ep.europa.eu
http://www.eprs.ep.parl.union.eu (intranet)
http://www.europarl.europa.eu/thinktank (internet)

Executive summary

The purpose of this study is to assist the members of the European Parliament's Committee on the Environment, Public Health and Food Safety (ENVI) in their evaluation of the implementation (i.e. the transposition, application and enforcement) of Directive 2009/128/EC establishing a framework for Community action to achieve the sustainable use of pesticides (SUD). A particular focus has been placed on the specific elements of the Directive which are essential for risk reduction. With respect to this, many of the elements discussed relate to the implementation of the eight general principles of integrated pest management (IPM).

The study follows a two-level approach. Firstly, the implementation of the Directive is assessed against a standard set of criteria for evaluation, namely relevance, coherence, effectiveness, efficiency and European added value. Special attention is given to the implementation of IPM, one of the main elements of the Directive. As a result, each of the eight general principles of IPM are examined, and the level of implementation is assessed. Secondly, given that the legal act in question is a Directive, the study considers the following three points:

- developing of a set of draft harmonised risk indicators to support this process at the EU level, since harmonised risk indicators are still to be established and adopted by the European Commission;
- assessing the implementation of the Directive with regard to the limitation and ban of the usage of pesticides in specific areas by Member States;
- establishing the various (economic, social and environmental) impacts of use of pesticides, and in particular its impact on drinking water over the last ten years.

A case study was conducted for each of the three above mentioned research activities. Three additional research activities were foreseen in the Technical Specifications of the study, namely:

- mapping and evaluating the usage of pesticides across the EU according to their exact specifications of use as authorised according to Regulation (EC) No 1107/2009 concerning the placing of plant protection products on the market, this includes a mapping of the uses of plant protection products in practice other than for the purpose authorised;
- developing a set of common EU-level guidelines (following successful guidance practices at the national level) for the various IPM principles that would underpin the proper implementation of IPM;
- developing a set of EU-level prescriptive and assessable criteria that would support the proper implementation of IPM.

The three additional research issues stated were not examined in-depth as case studies for a number of reasons. With respect to the first focal point, it was not possible to collect information on the other uses of plant protection products (PPP). Meaning, those uses other than the intent authorised. Without this information, the examination of the focal point loses much of its purpose. In terms of the second two focal points, after an initial evaluation took place, it was deemed undesirable to develop EU-level common guidelines and assessable criteria to support the proper implementation of IPM. The reasons for this are discussed in section 5.4.

This study summarises the responses of more than eighty relevant actors in the field (national authorities and other non-governmental stakeholders). These actors have been surveyed and interviewed to determine their assessment of the progress of the implementation of the Directive and of the national actions taken with respect to the its implementation. The latter notably includes the achievements and obstacles encountered during the implementation process of the National Action Plans (NAP). Expert views are gathered at the level of the EU, Member States, authorities and

stakeholders. A literature review and a detailed desk-based analysis of the National Action Plans complements the primary data collection.

Based on stakeholders' perceptions, the strengths and weaknesses of the SUD legal framework, and those linked to the implementation of the relevant rules and provisions at the MS level, are identified. To support policy improvement and the optimal implementation of the Directive, recommendations intended for each group of actors are presented. These recommendations further place an emphasis on IPM measures, as these were identified by respondents as problematic even though being an integral component of the Directive.

An important consideration is that the Directive covers a policy area which has not been previously regulated. It is the first time that the EU has adopted a regulatory framework related to the use phase of pesticides with a focus on risk reduction. Furthermore, this legislative framework is unique worldwide. Therefore, the NAPs were entirely new to the large majority of MS. Thus, the implementation of the provisions of the Directive should be evaluated carefully, with consideration of the lag phase between the development of this new policy framework, and the realistic expectation for concrete results.

The majority of respondents, being national authorities or other stakeholders, considered that the objectives of the SUD are still **relevant** to current needs. They stated that there is no major need to modify the legislation at this stage. However, some health and environmental NGOs highlighted that the objectives of the Directive should be updated. They suggest that adding an objective aiming at "reducing dependency on pesticide use" is required as it is currently not sufficiently reflected in the general objectives. The same NGOs add that Farm Advisory Services (FAS) and the Common Agricultural Policy (CAP) should more strongly incorporate IPM approaches.

As far as legal **coherence** is concerned, national authorities considered that the level of overall coherence with other legislations is rather high, in particular in the areas of the environment, food and feed safety, food and feed security, agricultural production, consumer protection, and public health. This includes legislation on maximum residual levels (MRLs) and the placing of PPPs on the market. Other stakeholders considered the objective of the Directive coherent with consumer protection, public health, environmental protection, food and feed safety and agricultural production. On the other hand, they considered the objectives less coherent with legislation on the internal market, biocides and chemicals.

With regard to the **coherence related to the enforcement and implementation of the other pieces of legislation,** national authorities considered that coherence between the implementation and the objectives for the legislation on climate change is especially high. They noted less coherence with respect to fertiliser and chemical legislation. Other stakeholders reported high coherence with the implementation of the legislation on chemicals but a lower coherence in the implementation of Regulation (EC) No 1107/2009 and of the energy regulatory framework. The current slow state of approval of low-risk substances via Regulation (EC) No 1107/2009 is seen as a major impediment by grower associations.

In terms of **effectiveness,** the majority of respondents, with the exception of health and environmental NGOs, considered that the objectives of the legislation have not yet been achieved but that progress has been made in the majority of MS. Therefore, based on findings, it appears that things "are moving in a good direction". Even if only a few concrete results have been observed to date on the impact of the different provisions. This is particularly the case with IPM. The same respondents highlighted the lack of available tools for measuring the progresses of the implementation IPM. Authorities, health/environment NGOs and farmers themselves consider that IPM is not sufficiently understood by farmers. This could be identified as a factor hindering the proper implementation of IPM and hence its effectiveness. IPM is an approach developed for crop specific management. The

promotion of alternative crop protection approaches and techniques is considered positive by authorities but insufficient by stakeholders (farmers and health/environmental NGOs). For these respondents, advisory services and researchers are not sufficiently involved in the search for alternative pest control methods. It is felt that national authorities should be much more proactive in initiating and implementing the changes necessary to improve the agricultural production paradigm. The availability of economically viable alternative methods is a key issue. Science and advisory services require resources and time to develop tailor-made and efficient control solutions.

With respect to **efficiency,** most respondents highlighted that resources (personnel capacities and budget) required for the proper implementation of the Directive are lacking. The study revealed that little information on the current budget devoted to the implementation of the SUD is available. Several authorities have highlighted that the costs are high for the full and effective implementation of the Directive. The same respondents reported that the main issues are related to the proper development of alternative methods (research funding is lacking) and implementation of IPM. Manufacturers of conventional chemical pesticides consider that, in general terms, adequate resources are devoted to the implementation of the Directive. On the other hand, they stated that in a range of Member States, resources at official extension service level have been constantly reduced. This has been felt to undermine training services and strongly limit the capacities for the provision of direct farm level advice.

Finally, the large majority of respondents considered that the implementation of the SUD has **added value** to national efforts in achieving the relevant health, environmental and market objectives. None of the respondents stated that the Member States would achieve better results without the SUD at the EU level. The role of the Directive was observed as serving as a key driver in ensuring that different ministries and stakeholders, in all MS, discuss the use of pesticides and methods for risk reduction, follow harmonised provisions and requirements, and thus gain a common knowledge related to risk reduction. This further includes, in particular, achieving increased awareness among professional users.

Harmonised risk indicators have not been developed to date, however work in this area is in progress. The Commission (DG SANTE) has recently drafted a proposal that will be put forward to a vote by Member States before the end of 2018. Two approaches to risk indicators have been taken by Member States to date. One is the simple and straightforward approach using descriptive indicators reflecting the direct and/or indirect effects of pesticide use. Direct effects include pesticides in surface and ground water and pesticide residues in food. Indirect effects include examples such as the number of farmland birds believed to reflect the effect on biodiversity and food web. Other MS have developed risk indicators based on models that calculate the risk, or potential risk, for each active substance. Through combining this information with pesticide use data, risks can be calculated at the field, farm, regional or national level. In contrast to descriptive indicators, the objective with the model-based indicators is, precisely, to estimate the effects of changes in pesticide use on overall risks. The usefulness of model-based risk indicators depends on the reliability and robustness of the underlying models and the quality of the pesticide use data applied. Regulation (EC) No 1185/2009 concerning statistics on pesticides requires MS to report total sales of each active substance every year. More detailed information on pesticide use in specific crops is only required once every five years. Poor quality and lack of uniformity of pesticide use data is a significant impediment considering the potential benefits of developing harmonised risk indicators.

Risk reduction measures in specific areas with restrictions on pesticide use have been widely adopted by MS. Pesticide use in areas used by the public or by vulnerable groups is authorised based on the risk assessment of the Regulation (EC) No 1107/2009 in the majority of Member States. There are various additional restrictions at the national level, and in given cases the regional level. Moreo-

ver, some MS are actively undertaking discussions on the ban of pesticides in public areas. For example, one case study Member State approves pesticide use in amenities, however, places limitations on the frequency of application and the types of areas that can be treated. Other MS ban individual pesticides in areas visited by children and golf courses. Further, MS have been observed to empower municipalities to impose specific restrictions, or contribute to the developed of national list of PPPs that are not allowed in areas used by the public or by vulnerable groups. Further, in some cases national rules for spray equipment are tailored to given specific areas, requiring better equipment to be used in these areas which reduces the risks associated with pesticide application. These measures are considered to contribute to reducing the risks associated with pesticide use in these particular areas. The same regulatory rules apply for areas related to the protection of water, conservation of wild birds and natural habitats directives. In these cases, in addition to the conditions determined from the authorisation process, particular restrictions in line with these directives may apply. Although all case study participants reported the general approach that the use of PPPs should be reduced as much as possible, with respect to specific areas, their NAPs do not clearly specify the approaches implemented to ensure that preference is given to low-risk and biological control measures. It can be concluded that the examined MS implement risk reduction measures in specific areas.

The issue of the **presence of hazardous chemical substances in drinking water** is addressed by several EU legislative acts and translated in specific actions. Monitoring of the quality of water (surface and groundwater) is performed by MS per identified river basin. Buffer zones are set up per substance based on its toxicological profile. Differences observed relates to the size of the zones. The use of more efficient spraying equipment sometimes has a modifying effect on the buffer zones. On the contrary, findings of our research highlight that very few activities and programmes have been established with regard to the planting of hedges at the borders of surface water, which aims to decrease exposure to drain flow, run-off, and spray drift. When existing, these projects are of a voluntary nature. Most experts and authorities interviewed have indicated that performing socio-economic and environmental studies related to water quality to quantify the wider impacts of pesticide use practices is not feasible for several reasons. To a certain extent, it is also felt that this is not required. Indeed, the threshold values of pesticide presence are clearly defined and monitored. The impacts on human health and the environment are researched during the risk assessment processes in the application for approval of active substances and the during the registration of PPPs. Thus, if thresholds are exceeded, the effects are well known. As long as the thresholds of the active substances are not exceeded, the risks to human health and environment are reported to be negligible. Therefore, it is felt that there is no need to enter into expensive socio-economic studies for which concrete and reliable assessment methodologies do not exist.

In light of the conclusions of the evaluation of the general implementation of the SUD, several practical recommendations for improving the implementation of the Directive are developed:

- National authorities should take on a leadership and proactive role in the practical implementation of the SUD provisions. NAs should not limit themselves only to national transposition and control mechanisms, but rather introduce into legislation local solutions that go beyond transposition of the Directive. Authorities should further prepare analyses covering whether the technical, operational and financing conditions are sufficiently met to support the proper implementation of the Directive. This extends to IPM implementation and other provisions of the Directive. Where issues are identified, appropriate action should be taken in a timely manner.
- MS should seek out collaboration between the relevant national authorities and stakeholders and further exploit the provisions of related regulatory frameworks (e.g. Water Framework Directive, Birds and Habitats Directives). In doing so, attention should be

paid on the overall aim of the SUD to ensure agricultural production and at the same time ensure risk reduction.

- Improving the relationships focusing on information exchange across MS and between experts, is highly recommended. This should focus in particular on good practice, and agronomic innovation. Along the same lines, the Commission should reinforce the activities of its expert committee and launch additional training activities under the Better Training for Safer Food initiative.
- With respect to NAP revision, attention should be paid to the inclusion of measurable objectives, quantitative targets. MS should further focus on strengthening the alignments between targets, measures, and indicators. This will subsequently enable a smooth evaluation process. This particularly applies to areas where the NAPs have been weakest, such as environmental issues.
- The NAPs should include timeframes and targets for their measures even in areas where the Directive does not directly specify these requirements. For example, with respect to many of the environmental topic areas.
- MS should agree on more ambitious and uniform objectives on the collection of pesticide use data, than what is currently in place.
- Model-based harmonised risk indicators should be developed on the foundation of the same algorithms across MS. In order to enable their calculation, robust pesticide use information must be available.
- The models for harmonised risk indicators be should be based on models already existing. Alternatively, in order to properly monitor the reduction of impacts of PPPs, they can be based according to environmental compartment.
- National experts and/or national risk assessment agencies should be responsible for the calculation of risk indicators.
- The Commission and MS should supplement the model-based harmonised risk indicators with simple descriptive indicators. These indicators should be calculated on a regular basis by national authorities to demonstrate whether progresses are made.
- National authorities should acknowledge that enhanced uptake of IPM takes time and that sustainable results cannot be expected over a short period. Long-term measures and policies with respect to IPM are required. This includes the expected impacts of IPM on agricultural systems and agricultural production.
- The general public should be informed by authorities that changing the crop protection paradigm is a long term objective requiring investments. It cannot be achieved instantaneously.
- The information flow between stakeholders (researchers, growers, producers, advisors, authorities) requires improvement, and coordination.
- IPM guidelines should be disseminated by experts and extension offices as widely as possible. An ERA NET, or a similar platform, should be re-established.
- It should be recognised that IPM guidelines are a moving target, requiring innovation and re-evaluation on a regular basis. Ongoing, funded, research in IPM is required.
- National multi actor platforms working toward the development of crop specific IPM guidelines is required. Users of PPPs (growers and producers) should have a leading role in these platforms. The operational groups of the agricultural European Innovation Partnership (EIP-AGRI) should be considered. Their appropriateness for these working groups should be assessed.
- National authorities, together with advisors, experts and academic researchers, should ensure that each of the eight IPM principles are fully addressed in the NAPs.
- An important element of current policies needs to be the advancement of research and development, including the systems approach of IPM, should be supported by current

policies and MS. The EU has set an example by launching a number of calls on IPM related topics in Horizon 2020. Support should continue in this direction and be amplified. Apart from a few exceptions, MS have not followed suit and dedicated funding for IPM research and implementation. These efforts should be improved as IPM will not be successful without solid nationally based research in place.

- Independent advisory services are necessary to promote IPM at the national level and require appropriate funding.
- IPM is often associated with increased costs and risks. These risks and costs should therefore be offset through subsidies, insurance, and financial and market incentives for growers to shift to IPM.

Additional practical recommendations from the case studies:

- Based on national criteria, MS should identify specific areas which require particular attention with respect to the protection of human health and the environment. The identification of these areas could require derogations with regard to limitation of authorised PPPs and the promotion of low-risk pesticides or the use of alternative methods.
- The use of PPPs could be subject to national or regional reporting or specific approvals (e.g. in municipalities) in order to closely monitor their uses.

The responsibility over developing and implementing each of the individual recommendations, as well as the manner through which the recommendations address each of the identified shortcomings and weaknesses in the implementation of the Directive, are depicted in Section 0 of the report. This section includes the priority assigned to each recommendation the potential need for further research and assessment in the study area.

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List of abbreviations

ARI	Aquatic Risk Indicators
BCF	Bioaccumulation Factor
BFSA	Bulgarian Food Safety Agency
CAP	Common Agricultural Policy
CAPER	Concerted Action on Pesticide Risk Indicators
CfS	Candidates for Substitution
CRD	Chemicals Regulation Directorate
DEFRA	Department for Environment, Food & Rural Affairs
EC	European Commission
ECC	Environmental Concern Concentrations
EEA	European Environmental Agency
Efsa	European Food and Safety Authority
EIU	Environmental Indicator Units
ENVI	European Parliament's Committee on the Environment, Public Health and Food Safety
EP	European Parliament
EPA	Danish Environmental Protection Agency
EPPO	European and Mediterranean Plant Protection Organization
EGPRI	Expert Group on Pesticide Risk Indicators
ERP	Emission Reduction Plan
EPRS	European Parliamentary Research Service
EU	European Union
FADN	Farm Accountancy Data Network
FAO	Food and Agriculture Organisation
FAS	Farm Advisory Services
HAIR	HArmonised Environmental Indicators for Pesticide Risk
IARC	International Agency for Research on Cancer
ICM	Integrated Crop management
IPM	Integrated Pest Management
IWM	Integrated Weed Management
JMPM	Joint Meeting on Pesticide Management
LFN	Letter of Formal Notice
MRL	Maximum Residues Limits
MS	Member State(s)
NCA	National Competent Authorities
NGOs	Non-Governmental Organisation
NMI	Dutch Environmental Risk Indicator
NOVANA	National Monitoring Programme for Water Environment and Nature
NPRI	Norwegian Pesticide Risk Indicator
NRoSO	National Register or Sprayer Operators
NSTS	National Sprayer Testing Scheme
OECD	Organisation for Economic Co-operation and Development
PEC	Predicted Environmental Concentrations
PLI	Pesticide Load Indicator
PPDB	Pesticide Property DataBase
PPP	Plant Protection Products
PRI	Pesticide Risk Indicators
RBMPs	River Basin Management Plans
RO	Reasoned Opinion
SUD	Sustainable Use Directive
SYKE	Finnish Environmental Institute
TERI	Terrestrial Risk Indicators
UBA	German Federal Environment Agency
VI	Voluntary Initiative
WFD	Water Framework Directive
WHO	World Health Organisation

List of Member States

AT	Austria	EE	Estonia	IE	Ireland	PO	Poland
BE	Belgium	EL	Greece	IT	Italy	PT	Portugal
BG	Bulgaria	ES	Spain	LT	Lithuania	RO	Romania
CY	Cyprus	FI	Finland	LU	Luxembourg	SE	Sweden
CZ	Czech Republic	FR	France	LV	Latvia	SI	Slovenia
DK	Denmark	HR	Croatia	MT	Malta	SK	Slovakia
DE	Germany	HU	Hungary	NL	The Netherlands	UK	United Kingdom

Introduction

This study was commissioned by the Ex-Post Evaluation Unit of the European Parliamentary Research Service (EPRS) to support the work of the European Parliament's Committee on the Environment, Public Health and Food Safety (ENVI) in producing a dedicated report on the implementation of Directive 2009/128/EC establishing a framework for Community Action to achieve the sustainable use of pesticides.

Thereafter, Directive 2009/128/EC is referred to as the Directive or SUD (Sustainable Use Directive).

The study is structured along the following sections:

- Section 1 sets the frame of the evaluation, presenting the overall context as well as the objectives of the study. Moreover, in this section, the main methodologies applied throughout this study are succinctly described.
- Section 2 presents a general literature review on the EU pesticides legislative framework.
- Section 3 examines the results of the National Action Plans (NAP) review and data extraction. This is the first main data collection phase conducted in this evaluation.
- Section 0 presents the results of the second data collection phase. In this section the findings from two surveys will be presented. The first survey gathers input from national authorities, in particular the main National Competent Authorities (NCA). The second survey gathers input from other relevant (non-governmental) stakeholders.
- Section 5 contains the analyses and results of the three case studies carried out in this evaluation study. In addition, the justification for not covering a set of issues specified in the Technical Specifications within the scope of the case studies is described.
- Section brings together the main findings of the different research methodologies applied to provide conclusions and recommendations addressing:
- the overall proper implementation of the Directive;
- The overall proper implementation of the IPM;
- Additional practical recommendations from the case studies
- Section 7 and 8 present the references used in this report and the Appendixes, respectively.

1. Background of the study and methodological approach

1.1. Context of the evaluation

Pesticides have been widely used in agriculture since the end of the Second World War, and have brought benefits such as contributing to an increase in food production. However, pesticides can present unacceptable risks to humans, animal health and the environment if used in an inappropriate manner. In its purest form, the issue of pesticide use is in preventing unreasonable risks to human, animal and environmental health while not introducing unnecessary adverse economic and food production impacts in the farming sector[15].

In order to address pesticide use issues, the EU has implemented, and regularly updated, a legislative framework governing pesticide use and marketing. In 2009, health and environmental concerns regarding the hazards and risks posed by the use of pesticides had led to the introduction of a new set of legislation with a focus on sustainability, commonly referred to as the "pesticides package".

By the end of 2017, the European Commission published a report on "Member State National Action Plans" and on the progress of the implementation of the Directive[16]. In this report, the European Commission called for a greater emphasis on the sustainable use of pesticides in the EU. Findings highlighted an insufficient implementation of the Directive to date, resulting in a reduced effectiveness of the Directive both in terms of pesticide use risk reduction and human and environmental health improvement. [17] [18]

Commission findings assert that MS need to significantly improve the quality of their NAPs by establishing specific and measurable targets and indicators supported by a long-term strategy for sustainable pesticide use. The Commission intends to continue to monitor the implementation of the Directive and provide support to MS. In this regard, the Commission is working with MS to develop a set of EU harmonised risk indicators, based on MS experience with national indicators. Alongside their 2017 report, the Commission has launched a new website[19] to facilitate information exchange. This website features a data base of links to Member States own sustainable use of pesticides websites. It further provides a depository of all NAPs (and their revision, if available) as well information on IPM.

It is in this overall context that this procurement takes place.

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[15] Skevas, T., Oude Lansink, A.G.J.M., Stefanou, S.E. (2013) Designing the emerging EU pesticide policy: A literature review.

[16] 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/sites/food/files/plant/docs/pesticides_sup_report-overview_en.pdf)

[17] 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/sites/food/files/plant/docs/pesticides_sup_report-overview_en.pdf)

[18] http://ec.europa.eu/food/audits-analysis/overview_reports/details.cfm?rep_id=114

[19] https://ec.europa.eu/food/plant/pesticides/sustainable_use_pesticides_en

1.2. Context of the SUD

Plant protection products (PPPs), more commonly known as pesticides, are industrial products of widespread use and application around the world. They are generally employed to protect crops from yield losses caused by plant pests with the aim of ensuring adequate levels of agricultural productivity and, in so doing, helping to achieve food security.[20]

In most industrialised countries the commercialisation of PPPs, and their use, tends to be subject to complex regulatory frameworks, which reflect the relevance that these products have from the standpoint of plant health, food safety, chemical safety and protection of intellectual property rights.

The use of PPPs has been subject to wide debate. Even international chemical conventions exist in this field, some of which call for the restriction, or complete ban, of the use, production, and trade of particular hazardous chemicals[21].

The EU can be placed amongst the category of institutional organisations that have developed a complex legal framework regulating the marketing and use of PPPs, spanning over many years, and starting as early as the 1970s. The following paragraphs succinctly introduce the main relevant pieces of EU legislation.

With respect to chemical products, **Regulation (EC) No 1907/2006 (REACH)** provides a legal framework aiming at improving the protection of human and environmental health from chemical use risks. The regulation works in the field of enhancing competitiveness, while at the same time ensuring that the risks posed by these chemicals are minimised. Furthermore, the regulation encourages new methods for hazard assessment with the aim of reducing animal testing.

The development of EU legislation on pesticides started in 1976 with the adoption of Council Directive 76/895/EEC which established harmonised Maximum Residues Limits (MRLs) for the occurrence of pesticide residues in and on fruit and vegetables.[22] Up until 1990, EU legislators set out maximum levels for food categories through the adoption of supporting directives. In 2005, this body of law was consolidated into a single act through the adoption of **Regulation (EC) No 396/2005[23].**

In 1991, the Council Directive 91/414/EEC[24] was adopted. This Council Directive established the very first harmonised legal framework for the approval of active substances and granting market authorisations for PPPs. This directive is generally regarded as a milestone of the EU regulatory regime on

[20] Fishel F.M., *Pest management and pesticides: a historical perspective*, Agronomy Department Florida Cooperative Extension Service, Institute of Food and Agriculture Sciences, University of Florida, P1219, p.1.

[21] Notably the Stockholm Convention on Persistent Organic Pollutants adopted in May 2001, the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemical, and the Basel Convention on the Control of Transboundary.Movements of Hazardous Wastes and their Disposal.

[22] Council Directive 76/895/EEC of 23 November 1976 relating to the fixing of maximum levels for pesticide residues in and on fruit and vegetables OJ L 340, 9.12.1976, p. 26.

[23] Regulation (EC) No 396/2005 of the European Parliament and of the Council of 23 February 2005 on maximum residue levels of pesticides in or on food and feed of plant and animal origin and amending Council Directive 91/414/EEC

[24] Council Directive 91/414/EEC of 15 July 1991 concerning the placing of plant protection products on the market, OJ L 230, 19.8.1991, p. 1.

pesticides. Nearly 20 years after its adoption, Council Directive 91/414/EEC was reviewed and ultimately replaced by **Regulation (EC) No 1107/2009** on the placing of PPPs on the market.[25]

Following the establishment of the Thematic Strategy[26], the **Sustainable Use Directive 2009/128/EC** was adopted. This Directive sets the rules for the sustainable use of pesticides with the aim of reducing the risks and impacts of pesticide use on human health and the environment. The Directive covers the use phase of pesticides, and bridges the gap between the registration of plant protection products and the consumption of treated produce. The Directive provides a framework for achieving the sustainable use of pesticides by reducing the risks and impacts of pesticide use on human health and the environment, and by promoting the use of integrated pest management and low-impact pesticides and crop protection techniques.

The SUD sets out required measures to be adopted by MS covering the use phase of PPPs and, in doing so, provides the basis for achieving the aims of the Thematic Strategy. The main provisions of the Directive are as follows:

- Member States are required to adopt National Action Plans which must contain measures, objectives and timetables for the reduction of the risks and impacts of pesticide use. The NAPs must include a description of the implementation of IPM and other measures for the promotion of low-risk plant protection techniques.

Several points must be taken into account in the NAPs:

(1) Training (Article 5): *"Member States shall ensure that all professional users, distributors and advisors have access to appropriate training by bodies designated by the competent authorities"*. Therefore, by 14 December 2013, Member States were supposed to establish certification systems and designate the national competent authorities responsible for the implementation.
(2) Requirements for sales of pesticides (Article 6): *"Member States shall ensure that distributors have sufficient staff in their employment holding a certificate"; "Member States shall take necessary measures to restrict sales of pesticides authorised for professional use to persons holding a certificate"*
(3) Information and awareness-raising (Article 7): information provision to the general public on the risks and the potential effects of pesticides on *"human health, non-target organisms and the environment arising from their use, and the use of non-chemical alternatives"*. The Member States must also put in place systems for gathering information on pesticide acute and chronic poisoning incidents.
(4) Pesticide application equipment in professional use (Article 8) *"Member States shall ensure that pesticide application equipment in professional use shall be subject to inspections at regular intervals"* and at least once within a period of five years after purchase. This means that professional users have to conduct regular calibrations and technical checks of the pesticide application equipment.
(5) Aerial spraying (Article 9) is prohibited, except in a few special cases.
(6) *"Member States may include in their National Action Plans provisions on informing persons who could be exposed to the spray drift"* (Article 10).

[25] Regulation (EC) No 1107/2009 of the European Parliament and of the Council of 21 October 2009 concerning the placing of plant protection products on the market and repealing Council Directives 79/117/EEC and 91/414/EEC

[26] Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions – A thematic strategy on the sustainable use of pesticides, COM(2006) 372 final.

(7) *"Specific measures to protect the aquatic environment and drinking water"* should be taken (Article 11). These have to include giving preference to pesticides that are not classified as dangerous for the aquatic environment and to the most efficient application techniques (low-drift equipment), especially in vertical crops like orchards. Also, the *"use of mitigation measures which minimise the risk of off-site pollution"* like establishment of buffer zones should be taken.
(8) The *"reduction of pesticide use in specific areas"* (Article 12) like public parks, sports, school and recreation grounds should be restricted. Low-risk plant protection products and biological measures have to be considered as a first choice.
(9) Member States must adopt the necessary measures to ensure that storage, handling, dilution and disposal of pesticides before and after application does not endanger human health or the environment (Article 13).
(10) *"Member States must take all necessary measures to promote low-pesticide input pest management"* (Article 14), giving priority to non-chemical approaches. This includes IPM as well as organic farming. They should establish, or support the establishment of, necessary conditions for the implementation of IPM. *"In particular they shall ensure that professional users have at their disposal information and tools for pest monitoring and decision making, as well as advisory services on integrated pest management"*. The implementation of this was required to be reported to the Commission by 30 June 2013. Whereas, the general principles of IPM had to be implemented by all professional users by 1 January 2014.
(11) Harmonised risk indicators should be established (Article 15) and trends in the use of certain active substances should be identified.

Furthermore, Member States are required to introduce measures which promote low pesticide-input systems. This includes encouraging non-chemical methods. In line with this, as of 1 January 2014, professional users are required to apply the principles of IPM Many definitions of IPM exist. However, the following most common definition[27] is supported by authorities and stakeholders: *"Integrated Pest Management (IPM) means the careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically and ecologically justified and reduce or minimise risks to human health and the environment. IPM emphasises the growth of a healthy crop with the least possible disruption to agri-ecosystems and encourages natural pest control mechanisms"*.

The key legislations described above are commonly referred to as the "pesticides package". To summarise, the EU pesticide package includes three main pieces of legislation covering the complete lifecycle of a PPP, starting from its placing to the market, moving to the use of pesticides and ending which the MRLs Regulation. The following figure illustrates this process.

Figure 1: The regulatory lifecycle of a Plant Protection Product:

Source: DG SANTE, 2018

[27] See definition at: https://ec.europa.eu/food/plant/pesticides/sustainable_use_pesticides/ipm_en

1.3. Objectives of the evaluation

The **general objective** of this study is to perform an evidence-based assessment of the implementation of Directive 2009/128/EC on the sustainable use of pesticides, as a whole, as well as providing an in-depth focus on some of its specific elements. According to this approach, the following **specific objectives** of the study can be defined:

- To analyse each phase of the Directive's policy cycle: the implementation phase (transposition and application) and the enforcement; and
- To evaluate the extent of a potential compliance deficit along the better regulation guidelines evaluation criteria; and
- To analyse the enforcement measures taken by each EU MS; and
- To evaluate the implementation of the IPM principles, in particular by examining the preconditions for the proper IPM implementation; and
- To measure results obtained to date in terms of use of PPPs and reduction of risks.

The study presents the results of various data-collection processes that will allow the European Parliament to evaluate the progress made to date in achieving the objectives of the Directive, as well as to establish whether it has delivered the expected benefits and results. The study also establishes whether the objectives remain relevant given recent developments in the sector.

The study assesses in particular the relevance, coherence, effectiveness, efficiency as well as the EU added value of the SUD legislation. The analysis identifies potential problems of compliance and underlines factors that hinder the achievement of the objectives of the Directive. The study assesses the implementation of Directive 2009/128/EC in all 28 Member States[28] and identifies both critical areas and best practices in order to provide lessons for future actions in this policy area.

1.4. Methodological approach

This section presents an overview of the methodological design of the evaluation developed by the core team. The authors of this report are members of the Consortium commissioned by DG EPRS to conduct the study as well as other external experts on the subject matter. These authors are referred to as "the core team". The core team's task principally consists in designing the overall methodological approach and the data collection tools, as well as conducting the analyses of the data collected and drafting the final deliverables.

Overall, the following methods are tailored and applied to address the various research activities:

- A general literature review covering the EU pesticides legislative framework and the results of the SUD observed to date,
- A National Action Plan (NAP) literature review,
- Online surveys addressed to national authorities (focusing on the main national competent authorities (NCA)) and other stakeholders (non-governmental actors),
- Case studies providing findings from key stakeholder interviews conducted in selected MS,
- Interviews of relevant Commission representatives (from DG SANTE)
- A deliberation of the core team members covering the results and recommendations of the evaluation study.

[28] The research scope varies depending on the method applied, e.g. while the review of the National Action plans covers all EU 28 NAPs whereas two studies were only conducted in several selected Member States.

1.4.1. Scope of research

Geographical scope. The methodological framework developed for the purpose of carrying out the evaluation of the implementation of the Directive on the sustainable use of pesticides covers all twenty-eight EU Member States. Yet, the geographical scope of the case studies (see further section 8.1.6 in appendix) will be limited to a selected number of countries.

Conceptual scope. In line with the two-level approach indicated in the Technical Specifications and the approach suggested by the project team, while level A tasks are completed as a minimum requirement and are addressed thoroughly, level B tasks are addressed in a concise and targeted manner wherever possible (see further section 8.1.6 in appendix).

Time scope. The time frame of the document analysis predominantly starts in 2009, with the introduction of the SUD. More precisely, the time span of the National Action Plan analysis is directly linked to the period covered by each of the NAPs initially published. For the literature review, a slightly wider window was taken into account in order to enable a comprehensive description of the progress of pesticide risk reduction in the EU.

1.4.2. Research Task 1: Evaluation of the implementation of the Directive as a whole – Level A

The objectives of the research activities to be conducted under Research task 1, level A, correspond to carrying out an evaluation of the implementation of the Directive against a set of evaluation criteria (relevance, coherence, effectiveness, efficiency and European added value). The project team follows the evaluation criteria as defined by the EC Better Regulation Guidelines, and as requested in the Technical Specifications for the assignment. The purpose of the study is to provide recommendations for due actions to be taken by the various actors relevant (EU institutions, Member States' authorities, manufacturers and growers, etc.) for achieving the optimal implementation of the Directive.

In this particular case, the understanding of the evaluation criteria subsequently described as:

- **Relevance** is used to ponder whether the objectives of the Directive are appropriate with regard to the needs and problems linked to the use of pesticides
- **Coherence** intends to examine whether the Directive's provisions, their implementation (i.e. transposition and application) and enforcement is in line with other EU policies and legislations as well as other relevant international commitments
- **Effectiveness** investigates whether progresses are made towards the achievement of the Directive's objectives as well as the factors, and the extent to which they have influenced the achievements or changes observed
- **Efficiency** inquires whether observed effects of the Directive implementation and enforcement could have been achieved with less costs/resources and
- **EU added value** assesses whether the results of the Directive's implementation and enforcement could have been better compared to what would have potentially been achieved by Member States alone.

Collecting evidence and conducting analyses for the purpose of comprehensively answering the above mentioned evaluation criteria relies on all of the methods listed in this section's introduction.

1.4.3. Research Task 2: Implementation of integrated pest management (IPM) – Level A

Research Task 2 focuses on a specific instrument of the Directive, i.e. the implementation of IPM. As defined under Article 1 paragraph 6 of Directive 2009/128/EC *"integrated pest management implies the 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."*

With this instrument, and its eight principles that are further detailed in Annex III to the Directive, MS should promote all necessary measures for low pesticide-input pest management. Each MS should outline the establishment of the necessary conditions for IPM in their NAPs. In order to map and assess the implementation of all eight principles, the following approach and methods are applied:

- Analysis of the NAPs providing an outline of how IPM principles are approached in each MS, including which principle(s) is/are receiving more attention,
- Examination of the implementation of IPM related measures by MS, based on the information extracted from the NAP on IPM and on the analysis of the Commission reports[29],
- Bridging the information gaps stemming from the document review and analyses by taking stock of the survey findings (targeting national authorities and other stakeholders) and case study interviews.

The second requirement is to investigate the factors influencing the (i) actual IPM implementation and (ii) the due preconditions for proper IPM implementation. These factors and preconditions include the wider economic, social, and environmental issues relevant for pesticide use. They may include the behaviours of pesticide users (awareness, willingness, capacities), the availability and accessibility of low risk and non-chemical pesticides, the economic and market incentives in place for IPM, the regional differences in climate and crops production, among many others.

In order to collect and analyse the information on such factors and conditions, the approach consisted of building on the information basis previously developed and gathering additional input – by means of interviews with national authorities, PPP manufacturers, and growers at the MS level (in the form of case studies). Attention is placed on whether MS have introduced a system for monitoring the progress and quality of IPM implementation.

For both Tasks 1 and 2, the research activities under "level B" have been partially addressed. More information on the approach adopted can be found in appendix 8.1.6.

[29] Fact finding Missions reports, the dataset underlying the conclusions of the EC´s report on Member States National Action Plans and on progress in the implementation of Directive 2009/128/EC on the sustainable use of pesticides. The EC database was not directly reused here in this study.

2. General literature review

2.1. Selected documents reviewed during desk research

This section provides a brief description of the scope and purpose of the selected documents used for the desk research on the implementation of the SUD. A list of relevant literature in the field of pesticides has been identified by the core team and reviewed in this study. The literature examined focuses on the following topic areas:

- EU legislation on the use of pesticides (including "the pesticide package");
- EU related legislation concerning water, organic production, energy and human health;
- Related international documentation (e.g. OECD);
- Several published reports and studies related to the implementation of the Directive across the EU and presenting impacts of use of pesticides.

2.1.1. Voluntary standard of conduct and international conventions

International conventions and codes of conduct on pesticides are relevant to the EU policy making context. Coordination and coherence, wherever possible, is undertaken. The following section will outline some of the most relevant international conventions and codes of conduct.

The FAO **International Code of Conduct on Pesticide Management** provides rules for pesticide management for all actors involved in the use of pesticides. The latest revision of the Code of Conduct on Pesticide Management was adopted by the Food and Agriculture Organisation of the United Nations (FAO) in June 2013 and endorsed by the World Health Organization (WHO) in January 2014. Technical guidelines have been developed by the so-called FAO/WHO Joint Meeting on Pesticide Management (JMPM).

Additional international conventions play a role in the overall policy context of chemical products:

- The Stockholm Convention on Persistent Organic Pollutants, signed in 2001, is an international treaty the aim of which is to protect human health and the environment from any harmful chemicals and their potential negative impacts.
- The Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade has entered into force in 2004. The aim of the convention is to protect human health and the environment from potential harm and to contribute to the environmentally sound use of certain hazardous chemicals. The convention works to support the facilitation of information exchange, promoting high quality national decision-making processes on the import and export of key hazardous chemicals, and disseminating the results.
- The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal was adopted on 22 March 1989 with the overarching objective of protecting human health and the environment against the adverse effects of hazardous waste. Its scope of application covers a wide range of waste defined as "hazardous wastes" based on their origin, composition and characteristics. This convention also addresses "other wastes" defined as household waste and incinerator ash.

2.1.2. Reports and studies

Since the SUD is a relatively new EU legislation, and one that introduces a variety of aspects, there continues to be a limited number of academic sources covering this specific field – particularly those which evaluate the impacts of the SUD and, more specifically, IPM. Therefore, along with academic studies, the desk research relies on the documents produced or commissioned by the actors closely involved in the design and implementation of the Directive.

2.2. Transposition of the SUD by the Member States

Member States bear the responsibility to transpose the obligations of the SUD into their national laws. While the Commission has to verify the completeness and correctness of the transposition of EU law into national laws, as formally notified by the MS. The collection of national transposition measures is regularly updated and published on the EUR-Lex website.

As of the 1 August 2018, national transposition measures communicated by MS read as follows.

All MS have adopted various approaches for the transposition of the Directive.

Table 1: National transposition by Member State

MS	Transposition deadline	Number of measures	Date of last update of the national legislation
AT	26/11/2011	24	24/07/2017
BE	26/11/2011	41	15/12/2013
BG	26/11/2011	1	26/11/2011
HR	01/07/2013	2	01/07/2013
CY	26/11/2011	1	26/11/2011
CZ	26/11/2011	39	04/07/2014
DE	26/11/2011	1	26/11/2011
DK	26/11/2011	31	n.a.
EE	26/11/2011	2	25/11/2011
EL	26/11/2011	1	26/11/2011
ES	26/11/2011	3	15/09/2012
FI	26/11/2011	7	n.a.
FR	26/11/2011	14	22/10/2011
HU	26/11/2011	12	n.a.
IE	26/11/2011	1	26/11/2011
IT	26/11/2011	1	26/11/2011
LV	26/11/2011	5	22/03/2013
LT	26/11/2011	41	02/08/2017
LU	26/11/2011	2	22/01/2015
MT	26/11/2011	1	26/11/2011

MS	Transposition deadline	Number of measures	Date of last update of the national legislation
NL	26/11/2011	13	13/12/2011
PL	26/11/2011	28	06/08/2013
PT	26/11/2011	4	11/04/2013
RO	26/11/2011	2	25/03/2013
SK	26/11/2011	7	20/12/2011
SL	26/11/2011	24	03/10/2014
SE	26/11/2011	21	n.a.
UK	26/11/2011	2	20/06/2012

Source: EUR-Lex, 2018

This summary table highlights that the majority of MS (17 in total: BG, HR, CY, DE, EE, EL, ES, FI, IE, IT, LV, LU, MT, PT, RO, SK, UK) have transposed the SUD obligations in a limited number of national legislation measures (less than 10 measures) while the remaining eleven MS (AT, BE, CZ, DK, FR, HU, LT, NL, PL, SL, and SE) have transposed the Directive based on more than 10 national transposition measures. The high number of measures in Belgium partly relates to the fact that agricultural law is the responsibility of the regions and therefore transposition acts are presented in both French and Dutch. In addition, 4 administrative measures (not legal) are included in the transposition measures in Belgium.

The last notifications of updates of their national legislation have been made by IT and AT in mid-2017.

The Commission has carried out verification of the correctness and completeness of the transposition since the deadline of 26 November 2011.

The Commission has the option of initiating infringement proceedings under Article 258 of the Treaty on the Functioning of the European Union whenever it considers that a MS has breached Union law. These proceedings aim to resolve issues in a timely and cooperative manner.

As reported by the Commission, the initial stage of the infringement procedure is a letter of formal notice. This letter is a formal invitation for the MS to present its views regarding the breach to the Commission. If it turns out that no reply is received to the letter of formal invitation, or if the response provided by the MS is unsatisfactory, the Commission proceeds to the following stage of the infringement procedure. This is named the *"reasoned opinion"*.

The Commission added that the EU Pilot investigation is meant to serve as an informal dialogue between the Commission and the MS concerned. The intent is to resolve issues at this stage, rather than initiating formal infringement procedures. In the context of the SUD, it has been related to the failure to submit the NAP or insufficient detail in the transposition document.

As of 10 July 2018, all infringements and EU Pilot investigations reported in the table below have been closed.

Table 2: Infringements/EU pilot investigations on SUD

MS	Member State Declaration on the Status of the Transposal Measures	Infringements for non-communication (failure to notify transposition measures)		EU Pilot investigations on "Failure to submit the National Action Plans"
	Complete	Letter of Formal Notice	Reasoned Opinion	
BE	☑	LFN sent on 22/03/2012	RO sent on 25/10/2012	EU Pilot on 22/4/2013
BG	☑	LFN sent on 22/03/2012	RO sent on 25/10/2012	
HR	☑			
CY	☑	LFN sent on 22/03/2012		
CZ	☑	LFN sent on 22/03/2012		
DE	☑			
DK	☑	LFN sent on 22/03/2012	RO sent on 25/10/2012	
EE	☑			
EL	☑			EU Pilot on 22/4/2013
ES	☑	LFN sent on 22/03/2012		
FI	☑	LFN sent on 22/03/2012		
FR	☑			
HU	☑	LFN sent on 22/03/2012		
IE	☑	LFN sent on 22/03/2012		EU Pilot on 22/4/2013
IT	☑	LFN sent on 22/03/2012		EU Pilot on 22/4/2013
LV	☑			
LT	☑	LFN sent on 22/03/2012	RO sent on 25/10/2012	
LU	☑	LFN sent on 22/03/2012	RO sent on 25/10/2012	EU Pilot on 22/4/2013
MT	☑			
NL	☑			
PL	☑	LFN sent on 22/03/2012	RO sent on 25/10/2012	
PT	☑			EU Pilot on 22/4/2013
RO	☑	LFN sent on 22/03/2012		EU Pilot on 22/4/2013
SK	☑			
SL	☑	LFN sent on 22/03/2012	RO sent on 25/10/2012	
SE	☑	LFN sent on 22/03/2012		EU Pilot on 22/4/2013
UK	☑	LFN sent on 22/03/2012		

Source: EUR-Lex, 2018

2.3. Implementation of the National Action Plans

This section presents the main literature review findings on the progress and quality of the implementation of the NAPS. The literature review findings are structured according to each of the research tasks, and follows closely the Commission Overview Report.

Table 3: Implementation of the NAPs: Main Findings

#	Main findings
1	The drafting of the NAPs has been facing significant delays in the large majority of MS.
2	The NAPs vary significantly with respect to how they are detailed and the quality of the plans for the implementation of measures
3	NAPs are inconsistent in establishing quantitative objectives, targets, measures and timetables for the various action areas
4	Every NAP includes certain measures to promote IPM, support the application of IPM guidelines, and provide training on demonstration farms.
5	There have been several notable achievements in risk reduction since the implementation of the NAPs

Source: Core team, 2018, adapted from the 2017 overview report on the implementation of Member States' measures to achieve the sustainable use of pesticides under Directive 2009/128/EC

The drafting of the NAPs has been facing significant delays in the large majority of MS.

Member States were required to adopt NAPs to implement the Directive, and were requested to inform the Commission of this by 14 December 2012. The NAPs were expected to contain a plan for pesticide risk reduction including targets, objectives, measures, and timelines. The timeline for the implementation of the measures included in the NAPs, according to the Directive, was to be between November 2011 and November 2016. With respect to this timing, MS were expected to review and update their original NAPs at the end of a five year period, i.e. by the end of 2017. All Member States adopted NAPs, however, there were significant delays in many cases, and several of the NAPs were adopted as late as 2013, respectively pushing the expected 5 year deadline of NAP review to 2018. At the time of the Commission overview report[30], only France and Lithuania had delivered revised NAPs. In order to evaluate the implementation of the Directive, the Commission prepared a report to the European Parliament on the Member State NAPs and on the progress of implementation of the Directive. This report draws on the Commission's assessment of the NAPs, two audits performed by DG SANTE (one on the controls on PPPs and the other on the marketing and use of pesticides), a survey-based questionnaire[31], and fact-finding visits. (EC, 2017)

Findings from the Commission study demonstrate uneven, and to a large extent problematic, results in terms of the formulation and content of the NAPs and the results achieved by the Directive to date. As a main conclusion, the report states:

> *The Directive offers the potential to greatly reduce the risks derived from pesticide use. However, until it is more rigorously implemented by Member States, these improvements are limited, and certainly*

[30] Report no 2017-6291 – Sustainable use of Pesticides – available at: http://ec.europa.eu/food/audits-analysis/overview_reports/details.cfm?rep_id=114

[31] The core was granted access to the survey results but not the official authorisation to reuse them. The survey results were taken into consideration, for the sake of coherency, when drafting the questionnaire and the analysis of our own survey results.

insufficient to achieve the environmental and health improvements the Directive was designed to achieve. (EC, 2017, p17)

The main gaps in the NAPs include inconsistency of the objectives with an inadequate focus on long-term goals, the insufficient use of quantifiable targets and a lack of clear timelines for the action areas and measures. This is in particular the case with targets for IPM and aquatic protection measures. Furthermore, there is a general weakness observed in the development of meaningful and measurable indicators that reflect systemic and long term sustainable pesticide use practices. (EC, 2017)

The NAPs vary significantly with respect to how they are detailed and the quality of the plans for the implementation of measures

Comparing the NAPs demonstrates a difference in coverage of measures, and comprehensiveness of the documents themselves. Further, the frameworks for addressing the aspects of the Directive (namely its Articles 5-15), are substantially different across Member States. Overall, a much greater amount of detail is provided on issues such as pesticide application equipment testing, and certification of spray operators. On the other hand, detail on aspects such as informing the public, providing specification regarding aerial spraying and associated derogations, and information gathering on poisoning incidences is limited. (EC, 2017)

Although the issues of spray equipment and certification are highly important to risk reduction in pesticide use, concerns arise when probing into other aspects of the Directive. Since the Directive is expected to be a comprehensive document, covering, among other aspects, IPM, its implementation should be based on the systematic and clear introduction of measures that relate to all of these components. This is something which is presently lacking. (EC, 2017)

Such findings are confounded by an uneven starting point across the EU with regard to frameworks already in place on sustainable pesticide policies, as well as varying pesticide use patterns. In some Member States[32] pesticide risk reduction programmes have existed before the introduction of the Directive, resulting in a different focus and degree of detail within the NAP. For example, the German NAP does not mention sprayer testing, because this requirement was already in place in the country. Furthermore, due to a significant diversity of land-use and agricultural production across the EU, Member States naturally apply different approaches to developing their NAPs. For instance, knotweed issues in the United Kingdom pose a considerable problem to which pesticides are deemed the most efficient response, with this in mind, pesticide use is acceptable in amenities and public areas throughout the country (Gov UK, 2018). When looking at coherence with other legislation in the pesticides package, some MS signify compliance with the Directive through the justification of having met the requirements of Regulation (EC) No 396/2005 on MRLs and Regulation (EC) No 1107/2009 on placing PPPs on the market. (DG Health and Food Safety, 2017)

In an attempt to present their key issues observed on pesticide-use reduction and also to assist MS in developing their NAPs, in 2010, the NGO PAN Europe released a detailed guide on the development and implementation of the NAP. The report focused on best practice observed in the EU in the field of pesticide dependency reduction, and further presented guidance notes on the topic. In addition to this, the report provided relevant contact information if MS wanted to learn more about any of the best practice examples. The guidance document emphasised the importance of an inte-

[32] Of the six MS visited, in the case of Denmark (1986), Germany (2004), the Netherlands (1990s) and Sweden (1980s), programmes had been in place for many years prior to the adoption of the Directive. (DG Health and Food Safety, 2017)

grated NAP, prepared with a high degree of engagement of all relevant actors, that contains an umbrella strategy, instruments, legislation, and communication tools. At the core of their argument, was pesticide use reduction, rather than pesticide risk reduction. (PAN Europe, 2010)

In 2014, PAN Europe began to prepare a follow-up document to highlight new sustainable policy measures and best practice. However, in their opinion, the review of the final NAPs demonstrated disappointing results. This shifted the intention of the study to a summary of the state-of-play of SUD implementation and the production of recommendations for moving forward. The document aimed to serve as a contribution to the expected Commission report on the implementation of the Directive[33]. Mirroring the findings above, overall the NAPs were found to contain few innovative strategies and lacked an explicit intent on lowering pesticide dependency and introducing meaningful IPM measures. In addition, the PAN Europe report found that comparing the NAPs alone was not meaningful as some Member States (such as DK) included only new measures introduced, those above and beyond what was already in place. Whereas, other Member States (such as BG) included every policy tool related to pesticide risk reduction. (PAN Europe, 2014)

Another PAN Europe report published in 2017 further echoes the PAN comments presented above, highlighting that issues arise if Member States rely primarily on Regulation (EC) No 1107/2009 on placing PPPs on the market and Regulation (EC) No 396/2005 MRLs to argue the sustainable use of pesticides, rather than promoting more strongly the holistic sustainability principles of the Directive. (PAN Europe, 2017)

NAPs are inconsistent in establishing quantitative objectives, targets, measures and timetables for the various action areas

In approximately 80% of the NAPs, there is no specification of how the achievement of many of the objectives and targets is to be measured. Where targets are included, they focus only on a small scope, such as training and certification. Although these measures are important, they represent a minimum of what should actually be considered sustainable pesticide use. Out of all of the Member States NAPs, twenty-one[34] reported risk reduction targets and nine[35] reported use reduction targets. Of these, only five were measurable – four risk-reduction[36] and one use-reduction[37]. As expected, the Commission report calls for a significant improvement in the level of detail in the revised NAPs. The focus being on the introduction of measurable and timely objectives and targets. With this aim, the Commission has been writing to MS informing them of omissions and is considering taking action on persistent infringements. (EC, 2017)

Denmark and Sweden argue that their shift from use-reduction to risk-reduction strategies in recent years is based on sound findings. According to these MS, use-reduction targets were no longer seen as the most effective approach, since the increases in availability of low-risk pesticides. They argue that applying a larger quantity of a lower-risk pesticide should be considered a better strategy in terms of health and the environment, than applying highly harmful PPPs – even if in smaller doses. (DG Health and Food Safety, 2017)

However, in principle, most sources agree that the overall lack of quantitative objectives and targets with timelines is a horizontal issue across most of the NAPs which greatly limits the implementation

[33] The EC report was subsequently published with delay in 2017.

[34] Spain, the Czech Republic, Cyprus, Estonia, Belgium, Sweden, Finland, Germany, Hungary, Poland, Latvia, Italy, Portugal, Croatia, Austria, Denmark, Lithuania, Romania, Slovakia, Ireland , and France.

[35] Luxemburg, Slovenia, Cyprus, Belgium, Finland, Hungary, Poland, Germany, and France.

[36] Belgium, Denmark, Greece , and Germany.

[37] France set a target– reduce the use of pesticides by 25% milestone in 2020 and by 50% in 2025

of the Directive. When indicators are available, they are often focused on activities, such as training, rather than outputs or outcomes which are linked to specific sustainable agronomic approaches (PAN Europe, 2014).

Every NAP includes certain measures to promote IPM, support the application of IPM guidelines, and provide training on demonstration farms.

IPM is the keystone concept of the Directive and is intended to serve as the fundamental tool through which pesticide dependence can be reduced and sustainable principles incorporated into national practice. Information on IPM measures implemented in the NAPs is lacking. This includes targets and clear information on how the implementation of IPM will be secured and monitored. Furthermore, there is no systematic process in place that assesses compliance with IPM. Problems arise particularly when considering that the economic argument for IPM is a long-term one, and thus when not enforced otherwise, short-term less sustainable practices can often win out. This bring into question the implementation of the Directive as a whole, being that IPM is seen as such an integral and fundamental aspect. (EC, 2017)

Self-reported findings from MS corroborate these findings, identifying the potential to upscale IPM, and shift from measures focusing on awareness raising to those ensuring IPM implementation within the NAPs. In response to this, the Commission has expressed their commitment to support MS in developing a clear methodological approach for compliance with IPM. As a first step, with regard to the NAPs, clear targets and indicators looking at both immediate and long term effects need to be introduced, as this is the only means of monitoring progress and adjusting strategies. In addition, enforcement measures should be developed to ensure IPM principles are being followed. (EC, 2017)

According to the Overview report, drafted by the Commission, on the *"Controls of Marketing and Use of Plant Protection Products"* compliance with the principles of IPM were incorporated into agricultural decision making and this was undertaken in a voluntary manner with a multi-stakeholder approach including industry, farmers associations and unions, and other interest groups. As per this overview report: "Compliance with the general principles of IPM is a legal requirement in all MS and all farmers met in the course of the audit series were growing their crops in line with the general principles of IPM, using tools such as rotation and resistant varieties, where feasible". Pest monitoring systems in principle were accessible, however, comparability was low. As expected, both the content and issues tackled varied. (DG Health and Food Safety, 2016)

In a 2017 study, DG Health and Food Safety outlined the best practices observed related to IPM. France introduced demonstration farms accounting for up to 1% of all farms in the country as well as other Member States to different extents In all of the MS visited by the Commission, wide dissemination and a voluntary nature of the IPM guidelines promoting engagement across stakeholder groups was observed. The United Kingdom and the Netherlands have intricate assurance schemes, through which IPM compliance is required and is monitored. An estimation is that in these MS over 90% of arable farms participate in assurance schemes. In the Czech Republic, pest monitoring is impressively developed. It consists of 85 agronomists undertaking over 50,000 observations annually to compile detailed data and prepare growers' guides. (DG Health and Food Safety, 2017)

While best practice is observed throughout the EU, in principle, while the guidelines of IPM are promising, the framework through which it is implemented and monitored remains patchy. Financial incentives for following IPM, and measures in place for tackling non-compliance, is lacking. Many Member States rely on cross-compliance to address these issues. (PAN Europe, 2013)

PAN Europe has stated that they support the Commission in their recent statement to push for adequate monitoring and reporting, and more proactive and holistic uptake of IPM. Such efforts can

be promoted in line with the new CAP policy framework by embedding IPM and Integrated Weed Management (IWM). Without a system in place for the collection of statistics on pesticide use, little can be done in the way of real responsive policy-making. In this regard, cross-compliance and monitoring could be introduced more efficiently. This could further promote public involvement and engagement, as pesticide use statistics can be made available online. Member States require record keeping on pesticide use and IPM measures, which is usually kept on farm in a register over a given time period, such as in the Netherlands. These records are audited using sampling methods. However requiring electronic reporting could improve efficiency in this monitoring system. (PAN Europe, 2017)

There have been several notable achievements in risk reduction since the implementation of the NAPs

According to the Overview report on Sustainable Use of Pesticides, Germany had achieved its target of a 30%[38] reduction in aquatic environment and non-target organisms risk, while Denmark achieved a 40%[39] reduction in pesticide risk, as stated in their targets. The Netherlands showed a 75% reduction in pesticide impact on drinking water, and an 85% reduction in that of surface water[40]. Sweden achieved a 69% reduction in the health related risks of pesticide use and a 31% reduction of the environmental related risks of pesticide use[41]. While these findings demonstrate positive results in terms of pesticide risk reduction, many predate the implementation of the Directive. The improved toxicological and environmental profile of PPPs authorised was seen as the main driver for the observed risk reduction. While Denmark had traditionally applied pesticide use reduction targets, they have also moved to more risk reduction targets in recent years. There is a high degree of complexity with regard to defining targets. Increased attention in this area is required as Member States are in the process up updating their NAPs (DG Health and Food Safety, 2017)

While aerial spraying was cited in previous years as an issue inadequately addressed, aerial spraying has declined significantly, and is limited to smaller areas where suitable alternatives are not feasible. However, derogations at the authorisation level could be argued to continue to be a policy area that should be addressed. (DG Health and Food Safety, 2016)

Several Member States have introduced pesticide bans in cities, and in specific areas. Cyprus has introduced a ban on pesticide use in schools, public parks conservation areas and bodies of water. Bulgaria has banned the use of pesticides found to be hazardous in pasture land, meadows, protected areas, and specific areas. Finally, Lithuania has banned pesticide use in the proximity of healthcare facilities and education facilities, among other limitations, allows only low risk substances in soil reserved and wetlands. (PAN Europe2014)

According to the PAN 2017 report, the main achievements since the 2012 introduction of the NAPs related to the ban on pesticide use in public areas in the Netherlands, Luxembourg, Belgium, and France, as well as strengthened rules on derogations in aerial spraying in France and Italy. (PAN Europe, 2017)

[38] When compared to the 1996-2006 period

[39] Between 2011 and 2015

[40] When comparing 2010 to 1998

[41] When comparing 1998 to 2015 value

2.4. Low-risk pesticides and integrated pest management

This section evaluates the extent to which MS have set up measures to incentivise the use of low-risk pesticides and have implemented IPM principles. The following table summarises the main findings, derived from the literature review, which are subsequently further detailed in this section.

Table 4: Implementation of the IPM: Main Findings

#	Main findings
1	Stepwise efforts, with specific milestones, have been put in place in the EU to incentivise the introduction to the market, and use, of low-risk pesticides and the implementation of integrated pest management.
2	Despite the existing regulatory structure in place for placing PPPs on the market, the use of low-risk PPPs and application of IPM in Member States remains limited.
3	There is an insufficient range and availability of low-risk PPPs, decreasing the effectiveness of IPM.
4	The R&D and adoption process for low-risk and non-chemical PPPs (bio-control products) is often not economically sustainable.
5	Regulatory expertise issues can impair and delay the approval process of low-risk PPPs
6	Detailed measures on the application of PPPs is lacking in the NAPs
7	Short-term solutions continue to be favoured. This can be attributed to a lack of measurable criteria for specifying the impacts (health, economic, environmental) of implementing IPM.
8	Awareness of IPM is evident across the EU, however, the amount of actual change in practices and innovation that have occurred cannot be quantified to date.

Source: Core team, 2018, adapted from Milieu, Annex I, in EPRS, 2018

Stepwise efforts, with specific milestones, have been put in place in the EU to incentivise the introduction to the market, and use, of low-risk pesticides and the implementation of integrated pest management.

Regulation (EC) 1107/2009 on placing PPPs on the market also contains regulatory requirements integral to understanding IPM and the use of low-risk pesticides in the EU. According to Article 55 of the Regulation, PPPs are required to be used in compliance with IPM principles defined in the Directive. Apart from the direct reference, several aspects of the Regulation overlap with the implementation of the Directive.

The Regulation states that approval of active substances is undertaken at EU level. It is a multi-actor process starting with Member States' competent authorities, then moving through a series of procedures at EU level, with the EC holding the final responsibility over approval. In a broad sense, the hazard and risk assessment aspects of the process are allocated to the Member States' competent authority and the European Food and Safety Authority (EFSA), while risk management (i.e. decisions over approval or not) is allocated to the Commission for the approval of active substances and to the MS for registration of PPPs. (EPRS, 2018)

In order to ensure human and environmental health, Regulation (EC) No 1107/2009 introduced a novel system named the "cut-off" criteria. This "cut-off" criteria applies to the assessment of hazard properties of the substances that are candidates for approval. As the name suggests, if a substance shows hazard properties under only one of the criteria, the evaluation must stop at the hazard assessment stage. This results in the assessment of the risks not being performed and approval (or renewal of approval) for this substance is automatically denied. Thereby, the Regulation applies a

hazard-based approach (as opposed to the risk-based approach abolished by the Regulation). Such an approach implies removing substances if they are evidenced to pose potential hazards. It further incorporates the precautionary principle in cases where insufficient evidence is available. In instances where human exposure is insignificant, derogations to cut-offs may be approved. This Regulation has created a system in the EU which limits the entrance of new high-risk active substances, and has been slowly removing previously approved higher risk active substances as they come up for renewal. (Bozzini, Annex II, in EPRS 2018)

Another novel feature of the Regulation is the classification of certain approved substances as candidates for substitution (CfS). PPPs which contain such active substance must be compared to lower-risk PPPs and non-chemical methods available for the same use. This is conducted at the authorisation stage by Member States through the national competent authorities. According to Regulation (EC) No 1107/2009, there are several types of applications[42], ranging from new applications, to emergency authorisation for short term use and extension for minor uses. One application type, *mutual recognition,* is organised in three zones[43]. Mutual recognition enables the authorisation of a given PPP for the same use and under comparable agricultural conditions, within a given zone if the PPP has already been authorised by an MS in that zone. In practice, it happens that MS limit or decline products authorised in other MS from the same zone. This may, in some cases, particularly occur in *specific areas,* as defined in Article 12 of the Directive.

Therefore, Regulation (EC) No 1107/2009 creates a system for placing PPPs on the market and prescribing the use of PPPs. This regulation provides the Commission and Member States, respectively, the opportunity to prevent the introduction of hazardous active substances, and block or limit the application of PPPs, based on risk-reduction principles. The findings of the European Implementation Assessment on Regulation (EC) No 1107/2009 conducted by the European Parliamentary Research Service[44] are of particular relevance to this study. They suggest that more research is needed on the coherence with the SUD, promotion of low-risk PPPs and IPM as well as the practical use of derogations by the Member States. (Milieu, Annex I and Hamlyn Annex III, in EPRS, 2018)

Stakeholders interviewed warn that the effects of the Regulation may lead to an inadequate portfolio of available PPPs on the market, creating barriers for controlling crop pests. A general consensus is that more attention should be paid to increasing the number of PPPs, with a focus on innovative and effective low-risk substances – something currently found to be lacking. (Milieu, Annex I, in EPRS, 2018)

Despite the existing regulatory structure in place for placing PPPs on the market, the use of low-risk PPPs and application of IPM in Member States remains limited.

There are several confounding factors which can be used to explain this observation. According to the EPRS study, these can be categorised into six problem areas (Milieu, Annex I, in EPRS, 2018).

Each will be discussed below, using supporting literature to enrich the arguments presented.

[42] 1) First authorisation/amendment or withdrawal of an existing authorisation of a PPP; 2) Emergency authorisation (120 day authorisations) of a PPP (under Article 53); 3) Authorisation under the mutual recognition principle; 4) Renewal of authorisation of a PPP; 5) Extension for minor uses; 6) Parallel trade permits; 7) Technical equivalence

[43] Regulation (EC) 1107/2009 Article 3(17) and Annex I: Zone A – North; Zone B – Centre; Zone C – South.

[44] http://www.europarl.europa.eu/RegData/etudes/STUD/2018/615668/EPRS_STU(2018)615668_EN.pdf

i. There is an insufficient range and availability of low-risk PPPs, decreasing the effectiveness of IPM.

Member States self-reported that the availability of non-chemical and low-risk PPPs is limited, and this was found to decrease the implementation of IPM (Milieu, Annex I, in EPRS, 2018). Looking into authorisation, only a small number of NAPs included measures to incentivise the registration of such PPPs. (EC, 2017)

Adoption of IPM is found to be much more common in orchards and in greenhouses, than in field crops and vegetable production (Lefebvre et al., 2015). One argument behind this observation is that farmers tend to rely on available pesticides, therefore, in crops where many pesticides are still available, update of IPM is reduced. Even when low-risk PPPs exist, their availability and marketing is insufficient. In greenhouses, where the availability of PPPs is limited, natural predators have been used world-wide as effective pest control measures. As of 2012, over 200 predatory species appropriate for use in greenhouses were available (van Lenteren, 2012), but the uptake could still be improved. (Lamichhane et al, 2015)

According to Barzman et al, (2015), the *"decision to introduce a new cultivar or crop species also depends on the market. If market forces alone are not sufficient to promote sustainable practices, other economic incentives are feasible"*. In order to overcome this issue, Switzerland has introduced a series of subsidies to promote IPM in crop production. As a result, in Switzerland today, 98% of agricultural production is registered to contribute to ecology, 88% of this falls under IPM, and 12% of agriculture is certified as organic (BLW, 2013). Similarly, DK is the only MS to introduce a tax on pesticides, which is scaled based on the toxicity levels of the PPPs used.

Minor crops can be used to demonstrate the issue of an insufficient range of PPP availability. Even though minor crops represent over 20% of the value of EU's total agricultural production, they are individually niche market. Specific PPPs are often required for each minor crop, for which there is not an adequate potential for economic return. As such, the availability of effective PPPs for use in these crops is reported to be declining. IPM can be seen as a way to ameliorate these issues, and reduce the need for PPPs in certain minor crops. In order for IPM to be effective in this regard, it requires a certain degree of specificity and agronomic innovation. The inclusion of molecules with pest control properties, predator species, cultures, bio-pesticides, and combination methods in IPM (and the development of such approaches on a crop-specific and climate-specific basis) is a required predecessor for effectiveness IPM. (Lamichhane, et al., 2015)

ii. The R&D and adoption process for low-risk and non-chemical PPPs (bio-control products) is often not economically sustainable.

Chemical pesticides account for a multi-billion euro market, and like other markets, one which bases its decision-making primarily on opportunity-cost. Low-risk, and particularly non-chemical, PPPs can be much more difficult to develop and place on the market because fixed costs remain high when compared to potential returns. This is observed with low risk PPPs. Low risk PPPs often service niche markets, however, their development still requires high investments in R&D and administrative costs for approval procedures. According to survey findings in the 2018 EPRS study, one CA respondent stated that *"the costs of the dossiers and the approval process are often too high for the niche markets they represent"* (Milieu, Annex I, in EPRS, 2018).

During the interviews, five stakeholders from different branches[45], all asserted that Regulation (EC) No 1107/2009 does not adequately promote IPM in agriculture, and in this regard, is incoherent with the Directive. Respondents suggested that promotion in the area of development and marketing of low-risk biological products is required. Findings of the EPRS study concluded that both the Commission and Member States should place a greater focus on the development of low-risk and biological PPPs and on the promotion of research programs in the area of biological and mineral low-risk PPPs. (Milieu, Annex I, in EPRS, 2018)

This can be looked at from an uptake perspective of individual farmers as well. If the uptake of IPM increases risks in production (or is even perceived to), in the context of a loose and semi-voluntary system, farmers will more often air on the side of caution rather than risk crop losses. With this in mind, in the context of the EU, the argument for public intervention in promoting IPM remains relevant. According to Lefebvre et al. (2015), the "adoption of IPM general principles has been made mandatory for all farmers through European Union legislation". Further, study results have shown that "incentive-based and information dissemination measures are useful complementary instruments".

This having been said, in the EU to date, there is an insufficient amount of specific IPM guidance for farmers. The general principles, while correct, lack the detail required to make them truly innovative and effective in a local farm setting. This detail includes aspects such as providing specifics on the most economically and labour efficient strategies to be applied according to crops and production models. When looking to the marketing aspects of IPM, assurance schemes exist in some Member States. Meaning that farmers who follow IPM principles to an adequate degree, gain access to certain markets which would not be otherwise accessible to them. For example, a retail chain may only stock produce from farmers participating in assurance schemes which require more comprehensive IPM application. However, in general, products are rarely labelled as having been grown with IPM, and no EU wide certification (as is the case with organic farming) exists. This supports the analysis that shows that there is little to no market place premium in the EU for products grown with IPM. (Lefebvre et al 2015)

iii. Regulatory expertise issues can impair and delay the approval process of low-risk PPPs

Given a regulatory framework that is centred around the approval of conventional chemical-based PPPs, low-risk and non-chemical products may be met with non-coherent requests for data, a lack of appropriate risk assessment guidance, and often meet unjustified delays. This is also attributed to a lack of appropriate knowledge, expertise, and risk assessment mechanisms in place. Findings of the EPRS study concluded that both the Commission and Member States should place more focus on the assessment of the economic and regulatory barriers to the authorisation of low-risk PPPs. This is mirrored in findings from the application of Article 53 of Regulation (EC) No 1107/2009.

This is mirrored in interview findings according to the EPRS study. One respondent stated that *fast-track* procedures with low-risk substances is not followed. On the other hand, another respondent stated that measures must be in place to ensure that only truly low-risk substances are given this flexible criteria, as they suggest that other products are sometimes registered through fast-track procedures even if they are not low-risk. Therefore, the effectiveness of these procedures is called into question. One of the main issues are the delays in approval of low-risk substances. Supporters of sustainable pesticide legislation feel that not only are active substances not given a favourable climate, they are actually put at a disadvantage, in comparison to conventional synthetic substances. It is argued that the criteria of *efficacy in targeting pests* results in conventional substances

[45] An environmental/health NGO, CAs/individuals belonging to CAs, associations representing the biocontrol industry and organic food and farming

receiving advantageous conditions. Recent efforts in this field include the adoption of Regulation (EC) No 1243/2017, detailing particular criteria for low-risk active substances. (EPRS, 2018)

In addition, the European and Mediterranean Plant Protection Organization (EPPO) recently published guidance on efficacy evaluation for low-risk plant protection products (OEPP/EPPO, 2017).

Overall, it is felt that both the Commission and Member States should place a greater emphasis on low-risk PPPs, including the development of training programmes for certifying authorities which are responsible for the authorisation process of PPPs. This is seen as relevant since barriers to authorisation of low-risk PPPs are found to deter IPM. (EPRS, 2018)

Finally, MS are facing difficulties in dealing with comparative assessments due to the high number of cases to be evaluated (About 75 substances have been classified *"candidates for substitution"* by the EC) (EPRS, 2018).

iv. Detailed measures on the application of PPPs is lacking in the NAPs

As mentioned in the previous section, NAPs appear to lack timely, specific, measurable tools that enable monitoring and evaluating the implementation of IPM principles. (EPRS, 2018)

While IPM is mandatory in the EU for all professional users of pesticides, the nature of IPM guidelines inherently creates a varied climate related to the degree of its implementation and compliance with the intended purpose of IPM. Furthermore, IPM faces two pronged challenges. External challenges include an observed increase in invasive species and pests and an upward trend in pesticide resistance. On the other hand, systematic intrinsic IPM challenges range from inadequate budgetary allocations in IPM research, a decreasing trend in human capital and expertise on the topic, and disjointed channels of communication for knowledge sharing. Trans-national networks could be one means of increasing capacity and knowledge sharing in IPM, however, this too requires investments and coordination at the government level to encourage such efforts. Ecozones[46] are seen as one example of this. In this programme, participants are grouped according to similar climactic zones and crop species, in an effort to contribute to knowledge sharing in IPM. The focus is on early warning systems and prevention, and on non-chemical alternatives. Another example of a similar knowledge network is ENDURE, a platform for experts and institutions in agricultural research and IPM. While these, and other examples, exist, investment continues to be limited when compared to the benefits of incorporating IPM in a more thorough and meaningful way. (Lamichhane, et al, 2016)

IPM is not an absolute, but is rather a spectrum of application types and forms. It can range from very little integrated practices, to high-grade, *biointenstive,* IPM (Benbrook et al., 1996). While it is normal that in practice farmers incorporate IPM in a gradual manner, consideration of this must be reflected in the NAPs and in the monitoring and evaluation plans, in order to be able to set targets that eventually lead to high-grade IPM practices. Encouraging the incorporation of high-grade IPM is often a highly agronomic, local, endeavour. Although guidelines exist, promoting IPM requires continued investment and policy emphasis on the development of site specific, detailed, information for IPM implementation. (Barzman et al, 2015)

Advisory groups, and information sharing can be seen as a way to promote high-grade IPM. A Danish initiative of *experience groups* which brought farmers together was found to have resulted in reduced pesticide-use and advisory costs among participating farmers (Kudsk and Jensen 2014). In France, in 2012, a demonstration network of 1900 farms (commercial and experimental) was set up (DGAL 2014). Results from a set of demonstration farms introduced in Germany found that, while

[46] http://www.eppo.int/

labour intensive, monitoring and guidance reduces pesticide use among participants (Freier et al. 2012). (Barzman et al, 2015)

v. Short-term solutions continue to be favoured. This can be attributed to a lack of measurable criteria for specifying the impacts (health, economic, environmental) of implementing IPM.

Looking at the issue from a policy-making perspective – without adequate information on uptake, effectiveness, and impact, of the IPM techniques in place, improving policy instruments and introducing adapted measures becomes difficult. According to the OECD workshop findings, in order to reduce administrative burden, an attempt to use data already being collected as much as possible is recommended when monitoring IPM. (OECD, 2012)

Similarly, the Commission study in 2017 found that Member States have not adequately translated IPM principles into criteria that can be monitored and assessed. Although IPM is promoted, mechanisms that ensure that appropriate IPM techniques are implemented are lacking. (EC, 2017)

There is a general absence of quantitative data on the impacts of IPM on long-term economic sustainability, in a given region, with a given crop, relative to non-IPM. Compounding this issue is that IPM encompasses a set of principles that are implemented in various ways, to various degrees, across various contexts. This makes assessing the cost-effectiveness of IPM difficult on a wide scope (Waterfield and Zilberman 2012). The degree of IPM implementation ranges greatly, minimal adoption of IPM, in many cases, may not change farming practices in a meaningful way. On the other hand, highly developed IPM systems are much more integrated. As expected, each of these would yield different impacts and have different cost-effectiveness models. (Lefebvre et al 2015)

While studies exist evaluating the economic, crop quality, and sustainability impacts of IPM, many are site-specific, and to date, none have been adopted as standard practice across the EU. Efforts can be made in improving such systems, and upscaling use. For example, a multi-attribute model (DEXiPM) for ex-ante assessment of IPM was proposed, this method can be applied in all arable crops (Pelzer, Fortino et al., 2012; Vasileidas et al., 2017). Self-reported results on automatic weed monitoring from five Member States[47], showed that forecasting, early detection, high quality cultivars, precision spraying, and knowledge sharing can result in a profit associated with IPM within the timeframe of 3-4 years. Many more examples exist, including *SustainOS,* a methodology developed for assessing regional sustainability[48] of IPM in apple orchards, which found varied results in the implementation of IPM across regions (Mouron, Heijine et al., 2012). Whereas, across landscapes, substitution with biological control (rather than chemical) is found to be effective (Bale et al., 2008), this is particularly true of greenhouse production (Waterfield and Zilberman 2012). (Lefebvre et al 2015)

The localised nature, and various findings, listed above are to be expected. They point to the need for more research and greater investments in the area of IPM in order to build on the knowledge base available to guide policy and agricultural practices. (Lefebvre et al 2015)

vi. Awareness of IPM is evident across the EU, however, the amount of actual change in practices and innovation that have occurred cannot be quantified to date.

According to findings of the 2017 Commission study, while the awareness around IPM has increased, it cannot be extended that this has resulted in meaningful increases in the implementation of IPM, or in reaching its full potential. (EC, 2017)

[47] Denmark, Netherlands, Hungary, Spain, and Italy

[48] In Switzerland, Germany, The Netherlands, France and Spain

According to Lefebvre et al. (2015), instruments that can influence farmers' plant protection decision-making can be categorised as: *regulatory instruments, information dissemination measures* and *incentive-based instruments.* Many of the EU regulatory instruments to promote IPM have been described in the sections above. However, even taking into account statements such as Article 14(5) of the Directive[49], the effectiveness of the regulatory mechanisms in place today for promoting IPM is called into question. Although efforts are being made, more work is needed to encourage Member States to develop their own crop-specific guidelines, in a specific manner and based on a strong scientific foundation. With respect to information dissemination, farmers should be provided with pest-management advisors for IPM apart from commercial advisory services (Waterfield and Zilberman 2012). Cost-sharing schemes via advisory services are also noted as best practice, as well as demonstration activities. Finally, effective incentive-based instruments include taxes on pesticide use (such as seen in Denmark), and payments for IPM adoption (applied in Portugal, Poland, Austria and parts of Germany). (Lefebvre et al 2015)

The OECD workshop results on IPM conducted in 2011 categorise recommendations based on three types of policy instruments: outcome-based, facilitative, and prescriptive. Where facilitative (i.e. via incentives) and outcome-based (i.e. setting targets) should generally be favoured in IPM uptake promotion, while applying prescriptive policies can be used to set cut-offs and lay the regulatory foundation. Recommendations include a wide range of approaches. For example, participatory approaches, where farmers are included in the research and development aspects of IPM, is seen as a way of stimulating *economic buy in,* and overcoming barriers to adoption. Insurance measures, such as those tailored for crop loss in IPM farming, could alleviate the risk farmers face when changing practices. Another approach to reducing risk for farmers is the provision of test and demonstration plots. Test plots enable farmers to practice IPM techniques before incorporating them into on-farm practices. More investments in technologically sound diagnostic and warning systems is also seen as a crucial aspect of effective IPM and a means of encouraging uptake. Furthermore, an emphasis on training and knowledge transfer is important since IPM is a knowledge intensive practice. Funding is seen as a primary concern in encouraging IPM, and funding models should be cross-sectoral and multi-actor. Registration processes for low-risk substances are also seen as a barrier to entry, and could accordingly be simplified for products that can prove to present low-risks for the environment and human health. As already seen in some Member States, labelling and certification could be a means of incorporating added value to high quality IPM farming models. The OECD workshop further emphasised the need for accurate measurement of IPM update with activity and performance indicators in place. (OECD, 2012)

2.5. Risk indicators

This section focuses on the state of play of harmonised risk indicators' development. The following tables firstly introduces the main findings, which are then further detailed.

Table 5: Development of risk indicators: Main Findings

#	Main findings
1	Most of the work on indicators conducted over the last 5 years seems to address the fine-tuning of existing indicators rather than developing new ones.

[49] Member States shall establish appropriate incentives to encourage professional users to implement crop or sector-specific guidelines for integrated pest management on a voluntary basis. 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

#	Main findings
2	At an international level, the OECD restarted its activities in 2013 and launched a guidance document which provides guidance on selecting pesticide risk indicators.
3	The list of indicators that have been developed to date is well-known
4	While many indicators have been developed, few sources of literature stipulate how indicators could be operationalised (including the approach for implementation, governance, sharing of responsibilities, etc.)

Source: Core team, 2018

Recital 20 of Directive 2009/128/EC indicates that *"it is necessary to measure the progress achieved in the reduction of risks and adverse impacts from pesticide use for human health and the environment. Appropriate means are harmonised risk indicators that will be established at Community level. Member States should use those indicators for risk management at national level and for reporting purposes, while the Commission should calculate indicators to evaluate progress at Community level. Statistical data collected in accordance with the Community legislation concerning statistics on plant protection products should be used. Member States should be entitled to use, in addition to harmonised common indicators, their national indicators".* This need is reflected in Article 15 (1) of the Directive which indicates that *"harmonised risk indicators as referred to in Annex IV shall be established".* Annex IV has not been developed at the time of entry into force of the SUD.

Today with regard to harmonised risk indicators, very few academic or grey literature can been identified. Furthermore, this subject has not been widely discussed in the literature over the last decade. Because of this, no detailed analysis of national literature which describes how indicators can be applied (data needs, computation approach, modelling, etc.) has been included.

Most of the work on indicators conducted over the last 5 years seems to address the fine-tuning of existing indicators rather than developing new ones.

Identified sources tend to demonstrate that a lot of the activities aiming at developing harmonised risk indicators took place between 2000 and 2010. Since this date, the number of publications addressing this issue have decreased. Tt seems that the bulk of the activities now have concentrated on fine-tuning the already existing tools, rather than developing new ones.

Eurostat, in its work on agri-environmental indicators[50], considers that more modelling work is required. Pesticide risk indicators should be based on an index of the risk of damage from pesticide toxicity and exposure. The conceptual, and where appropriate modelling, framework underpinning these indicators still needs to be developed.

At an international level, the OECD restarted its activities in 2013 and launched a guidance document which provides guidance on selecting pesticide risk indicators.

The OECD has been one the first horizontal organisation to work on the implementation and use of pesticide risk indicators. The first project aiming at developing harmonised risk indicators dates back to 1997. During this project, the OECD member countries came to the agreement that risk indicators should respect the following principles:

- be scientifically robust and user friendly;
- link hazard and exposure data with data on pesticide use;

[50] See: https://ec.europa.eu/eurostat/statistics-explained/index.php/Agri-environmental_indicator_-_pesticide_risk

- complement but not replicate or compete with the tools used for pesticide registration and risk assessment; and
- address risks to humans and the environment separately.

Within the scope of this initial project, two different sets of indicators addressing two main risk compartments were developed:

- Aquatic Risk Indicators (ARI)
- Terrestrial Risk Indicators (TERI).

These indicators do not directly measure the level of risks but rather estimate the evolution (trend) in risks at national or regional level. The results of this initial project have fed the 2010 and 2014 HAIR project.

- The OECD restarted its activities in 2013 by setting up a new *ad hoc* Expert Group on Pesticide Risk Indicators (EGPRI). The main two objectives of this new group were to perform an inventory of all existing risk indicators developed to date and to determine how to implement them in order to assess the sustainability of pesticide use. The EGPRI developed the PRIER database (pest risk indicators evaluation reports) which contains available and active Pesticide Risk Indicators. As a follow-up a guidance recommending risk indicators to be used by risk and policy authorities has been published in 2016.

The list of indicators that have been developed to date is well known (further details to be found in the case study report on harmonised risk indicators, see Section 2.5).

DG SANCO, now DG SANTE, commissioned a study in 2012 which, inter alia, presents an inventory of the different types of indicators under use and development at Member State level. The study report has been recently published on the Commission website[51].

The study identifies two basic approaches:

(a) descriptive indicators aiming at measuring progress in the achievement of the objectives of the SUD, and
(b) indicators based on theoretical models for the prediction of specific risks/impacts.

As example, three model-based risk indicators and their brief description are also presented in this report in section 5.1.2.

This inventory also presents the outcome of the most important work being undertaken on the development of an integrated indicator approach across Europe: the EU-funded *"Harmonised environmental indicators for pesticide risk"* (HAIR). The HAIR project aims at developing indicators on the overall risk of pesticides. It provides integrated multidisciplinary expertise on the environmental and human impacts of pesticide use. The main deliverable of the HAIR project is a set of harmonised environmental and human health risk indicators, complementing with a software package. Developed first in 2007, subsequently, the indicators and the related tools haven been updated in 2010 and 2014[52]. (EC, 2015).

Reus et al. (2002) evaluated and compared eight pesticide risk indicators developed in Europe based on results of the CASPER (concerted action on pesticide risk indicators) project. Through this study, recommendations on how to use indicators were presented. The CASPER project concludes that a

[51] Available at https://ec.europa.eu/food/sites/food/files/plant/docs/pesticides_sup_ppp-report_monitoring-study_20120712.pdf

[52] Available at http://www.pesticidemodels.eu/hair/home

scientific framework for indicators is required at farm level. According to the authors, rather than developing new indicators or fine-tuning the existing ones, efforts should be devoted to collecting pesticide use statistics data as foreseen in EU Regulation (EC) No 1185/2009 on pesticide use statistics.

While many indicators have been developed, few sources of literature stipulate how indicators could be operationalised (including the approach for implementation, governance, sharing of responsibilities, etc.)

In 2006, the DEFRA in the United Kingdom developed a proposal indicating that for each of the three pillars of sustainability (economic, environmental and social), the strategic outcomes, headline indicators relevant to plant protection product use, were first identified. For each of the headline indicators, core indicators (outcome measures and process measures) were then established (some of which were outcome measures and others process measures). (DEFRA, 2006)

In 2011, the Italian OPERA Research Centre organised an expert working group aiming at identifying a process and a common approach to assess reliability and effectiveness of the existing risk indicators. This selection methodology has led to a sharing of perspectives and knowledge between the participants of the workshop. (Calliera et al, 2012).

3. National Action Plan analysis

This section examines the information extracted from the 28 National Actions Plans (NAPs). Section 3.1 introduces general information on the NAPs. Section 3.2 provides further information on the NAP content, particularly on the translation of the Directive's provisions into the NAPs. Section 3.3 presents the conclusions of the NAP review.

3.1. General information on the NAPs

What is the NAP's time span?

In the majority of cases, the timespan for the NAPs is from 2012/2013 to 2017/2018 with a review planned after an initial five year period.

The table below provides specific information on several MS which have indicated their respective NAP time span.

Table 6: NAPs time span

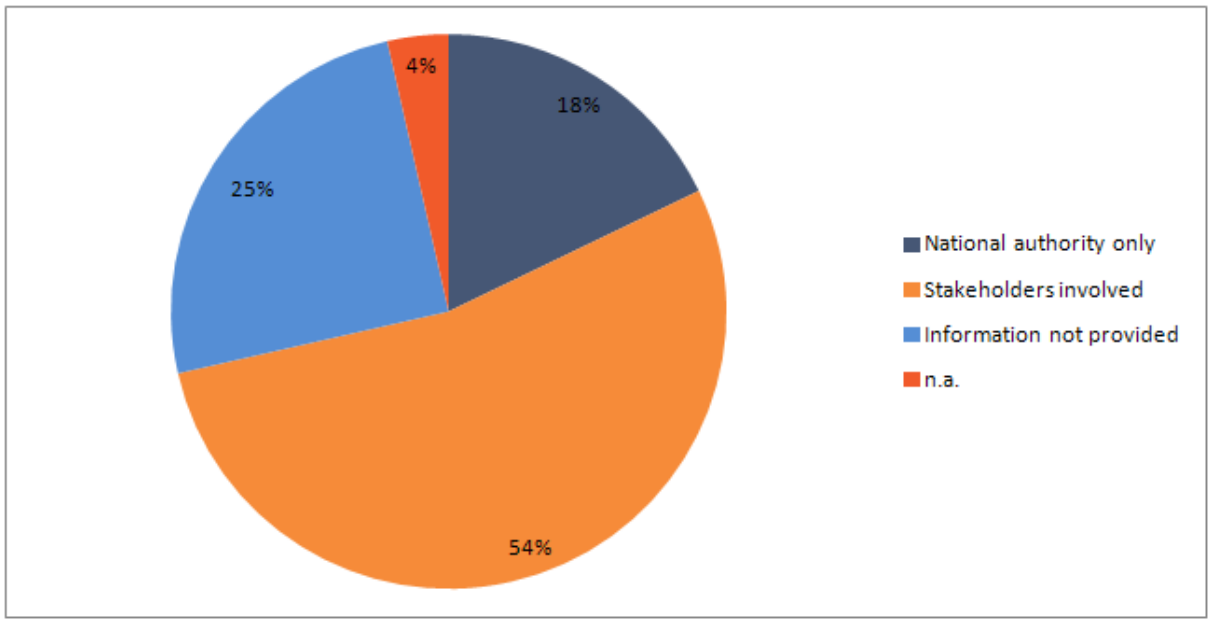
MS	NAP time span
DK	The initial NAP covered the period 2013-2015. It was extended to cover 2016 and the revised version of the NAP was adopted in 2017. The period covered in the revised version of the NAP is 2017-2021
HR	The NAP spans over a ten-year period (2013-2023). As per the Directive, the NAP is supposed to be reviewed at least once every five years
SI	The duration of the initial NAP covers a 10 years period (2012-2022). The Slovene government prepared a NAP review covering the period 2013-2015, which was adopted by the NAP expert group (experts of competent authorities and external experts) in November 2016. A revised NAP has been adopted in May 2018.
AT	In Austria, in accordance to the provisions of the Austrian Constitution, nine LAP (Land Action Plans) were developed to cover the period 2012-2016, one for each Länder. At the end of this period, the Federal Government compiled the revised individual chapters in order to ensure the creation of a uniform, country-wide National Action Plan (2017-2021).
FR	The first plan called Ecophyto I was adopted in 2008 and covered the period 2008-2018. Therefore, a modified plan (Ecophyto II) was adopted in 2015 and runs until 2025. The main objective of the second plan remains the same (decrease of the volumes of use by 50%). In June 2018, the French government decided to modify Ecophyto II in order to reinforce its governance and its functioning.

Source: Core team, 2018

Eight MS do not provide any information with respect to the period to be covered by the actions in their NAP (BG, EL, IE, PL, PT, RO, SK, and the UK). However, for BG, deadlines for single measures are indicated. Each measure comprises of various sub-measures, each having different deadlines[53].

[53] For example, the implementation deadline of the sub-measure "Plant protection products of the professional use category are only to be sold by persons who hold a certificate to work with plant protection products of the professional use category" is "from 26.11.2015.

Figure 2: Who participated in development of the NAPs?



Source: Core team, 2018

As illustrated by the previous figure, the NAPs mention that stakeholders have been voluntarily involved in the development of the plan in 15 MS (AT, BG, CZ, DE, DK, FI, FR, HR, HU, IT, LU, LV, MT, PT, UK).

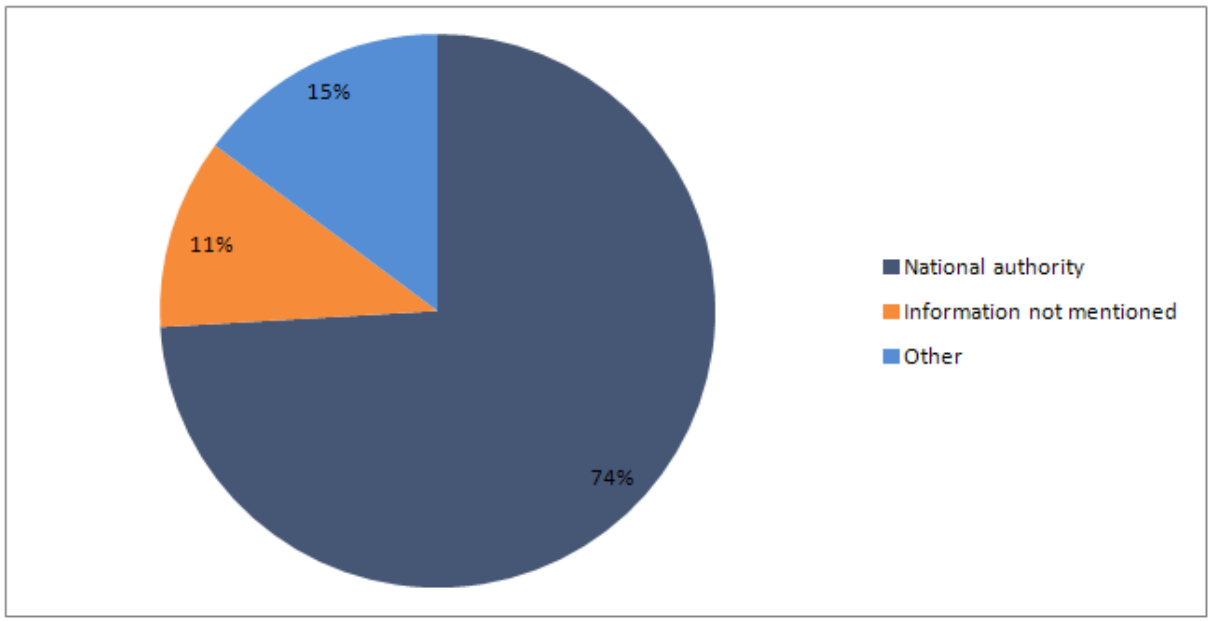
In UK, the development of the plan involved consultations with UK stakeholders, including the public. The oversight and coordination of stakeholder input is carried out by the UK Pesticides Forum. The UK Pesticides Forum is a stakeholder organisation that carries out several functions related to pesticide policy. The Forum further prepares annual reports and provides advice to the UK government on responsible pesticide use. In PT, a working group of representatives of governmental administrations, private organisations, agricultural organisations, the plant protection industry and renowned plant protection specialists was created for the purpose of developing the action plan.

In HU, the draft NAP has been prepared by the authorised directorate of the Ministry of Agriculture and was adopted by the Hungarian government. The drafting process involved the participation of key stakeholders, interest groups, scientific and expert institutions, associations and organisations.

In the PL NAP, public involvement in the development of the document is mentioned in the text. However, there is no indication of how public involvement is coordinated or undertaken. A similar situation applied for ES. In the ES NAP, it is mentioned that public participation pursuant to the provisions of Article 2 of Directive 2003/35/EC is foreseen, but the manner in which this participation will be incorporated is not mentioned. The Italian Ministry of the Environment and Protection of Land and Sea opened a public consultation on the drafting of the NAP. Regions, Research Institutes, NGOs, national federations and cooperatives sent in their contributions to that consultation.

In FR, NAP Ecophyto II was developed based on the 68 recommendations submitted by the MP Dominique Potier on 23 December 2014, highlighting that the conditions required to meet the objective of reducing plant protection product use in France have been created, but on an insufficiently large scale. The plan was also developed through consultation with the Ecophyto II stakeholders and the public.

Figure 3: Overall responsibility: who is in charge of implementing the NAPs?



Source: Core team, 2018

While national authorities are in 74% of cases (20 MS) responsible for implementing the plan, four MS (15%) took a different approach as follows:

- In AT, the nine provinces ("Bundesländer") are in charge of implementation.
- In ES, Article 4 of the Royal Decree 1311/2012 names the responsible administrative bodies as well as the decision-making body in charge of ensuring compliance with the NAP obligations. The information is not repeated within the NAP. Nevertheless, for each measure, the NAP indicates the bodies competent for implementation: these range from national (and designated bodies of the autonomous regions) to local bodies.
- In IT, the overall responsibility for the implementation of the NAP lies with the Ministry of Agricultural, Food and Forestry Policies. Yet, the Ministry of the Environment and Protection of Land and Sea, the Ministry of Health, the Ministry of Education, University and Research, the regions and the autonomous provinces, and municipalities, all take some responsibilities in implementing the plan.
- In UK, the NAP is managed by the Chemicals Regulation Directorate (CRD) of the Health and Safety Executive as the UK pesticides regulator. Strategic oversight is the responsibility of the Department for Environment, Food & Rural Affairs (Defra) who has responsibility for pesticides policy, in collaboration with policy units in devolved governments. *"The plan can only be delivered through Government working in partnership with a wide range of stakeholders including the crop protection industry and the wider agriculture, horticulture and amenity interest groups and other non-government organisations"* (Defra, 2013).

In addition, the information related to the overall responsibility of implementing the NAP is not mentioned in 11% of the cases, precisely in the EL, FI, SI, and the NL plans. However it should be noticed that in the FI NAP, the roles and responsibilities are mentioned but for individual proposed measures only.

Does the NAP indicate any reference to the budget allocated to the NAP and how each of the measures will be funded?

In most of the NAPs, there is no detailed reference to the budget allocated to the plan nor a description on how each of the measures will be funded. The few indications that have been found in the plans read as follows:

Table 7: NAPs annual budgets

MS	Annual budget (in million Euros)
FR	71
BG	5.4
CZ	0.06
DK	12.3
FI	7.9
Other MS	Not available

Source: Core team, 2018

In FR, EUR 71 million per year is dedicated to Ecophyto II. The financial envelope for the plan has increased from EUR 41 million to approximately EUR 71 million per year as of 2016. The additional annual EUR 30 million is mobilised at the local level. This additional funding is specifically intended to finance actions identified by the agro-ecology committee and is used primarily to provide financial support to farmers to enable a significant reduction in the use of plant protection products and the risks associated with their use.

The BG plan indicates that EUR 5.4 million is allocated to the plan. However, there is no indication if the budget is provided annually or for the complete period. Furthermore, no details on how this budget will be used are provided.

In CZ, three ministries are involved in the coordination and control of the NAP implementation. For this purpose, an approximated budget of 0,06 million is annually earmarked. The National Rural Development Programme (under the current programming period) is assumed to be the main source of financing, e.g. covering the costs for *"transferring professional information and completing the professional advisory system in the protection of plants"* (Ministry of Agriculture, 2012). In DK, in 2017, the total annual budget allocated amounts of EUR 12.3 million. This annual allocation will slightly decrease during the period 2018/2021 to approximately EUR 11.3 million per year.

In FI, based on rough estimates, the total costs over the first 10-year period of the National Action Plan (2011-2020) will amount to about EUR 7.9 million (less than EUR 1 million per year).

In LT, the NAP reports that funding is taken from the resources allocated in the Law on the State budget and that additional funding has been requested for new policy initiatives for the 2014-2016 period, which are included in budget programme 27.00.00 *"Plant health and monitoring of plant circulation"*. However, no figures are provided.

Other plans (SK and MT) clearly indicate that funding from the National Rural Development Programme for 2014–2020 will be activated to finance operations such as the exchange of information and expertise, trainings for agricultural entrepreneurs (of which completion is a prerequisite for handling of PPPs), and the creation of advisory centres for the use of PPPs. However no figures have been provided.

Other Member States such as Germany or Italy have not dedicated a particular budget share to the NAP. The German NAP for instance remains rather vague with regard to the financing of the measures indicated in the NAP. The NAP states: "For financing, the Federal Government and the Länder respectively have different possibilities at their disposal. The principle is that the financing needs to be in accordance with the respective funding organisation's remit." Similarly, the Italian NAP indicates that "the Management Authorities of each programming document shall define the relevant measures and the associated financial resources; they shall also provide quantitative data on the objectives set out in the Plan. The necessary quantitative definition of the Plan's objectives, required by Article 4 of the Directive 2009/128/EC, and any additional objectives, shall be set out in an addendum to the Plan as soon as the set of planned measures and associated financial resources is available".

3.2. Translation of the Directive's requirements into the National Action Plans

3.2.1. Article 4

Are general quantitative objectives across specific actions clearly set? Which ones? In which time frame(s)?

Six MS have included quantitative targets in their NAPs, as illustrated in the table below:

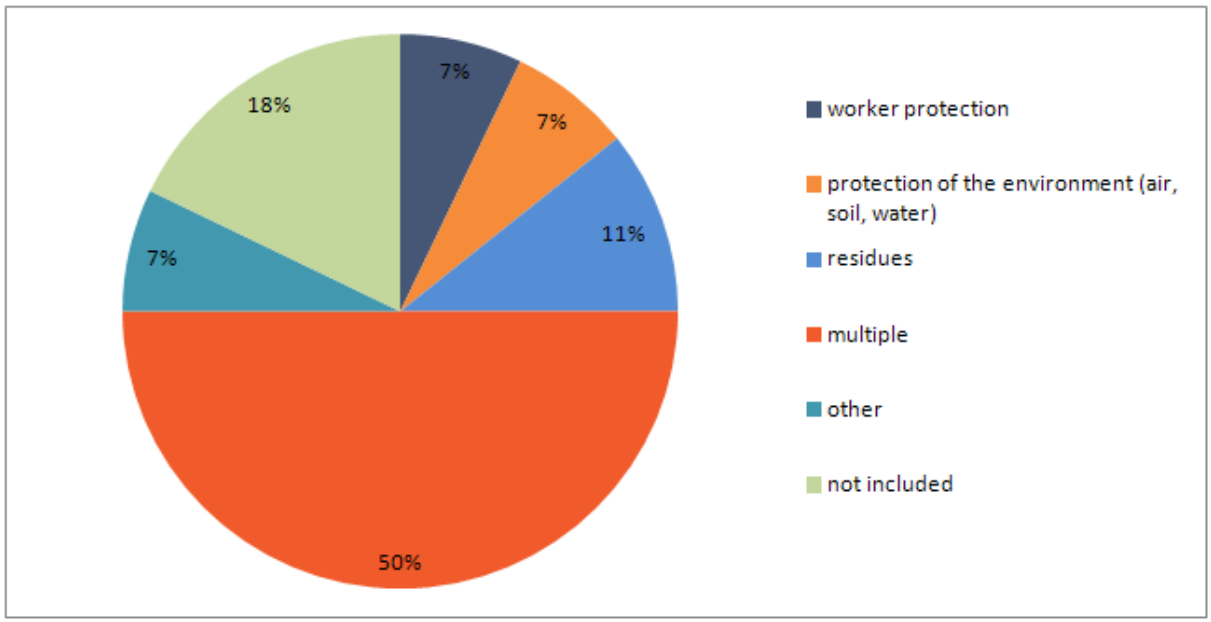
Table 8: Quantitative targets mentioned in NAPs

MS	
BE	Walloon plan: *"The initiatives within the programme must enable Wallonia to progressively achieve the targets in the initial Federal Pesticide and Biocide Reduction Plan with a 50% reduction in the environmental impact for non-agricultural use and a 25% reduction in the environmental impact for agricultural use"* (NAPAN Task Force, 2014). This system will be followed for successive plans as well.
CZ	The objectives set in the NAP correspond to a 10 to 15% reduction of PPP residues in food and water by 2020 compared with the average of all measurements taken during the reference period 2008–2010
DE	DE sets quantitative targets for risk reduction of 20% by 2018 and 30% by 2020
DK	The current ambitious goal of a Pesticide Load Indicator (PLI) of 1.96, calculated based on sales data, must, as a minimum, be met. In the previous NAP, the overall goal of the Danish Government was to reduce the pesticide load by 40% by the end of 2015 compared with 2011. Another quantitative objective of the revised NAP is to reduce the percentage of non-compliance with regulations on illegal Danish pesticides by distributors of products for professional use from 30% to 5% by 2019
FR	The NAP Ecophyto I was aimed to reduce the use of plant protection products by 50% within ten years (over the period 2008-2018). In the NAP Ecophyto II, the target of a 50% reduction in the use of plant protection products in France within ten years was reconsidered under a two-phase timeframe. The first phase aims for a 25% reduction by 2020 through mainstreaming and optimising currently available techniques. The second phase aims for a 50% reduction by 2025.
LU	LU sets several targets: 1. reducing the use of plant protection products by 50% (reduction in tonnes applied) by 2030; 2. establishing indicators to monitor the amounts of plant protection products placed on the market and used by both professional and non-professional users; 3. based on indicators, envisaging a 30% reduction in "big movers" by 2025

Source: Core team, 2018

The other MS NAPs do not include such quantitative targets.

Figure 4: Issues receiving particular attention in the NAPs besides the quantitative targets(n=28)



Source: Core Team, 2018

The term "multiple" in Figure 4 indicates that more than one of the issues receive particular attention in the NAP. The percentage indicates the total citations.

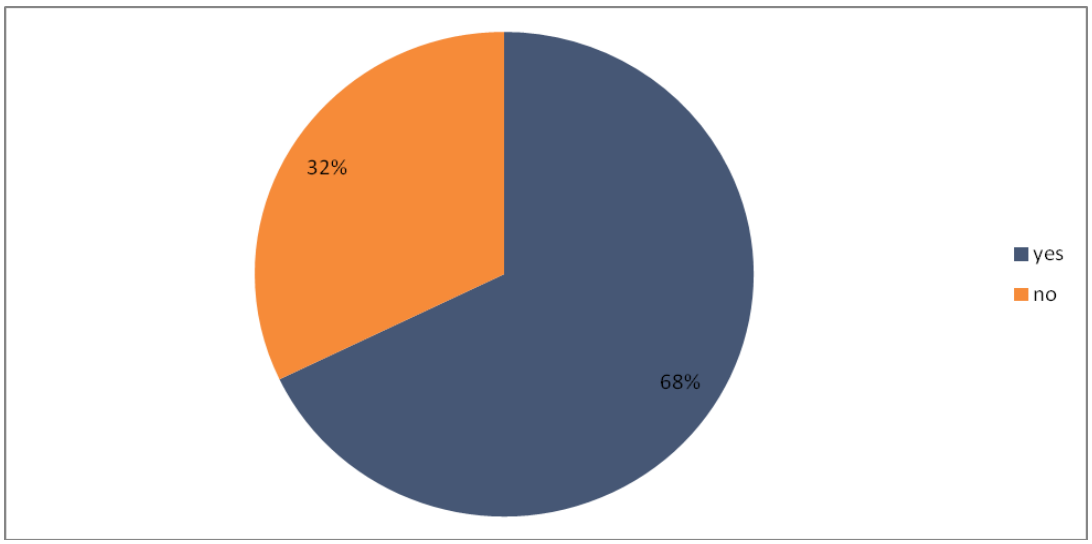
In the NAPs, multiple issues received attention apart from the clearly quantitative targets. The main issues were:

- Residues (11% of citations)
- Worker protection (7.1%)
- Protection of the environment (air, soil, water) (7.1%)
- Other issues (50%)

Under other issues, the following actions in all 28 NAPs have been mentioned:

- Detection of the import and sale of unauthorised PPPs. This includes the illegal distribution and use of plant protection products;
- Biodiversity (monitoring the effects of PPPs and biocides on bees); and
- Developing and implementing strategies to phase out certain active substances.

Figure 5: Does the NAP include clear sections related to each of the Articles 5 to 15 of the SUD?



Source: Core team, 2018

Nineteen NAPs[54] include clear sections related to each of the Articles 5 to 15 of the SUD. In the remaining nine cases, in which the NAPs do not follow the structure of the SUD, the following approach has been undertaken:

- In FR, the sections related to each of the Articles 5 to 15 are contained within the six priority areas of Ecophyto II. Priority area 1 includes: certification for the use of low-risk plant protection measures; training; integrated pest management. Priority area 2 includes: national research and innovation strategy; actions for promotion and transfer. Priority area 3 includes: risk related to the use of pesticides in public areas and monitoring; exposure and risk for professional plant protection product users; harmful substances for human health and biodiversity; information and awareness-raising; indicators. Priority area 4 includes: non-use of plant protection products in gardens, planted spaces and infrastructure; stakeholders' involvement in reducing plant protection product use and encouraging the use of alternative solutions. Priority area 5 includes: integrated pest management; information and awareness-raising at territorial and sectoral level; promotion of exchange of practices and cooperation between overseas departments. Priority area 6 includes: information and awareness-raising (communications across all priority areas) and implementation of the governance structure and financial resources.
- For BE, CZ, and PT, the NAP sections related to each of Articles 5 to 15 are inside the objectives and milestones of the NAP. In these three NAPs, objective 1 addresses limiting the risks associated with the use of PPPs, by including the following topics: human health protection (health effects of the use of plant protection products, including vulnerable areas); water protection; environmental protection (environmental effects of the use of plant protection products including areas of extreme environmental vulnerability). Objective 2 covers optimising the use of PPPs without limiting the scope of agricultural production and the quality of plant products (Integrated pest management). A dedicated section is included on risk indicators (quantitative evaluation performance indicators for the objectives of the NAP).

[54] AT, BG, CY, DE, DK, EE, HR, HU, IT, LT, LU, LV, MT, NL, PL, SE, SI, SK, UK.

- In the case of EL, the requirements for the sale of pesticides (Article 6) are not addressed. Information and awareness-raising (Article 7) is only partially covered under Chapter III on information to the public, but not mentioned in Chapter II on the procedure for granting certificates of knowledge on sustainable use of pesticides. Inspection of equipment (Article 8) is tackled for aerial spraying equipment (Chapter IV) and aerial spraying (Article 9) is tacked only through the inspection of equipment perspective (also in Chapter IV).
- Concerning ES, there is only a reference to the articles of the Directive. Specifically, Article 6 is mentioned in the requirements for sales in measure 6.2 – implementing electronic communication system for product sales. Article 9 on aerial spraying is also not addressed in the NAP.
- In the case of IE, articles covered by specific sections are Articles 5 and 7 (implemented in section 1 of the NAP) and Article 8 (section 2). Article 6 on sales of pesticides is only partially addressed inside section 3 (controls on storage, supply & use) and limited to recording of information during sales; Article 9 and Article 12 are only partially addressed under section 3 and Article 14 under Area 4. Article 11 is not addressed in a dedicated section or through specific actions. There is no section dedicated to risk indicators, however these are discussed in each thematic section.
- In FI's NAP, the requirements for the sale of pesticides (Article 6) are not addressed in a separate section, rather they are only referenced inside the training section. The reduction of pesticide use or risks in specific areas (Article 12) is limited to green areas.
- The RO NAP does not describe Article 6. Article 9 is mentioned in the national legislation, but no action is included in the NAP. Article 11 is mentioned in the section presenting the objectives of the NAP, but does not have a specific section. For Article 15 there is no dedicated section, rather, risk indicators are described under the different sections. In general, there is not a clear division between the sections of the NAP related to the articles of the directive.

Does the NAP refer to additional activities or programmes related to risk reduction or the sustainable use of pesticides which are not related to any of the Articles 5 to 15?

Twenty Members States[55] have reported the presence of additional activities or programmes related to risk reduction which are not related to Articles 5 to 15. The main ones being (by decreasing order of citation):

- Reduction of residues in food and feed;
- Sustainable management of empty packaging and unusable plant protection products;
- Counterfeit products and the designation of anti-fraud strategies;
- Protection of non-target arthropods and bees;
- Post-authorisation control of plant protection products;
- Reduction of pesticide loads in private gardens;
- Adaptation of the legislation to avoid "borderline cases: PPP or/and biocides" or "dual use"; and
- Improvements of the judicial handling of controls.

[55] EE, HR, SI, BE, BG, CZ, DK, EL,ES, FI, HU, IT, LU, LV, MT, SK, DE, PL, FR, UK

Is information communicated by MS on the NAP available on a national public web site?

Twenty-three NAPs clearly indicate the existence of a platform (website) for communication to the national public. On the other hand, the existence of such a platform is not mentioned in the remaining 5 NAPs (AT; BE, LT, PL and SE).

3.2.2. Article 5

Does the NAP provide information on the amount of the organised initial trainings?

In the majority of cases the NAPs do not provide quantitative targets on the amount of organised initial trainings.

Table 9: Number of initial trainings per type of users foreseen in the NAPs

Type of trainings	Yes	No
Professional users	12	16
Advisors	8	20
Distributors	7	21

If included, the NAPs present targets on the training of professional users. These targets may be described in terms of the number of training sessions, the types of training modules and the number of professional users to be trained to be organised per year. However, none of the NAPs, except PL, present a timetable for the training activities along the NAP period, nor the content of the training activities.

With regard to training, only minimum requirements are provided in the NAPs. Some information on the differences between trainings and on the main contents are given, but this is not discussed in any detail. Trainings must include all topics listed in Annex I of the Directive.

Only the HR NAP provides details on the set-up of trainings and their content which reads as follows: *"The new training system consists of initial and additional training and will cover all professional users of pesticides, distributors and advisors taking into account their respective roles and responsibilities. The initial training module includes at least 15 school hours. Training for all those for whom it is compulsory must regularly update their knowledge with additional training within five years of acquiring initial or additional training. The additional module consists of at least five school hours. The training system will cover all areas listed in Annex I of Directive 2009/128/EC, in particular the principles of integrated pest management, the use of pesticide application equipment, the calibration of this equipment, their maintenance, special application techniques and work with the least possible risk to the health of professional users, agricultural workers, other persons, non-target animals and plants, birds, mammals, bees and the environment— including surface and ground waters, the aquatic environment and the health of humans through food containing pesticide residues."*

3.2.3. Article 6

Is information on the requirements for the sale of pesticides included in the NAP?

Information on the requirements for the sale of pesticides is included in 21 NAPs[56]. In most of these NAPs, the description details the obligation for distributors that sell PPPs to end users, including

[56] BG, CY, CZ, DE, DK, EE, FR, HR, HU, IE, IT, LT, LU, LV, MT, NL, PL, PT, SE, SK, UK

internet distributors. Within this, distributors are obligated to have staff available at all times holding a certificate demonstrating they are knowledgeable in the subject areas listed in Annex I of the SUD.

In the case of FR, a trial certification scheme for the use of low-risk plant protection products has been introduced throughout mainland France for a five-year period. This scheme started in 2016. The scheme entails certificates for the use of low-risk plant protection products or actions being awarded for promoting such solutions. Distributors (agriculture cooperatives and traders) are therefore trained to promote the application of recognised low-risk products on farms to reduce the use, risks and impacts of conventional plant protection products. Should distributors fail to comply with the obligation placed upon them under the certification scheme, they shall be liable to pay a penalty at the end of the trial period.

Does the NAP include measures/actions to ensure that pesticides are only sold to professional users?

The majority of NAPs (16 out of 28)[57] include general information on this obligation and contain procedures on how to obtain this certificate. However, none of the NAPs indicate the requirements to be fulfilled in order to receive the certificate for the sale of PPPs.

In CY, the registration number of the holders of a professional user certificates has to be recorded on the invoices.

In DE, each professional user has to present his certificate at the individual sale points and this information is recorded.

In SE, the purchase of PPPs for professional use is severely controlled by distributors which check the identity of the buyer. Although this is a voluntary measure, the majority of PPPs distributors are applying it. In addition, distributors can have access to parts of the Swedish register of authorised professional users to verify that their customers are listed.

UK's NAP mentions that the majority of pesticides for professional use are sold *"on account"*. This implies that the distributor has to know the buyer. If this is not the case, the distributor is required to verify the identity and the potential buyer's right to purchase PPPs.

In FR, as of 1 January 2017, it is no longer possible to purchase PPPs over the counter. Purchase is only possible through an intermediary of a certified vendor.

3.2.4. Article 7

Which actions or measures regarding information and awareness-raising are included in the NAP?

The majority of the other NAPs presents general information on how this obligation is fulfilled. Most communication is done via websites and dedicated web portals and via dedicated communication campaigns (DE, DK, LU, LV, MT, PL).

French authorities implemented a very detailed and complete programme in 2012 based on several communication activities and programmes (such as demonstration activities, conferences, newsletter, web platforms, workshops, diffusion of videos and media campaigns) and the creation of an

[57] BG, CY, CZ, DK, EE, ES, HR, HU, LU, LV, LT, MT, NL, PL, SE, and SK

observatory of agricultural practices and experimental stations. In addition, agreements for reducing the use of pesticides and research activities have been established. According to Ecophyto II, actions or measures regarding information and awareness-raising include:

- Raising awareness of the risks related to plant protection products and their environmental and health impacts (including indirect and long-term impacts, the effects of combinations and low doses, their endocrine disrupting properties etc.). Awareness raising also extends to exposure pathways and determinants as well as mechanisms involved in regulating potential harmful effects.
- Initiating a positive and constructive public debate on the issue of plant protection products.
- Showcasing the regional level as a source of experience and a focal point for information dissemination and knowledge transfer;
- Development of the crop health newsletter, which will be promoted as an information source, and supplemented by the presentation of alternative control methods and prophylactic measures.
- Development of EcophytoPIC portal for sharing documents setting out the results of the plan, the organisation of national or regional events, data sharing and the creation of decision-making tools;
- Promotional activities to raise awareness of the results of research programmes on the environmental and health impacts of plant protection products among those working on the ground, public authorities and training sectors.

Do the NAPs mention that methods are in place for collecting information on pesticide acute poisoning incidents and chronic poisoning developments?

Ten NAPs[58] indicate that methods are in place to collect information on acute poisoning incidents and eight[59] on chronic poisoning developments.

Seven other MS (BG, CZ, LV, LU, MT, PL, and SL) indicate that national competent authorities have an objective of creating a centre aiming at recording acute poisoning incidents and chronic poisoning developments.

Table 10: Relevant actors and methods in place to collect information on acute poisoning incidents and on chronic poisoning developments included in the NAPs

MS	Acute poisoning incidents	Chronic poisoning developments
AT	No information included in the NAP	
BE	Human biomonitoring in Flanders (3 consecutive plans from 2002 to 2015). Nothing in Wallonia. The SUD *"provides for the drafting of strategic guidelines on how to monitor and study the effects of pesticide use on human health and the environment"* (NAPAN Task Force, 2014). This document was not yet available at the time of writing of the NAP.	The NAP refers to the intended development of a framework by taking into consideration the *"understanding of the complex issue of chronic intoxication and allowing for itemization of the priorities (monitoring, prevention, etc.), based on the developments at the (European) international level as well as on the target groups and active substances."* (NAPAN Task Force, 2014).

[58] BE, CY, DE, EE, EL, ES, FR, IT, SK, and SE.

[59] BE, CY, EL, ES, FR, IT, SK, and SE.

MS	Acute poisoning incidents	Chronic poisoning developments
BG	Authorities have the objective to create a centre aiming at recording acute poisoning incidents and chronic poisoning developments	
CY	The medical and public health services have to gather information on such developments and forward all information to the NCA annually. Further assessment and development of measures to avoid future incidents is done in cooperation between NCA and medical and public health services.	
CZ	Authorities have the objective of creating a centre aiming at recording acute poisoning incidents and chronic poisoning developments	
DE	There is a national poisoning incidence centre at the Federal Institute for Risk Assessment. Medical practitioners are obliged to report suspected cases of poisonings (§16e German Chemicals Act). Currently there is a new system under construction to collect information based on a European harmonized reporting system which in the future would allow more systematic assessments.	No information included in the NAP
DK	No information included in the NAP	
EE	The Poisoning Information Centre has to collect and maintain up to date information on poisoning based on calls made to their centre.	No information included in the NAP
EL	Methods for collecting information are not mentioned. However, under Article 21 of the NAP the organisation of training programs is planned with the participation of pesticide authorisation holders, local authorities, agricultural doctors and/or doctors employed at local hospitals who are expected to be the first to treat the incidents caused by pesticide exposure.	Methods for collecting information are not described and the issue of chronic poisoning is not mentioned in the NAP
ES	The NAP foresee the *"set up of a health information system making it possible to determine the number of cases related to health risks arising from exposure to plant protection products. This system is based on three subsystems:* *- Information handled using the rapid chemical information exchange system of the national chemical monitoring, inspection and control network.* *- Information provided by the Spanish national institute of toxicology and forensic science on call-centre queries related to the use of pesticides.* *- Information on cases treated in accident and emergency departments and intensive care wards related to the exposure to or contact with plant protection products"* (Government of Spain, Ministry of Agriculture and Fisheries, Food and the Environment, 2017).	
FI	No information included in the NAP	
FR	The French Institute for Public Health Surveillance is in charge of coordinating a national toxicovigilance system. This system monitors the toxic effects of harmful substances and reports on chronic and acute poisoning incidents. The data is to be made available to public.	

MS	Acute poisoning incidents	Chronic poisoning developments
HR	Measure 3 covers the following: publishing data on acute poisoning and chronic poisoning, if available for *"groups that are regularly exposed to pesticides, such as operators, agricultural workers or persons living near areas where pesticides are intensively used"*. Measure 4 covers the following: *"during the project to build a system to monitor cases of poisoning, which is envisaged to become operational in 2014, the Ministry of Health will ensure that cases of poisoning with plant protection products are adequately monitored, for the purpose of planning further education for users and for improving human health and protection."* (Republic of Croatia, Government of the Republic of Croatia, Ministry of Agriculture, 2013) Of note, Croatia does not presently have a national information system for monitoring cases of poisoning. Nonetheless, a few health care institutions do monitor the numbers and collect information on poisoning cases. A project intending to harmonise the currently fragmented approach is underway. Apart from the endeavour of those health care centres, relevant information on the frequency of acute poisoning with pesticides are recorded in the annual reports of the Centre for Poison Control.	
HU	Operation of monitoring for mapping and documenting the poisoning incidents caused by exposure to plant protection products (also taking into consideration the Wildlife Poisoning Database coordinated by MME/BirdLife Hungary); Identification of the number of poisoning cases affecting the animal species protected by law as a result of improper use of plant protection products or of illegal use of plant protection products	
IE	No information included in the NAP	
IT	It is the role of the NCA, supported by a special committee, to set up a control plan structuring the collection, classification and analysis of information on acute pesticide intoxication cases. The National Information System for Acute Pesticide Intoxication Monitoring (SIN-SIAP), handled by the National Health Institute (Istituto Superiore di Sanità – ISS), ensures the provision of relevant data. The data gathered in the national information system is reported in a standardised manner by several key actors such as the Anti-poisoning Centres (Centri Antiveleni – CAV), Local Health Authorities, and other public agencies.	The main public health agency (Institute Superiore di Sanita), assisted by other relevant authorities, is in charge of evaluating the quality of the information reported in the national information system, comparing the information stemming from different sources and analysing pesticide exposure data. The health agency publicly discloses its monitoring activities in an annual report which comprises of national-level analysis that can also be examined at the regional scale. The National information system is also intended to be used for the scrutiny of emerging issues.
LT	No information is included in the NAP, apart from a statement that the Health Emergency Situations Centre (Ministry of Health) is responsible for collecting information on such cases.	
LU	Authorities have the objective to create a centre aiming at recording acute poisoning incidents and chronic poisoning developments. A grand-ducal regulation formalising all of the relevant measures and procedures is foreseen to be adopted during 2014.	
LV	Authorities have the objective of creating a centre aiming at recording acute poisoning incidents and chronic poisoning developments.	
MT	Authorities have the objective of creating a centre aiming at recording acute poisoning incidents and chronic poisoning developments.	
NL	No information is explicitly mentioned in the NAP	

MS	Acute poisoning incidents	Chronic poisoning developments
PL	Authorities have the objective of creating a centre aiming at recording acute poisoning incidents and chronic poisoning developments.	
PT	No information is included in the NAP	
RO	No information is included in the NAP	
SK	The Ministry of Health of the Slovak Republic, pursuant to Act No 576/2004 on health care, services related to health care and amending certain laws has issued an Expert Guideline on the Method for Reporting and Recording Poisoning (No 107). According to this guideline all cases of poisoning must be reported to the National Toxicological Information Centre, including those caused by pesticides or biocides.	
SL	Authorities have the objective of creating a centre aiming at recording acute poisoning incidents and chronic poisoning developments.	
SE	Information on the risks, symptoms and treatment of acute poisoning caused by medicines, chemical substances, plants, fungi and animals is collected by the poisons information centres (which are under the supervision of the Medical Product Agency). The data base contains information on almost 100 000 chemical products, including PPPs. In cases of poisoning, the procedure is two-step. First, the Swedish health service request information on the appropriate treatment approach to the poisons information centres. Second, the centres update their information database and maintain statistics on these poisoning cases.	
UK	No information is included in the NAP	

Source: Core team, 2018

3.2.5. Article 8

Does the NAP include information related to inspection of equipment of use?

All 28 NAPs include information related to inspection of equipment of use. However, 10 NAPs do not include clear timelines and planning.[60] The other 18 NAPs cover the respective provisions in other pieces of legislation. For example, in DE inspections of pesticide application equipment have a long history (since 1993) and the NAP refers to the German Plant Protection Act and the Ordinance for Inspections of Pesticide Application Equipment, where the inspection intervals and requirements are regulated.

A few NAPs (BE, CY and MT) indicate that new protocols have to be developed in cases of newly marketed equipment (e.g. devices intended for ultra-low volume applications, foggers, and devices for the application of a PPP as a solid substance and drones).

3.2.6. Article 9

Does the NAP include information regarding an aerial spraying ban and possible derogations?

Information on aerial spraying is included in 22 NAPs (not included for CZ, DK, EE, EL, ES and RO). In DK, aerial spraying has been restricted since 1981 and no derogations have been given for the last 20 years.

[60] BE, CY, CZ, EE, EL, FI, RO, SE, SI,UK.

Only two NAPs explicitly indicate that aerial spraying is forbidden (HR and the NL). In the NL, the Ministry of Economic Affairs can provide exceptions in emergency situations as long as there is a specific need for the application (in accordance with the Directive).

All other NAPs present information and conditions under which derogations may be granted. For example, in CY, the department of Agriculture must define the conditions under which aerial spraying can be conducted. Aerial spraying, in general, can only be permitted when there are no feasible alternatives. A number of information actions addressing residents and various authorities are in place.

In DE, details for derogations are included in the German Plant Protection Act § 18 and an additional Ordinance. Derogations are only granted based on case-by-case decisions. In steep slope vineyards and forestry, derogations are only permitted with PPPs especially authorised for aerial application.

According to the Italian NAP, *"the aerial application of pesticides is prohibited. Derogations may be granted, for ordinary pest management or to tackle a pest emergency, but only where there are no other viable alternatives or when aerial spraying affords clear advantages in terms of reduced impacts on human health and the environment compared to other spraying methods"* (ENEA, 2012).

In LT, aerial spraying is in principle forbidden, however derogations are possible. The NAP highlights that the conditions for the aerial application of plant protection products had been introduced in Latvia before the directive entered into force.

In PT, the NAP does not mention that aerial spraying is forbidden. It refers to *"monitoring and control of the aerial application of PPPs"*. The NAP states that *"the aerial application of plant protection products in Portugal is a common practice for large-scale crops such as cereals, maize, rice and some vegetable crops, such as tomato."* (Ministry for Agriculture, the Sea, the Environment and Regional Planning, 2013)

For UK, the NAP reports information on aerial spraying, highlighting that aerial application of pesticides is not extensive in the Kingdom. Aerial spraying operators must comply with aviation legislation. Therefore, *"the UK Aerial Application Association has developed Operating Standards to advise operators how they can demonstrate due diligence in complying with their legal requirements"* (Defra, 2013)..

Finally, the French NAP indicates that the Ecophyto I reports that it is necessary to identify sustainable alternatives to aerial treatment. Importantly, it is highlighted that those alternative also need to be affordable for growers. Aerial spraying is prohibited in France, expect in the case of major health hazard. Ecophyto II reports some limited information on aerial spraying concerning derogations.

With regard to information related to the decisions that derogations to aerial spraying have been granted, the following can be reported:

In FR, the NAP reports that the government has removed certain derogations for the aerial application of PPPs under the Order of 19 September 2014.

In SE, it is reported that derogations have been granted in exceptional cases. The cases of aerial spraying *"have been restrictive and have been limited to biological products (Bacillus thuringiensis). Exemptions have been granted for spraying of plant protection products against Bordered White butterfly in Hökensås in 1997 and Black Arches in Skåne in 1998) and biocidal products (mosquitoes in the lower Dal River area during the 2000s)"*. (Ministry for Rural Affairs, 2013).

No other information has been reported for other MS..

3.2.7. Article 10

Is information targeting people who could be exposed to pesticide spray drift included in the NAP?

Nineteen NAPs[61] include information concerning targeting people who could be exposed to pesticide spray drift. There is no information in NAPs from AT, BE, DE, EE, ES, LV, PT, RO, and SE. Of the nineteen NAPs including information, most of it is rather generic. Nonetheless, a few measures have been reported:

- In FR, the NAP reports that necessary provisions will be implemented for the full application of measures to prevent drift of PPPs and for the establishment of tailored treatment dates and times to help avoid vulnerable individuals being present during the treatment process. In addition, where these measures cannot be implemented, the prefect (local authority) will set a minimum spraying distance to be strictly respected.
- In EL, national legislation states that professional users are obliged to inform, in writing, the residents, professionals and permanent region visitors in case of possible exposure to spray drift at least 48 hours before application.
- The same applies in IT, where the authorised party, acting through the municipalities concerned, must disseminate information and give a 48-hour notice period for each application on the aerial spraying to the general public concerned. This includes posting *"an appropriate number of spray signs at suitable locations to ensure that the public receives appropriate information. The signs shall advise the public of the aerial spraying period, the areas concerned, the pesticides used and the date when the area will be safe for re-entry"* (ENEA, 2013).

In LU, the government considers paying subsidies only to those operators having spraying equipment fitted with anti-drift nozzles and using a system for automatic rinsing of the spray liquid tank.

The Health Council of the Netherlands issues advisory opinions on the possible health risks for residents and passers-by. As in the United Kingdom, a "Neighbourhood Initiative" is launched, to promote good communications between farms and local residents, as well as mutual understanding between farmers, local residents, and passers-by. This initiative is supported by pesticides producers, agri-sector organisations, and other stakeholders.

3.2.8. Article 11

Is information on the specific and dedicated measures to protect the aquatic environment and drinking water included in the NAP?

Information on the specific and dedicated measures to protect the aquatic environment and drinking water is included in 25 NAPs (not in IE, PL and RO) but only 19 NAPs indicate how these measures are coordinated with the national water management plan adopted to implement Directive 2000/60/EC[62]. This degree of information is not included in the AT, CY, EL, FI; IE, LT, PL, RO, and SE NAPs.

In FR, the Ecophyto I aimed to set up initiatives for pesticides reduction at the regional or at the unit of land level, in particular via the development of specific water authority programmes. Ecophyto II reports that multidisciplinary research will be carried out to assess the impacts of water pollution

[61] BG, CY, CZ, DE, EL, FI, FR, HR, HU, IE, IT, LT, LU, MT, NL, PL, SI, SK and the UK

[62] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy

linked to the use of PPPs. In particular, special attention will be paid to monitoring herbicidal substances in water. This is undertake in addition to the monitoring of other active substance categories. The work conducted on water-based monitoring methods for improved water indicator reliability is used as the foundation for these efforts. The Ecophyto II will establish a plant pharmacovigilance mechanism in order to monitor the adverse effects of plant protection products on water, and on the development of resistance to these products. The role of the plant pharmacovigilance mechanism with further be to alert the NCAs where adverse effects appear to require specific management measures.

In BE, *"harmonisation of the methods, standards and reports regarding contamination by PPP of (surface and underground) water bodies at a regional and national level"* is mentioned in the NAP. The Flemish Parliament Decree on Integrated Water Policy and the subsequent river basin management plans are presently of utmost relevance. *"However, a de-phasing exists with the river basin management plans. That is why a mid-term evaluation was carried out for this plan of the measures concerning pesticides, which were subsequently adjusted, if required. The measures in the programme of measures for the river basin management plans were evaluated in terms of their effectiveness and relevance for this plan. This plan examines, among other things, the desirability and/or feasibility to make certain measures (which are currently voluntary) mandatory in order to achieve the objectives of the Water Framework Directive 2000/60/EC and the SUD. The plan also aims at improving the enforcement of existing legislation, in particular with regard to the safeguarding of buffer zones in agricultural and horticultural activities along watercourses."* (NAPAN Task Force, 2014).

In Wallonia, *"a buffer zone is maintained outside of crop areas and grasslands alongside surface waters over a minimum width of six metres from the peak of the bank, and which may not be less than the zone defined in the approval certificate for each pesticide"*. These buffer zones are also set *"alongside paved land not suitable for crops (impermeable surfaces or surfaces with low permeability, such as roads, pavements, paving, gravel, etc.) connected to a rainwater collection system (e.g.: grid, downpipe, water trickle, etc.) with a width of one meter"*. In addition, *"the application of plant protection products is prohibited on paved land not suitable for crops (impermeable surfaces or surfaces with low permeability such as roads, pavements, paving, gravel, etc.) connected to a rainwater collection system or directly to surface water"*. From 1st June 2019, managers of public areas (municipalities, authorities, etc.) must manage their allocated areas without using PPPs. Very few exemptions will be granted. (NAPAN Task Force, 2014).

Several NAPs present various buffer zones/safety zones under national laws as well as buffer zones indicated on the PPPs have to be obeyed (CY, DE, DK, EE, FI, LT, LU, and MT).

The Swedish NAP indicates that *"the Swedish legislation includes a ban on using plant protection products without a licence in water catchment protection areas. The ban also appears in water protection regulations which apply to water catchment protection areas"*. The NAP adds that in *"the proposal for an ordinance circulated for consultation by the Swedish Government, there is a requirement for a licence to apply plant protection products on highly permeable surfaces and other infrastructure close to surface water or groundwater and on impervious surfaces with a high risk of run-off into surface water or sewage systems. Licences are granted by the municipal executive board. The municipal executive board must be notified of plans to apply plant protection products along roads and railways. The proposal also includes a provision which requires people considering using PPPs as part of their business to give preference to products which are not dangerous to the aquatic environment."* (Ministry for Rural Affairs, 2013)

3.2.9. Article 12

Is information on the reduction of pesticide use or risks in specific areas included in the NAP?

All NAPs, apart from PT, provide information on the reduction of pesticide use or risks in specific areas included in the NAP.

An extensive programme has been set-up in the Ecophyto II programme in France contributing to this topic. The NAP will establish *"a plant pharmacovigilance mechanism"* to *"monitor the adverse effects of plant protection products on humans, livestock, including the honey bee, crops, biodiversity, wildlife, soil, on air and food quality, and on the development of resistance to these products, and to alert the competent authorities where adverse effects appear to require specific management measures"*. (Ministère de l'Agriculture, de l'Agroalimentaire et de la Forêt, 2015).

The CZ NAP reports information on the reduction of pesticide use or risks in specific areas, specifically concerning the implementation of measures to reduce the risks to the general public related to the use of PPPs in these areas. The NAP reports the following implementation measures: 1) *"Improve mutual awareness among users of PP products, nature conservation authorities, plant health care authorities and the public"*, 2) *"set up a system of professional guidance on plant protection"*, 3) *"propose legislative measures to reduce the risks associated with the use of PP products and a system of control to protect the environment and conserve biodiversity"*, 4) *"harmonise the controls systems of the states administrative bodies"*. (Ministry of Agriculture, 2012).

In Lithuania, the NAP indicates that the use of PPPs in public areas is banned. Laws on plant protection provide restrictions on use in specific areas. The pubic has to be informed if PPPs are applied to areas designated for public use, recreational land, land for commercial use or land with family residential buildings or student residences.

According to the Italian NAP, *"it is necessary to reduce the use of pesticides or the risks associated with their use in the areas used by the general public by using non-chemical alternatives (mechanical, physical or biological control methods)"* (ENEA, 2013). Furthermore, the NAP addresses reducing doses of PPPs and employing spraying equipment and methods minimising pesticide exposure in the surrounding environment. Finally, the NAP states that it is necessary to apply biodiversity protection measures in Natura 2000 sites and protected nature areas.

In BE, the federal plan includes a proposal aiming at reducing exposure to PPPs among citizens living close to locations of application after the development of a feasibility study.

The NL NAP indicates that transboundary measures are discussed with other MS.

3.2.10. Article 13

Is information on handling and storage of pesticides and treatment of their packaging included in the NAP?

All 28 MS, except AT, have provided information on handling and storage of pesticides and on the treatment of their packaging and remnants in the NAP.

The following good practices are included the NAPs:

- In BE, 3 complementary projects are in place. "PhytEauWal is specialised in the design, installation and follow-up of biofilters and phytobacs". In addition, the programme "can offer specific advice and services for professional users in relation to the storage and handling of products as well as the elimination of their residue on the operating site itself". "PhytofarRecover coordinates the collection of empty plant protect products

packaging and unusable plant protection products from all professional users of plant protection products for agricultural usage". Finally, "PreventAgri aims to ensure the awareness of actors in the green sector of health and safety in the workplace" (NAPAN Task Force, 2014).

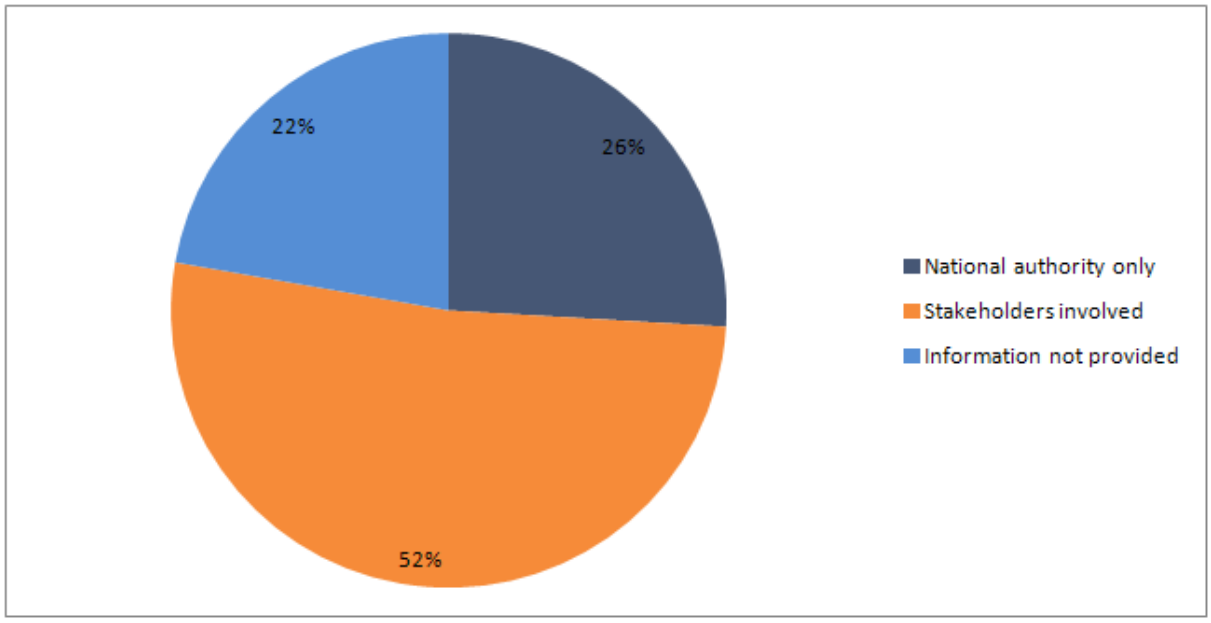
- In DE, the industry has established a voluntary collection system (PAMIRA) for collecting empty containers of PPPs but also empty containers of fluid fertilizers. Via another system, pre-obsolete and expired PPP and PPP remnants are collected.

3.2.11. Article 14

Does the NAP include detailed information with regard to IPM obligations?

All MS NAPs include detailed information with regard to IPM obligations with the exception of the BG and SK NAPs. In these two NAPs, it is indicated that the general IPM obligations are set out for practical use. Further details are however presented in voluntary guidelines.

Figure 6: Who has participated in the development of the IPM guidelines?



Source: Core team, 2018

IPM guidelines have been developed by authorities in 7 MS (BE, BG, IT, LV, MT, PL, and SE). In 14 MS (AT, CY, CZ, DE, DK, EE, ES, FR, HR, HU, LU, NL, PT and the UK) stakeholders have been involved in the development of IPM guidelines. However, the list or types of stakeholders involved in the activity is not indicated for 7 MS (EL, FI, IE, LT, RO, SI, and SK).

It is worth mentioning that in DK an IPM task force was set up with representatives from key stakeholders, research institutions and relevant authorities. Among other aspects, the task force has examined how IPM has been implemented in neighbouring MS and has established an overview of existing and emerging alternative pest control methods, including microbiological control methods. Building on the work of the IPM task force, decisions will be taken in 2018 on future IPM efforts. In DK, advisory services are the main actors in charge of providing extensive advice on the available methods of IPM.

Moreover, Germany has adopted a unique approach as the guidelines are developed by grower organisation with the support of the Federal Research Centre on Cultivated Plants. The approach was

considered as being the best way to gain great acceptance and support in the implementation of the guidelines by the growers.

The Bulgarian Food Safety Agency (BFSA) publishes practical notices providing information on the appearance and spread of agricultural pests which may have a significant economic impact. Effective ways to address these issues are also reported. The informative bulletins contain information on the biology, phenology and control of economically significant pests within a given region.

In FR, the dissemination of innovative, low-risk plant protection product practices is currently carried out through the DEPHY network[63]. The DEPHY network will serve as an initial foundation, by sharing knowledge gained on supporting farmers in reducing the use, risks and impacts of plant protection products and on the engineering aspect of the role of the network engineer.

Seven MS provide compulsory training on IPM (AT, DE, HU, PL, SE, SI and the UK).

Several voluntary CAP instruments, which can be used to help funding activities, mainly IPM, are mentioned in 14 NAPs. In the CZ NAP, the development of plant protection advisory services is to be planned for incorporation into the National Rural Development Programme for 2014–2020. These services are to be developed on an analysis of existing national systems of agricultural advisory services, prompting the identification of effectiveness for use in the field of IPM. Other NAP actions in several MS (BE, CZ, FR, HR, HU, IT, LV, MT, SE) link in with some of the provisions of the CAP, particularly those related to agro-environmental climate measures. In these cases, more robust and resilient crop systems and operating models featuring an integrated approach to the PPP issue is most often discussed.

National funds are mentioned in 2 NAPs (BE and UK). In Flanders, IPM is developed through aid from the Flemish Agricultural Investment Fund. In UK, Assured Food Standards Schemes impose on PPPs users to carry out activities which are consistent with the IPM principles. Specific standards are established for individual crops. The UK Woodland Assurance Scheme and the Forestry Commission's Practical Guide to Reducing Pesticide Use in Forestry are two British examples of initiatives fostering practices in line with the Directive's provisions and national legislations, in particular concerning the implementation of effective IPM strategies.

There are references to the promotion of research projects targeted at biological control in the some of the NAPs. However, this is only addressed in a general manner without any reference to funding tools, methods, or timing. The AT NAP, for example, mentions an interest in developing IPM measures through the European Innovation Partnerships (EIP).

Research support is described in greater detail in DK where research projects are put in place in order to promote the development of alternative pest control and pest prevention methods. Prevention of pesticide resistance and the continued development of IPM are also a focal point. Moreover, research is carried out to launch "bottom-line analyses" outlining the opportunities associated with the optimal use of existing technologies. This can include for example smart spray technologies and precision spraying, IT technology, mechanical control using precision equipment, and combined mechanical and chemical weed control. The public-private partnership is expected to promote exports of Danish environmental technology solutions.

In FR, research initiatives on the design, testing and development of alternative PPP techniques offering sound economic, environmental and social performance are carried out. This ambition is re-

[63] DEPHY network consists of 3000 farms that work in developing new practices in crop rotation on a crop by crop basis.

alised through specific trial platforms and the reinforcement of the DEPHY EXPE network. In particular, this includes participatory research actions connected with the DEPHY EXPE network[64] and innovation networks which are planned as of 2018. A co-financed research programme concerns CASDAR – a special fund for agricultural and rural development – programmes for *"Innovation and partnership", "Seeds and plant selection"* and *"Technological research",* coordinated by the Ministry for Agriculture.

The HU NAP also mentions research programmes and indicates that support of the participation in international research programs and co-operations (IOBC, ENDURE, EUPHRESCO) is foreseen. However no date is mentioned in the NAP.

Another concrete example is provided in the SE NAP. The Swedish Government has commissioned the Swedish Research Council for supporting *"research into the environment, agricultural sciences and spatial planning, to produce a knowledge overview and to carry out a survey of ongoing research and development in the field of plant protection"* (Ministry for Rural Affairs, 2013). On the basis of this, the Swedish Research Council is to identify the need for research and development in the promotion of sustainable and long-term oriented agricultural, forestry and horticultural production. The scope of the investigation shall include new and existing harmful organisms to provide a comprehensive view on the research and development needs for IPM.

Finally, in UK, the CRD steers a Defra-funded pesticides R&D programme which features a now well-established programme specialised in reducing reliance on chemical pesticides by developing low-risk novel alternative technologies.

Twelve NAPs[65] included dedicated measures addressing the development of the use of biocontrol products. However, this was mainly discussed in general terms.

The French NAP Ecophyto II presents the following measures concerning bio-control:

- Greater assistance for marketing authorisation requests that concern innovative bio-control product applications;
- Dissemination and integration of innovative or emerging bio-control solutions into crop systems, on a voluntary basis;
- Development of a list of bio-control products no later than 1 January 2016, then widely distributed and regularly updated;
- Promotion of the "Healthy land – Pesticide-free municipalities" process, which identifies local communities that no longer use plant protection products, in order to move all communities towards the substitution of plant protection products, while also promoting the use of bio-control products;
- Support for the development of bio-control solutions for high-input consumption sectors, and for facilitating "orphan" treatments, for which no explicit authorisation is available, and identifying bio-control solutions – of which there are currently few – for weed management, including invasive species of concern to agriculture, biodiversity and health.
- To support the use of these solutions, their use will be recognised as an action entitling the user to low-risk PPP certification.

The HU NAP proposes to simplify procedures of authorisation of macro and microorganisms used for biological control. Such simplifications may allow for a better alignment of the authorisations

[64] The DELPHY EXPE network is a network of experimental sites that are testing low-risk alternatives to PPPs.

[65] BE, SE, CZ, DK, FI, HU, LU, LV, SK, UK, DE, FR

provided with the IPM programmes. The NAP mentions that it will support the development and licensing of the tools and equipment used for trapping or repelling predatory pests. Through this initiative, such tools and equipment shall also be integrated into the plant protection programs in order to foster their use. However, no mention of the details of this approach are included.

Eight NAPs (AT, CZ, DE, DK, FR, HU, IT, and LV) include a clear *"roadmap"* on how IPM will be further developed. The UK indicates its objective to develop this immediately after the release of the initial NAP.

3.2.12. Article 15

Does the NAP include information on risk indicators?

All NAPs include various indicators ranging from generic, and those without targets or measurements, to more sophisticated indicators. The only exception is the CY NAP which mentions that indicators have to be developed at EU level.

Examples of descriptive indicators could be found in the SK and LV NAPs, for example. The only indicators presented and even implemented in the SK NAP are on the volume of PPP used. According to the LV NAP, the collection of statistical data on PPPs is supposed to be put in place between the years 2013-2015. Information on the usage of PPP (dosages, frequency, stage of crop development) and crop production (areas occupied by particular crops and location), will be used to determine, with the software developed during the HAIR project, the load that certain PPPs exert on specific crops.

On the other hand, several NAPs (FI, DK, DE, and FR) indicate that models of risk indicators have been developed. For example, there is a section dedicated to indicators in the FI NAP in which it is affirmed that the Finnish Environment Institute (SYKE) has developed a risk indicator calculation model for the environmental load of PPPs.

The FI NAP also states that indicators should be implemented once the EU Member States have reached an agreement on the most viable indicators for use at the EU level. Neither indicators on the implementation of the NAP nor risk indicators are listed.

The German NAP includes a number of indicators ranging from evaluation of general trends to specific risk models (e.g. SYNOPS). All indicators are summarized in the German Plant Protection Index (PIX).

The Danish NAP informs on the use of the Pesticide Load Indicator (PLI) as a measure of assessing the potential pesticide load on human health, nature and groundwater. DK has had a pesticide tax in place for a long period of time, which was changed in July 2013, so that pesticides causing the highest load became more expensive.

The French Ecophyto II plan reports on indicators that are mainly linked to risks and impacts on human health and the environment. Further indicators cover the development and introduction of IPM and of alternative low-risk plant protection techniques. Indicators that provide information on health and climate as well as crop rotation and yields, will also be collected for each marketing year to provide important context information on the use of PPPs.

The following table provides information on the indicators described in the NAPs. An X included in the table means the information is included, the information in the brackets indicates that the indicators are mentioned in the NAP, however details are not provided. The empty cells means that no information is reported in the NAPs. Into brackets, the name of the selected indicators are mentioned.

Table 11: Indicators reported in the NAPs

MS	Indicators to measure progress in implementing IPM	Indicators to measure reduction of use	Indicators to measure reduction of risk as regards human health	Indicators to measure reduction of risk as regards to water protection	Indicators to measure reduction of other risks as regards respect of the environment
AT	X		X	X	
BE					
BG	X		X	X	X
CY	X	X	X		X
CZ	X	X	X	X	X
DE	X	X (Treatment Index)	X (MRLs)	X (SYNOPS)	X (SYNOPS, SPEAR)
DK	X	X (The treatment frequency index -TFI)	X (Pesticide Load Indicator-PLI)	X (Pesticide Load Indicator-PLI)	X (Pesticide Load Indicator-PLI)
EE	X	X	X		X
EL	X		X		
ES	X		X		
FI					
FR	X	X (Summary indicator – no acronym)	X (Summary indicator – no acronym)	X (Summary indicator – no acronym)	X (Summary indicator – no acronym)
HR		X	X	X	X
HU	X	X	X	X	X
IE	X			X	X
IT	X	X	X	X	
LV					
LT		X	X		X
LU	X	X (NODU)	X	X (PESTEAUX)	X
MT			X	X	X
NL				X (HAIR 2020–NMI-3)	
PL		X	X	X	X
PT					
RO	X		X		X
SK		X			
SL	X	X	X	X	X
SE	X (National risk index and the toxicity index)	X (National risk index and the toxicity index)	X (National Risk Index)	X (the toxicity index)	X (National Risk Index)
UK	X	X (headline indicator)		X (headline indicator)	X

Source: Core team, 2018

3.3. Conclusions of NAP review

Considering that the NAPs are required to address the provisions of Directive 2009/128/EC, it is not surprising that all 28 NAPs have various similarities. Conversely, there are also major differences observed, which partly reflect that health and environmental management issues in pesticides use are viewed and approached differently across the MS.

It is expected that the initial NAPs should be in effect for 5 years, with a review scheduled at the end of this period. However, for 9 MS no indication is given on the duration, or expected review period, of the NAP. In DK, the NAP was revised after 3 years, and at this stage a new 5-year NAP was developed. In FR, the first NAP, dating back to 2008, was replaced by a revised NAP in 2015. In more than 50% of the MS, stakeholders were voluntarily involved in the development of the NAPs, but in at least 5 MS the authorities were solely responsible for drafting the NAP. The implementation of the NAP was, in most MS, the responsibility of the national authorities. With regard to the budget associated with the implementation of the NAPs, major differences were observed. These ranged from not allocating any funding (or at least not providing this information in the NAP), to reallocating funding from national rural development programmes, and through to allocating earmarked national funding for NAP implementation. FR tops this list, of the countries including this information in their NAP, with EUR 71 million allocated annually.

According to Article 4, MS are expected to set quantitative targets for reducing pesticide risk, impact and use. However, only 6 MS have done so in their NAPs. The other 22 MS have instead defined targets relating to pesticide residues in food and feed, pesticide use in private gardens, worker protection, handling of empty packaging and obsolete/non-used PPPs, as well as protection of specific environmental compartments (air, water or soil).

The majority of the NAPs include clear sections individually addressing Articles 5 to 15. On the other hand, a smaller number of MS have instead have incorporated the requirements listed in Articles 5 to 15 into defined *"priority areas"* or *"objectives and milestones"*.

Some MS did not address Article 6 relating to the education of persons selling and using pesticides but, nonetheless, 23 MS did. For instance, French vendors of pesticides are now required to promote low-risk plant protection solutions, and in the future will be fined if they do not meet their quota for low-risk PPPs.

Article 7, on information and awareness-raising, is addressed in very general terms through websites and communication campaigns. Again, FR represents an interesting example having set in place a very ambitious plan addressing both the end-users of PPPs and the public. 19 MS have established systems for collecting information on acute and/or chronic pesticide poisoning incidents.

Inspection of pesticide application equipment for professional use is a requirement, listed in Article 8. This is in place in all 28 NAPs, however, the timeline for inspections is not always mentioned.

Information on the regulation of aerial spraying (Article 9) is available in the NAPs of 23 MS. For some of the remaining MS, aerial spraying was restricted before Directive 2009/128/EC went into force and has therefore received little attention in the NAP. Typically, aerial spraying is either forbidden (with the possibility to apply for derogations in emergency situations) or restricted to specific conditions.

MS were also encouraged to incorporate mechanisms to inform persons who could be exposed to spray drift. In 20 MS this issue in addressed in the NAP, but in most cases in a very generic format. Only the NAPs of FR, EL and IT contain more detailed information on how exposure of neighbours

and by-standers should be avoided. In the NL, the authorities will issue opinions on health risks and, in UK, a *"neighbourhood initiative"* was launched.

Article 11 enables MS to *install appropriate measures to protect the aquatic environment and drinking water supplies from exposure to pesticides*. Nearly all MS (26 out of 28) have done so in their NAP, but only 19 report how these initiatives are coordinated within their national water management plan (under Directive 2000/60/EC). Buffer zones are the most common measure introduced in MS, but more regional initiatives have also taken place. For example, this can been the case in BE and FR. In SE, the use of pesticides in water catchment protection areas is only possible for holders of a special license. Similarly, all MS, with the exception of PT, included information on the reduction of pesticide use in specific areas (Article 12) in their NAPs. In FR, the ambition is to monitor the adverse effects of pesticides on a wide range of non-target organisms and to use this information as an early warning system.

All MS provided, as requested in Directive 2009/128/EC, information on the handling and storage of pesticides and pesticide packaging. In most cases these initiatives only included professional users of pesticides.

Information on IPM was included in all NAPs except for BG and SK. In the first versions of the NAPs, only general information on IPM was required while more specific information such as IPM guidelines was supposed to be included by the end of 2014. In 50% of the MS, the IPM guidelines were developed in collaboration with stakeholders, while the authorities were solely responsible in 25% of the MS. Apart from fulfilling the formal requirements; many MS have taken special initiatives to ensure the implementation of IPM. In DK, for example, an IPM task-force with representatives from the authorities, research, advisory service and other stakeholders produced a list of IPM initiatives. Their recommendations are to be incorporated in the next revision of the NAP. In FR, the DEPHY network, with more than 3,000 farms, is the main driver of IPM implementation by serving the function of "role models". Another element is IPM training, which is compulsory in 7 MS. In some MS funding is available for research and advisory activities that can promote the implementation of IPM. Developing and integrating biocontrol products into IPM strategies is highlighted in the NAP of 12 MS, and 8 MS have provided a roadmap of how they will further develop IPM.

In the absence of harmonised risk indicators at the EU level, most of the MS are using national risk indicators to assess, wholly or partly, the adverse impact of pesticide use (Article 15). The risk indicators currently in use range from very simple ones (e.g. on the volume of PPP sold) to more complicated ones based on models (e.g. the inherent properties of the PPPs).

The review of the 28 NAPs performed above, in general follows the findings of the COM conclusions. However, it provides additional insight into the implementation of the Directive objectives not included in the Commission report. Whereas, the Commission report provides a detailed summary of the main findings of the results of a questionnaire and a series of fact-finding missions to six Member States, this NAP review analyses significant in detail the structure and the content of the NAPs.

The series of fact-finding missions to six MS allows, for example, the Commission to conclude that substantial progress towards the achievement of risk reduction targets could be demonstrated in three Member States (DE, DK and the NL). For these six countries, detailed information and examples are provided. One may find that the presentation of the examples on good practices, mainly concentrating on 6 MS only, does not provide an adequate overview of the situation across all MS. In contrast, this NAP review systematically assesses the content of the NAPs of all MS, article per article, and therefore, balances the examples provided in the COM report.

4. Surveys Analysis

This chapter presents the main findings from the two surveys gathering inputs from national authorities and other stakeholders. Section 8.1.3 (in the appendix) details the approach followed in the design the survey questionnaires. It also outlined the process for selecting and contacting the target respondents. In cases where the same question was asked in both respondent groups, the responses are compared and contrasted to identify the main differences and similarities. Questions tailored to individual respondent groups are discussed only with respect to that respondent group.

This survey analysis firstly presents an overview of the types of respondents included in both surveys. Following this, an analysis of the different sets of questions relevant to each evaluation criterion is presented. The next sub-section examines the respondents' answers on the implementation of the Directive. Finally, an examination of the main findings and takeaways framing the approach to the rest of the study is presented.

Although 43 "other stakeholder" and 19 authorities[66] (entries) took part in the survey, the number of answers for each question is uneven, as individual respondents did not provide answers to every question of the survey. It should be stressed that the depth of the responses provided is unfortunately limited. This is particularly the case for the responses coming from national authorities. The other stakeholders' responses are conversely both more numerous and more detailed when compared to the limited number and amount of information reported by the national authorities respondents. In addition, one NGO has responded twice to the survey (once via their EU office and one additional time via their national association). The remarks and comments are similar however their entries have been individually processed.

When analysing the survey data, opinions commonly shared by the respondents are highlighted. This chapter intends to provide the main findings from the two surveys. Findings are analysed and presented to ensure the formation of representative and consistent conclusions and to enable the drafting of recommendations.

4.1. Presentation of the respondents

National authorities

The first survey targeted Member States national authorities that work with pesticide issues. In particular, a focus was placed on national authorities responsible for the incorporation of the SUD's provisions into national legislation. The survey received 19 responses. In some cases, multiple authorities responded to the survey in one group, completing one survey collectively. In these cases only a single entry was counted. Therefore, the number of authorities responding to the survey exceeds the number of single entries.[67] In general, participants include national ministries of public health, food, environment, or forestry. Collaboration with regional authorities was further observed.

Respondents of the "national authorities questionnaire" are based in the following eleven Member States: AT, BE, CY, CZ, DE, IT, SE, SK, HU, SI, RO based on their self-identification. Respondents from six authorities did not identify their Member State. Therefore, more Member States may be represented, but this cannot be confirmed. In two Member States (RO and DE), two of the responding

[66] From at least 11 Member States.

[67] For example, the main competent authorities in Belgium consulted and gathered inputs from four different authorities (Federal authority, Flanders, Wallonia and Brussels). Likewise, Germany also consulted several agencies when filling out the survey.

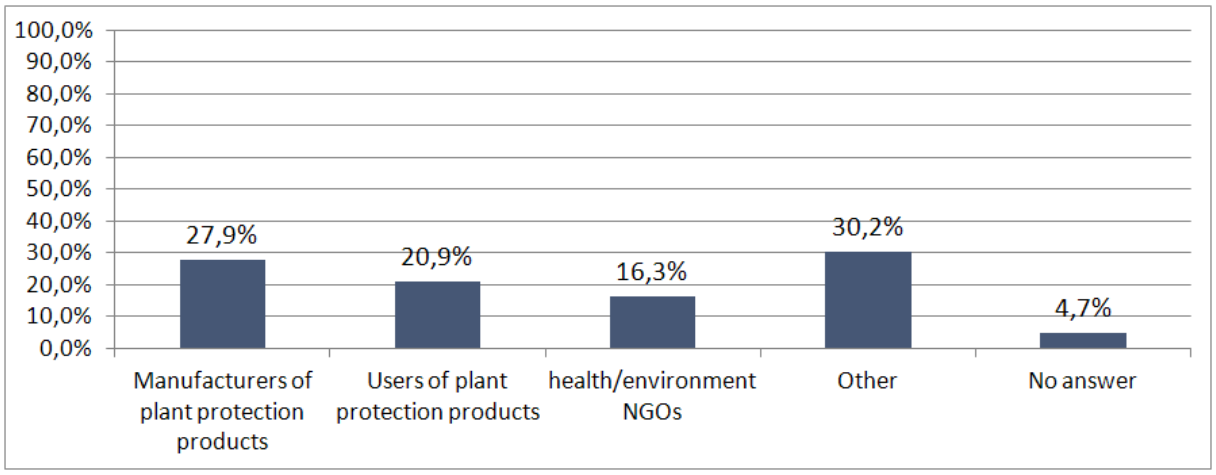
authorities registered two surveys each.[68] It was not possible to trace respondents via the IP or any other technical measures.

Other stakeholders

Among other stakeholders (those other than authorities), 43 respondents participated in the survey. The largest category of respondents were manufacturers of PPPs, accounting for approximately 28% of the sample. This is followed by users of PPPs (21%), health and health/environment NGOs (16%), and other organisations at 44%[69]. Two participants have chosen to remain entirely anonymous and they have not notified their category (core activity) or country.

Respondents in the "other stakeholder" group are based in the following Member States: AT, BE, DE, EL, ES, FR, HU, IT, LT, NL, PT, SI, SK, and UK. Many respondents are based in Belgium registered as international or European trade associations. It has to be highlighted that, upon request, some of the identified stakeholders with a headquarters in Brussels were asked to share the survey link further with their national branches. This sampling technique was applied to maximise the reach of the survey toward the target respondent group.

Figure 7: Categories of "other stakeholders" (n=43)



Source: Core team, 2018, based on results of a survey

Note: the category "other" mostly includes representatives of organic farmers' organisations as well as "farmers" who apparently decided not to opt for the "users of PPPs" option. A few water utility companies are also represented.

4.2. Survey findings per evaluation criterion

Both surveys cover the five evaluation criteria (relevance, coherence, effectiveness, efficiency, EU added value) and discuss the assessment of the implementation of Articles 4 to 15 of the Directive. The questionnaire (see appendix 8.1.4, "authorities questionnaire", and appendix 8.1.5, "other stakeholders questionnaire") consisted mainly of closed questions. Closed questions were supplemented with the option of providing comments on an individual closed question and/or providing additional information on particular topic areas covered in the survey.

[68] Each entry is always considered individually regardless whether the respondents are from the same country.

[69] The category "other" includes several organic farmers associations, other farmers associations and cooperatives, traders and distributers of PPP. A few water utility companies are also represented.

The results have been presented in graph format. Given the relatively low number of respondents, especially from national authorities, the graphs have been included for illustrative purposes, rather than for establishing trends.

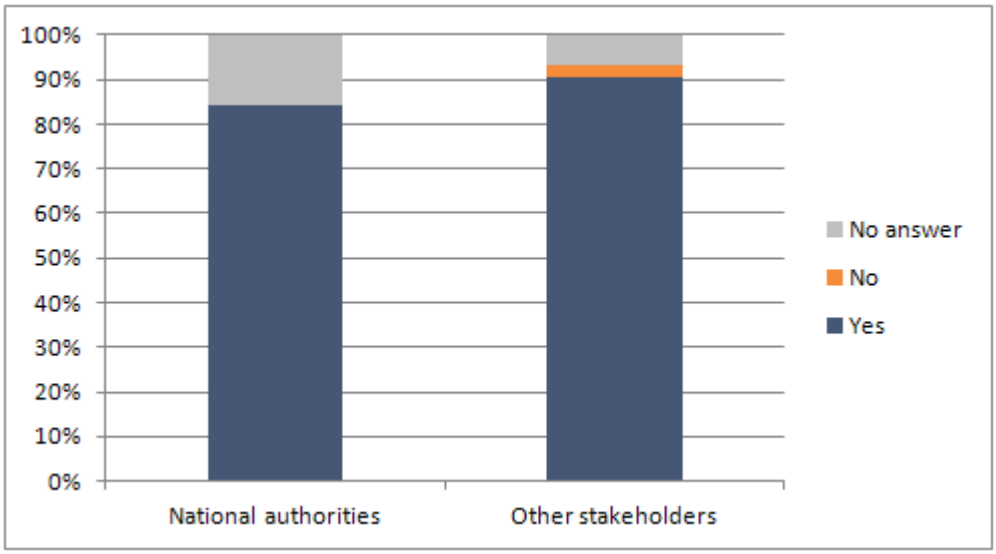
4.2.1. Relevance

A specific set of questions addressed the evaluation of the relevance of the Directive. Both respondent groups, national authorities and "other" stakeholders were asked those questions.

Are the original objectives addressed by Directive 2009/128/EC still relevant to current needs? (Reducing risks and impacts of pesticides on human health, reducing risks and impacts of pesticides on the environment, promoting the use of integrated pest management, promoting the use of alternative approaches or techniques such as non-chemical alternatives to pesticides)?

The large majority of both respondents groups considered the objectives of the Sustainable Use Directive still relevant to address the current needs.

Figure 8: Are the original objectives of the Directive relevant to current needs? (Other stakeholder n=43; Authority n=19)



Source: Core team, 2018, based on results of two surveys

Although the majority of all respondents indicated that, in general terms, the objectives of the Directive remain valid, several comments were made concerning the revision of the wording, and the re-ordering of the objectives.

Other stakeholders, mainly health/environment NGOs, made the following comments:

- A part of the objective *"reducing dependency on pesticide use"* laid down in the SUD seems to be missing in the description of the objectives. This is observed even though the intention to reduce pesticide dependency is mentioned 7 times in the recitals and in Articles 4 and 15 of the Directive. It seems that the wording being used in the description of the objectives of the Directive does not fully correspond to the aim of specifically reducing pesticide dependency.
- The order of the objectives could be rearranged to place a greater priority on the *"promotion of IPM measures"* and the *"promotion of alternative approaches or techniques such as non-chemical alternatives to pesticides"*. MS implementing the IPM principles need to

intensify efforts in order to promote innovative development, and encourage IPM implementation. The directive should address this aim more explicitly.

Several respondents have further indicated that it is very positive that the SUD required the development of NAPs, makes IPM compulsory and promotes alternative approaches and non-chemical techniques. In this regard, the SUD is essential for implementing IPM and the sustainable use of plant protection solutions. It is the basis for introducing non-chemical solutions and biocontrol products. However, these respondents have indicated that to their knowledge, IPM are still not applied generally in agriculture. Therefore, there are still an inadequate variety and quantity of approaches which are being developed, introduced and used within the framework of conventional agriculture. According to these respondents, the objectives set by the SUD should better promote an integrated approach, based on scientific evidence, to support the use of both chemical and non-chemical solutions, since they are both fundamental for a truly sustainable agricultural system. Finally, it was stated that the general objective of the promotion of alternative approaches should not bring as a consequence the demonization of plant protection products.

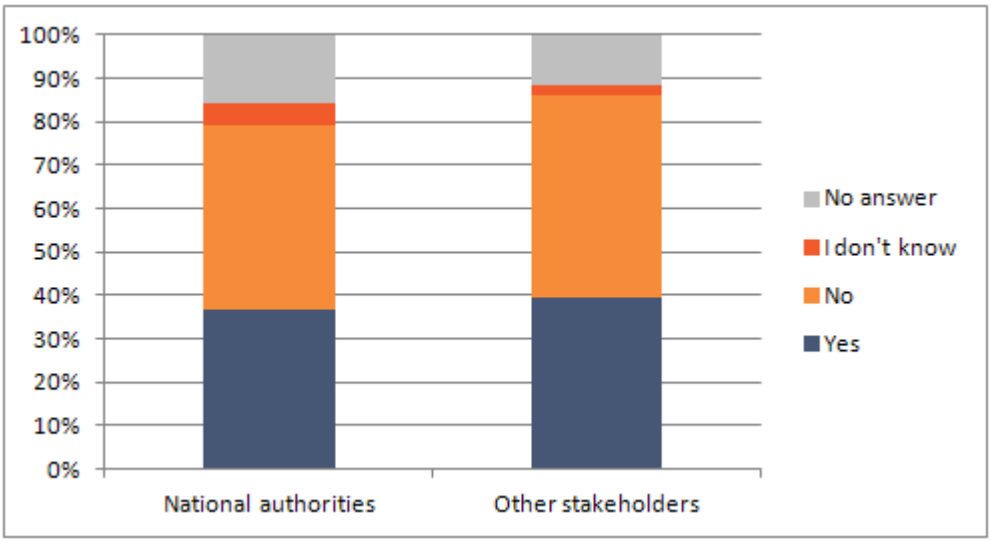
The majority of national authorities have commented that the original objectives addressed by the SUD still remain relevant. Regarding the environment, today's chemical plant protection practice in several Member States is not always sustainable. Negative trends regarding e.g. biological diversity – especially wild birds and insects/pollinators – can still be observed in agricultural and other landscapes.

In addition, several national authorities have mentioned that it is important to keep the objectives in place for a period which is long enough to see the results of the introduced measures of the NAPs. Effects of changing practices, and pesticide alternatives availability, will be traceable and visible only after some time (several years). Therefore, the success of risk reduction measures is not immediately reflected in all cases. For example, the promotion and implementation of IPM measures in particular requires time. As of today, few alternative methods exist, and alternative methods are not (yet) available in all agricultural sectors. However, with continued effort, this is expected to increase over time.

Do you consider that these objectives should be updated in order to reflect the current needs?

The large number of respondents provided an answer to this question. Approximately 35-40% of respondents have indicated that some adjustments should be made.

Figure 9: Do you consider that these objectives should be updated in order to reflect the current needs? (Other stakeholder n=43; authorities n=19)



Source: Core team, 2018, based on results of two surveys

Both categories of respondents, national authorities and other stakeholders, are divided on this issue. Overall, the "no" answer slightly prevails in both respondent groups. However, no major comments have been made that illustrate this position. One national authority pointed out that first results should be achieved and evaluated, which requires time.

Most of the remarks and comments to this question have been made by stakeholders, and mainly NGOs). It was highlighted that the Directive objectives are wide enough to cover all steps of the use phase of a plant protection product and give a full range of options to the national authorities. This includes providing support for the actions introduced by national authorities, and enabling an adequate focus on specific national priorities. The same stakeholders have indicated that the objectives should be updated to place a greater emphasis on concrete results, achieved progress and the measurement of achievements of the risk reduction actions.

The emphasis on the need to revise the objective with respect to measurable results was shared by most health/environment NGOs. Respondents indicated that the objectives are appropriate, but more effort is required to achieve these objectives and to prevent them from being weakened as a result of inadequate consequences for non-compliance. These NGOs observe that the implementation of the Directive has not been resulting in the expected objectives at the MS level. For example, clear quantitative use reduction targets and timetables are needed. Further, a clear emphasis should be placed on the implementation of IPM and on ensuring that non-chemical alternatives are given priority.

The quantitative use reduction targets are often a long-term objective. The Directive should include shorter and medium-term objectives. Several national authorities have indicated that more time is needed to see the results of their actions. In that context, a few stakeholders (health/environment NGOs) have mentioned that the reduction of risks and impacts on health and the environment needs to be measurable. With respect to this, so far the EU has not even set up harmonised risk indicators.

Users of plant protection products also consider that objectives should be reinforced, with respect to increased communication and awareness raising campaigns to the wider public. Consumers and

citizens should know more about what farmers and producers concretely do on, especially with respect to IPM. The scientific efforts to identify alternative methods and the political support for such actions should be further enhanced.

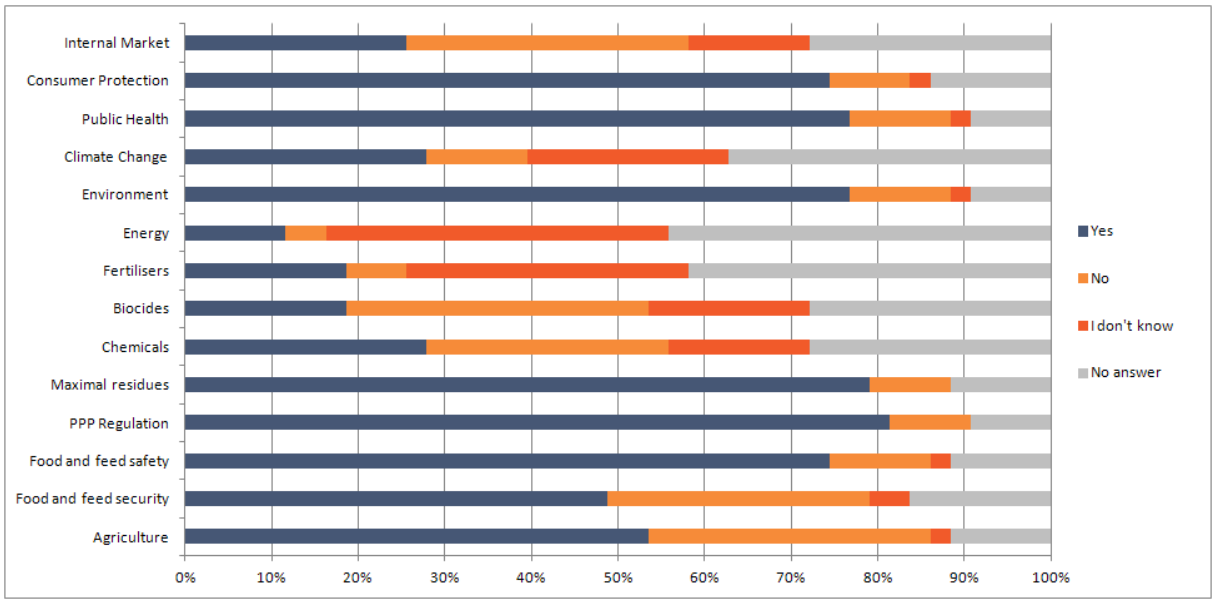
In addition, several stakeholders (mainly manufacturers and users of PPPs) have indicated that it will be necessary to add objectives, especially those to encourage the adoption of all of the new relevant technologies able to provide and measure the sustainable use of all the technical means available. This should also focus on those foreseen to come into practice in the near future. In addition, the same stakeholders have mentioned that more non-chemical alternative solutions should become available to farmers. This shall be achieved by accelerating the adoption of non-chemical solutions, and in particular the release and marketing of more and better suited biocontrol products on the EU market.

4.2.2. Coherence

The criterion coherence intends to examine whether the Directive's provisions, their implementation (i.e. transposition and application) and enforcement is in line with other EU policies and legislations as well as other relevant international commitments. The following questions are therefore examined:

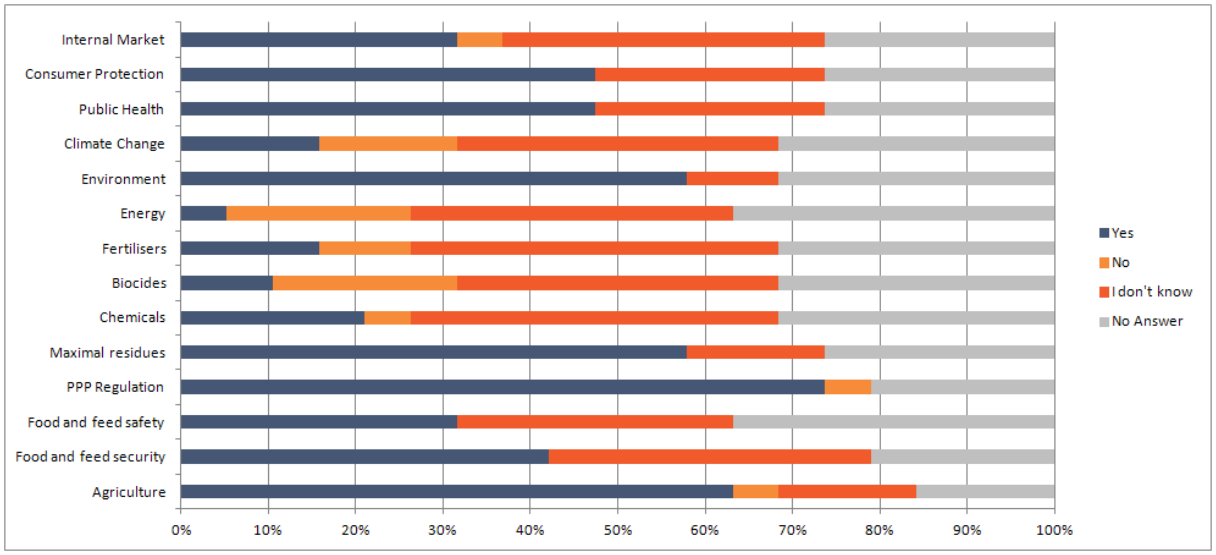
Are the objectives of Directive 2009/128/EC, in your opinion, coherent with other pieces of EU legislation?

Figure 10: Are the objectives of Directive 2009/128/EC coherent with other pieces of EU legislation? (n=43) – Other stakeholders



Source: Core team, 2018, based on results of a survey

Figure 11: Are the objectives of Directive 2009/128/EC coherent with other pieces of EU legislation? (n=19) - National authorities



Source: Core team, 2018, based on results of a survey

The percentage of *"no answer"* and *"I don't know"* is rather high for the majority of cases investigated. It is rather surprising that national authorities have cast a significant number of *"don't know"* answers, whereas stakeholders consider that there are several issues concerning the coherence between the SUD and other EU regulatory framework.

Both authorities and other stakeholders consider that coherence between SUD and the maximum residues limits and plant protection product regulations is good (ranging from 60% to 80% of respondents indicating that SUD is coherent with other pieces of legislation).

Of consequence, most, but not all, of the comments and remarks to this question have been made by the various types of stakeholders.

Both types of respondents, national authorities and other stakeholders agree on the fact that there is a significant issue of coherence with the biocide legislation because the scope of the Directive covers PPPs but does not cover biocides. The issue is mainly that biocides can be used also in the agricultural sector and fulfil a role as pesticide e.g. as useful products in IPM for cleaning greenhouses after the growing season. In the future this might lead to conflicts in actions in cases when the NAPs are extended to biocides.

A general remark was that more attention should be paid to creating synergies in actions to achieve the similar goals and objectives of the above-mentioned legislations.

Stakeholders (most categories) have highlighted a lack of coherence with the policy of the agricultural sector, and in particular, of the CAP. The objectives of Directive 2009/128/EC are insufficiently reflected in the Common Agricultural Policy. The CAP reform could give emphasis on alternatives and pesticide use reduction. Respondents, mainly manufacturers and users of PPPs, highlighted the coherence with Regulation (EC) No 1107/2009 by, for example, describing that the SUD ensures that all professionals who use plant protection products (PPPs) are trained, have access to ongoing training and are certified. In their opinion, it also ensures that application equipment is tested to ensure accurate application and to minimise off-target application. In this way, PPP residue levels are more likely to be below MRLs. The provisions in the Directive drive the *"proper use"* of plant protection products and so meet the objective of Article 55 of the PPP Regulation. In addition, the same re-

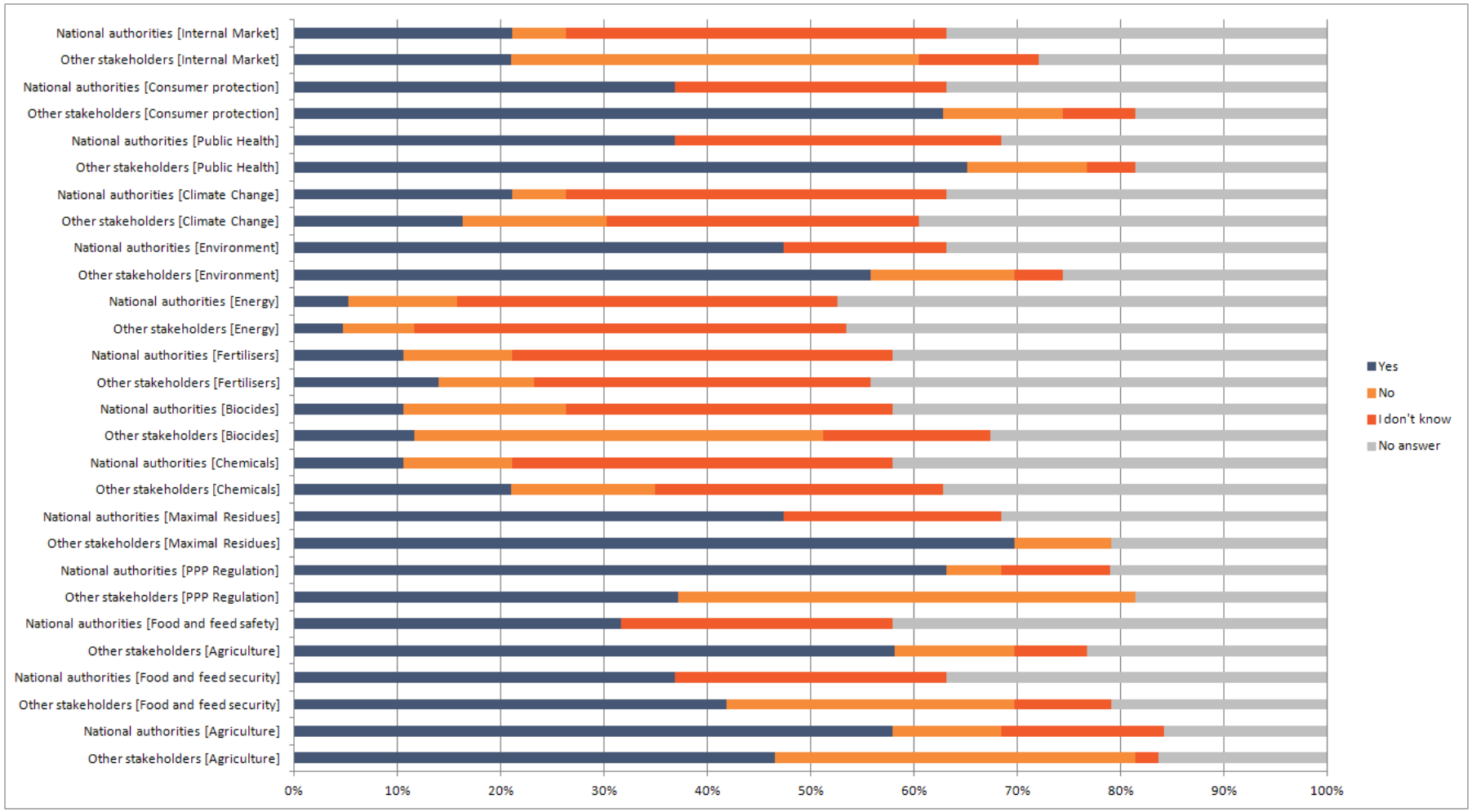
spondents added *"good and successful IPM can only be reached when a wide range of solutions is available to the producers (tool box including mechanical, biological, and chemical solutions). The current PPP Regulation does not sufficiently take into account those principles"*.

The PPP Regulation includes provision aiming at diminishing data requirements for product registration for low risk products unfortunately only a very few low risk active substances have been authorised in the last years at EU and further MS levels. Therefore, SUD is coherent with PPP legislation but Regulation (EC) No 1107/2009 is not effective enough with regard to the placing on the market of low-risk products. In addition to invertebrate biocontrol agents and micro-organisms, natural substances (e.g. botanicals and semio-chemicals) should be clearly recognised as low-risk products. Producers and other users of PPPs require many more authorisations of this type to fulfil the obligation of reducing the risk of PPPs.

With respect to the PPP Regulation, growers and the PPP chemical industry added that the lack of uniform implementation of the PPP Regulation leads to distortion of competition as MS have different implementation approaches.

Is the implementation of Directive 2009/128/EC coherent with other pieces of EU legislation?

Figure 12: Is the implementation of Directive 2009/128/EC coherent with other pieces of EU legislation? ? (National authorities (n=19); Other stakeholders (n=43))



Source: Core team, 2018, based on results of a survey

The main remarks made by a large majority of stakeholders (both national authorities and other stakeholders) on the implementation of the Directive relate to the fact that the implementation is not yet coherent with a few other legislations. In particular, Regulation (EC) No. 1107/2009 is mentioned as a limitation, with respect to the placing on the market of low-risk products. The same stakeholders highlighted that MS still have not fully implemented IPM systems for all crops. Also, the coherence issue with the Biocides Regulation was mentioned, again.

NGOs added that the lack of coordination between the actors in charge of implementing the PPP Regulation and the SUD has also been mentioned as a coherence issue. In many MS different authorities oversee implementing the two pieces of legislation and, often, insufficient interaction leads to implementation issues. For example, it may be difficult to carry out actions, as described in NAPs, when in the meantime active substances used in agriculture (based on Regulation (EC) No. 1107/2009) are withdrawn or not renewed without considering their possible usefulness in IPM-programmes.

In conclusion most of the other stakeholders have highlighted that seven years after the implementation of the SUD, most Member States (if not all) still have not fully implemented IPM systems for all crops. Health/environment NGOs have added that often the use of pesticides (in volumes) has not been reduced significantly because Member States have not adapted their legal frameworks nor their risk assessment processes to really push for alternative non-chemical plant protection systems. The same stakeholders and the users of PPPs have, also, mentioned that in some MS there is a lack of funding for research concerning alternative farming systems like organic farming (e.g. in Germany, only 1.5% of public agricultural research funding is spent on organic farming issues) and there is a lack of enforcement concerning adherence to good agricultural practice, e.g. by effective sanctions for farmers who do not implement IPM.

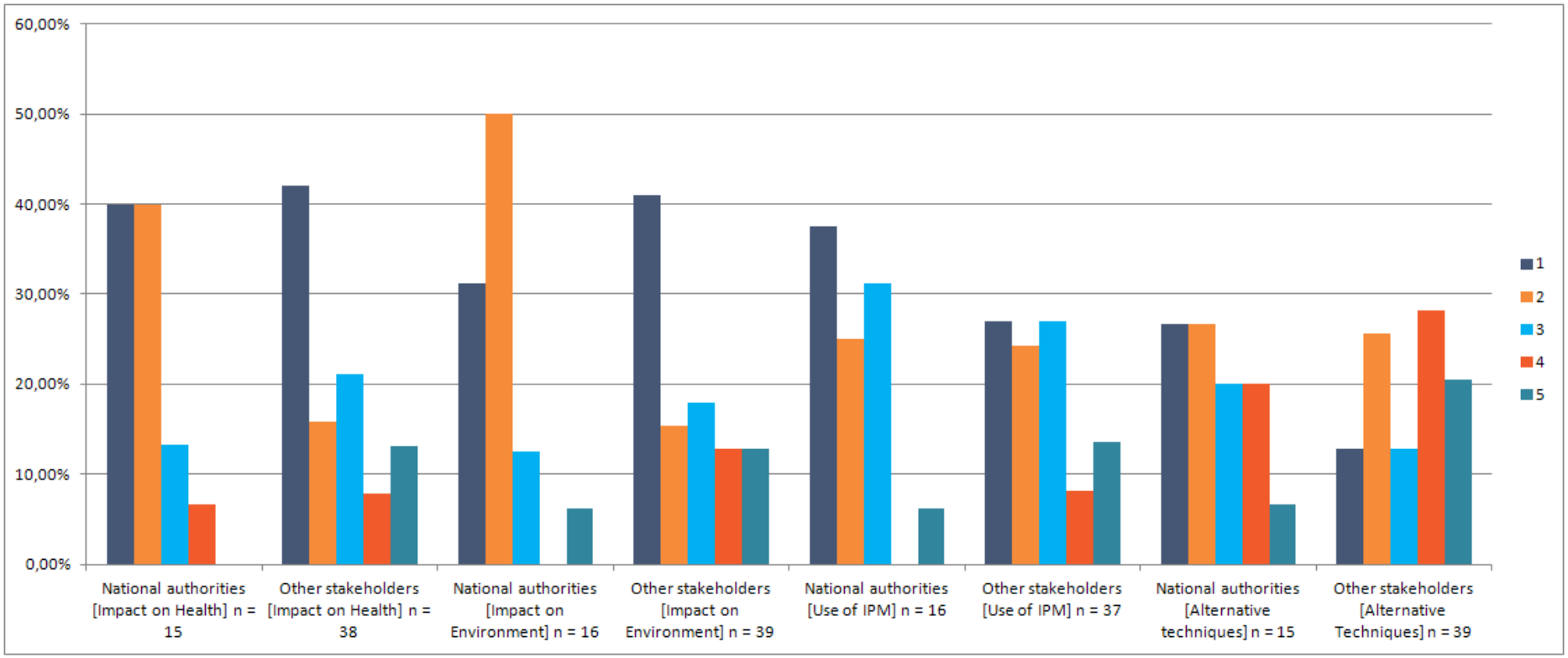
4.2.3. Effectiveness

The objective of this section is to assess the effectiveness of the SUD implementation by considering firstly if specific objectives have been achieved and secondly by analysing how national authorities and other stakeholders assess the implementation of Article 5 to 15 of the Directive by Member States.

In general terms, to what extent does the implementation of Directive 2009/128/EC, via the respective national provisions, allow its objectives to be achieved? Please use a scale of 1 (implementation fully allows the objectives to be achieved) to 5 (implementation does not allow the objectives to be achieved).

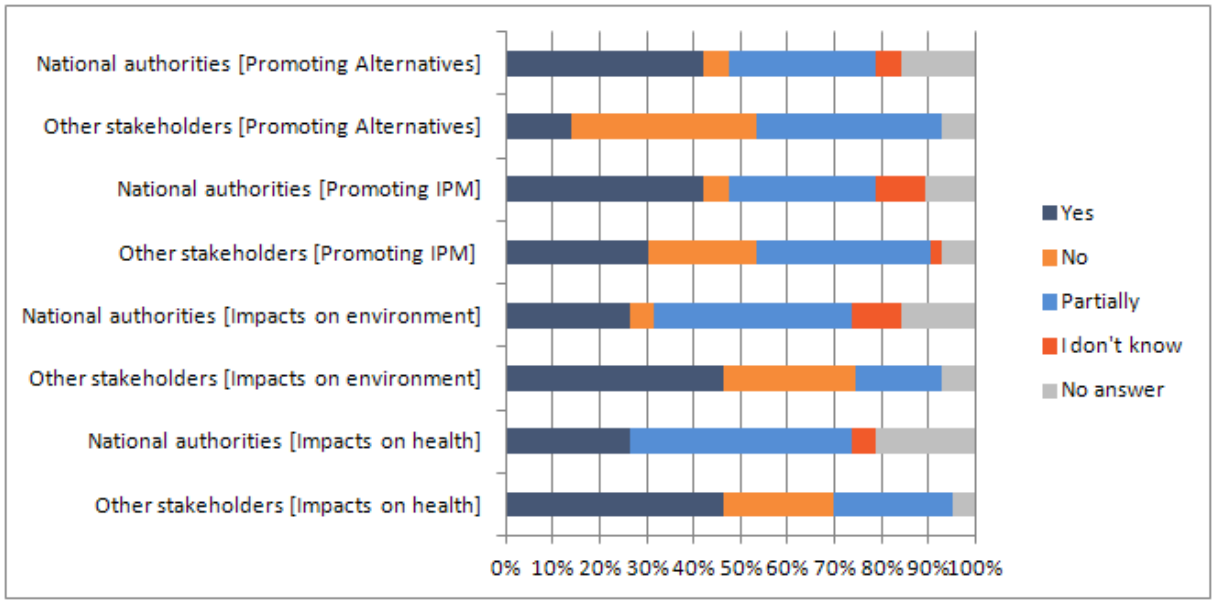
Have the objectives of Directive 2009/128/EC been met?

Figure 13: In general terms, to what extent does the implementation of Directive 2009/128/EC, via the respective provisions of national, laws, allow its objectives to be achieved?



Source: Core team, 2018, based on results of two surveys

Figure 14: Do you think that the objectives of Directive 2009/128/EC have been met? (Other stakeholder n=43; authority n=19)



Source: Project team, 2018, based on results of a survey

Several respondents (both national authorities and other stakeholders) emphasised positively the fact that the Directive covers an area which was not previously regulated. It is the first time that the EU has developed a regulatory framework related to the use phase of pesticides with the focus on risk reduction, and this is unique worldwide. NAPs were completely new in many MS. Therefore, the achievements of the NAP objectives have to be evaluated carefully taking this feature into consideration. The goal of the Directive was to create common ground for risk reduction by setting up harmonised requirements in various sectors relevant to risk reduction. It has to be considered that many Member States had to develop and introduce completely new systems.

The same respondents added that a major achievement of the Directive is that it has been a key driver in ensuring that different ministries in all Member States discussed the use of pesticides and methods for risk reduction. This is a key achievement *per se*.

However, the overall objectives of the NAPs remains vague and focuses on the reduction of risks and impacts in general in the majority of the Member States. Only 6 MS set-up quantifiable objectives (see analysis of the NAPs above – Section 3). Despite quantitative objectives, specific measures and/or quantifiable targets are missing in some cases hence making it difficult to evaluate results.

Other general opinions from authorities indicated that it has taken time to establish working relationships and to commit to the same goal for administration/politics, researchers, advisory services and farmer/producers.

The evaluation of impacts in the different sectors of health, environment, IPM and alternative techniques was mainly commented on by the other stakeholders, whereas authorities mainly opted for only the closed questions.

Effectiveness of the SUD with respect to the objective of reducing risks and impacts of pesticides for human health

As a preliminary remark, and based on the findings of the literature review, it has to be mentioned that the Directive, on the one hand, only contains more detailed conditions on health issues relating to acute poisonings which might be regulated in other sectors of national legislation. On the other

hand, it is very complex to assess the risks and impacts on health caused by pesticide use and exposure. Therefore, it is assumed that specific risk reduction measures contribute to an overall risk reduction for human health. The former is very complex to assess due to multi-causal relationships.

In summary, the majority of both groups of respondents agreed that the provisions of national legislation allow for the desired goals to be achieved.

In their additional comments, a few other stakeholders (manufacturers) have indicated that the Directive does not include detailed provisions to reduce the risk and impacts of pesticides for human health. Therefore, implementation in the Member States allows for a potential wide scope of activities.

Most of national authority respondents indicated that, in principle, the Directive has been effective with regard to the reduction of risks and impacts for human health but indicated that it is nearly impossible to measure this evolution. Literature shows that, to date, there is only a few reliable instruments to assess or measure progress. First, protocols on what to measure (indicators) and how to measure them are not available. Secondly, monitoring and measuring e.g. presence of pesticides in the air is a very expensive task. MS do not have the required budgets to set-up such type of monitoring activities. Thirdly, even when such instrument may exist, it would probably be not clear whether any observed evolution is due to the measures implemented in the frame of the NAPs.

Therefore, health/environment NGOs indicated that effectiveness of the SUD with respect to protection of human health can be only indirectly assessed by analysing how measures included in the NAP have been implemented. If the large majority of professional users have been trained, one can argue that the risks to human health have decreased as farmers/producers know how to use the products to avoid the risks. Also, if the use of the number of alternative solutions increases, it could also be argued that the risks are decreasing.

Effectiveness of the SUD with respect to the objective of reducing risks and impacts of pesticides for the environment

In summary, the majority of national authorities stated that the objective towards reducing risks to the environment can be achieved via the national provisions; this assessment could be anticipated given that NCAs have ownership on their NAPs. The rating of other stakeholders was slightly lower but nevertheless the majority agreed that the provisions are effective.

For example, one national environmental agency criticises that the current NAP is not ambitious with regard to the protection of the environment and nature conservation policies. Several other stakeholders and national authorities have clearly highlighted that severe trends in biodiversity are due to several factors related to intense agriculture; however, pesticides are clearly one of the most relevant, as demonstrated by an increasing number of studies.

Similarly, as stated by national authorities, for the points raised in relation for the reduction of risk on human health, the effects of the measures with a focus on risk reduction for the environment might not immediately be evident. It is expected to take time for environmental risk reduction measures to increase their effectiveness, and reverse the impacts of conventional less environmental practices. Therefore, it will take time for impacts to be observed. However, specific provisions of the Directive do contribute to the achievement of the objectives. The Directive has introduced mandatory training for all professional users, advisors and distributors of PPPs and the requirement for regular inspections of PPP application equipment to ensure that correct doses are applied and that drift reduction is ensured. Also, aerial spraying is banned, and derogations can only be granted under strict conditions. Furthermore, provisions on the correct storage and disposal of PPP remnants are included in order to prevent unwanted contamination and residual PPPs which might endanger

human health or the environment. In summary, all these elements contribute to reducing the impacts of PPPs on the environment. The assessment or measurement of the impacts of those measures is indeed complex, and the reduction of risks to the environment is achieved by the implementation of the whole suite of measures. Therefore, a first step to assess evolution should focus on the trends of compliance with individual provisions.

In addition, the same respondents indicated that measures aiming at reducing the impact of PPPs on the environment are included in other pieces of legislation (mainly Regulation (EC) No 1107/2009, Birds and Mammals Directive[56], Water Framework Directive[57]). These measures also contribute to the positive impacts although it is difficult to assess the progress achieved.

Effectiveness of the SUD with respect to the objective of promoting the approach of integrated pest management (IPM)

According to the provided answers, a majority of national authority respondents (62%) with respect to the implementation of the Directive's provisions as effective and a third of respondents partially effective. On the other hand, the opinions of other stakeholders show a slight majority assessing the provisions to promote IPM implementation as effective, also one third rating them as partially effective and a fifth as mainly ineffective. National authorities were less than 10 percent to evaluate that the measures have been non-effective.

Many of the other stakeholders claim that IPM is not clearly defined with respect to clear reduction targets and timeframes which would lead to significant changes in farming systems. In their opinion, IPM includes the vaguely operationalised and different approaches between MS exist. Without significant increase in spending for research for non-chemical farming systems, most farmers will continue to use agricultural practices that rely more on the application of pesticides than of the establishment of sustainable farming systems.

Most respondents (national authorities and other stakeholders) consider that IPM is not sufficiently known at the farm/producer level. The main reason explaining this situation is the complexity and the range of possible actions within IPM systems. IPM can only be efficiently promoted if it is specified at the crop level taking into account regional approaches. This requires a well-funded and staffed advisory system to be in place.

One national authority stated that the Farm Advisory Systems (FAS) under the direct payment rules of the Common Agricultural Policy (CAP) should also inform e.g. about alternatives to pesticides as of 2015. Some other national authorities mentioned the existence of dedicated websites which have been created to publicly promote IPM. In several MS there are IPM guidelines for various crops available and in other ones additional guidelines are currently under development.

A user of PPPs added that IPM is an approach built for crop specific management. Therefore, guidelines and management practices must be developed and disseminated per MS, climactic region, and per crop or group of crops. For this respondent, knowledge transfer is essential which should ideally be performed by advisory services, public or private.

In this context, one health/environment NGO proposed a change to the term "promotion of the use of IPM" to "promotion of the use of alternative approaches or techniques such as non-chemical alternatives to pesticides". This type of clarifications will certainly help authorities and practitioners to

[56] Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds

[57] Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy"

fully understand the scope and objectives of IPM. As long as the concept is not clearly delineated, insufficient guidelines will continue to be released, as has been observed to date.

Several other stakeholders (mainly health/environment NGOs) mentioned that there is a lack of incentives at the EU level for supporting the uptake of IPM approaches. There is an observed need to set-up more incentives for the use of IPM methods and practices. For example, such as through financial support for interested farmers (as reported by a German producer association to be the case in DE). In addition, increased awareness should be brought into the realm of the EU public. Since, as of right now, the public often thinks that farmers use only chemicals, and are less aware of the alternatives available or how to promote their use.

Finally, a health/environment NGO mentioned that monitoring the uptake of IPM measures should be carried out to measure progress and to determine what exactly has been achieved. It seems that such monitoring is currently missing.

Effectiveness of the SUD with regard to the objective of promoting the use of alternative approaches or techniques such as non-chemical alternatives to pesticides

The answers from the two surveys differ with regard to the evaluation of effectiveness of the directive in promoting the use of alternative approaches or techniques such as non-chemical alternatives to pesticides. National authorities, with a slight majority, evaluate the policies more positively. In the evaluation reported by stakeholders, the effectiveness is rated as insufficient by almost half of the respondents.

Similar to IPM, as reported by advisory services and users of PPPs, the encouraging the use of alternative approaches or techniques (such as non-chemical alternatives to pesticides) is very complex and difficult to evaluate on a global level. The introduction and application of these approaches depends not only on national legislation, but also on the availability, specific condition of use, and the efficacy of the methods available. In addition, uptake depends on specific technical knowledge, on the advisory services in place, and on the willingness of the growers themselves to incorporate new practices.

The EC report on the fact-finding mission in DE in 2017 highlights some achievements on risk reduction, but also concludes critically: *"Nevertheless, in the absence of effective and economically viable alternative controls to combat harmful organisms, the production of field crops in Germany continues to depend on pesticides."*

Many comments from users of PPPs supported the opinion that the availability of economically viable alternative controls is an issue. Alternative approaches or techniques have to be as efficient as the chemical solutions they aim to replace. They must also not introduce additional cost to agricultural production. However, a related key issue is the evaluation of effectiveness and economic profitability of such solutions. If there are deficits, for example lower yields, they should be weighed up against the considerable benefits of non-chemical alternatives for the society, as they cause less impacts to people and the environment and also lower costs. The same respondents added that to their opinion *"until now the key question who incurred for yield losses or benefit to the environment has not been solved. Farmers, as any enterprise, are concerned about the economic return from their production and therefore economic viability at farm level is essential"*.

Several other stakeholders (manufacturers of organic products and users of PPPs) also mentioned that the provisions of Regulation (EC) No. 1107/2009 aiming to increase the availability of low-risk active substances have not been adequately applied (Motion for Resolution from the European Parliament (B8-0140/2017 from 8 February 2017). As an example, a manufacturer of alternative products mentioned that in Belgium, the Royal Decree (RD 534/2017) which covers biological control

organisms, traps and other monitoring means or devices, which are not directly linked to the control of pests, does not include e.g. food attractants such as vinegar that are being used in other EU countries for monitoring. Since these biological controls are basic substances, the Royal Decree considers they are covered under Regulation (EC) No. 1107/2009 and not under this Royal Decree. This is an obstacle to the use of monitoring tools and goes against the SUD principles.

The same group of stakeholders also mentioned that the provisions under Regulation (EC) No. 1107/2009 aiming at increasing the availability of low-risk active substances have not been applied (Motion for Resolution from the European Parliament (B8-0140/2017 from 8 February 2017)[58]. For example, this affects the availability of monitoring tools (e.g. traps or other devices) and control agents which fall under the category of basic substances but are contained in tools for IPM. For these stakeholders, the enhancement of the availability of low-risk pesticides and Biological Control Agents (BCAs) should be addressed with urgency by the EU and Member States. In fact, the lack of use of agronomic practices or the limited flexibility renders the use of pesticides, both about EU decisions on active substance approvals, and national decisions on emergency authorisations. This is especially the case when chemicals or products are withdrawn from the market, or their uses are restricted. In these instances farmers face severe difficulties due to the lack of chemical alternatives. The issues are multifaceted. On the one hand, farmers change farming practices very slowly. On the other hand, in some cases there are no viable control options available or resistance management is at risk leading to more serious problems in pest or disease control in the future.

Health/environment NGOs expressed their opinion that organic farming is a key farming system for reaching the objectives of the SUD with respect to the use of alternative methods. They further stated that organic farming should be prioritised under MS NAPs as part of the SUD implementation, even though there are also production systems in organic farming which include pesticide use (e.g. vineyards and fruits). In their opinion, this can be achieved by incentivising the uptake of agro-ecological practices under the CAP including knowledge transfer and innovation as well as market development for products (e.g. legume or protein crops) which are included to diversify crop rotation. Therefore, it is vital to adapt the authorisation process of naturally occurring substances in order to promote the availability and uptake of alternatives to synthetic pesticides and to scrutinize whether their natural occurrence provides sufficient evidence for the evaluation of risk and exposure.

One manufacturer and distributor of PPPs indicated that non-chemical solutions are neither *per se* a better health or environment protection nor are they *per se* more sustainable than chemical PPPs. For example, modern hoeing machines are very expensive and require a considerable investment; therefore, they are currently not widely used in farms. Their use requires multiple passages through a field causing more CO2 emissions. They are also more labour intensive for the farmer; their efficacy in the row is not always optimal (dependent on the type of machine and the developmental stage of the weed). Also, the climate and soil conditions do not always allow for their usage. Finally, the use of these hoeing machines can cause environmental damage to nesting birds, earth worms and other organisms of the macro-and micro fauna. The use of machines for soil conversion on uneven and erosion-sensitive fields is particularly limited to unfeasible from a practical point of view but also as it can cause soil erosion on lighter soils. Therefore, in some cases, alternatives have more negative impacts on the environment than chemical pesticides.

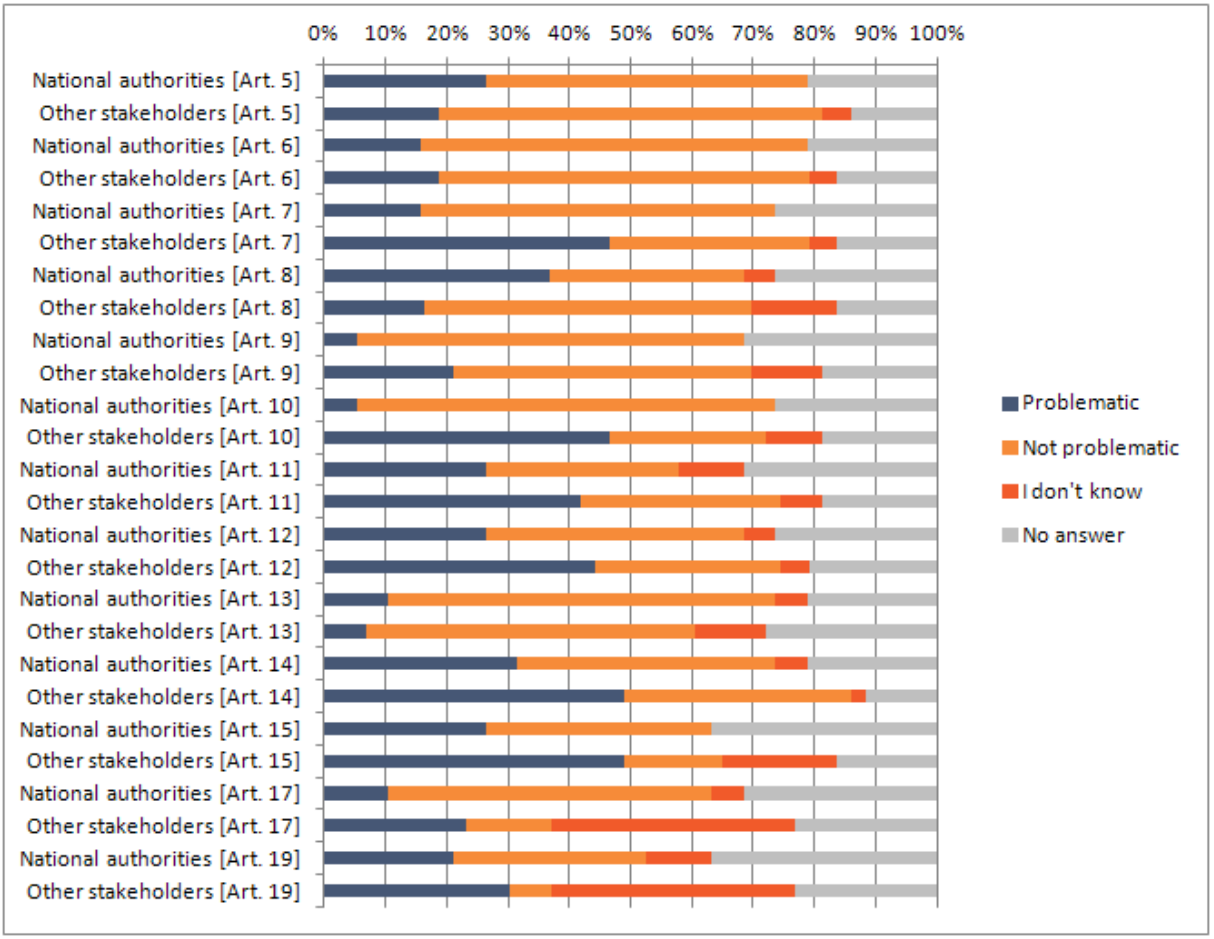
Implementation of the specific provisions of Directive 2009/128/EC (Articles 5 to 19)

In general terms there is a significant difference between other stakeholders" and authorities" opinion about the implementation of Articles 5 to 19 of the Directive (see Figures 16 and 17 below). All

[58] Consulted at: http://www.europarl.europa.eu/sides/getDoc.do?type=MOTION&reference=B8-2017-0140&language=EN

categories of other stakeholders consider that several issues exist with respect to the implementation of several SUD Articles (mainly Articles 10,11,12,14 and 15), whereas national authorities consider that implementation for Article 12 out 13 is not problematic (only Article 8 was consider more problematic).

Figure 15: Implementation of the specific provisions of Directive 2009/128/EC (National authorities n=19; Other stakeholders n=43)



Source: Core team, 2018, based on results of a survey

The following sections present the results and findings from the two surveys which have been conducted during this evaluation. It should be mentioned that our survey did not repeat questions that were already addressed by the European Commission survey, conducted in 2017, which served as the main input for the drafting of the 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. However, taking the conclusions of the Commission survey into account is considered as necessary to draft comprehensive answers to the evaluation criteria. While the core team was granted access to the Commission's survey output, it does not have the official authorisation to re-use the raw data. Accordingly, the authors of this study solely analysed the results of the surveys conducted by the Commission to ensure the coherency of this evaluation with the information provided by the Member States in the 2017 survey. Moreover, the following assessments, besides relying on the core team's own data (the national authority survey and the "other stakeholders" survey), are also complemented by, or examined against, infor-

mation extracted from the publicly available 2017 Report as well as from the six fact-finding-missions reports conducted by the Commission. Any subsequent references to "surveys" likewise correspond to the core team own data and not to the Commission's 2017 survey.

Effectiveness of the SUD with regard to the implementation of Article 5 (training)

According to the 2017 Commission report on Member State National Action Plans and on progress in the implementation of the SUD, overall, *"there is a high level of compliance in the area of training and certification of professional users, distributors and advisors. There is no accurate data, however, on the total number of professional operators in this area and therefore it cannot be certain that all are trained."* The same report adds *"Nevertheless it must be emphasised that MS made considerable effort to set up schemes for initial and further training and to introduce certification systems"*.

According to the information retrieved by the surveys, national authorities, manufacturers and users of PPPs have commented in the same way. This indicates that a large number of training sessions has been organised in the EU. Therefore, at the EU level, training and certification measures of professional users, distributors and advisors have made significant progress.

A few users of PPPs and several health/environment NGOs have mentioned that training content will need to be continually adapted and further developed. The link between farm advisors, researcher and farmers is vital to guaranteeing a fast uptake of innovations in farming practice. Training should focus on practical alternatives, and not just technological solutions. Cross cutting issues like agro-ecological practices and/or alternative farming methods like organic farming should be a further focal point. Health/environment NGOs have expressed concerns with regard to the quality of trainings and the content of the training seminars. According to these respondents, training can only significantly contribute to reaching the objectives of the Directive if the content of training programmes is actually designed to help farmers reduce dependency on pesticides. Failure to accept and implement new approaches should have direct consequences for farmers (for example, loss of CAP funding). Representatives from the organic production supply chain (other stakeholders survey) added that *"there is a severe lack in training and education programmes for existing organic farmers and for farmers who might be interested in converting to organic farming"*.

Effectiveness of the SUD with respect to the implementation of Article 6 (requirements for sales of pesticides)

The main issue to assess effectiveness of such provision is the lack of tools to measure progress. In addition, national authorities that have responded to the survey questionnaire have not listed measures that have been taken to restrict sales of pesticides authorised for professional use to persons holding a certificate. However, it can be assumed that, as a minimum, the certificates of professional users will be verified at the point of sale. For example, in Germany the certificate is checked, and the holder of the certificate is registered for each purchase.

Several other stakeholders (grower organisations) have indicated that the level of information provided at the sales level has increased allowing the proper selection of the best solution for the end user. For these stakeholders, the renewal aspect of the certificate ensures the continuous update of knowledge, especially when new techniques become available.

The same stakeholders have mentioned, in their survey answers, that the term *"at the time of sale"* (Article 6 (1) SUD) creates certain confusion as illustrated by the following examples from the UK and France. Within the United Kingdom, the advisers are available at the time of sale, usually by phone, to give advice to purchasers if required. Requiring these individuals to be physically present at each distribution point is problematic as the majority of PPPs are delivered to farms by trained drivers in

specially equipped lorries and not collected by customers from distribution points. A French manufacturer of PPPs added that, for this reason, requiring an individual to be present in the distribution point would represent a significant increase in cost for all businesses, but no gain to human health and environmental protection. The costs for the French farms have been estimated at about EUR 1 million per year for implementing this measure.

Other stakeholders (health/environment NGOs) have indicated that, in their opinion, in some cases the information on the restrictions or modifications of use is not sufficiently transparent. Furthermore, the transmission of the information related to these changes is not fast enough. This measure leads to the situation that the distributors cannot develop market strategies in the medium term and, therefore, limit the provision of general information to its minimum. Furthermore, the provision on the advice at the time of sale cannot be achieved if the PPPs are purchased via the internet. It is thus difficult to secure that buyers read the online advice statements. However, there are systems under development, (in DE for example), to ensure that only professional users can purchase the respective PPPs via the internet.

Effectiveness of the SUD with regard to the implementation of Article 7 (information and awareness-raising)

In its 2017 report, the Commission concludes that the principle tool for the provision of balanced and accurate information on the sustainable use of pesticides by Member States toward the public, is their website. This is seen to be insufficient according to the Commission report. The Commission adds, however, that there is still some potential for disseminating good practice via websites. For example, websites should be more widely used in order to inform the public and stakeholders of relevant issues. This general statement is also supported by the comments made by respondents in the surveys conducted under this research project.

Apart from their websites, authority respondents also mentioned other channels such as the distribution of brochures, the organisation of events and conferences and the provision of subsidies and support for local associations. However, impacts of such approaches have not been measured and the number of activities undertaken is not reported by the national authority respondents. On that basis, it is not possible to assess the effectiveness of such provisions due to the lack of reliable data.

In the survey, national authorities recognised that awareness raising is an ongoing process, sometimes slow, but in accordance with the work devoted to implementing this task, progress is being made.

Other stakeholders (mainly health/environment NGOs) are of a different opinion. The first issue is related to responsibilities: who should be in charge of communicating what? The existence of negotiations between national ministries that results in the provision of neutral information and unbiased awareness raising, including informing the risks of using pesticides was reported. However, most activities on information and awareness raising in Member States are orchestrated by the ministry for agriculture. These activities focus more on public acceptance for pesticide use than on promoting the reduction of use. Information and awareness raising should be implemented by all ministries involved (agriculture, environment, health) in a coherent way to promote the goals of the SUD.

In their survey responses, PPP manufacturers mentioned that Member States have produced specific websites or leaflets to detail their approach of the National Action Plan or other actions linked to pesticide risk reduction. Unfortunately, only a few of these sites provide comprehensive information addressing the general public, such as the reasons why pesticides are used and their benefits. This contributed to the development of very a negative perception among the general public.

To a large extent, only the PPP industry and end users provide explanation and information on why PPP use is sometimes required and beneficial.

According to the survey results, growers, PPPs users acquire and share information from various sources, e.g. extension services, magazines, participation in study groups and demonstration meetings. For them, general websites do not contain enough technical information.

Effectiveness of the SUD with respect to the implementation of Article 8 (inspection of equipment of use)

According to the 2017 EC report, Member States had generally established systems for inspections of equipment in use. Although the deadline was not met by a few MS, currently the enforcement of this measure is applied.

Based on the survey results, growers associations also confirmed that the implementation of the measure was late. They added that the objectives of Article 8 are appropriate. However, it was also reported that the provision's implementation led to the complexification of administrative requirements born by farmers.

A key requirement of this measure is that pesticide application equipment is tested on a regular basis. Many MS had already implemented such measure prior to the entry into force of the SUD. In all reported cases, the period between two inspections was longer than the new required one of 3 years, with the exception of DE were the prior inspection intervals were two years. Users of PPPs mentioned that the requirement of 3 years between two inspections until 2020 would create new costs for farmers.

Effectiveness of the legislation with regard to the implementation of Article 9 (aerial spraying) of the SUD

According to the 2017 Commission report, *"aerial spraying is banned and derogations are only granted under strict conditions"* (EC, 2017). When derogations are granted, the areas sprayed are limited in surface and in number, the spraying being likewise effectively controlled.

The large majority of respondents to the "other stakeholders" survey questionnaire recognised that progress has been made in the majority of MS (except for two MS), despite the number of derogations that are still granted.

Users of PPPs have notably highlighted that it is important to maintain the possibility of derogation. For example; in maize production, at a certain development stage of the crop, it is very difficult or impossible to access the field. A complete ban of aerial spraying creates difficulties in such case. Another example is treatment with fungicides in steep slope vineyards which are not accessible with other machinery. Derogations are also essential in emergency situations.

The only significant issue that has been reported by the stakeholder respondents is related to the use of drones. For health/environment NGOs, the problem of drones to be considered as new airplanes is still questionable. For other stakeholders (users of PPPs), the targeted use of drones should be positively considered, in particular when applying highly pest-specific low-risk biological products. The use of drones is a technique suitable for many biocontrol products. When the use of biocontrol products increases, the number of requests for derogations may increase significantly. This potential issue should be analysed rather soon to avoid increases in administrative burden for national authorities.

Effectiveness of the SUD with respect to the implementation of Article 10 (information to the public)

National authority respondents mentioned that the same communication channels (mostly websites) than the communication steams used for Article 7 are used by national authorities.

As for Article 7, the Commission concludes in its 2017 report, that effort is clearly insufficient and that other channels should be developed.

In addition, health/environment NGOs highlight that information and awareness raising is largely targeted to the agricultural sectors and therefore does not reach a broader audience. For these stakeholders, it is important to maintain flexibility in order to adapt information to each Member State context. They also note that there is a large potential of further disseminating good practices to better inform the public and stakeholders on the risks of the spray drift.

Stakeholders of a similar type consider that much more work needs to be done with regard to the implementation of Article 10. One respondent indicated that a survey conducted (in DE) demonstrated that around 50% of private gardeners use chemical pesticides. They concluded that providing information for the public should not be too complicated but is of utmost importance.

Effectiveness of the SUD with regard to the implementation of Article 11 (specific measures to protect the aquatic environment and drinking water)

The 2017 Commission report on Member State National Action Plans concludes that *"Member States have taken a range of measures to protect the aquatic environment from pesticide use"* although *"it is difficult to assess the progress achieved"* (EC, 2017).

Without presenting concrete evidence of their actions, the national authorities who have commented on this issue (in the survey), mentioned that monitoring progress is very difficult and that the prohibition of PPP use in areas such as buffer zones and in water catchment protection zones is difficult to control in practice. It can be assumed that in many MS, systems for surface or ground water monitoring are in place and also PPP use in catchment areas is closely monitored.

About this provision, the core team deems it important to highlight that in several MS, the authorization of PPP considers the protection of the aquatic environment by risk mitigation measures. For example, in DE, the application of PPP is forbidden in or in the immediate vicinity of surface water as laid down in the German Plant Protection Act. Also, in DE, small water courses are recognised as important sources for biodiversity. Therefore, its protection gains increasing attention and pilot monitoring studies were started under the German NAP.

Another significant issue is linked to the fact that the results of a given action may be seen only after a long period of time (sometimes several years). Therefore, assessing the effectiveness or results of actions aimed at protecting the aquatic environment are not always possible.

Health/environment NGOs consider that additional efforts are required for the protection of the aquatic environment from PPP use. They are particularly puzzled by the fact that the Water Framework Directive has seemingly not delivered results. In many MS, relevant general objectives on the protection of the aquatic environment are in place. Nonetheless, the information on this subject should be improved. Concretely, the systematic provision of trainings and advice covering responsible behaviour are needed. Similarly, the development of decision support tools that would help operators to prevent losses of pesticides. This includes i) during sprayer mixing/filling, transport, during and after spraying, cleaning the sprayer and managing excess spray solution and (ii) the necessary equipment or farm infrastructure. According to one stakeholder respondent, an example of

the kind of materials available to support such training/operator awareness can be seen through the EU LIFE TOPPS project (see www.topps-life.org).

According to the survey, organic producers added that sustainable water management goes hand in hand with organic production. For example, cropping practices reduce nutrient leaching and avoid run-off into water bodies. Furthermore, the benefits of organic production, through the importance of soil structure and increased humus quality, have positive impacts on water-holding capacity. As a result, organic production contributes to building an environment resilient to extreme climate events such as heavy rainfall and droughts.

Effectiveness of the SUD with respect to the implementation of Article 12 (reduction of pesticide use or risks in specific areas)

The majority of national authorities claim that the implementation of the provisions of Article 12 are not problematic. By contrast, the majority of "other stakeholders" respondents see more difficulties with regard to the implementation of these provisions.

However, most of the respondents from both groups (national authorities and other stakeholders) provided concrete examples of actions that have been implemented to ensure that the use of pesticides is minimised or prohibited in certain specific areas. For example, several MS have decided to establish pesticide-free public areas in towns or envisage to extend these restrictions to inhabited areas. Other MS have established specific strict rules for the authorisation and use of PPP in public areas.

These efforts have been highlighted in the 2017 Commission report which specifies that 26 Member States have prohibited or restricted the use of pesticides in protected areas and conservation areas. The Commission adds that, on top of these restrictions, implementing Regulation (EU) No 540/2011 establishes specific mitigation measures for the approved active substances. In accordance with Article 3 of Regulation (EC) No 1107/2009, in areas widely used by the public and especially by vulnerable groups, (for example, in a park, sports field, recreational area, school territory, hospital territory), the use of PPPs shall only be allowed if (i) *"it is not otherwise possible to restrict the spread of organisms harmful to plants"* and if (ii) *"such use of the particular Plant Protection Product is allowed according to the instruction for use"*. Furthermore, to the extent possible, a PPP can be used in areas that are accessible to the public if this is during hours that people are not present. Users and manufacturers of PPPs responding to the survey questionnaire recognise the positive results obtained in reducing risks by excluding specific sites from use (e.g. around hospitals, schools, playgrounds), Nevertheless, they also highlighted that some MS exaggerated by banning entire groups of uses without proper alternatives in place, this contrary to risk assessments which showed no risks or exposure. As a result, such bans have led to the insufficient control of certain pests and increased costs without any clear benefit to health or environment.

Effectiveness of the SUD with regard to the implementation of Article 13 (handling and storage of pesticides)

The implementation of Article 13 is widely considered effective. Approximatively only 10% of the respondents, respectively in each surveyed group, criticise the measures.

The 2017 Commission report indicates that systems for controlling the handling and storage of pesticides are in place in nearly all Member States. According to the report, 25 Member Stated have systems in place for collecting and safely disposing of empty containers and PPP packaging. In 21 Member States there is further a system of collection and safe disposal of expired and obsolete pesticides and their packaging.

Users and manufacturers of PPPs responding to the other stakeholder survey questionnaire indicated that systems for the controlling and handling and storage of pesticides have been in place for many years. This correspondingly ensures the safe collection and disposal of containers, packaging and expired pesticides.

Another specificity of the provision stressed by these respondents is that control can be easily performed at low-moderate costs for authorities.

Effectiveness of the SUD with regard to the implementation of Article 14 (Integrated Pest Management)

Respondents from national authorities and other stakeholders evaluate the implementation of IPM differently. Whereas a slight majority of national authorities deem the implementation as rather straightforward, almost half of the other stakeholders respondents consider the implementation as problematic.

The Commission performed *"six fact-finding-missions"* on the implementation of the SUD and, with respect to IPM, concluded that based on the authorities' statements *"some IPM techniques could be adopted on a more widespread basis, such as crop rotation, proper selection of seed and planting material and use of adequate cultivation techniques"* (EC, 2017). The findings from NL support this view. In NL, IPM principles were found to be implemented by farmers in only a very general manner. None of the principles were found to be applied to their full potential. Furthermore, findings in DK demonstrate that although awareness with respect to IPM techniques among farmers has increased, the degree of implementation of IPM has only marginally followed suit. The results from the fact-finding-missions also demonstrate that *"Member States have not converted the IPM principles into assessable criteria"* (EC, 2017). Indeed, MS see IPM mainly as *"an education tool for farmers"* and have not established any methods to adequately assess the compliance of farmers with IPM principles (EC, 2017). While Member States have introduced a set of measures that aim to promote the use of IPM, these measures do not sufficiently ensure that IPM measures are being implemented by users, or that the IPM implemented in of a high quality.

The Commission report highlights that *"IPM is a cornerstone of the Directive but compliance with the principles of IPM at individual grower level is not being systematically checked by Member States"* (EC, 2017). Furthermore, the Commission report adds that *"Member States have not yet set clear criteria to ensure that the general principles of IPM are implemented by all professional users"* (EC, 2017). These tools may help establish whether the IPM outcome intended of a reduction on the reliance of pesticides is being achieved.

Several national authorities indicated in their answers that authorities are missing EU level financial and technical support to implement IPM. This is in particular an issue for conducting the complex monitoring of optimal IPM implementation. In addition, the same respondents report that the Directive assumes that IPM could be applicable in all geographical and agronomical situations, across Europe. The respondents in question entirely reject this assumption. Additionally, these respondents stress that changing grower's habits takes time and the IPM results are far from being immediately visible.

Of note, in its 2017 report, the Commission announced it *"will support Member States in the development of methodologies to assess the compliance with the eight IPM principles, taking into account the diversity of EU agriculture and the principle of subsidiarity"* (EC, 2017).

The surveyed users of PPPs and organic growers have mentioned that another issue contributing to the diverse results in implementing IPM is due to the variability of situations (crops by region by agronomic practices) that makes it impossible to develop concrete guidelines for each case and

each situation. Accordingly, it is therefore impossible to set up clearly defined criteria for implementation.

Another stakeholder, a farmer organisation, highlighted that it is important to create a more supportive environment (including EU policies) that stimulates the development of sustainable plant protection strategies. Knowledge from organic farming as a systems approach to sustainable agriculture based on agro-ecological practices can make a very important positive contribution to the reduction of the reliance on pesticides, as well as to the risks which might occur from the use of these substances.

In the opinion of stakeholders such as health/environment NGOs, MS do not push strongly for implementation of IPM principles into practice. This echoes the findings of a study[59] on crop rotation that shows that farmers do not always use the preventive measures available which results in the increased reliance on pesticides for pest and disease control.

Effectiveness of the SUD with regard to the implementation of Article 17 (penalties)

The 2017 Commission report does not cover the establishment of penalties by MS. In addition, the Commission has not launched any infringement procedure against Member States for not complying with the SUD provisions.

National authority respondents provide a different picture. Several of them mentioned that the rules for penalties exist and are included in the NAP. One national authority indicated that penalties applicable to any infringements to the provisions adopted pursuant to Directive 2009/128/EC are taken and pose no problem. However, this does not automatically mean that they are implemented in each case.

Surveyed users of PPPs have indicated that, to their knowledge, no EU Member State has introduced effective penalties to farmers/producers for not complying with the requirements of the SUD.

The majority of respondents from national authorities do not consider the use of penalties in the cases of infringement as an issue. The low response rate to this question by other stakeholders probably indicates that they are not very familiar with the provision.

Effectiveness of the SUD with respect to the implementation of Article 19 (fees and charges)

The responses to the national authority survey questionnaire do not allow drawing an overall conclusion with regard to the establishment of fees and charges by Member States. Only 2 authorities (out of 3 respondents to this question) have indicated that fees and a charge system are in place in their country.

In addition, as reported by a user of PPPs (other stakeholder survey), FR has established a special tax *(redevance pour pollutions diffuses)* which is paid by farmers when buying PPPs. This tax increases over time each year. Farmers consider that all money collected through such measures should entirely go back to them to help in implementing IPM and other transitional measures. To date, this is not the case in any examples.

[59] DG ENV report on crop rotation (http://ec.europa.eu/environment/agriculture/pdf/BIO_crop_rotations%20final%20report_rev%20executive%20summary_.pdf) and Brisson et all 'Why are wheat yields stagnating in Europe? A comprehensive' Field Crops Research Volume 119, Issue 1, 9 October 2010, Pages 201–212

4.2.4. Efficiency

Are sufficient resources devoted to the implementation of the measures of the National Action Plan?

Figure 16: Does the implementation of the obligations of Directive 2009/128/EC leads to too high administrative costs[60]? (National authorities (n=19); Other stakeholders (n=43))

Source: Core team, 2018, based on results of a survey

National authorities and other stakeholders alike have indicated that due to limited resources, it is very difficult to plan and implement all activities and obtain the expected results. This is a major issue in most of the Member States.

In addition, several national authorities have indicated that no dedicated budget has been foreseen for the implementation of the SUD. Other stakeholders mentioned that the accounting system in place does not provide information on the quantity of resources is being dedicated to the action.

Commenting on the efficiency of the SUD, users and manufacturers of PPPs have indicated that obtaining good results in line with the SUD implementation is very costly and demanding.

One of the national authorities indicated that it is difficult to quantify the resources to be earmarked for the implementation of the measures in the NAP. Indeed, different authorities and other stakeholders have to be involved in the implementation. This leads to difficulties in estimating the overall costs for all actors.

Another national authority indicated that some specific actions (for example, the national environmental surveys of pesticide residues in aquatic environment) should have received more resources. Conducting surveys to monitor water quality being extremely expensive.

[60] Administrative costs in this case mean the costs incurred by enterprises, the voluntary sector, public authorities and citizens in meeting legal obligations to provide information on their activities (or production), either to public authorities or to private parties. They are different from compliance costs which stem from the generic requirements of the legislation, such as costs induced by the development of new products, or processes that meet new social and environmental standards.

Yet another national authority indicated that one way to reduce administrative costs for the public sector would be the establishment of a labelling/certification system by the private sector, in line with the relevant goals of the SUD.

Does the implementation of the obligations of Directive 2009/128/EC lead to overly high enforcement costs?

The majority of national authorities having responded to this question consider that the costs of enforcement are high. Moreover, they bring forward a lack of resources as the critical hindering factor for the proper implementation of the SUD.

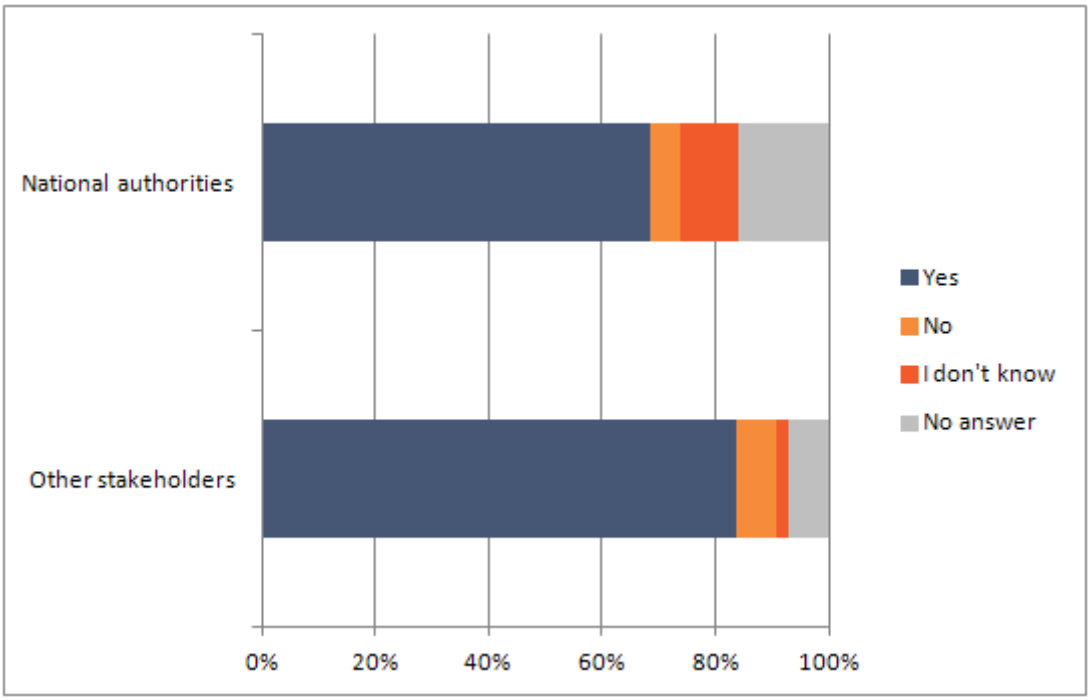
The same respondents also added that implementation costs of the SUD (which presumably cover both enforcement and administrative costs) need to be put into perspective. The costs of spraying pesticides on society should also be considered. If concrete and ambitious measures are planned as well as adequately implemented and controlled, this would result in considerable administrative costs (administrative burden). However, it is important to consider the overall balance of costs and benefits for the society.

Health/environment NGOs indicated that one approach to solving the budget issue being faced by a majority of MS could be to abandon the low level of VAT, applied in several countries, and apply a higher VAT rate on the sales of PPPs. This measure might act as an indirect incentive for increasing grower awareness when buying more expensive pesticides. A system of high prices may influence farmers that would consider changing behaviour and practice.

4.2.5. EU Added Value

Do you think the EU level is adequate for regulating the use of pesticides in agriculture?

Figure 17: Do you think the EU level is adequate for regulating the use of pesticides in agriculture? (National authorities n=19; Other stakeholders n=43)



Source: Core team, 2018, based on results of a survey

The large majority of stakeholders (80%) and authorities (70%) considered that the EU is the adequate level for regulating the use of pesticides.

This EU intervention aims at ensuring a level playing field across MS. Harmonisation is an important aspect of the Directive (e.g. harmonised guidance and statistics to compare and monitor data such as poisoning, pesticide use, environmental impacts, and quality standards for farmer training and pesticide application technics). It should also allow dissemination of good practices and approaches across countries. For the majority of all types of respondents, these EU basic rules are needed in order to avoid significant discrepancies between and among MS.

However, it is also necessary to consider regional conditions such as climate and soil conditions and the type of crops. This supports that specific IPM guidelines and non-chemical methods are developed as "best practice" on a national level, with a local and regional focus. Therefore, interventions should include sufficient proportionality. The EU approach based on a directive seems to be the best approach.

Some health/environment NGOs even estimate that more harmonisation is required. A good example could be the greater harmonisation of risk management measures in place in various MS. Greater harmonisation in risk management measures would also provide more clarity to PPP evaluators and manufacturers. Along those lines, further support from the Commission is reportedly necessary for the continued development of a toolbox of EU harmonised risk management measures reflecting the numerous effective risk management tools available across the European Union.

4.3. Directive's provisions analysis

This sub-section analyses the respondents' answers with regard to the actions undertaken by each MS when transposing the Directive's provisions into their national legal acts. Since the two surveys focussed on gathering information that is not reported in the NAPs, several elements of the Directive's provisions were not addressed in the survey. Rather, they were included in the NAP review analysis above. For example, gathering information relevant to Article 10 of the Directive on "information to the public" is part of the NAP review analysis.

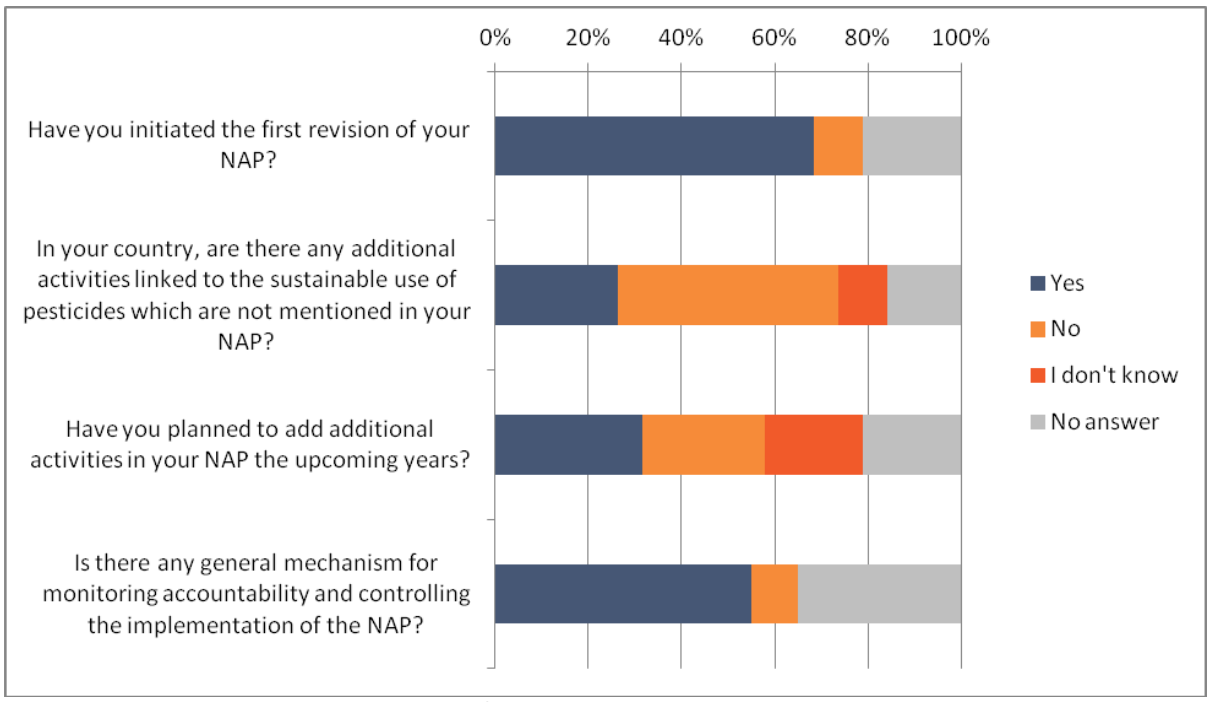
Because of the reasons described in subsection 4.1. also this section is limited to the presentation of the statistical results completed by specific comments made by respondents.

4.3.1. Article 4

As indicated in the previous section on the NAP review, NAPs shall be revised at least on a five year interval. Although the MS published their initial NAPs at different points in time, as of today, along

the requirements of the SUD, each MS should have at least published a revised NAP. National authorities were accordingly asked to speak to the state of their NAP.

Figure 18: Article 4, NAPs (n=19)



Source: Core team, 2018, based on results of a survey

Thirteen national authorities (68,4% of the authority respondents) stated that they have initiated the first revision of the NAP. In Romania, for example, a review of the initial plan was completed in 2016 with new indicators developed prolonging validity until 2023 (5 years).

In Sweden, only very small changes from NAP 2013-2017 have been inserted into the NAP 2018-2022

Overall, very few authorities provided in-depth information with respect to the changes made to the initial NAP. The survey inquired on whether any additional activities linked to the sustainable use of pesticides, and in general, had been undertaken and included in the revised NAP.

One official body indicated that it is intended to achieve more: more concrete and more ambitious activities in order to protect the environment from the impact of pesticides, as indicated in the upcoming revised NAP. The authority presented the following five key principles for a sustainable use of pesticides: (1) minimising use; (2) identifying, quantifying, and communicating risks; (3) optimising risk management; (4) compensating for unavoidable effects; (5) internalising external costs.

One national authority also mentioned a dedicated upcoming project on the safeguarding of pollinators with a particular focus on bees.

Regarding the overall/annual budget allocated to the implementation of the NAP, only one country (which cannot be named) provided a figure on the annual budget devoted to the implementation of the SUD. This budget amounts to EUR 240,000. This budget figure is not mentioned initial NAP of this MS.

Other respondents have indicated that there is no specific budget or that the budget is unknown as the accounting systems do not allow identifying the individual estimated costs. It was also mentioned that the budget cannot be specified because many of the activities are carried out by national

authorities (i.e. in accordance with the work of the national environmental objectives), regional authorities or municipalities. Furthermore, implementation is chartered a number of different activities: proactive activities (law/regulation, information etc.) and retroactive ones (i.e. survey of pesticide residues in aquatic environment), all of these combined activities intending to reach the Directive's objectives. Therefore, providing budget estimates was deemed to be difficult.

In line with the SUD Article 4, authorities were also asked whether any mechanism for monitoring accountability and controlling the implementation of the NAP was in place. If such a mechanism was in place, authorities were requested to identify who is responsible for monitoring and overseeing the implementation of the NAP. Eleven authority respondents (57,9%) declared that such system is in place.

One authority commented that the monitoring of the SUD implementation is conducted through periodic meetings of nominated experts. This includes analysis of indicators, results and the development of regional reports.

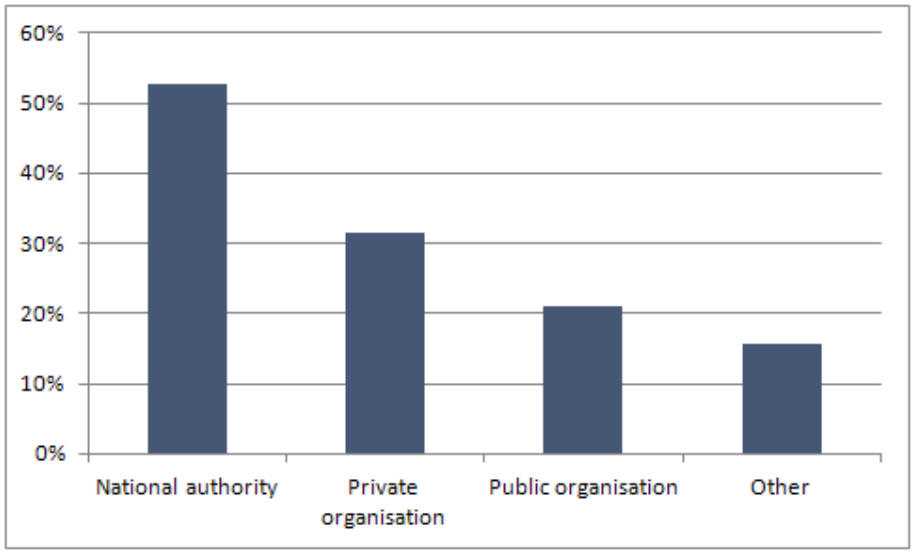
Monitoring is also reported at various levels (inter-ministerial, federal and regional meetings). All relevant stakeholders are represented during the meetings.

Several MS have likewise set up intermediary revisions of the NAP implementation (e.g. on a yearly basis, every 3 years, etc.) to better monitor the level of achievement of the SUD objectives. Apart from the references to those meetings, no specific information was provided with regard to the specific types of initiatives undertaken to monitor accountability and control the implementation of the NAP.

4.3.2. Article 5

The survey inquired on the provision of required training, in particular regarding the type of actor providing such trainings.

Figure 19: Subjects providing the trainings (n=19)

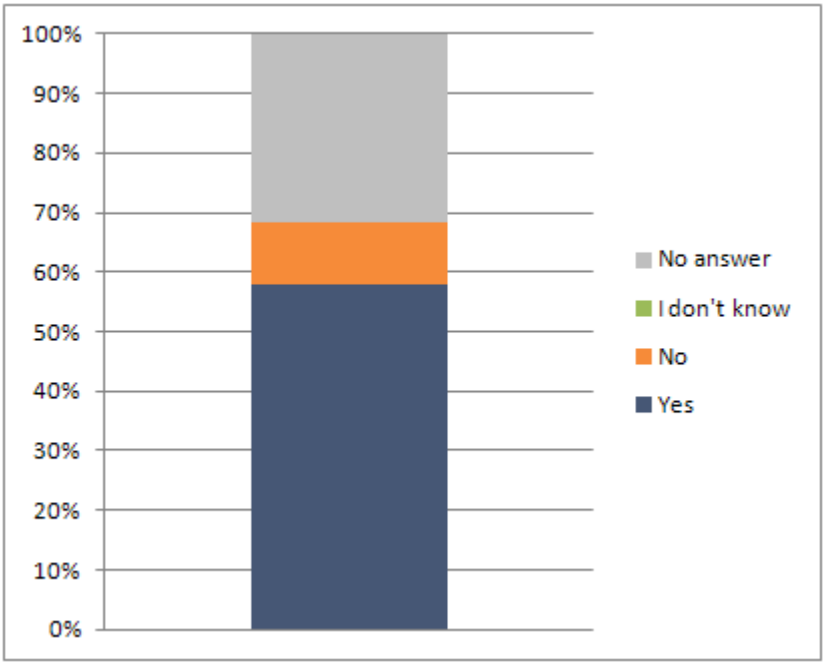


Source: Core team, 2018, based on results of a survey

According to the results of the survey, the majority of the trainings (52,6%) are provided by the national authorities and other public organisations. Trainings are performed by private organisations in only approximately 30% of cases.

While the provision of trainings *per se* is a key aspect to be verified, assessing the quality of the trainings provided is also of utmost importance. Accordingly, a survey question notably intends to examine whether the competence of the trained persons is assessed and repeatedly checked (if so, in what frequency).

Figure 20: Is the competence of trained persons assessed (re-evaluated) and repeatedly checked? – National authorities



Source: Core team, 2018, based on results of a survey

Most of the respondents (58%) indicated that professional pesticide users are obliged to update their certificate at a frequency ranging from 3 years to 10 years, depending on the MS.

One MS specified that the frequency of control is specific to the type of training. For example, a basic training of 25 hours is valid for 5 years. In some MS, the frequency of control also varies based on the type of trainee, i.e. sellers and advisors' trainings are checked every 3 years, while professional users are re-assessed every 5 years.

For this MS, the main measure to restrict sales put in place to verify that buyers are holding a certificate is to prevent PPPs from being freely accessible in selling points. Therefore, buyers need to ask product to vendors directly. These vendors can then easily check if the buyers hold a certificate. However, distribution of pesticides through online channels has not been effectively regulated to date.

One stakeholder (user of PPPs) pointed out that restricting sales of professional pesticides to a certified individual does not mean that they will be used (sprayed) by a certified individual. The certified purchaser may use a third party to apply the product. The same respondent added that, in UK, the vast majority of professional PPPs are delivered to customers with an account with the business, which is set up only following recommendation for use provided by a certified agronomist. Professional pesticides are not collected from distribution points or conducted on a cash sale basis. Distributors exercise a strict duty of care and do not supply professional products to individuals not known to them.

With regard to measures taken to monitor that distributors provide sufficient information on the risks and impacts of pesticides to non-professional users, two stakeholders respondents mentioned

that the sale of pesticides via building centres, garden stores and other similar vendors is restricted to those pesticides authorised for non-professional use. Furthermore, the pesticides available are not freely accessible in these selling points. Pesticides that are sold in public outlets are kept under lock and key. They can only be bought after a staff member has "advised" buyers on how to use them. However, one national authority indicated that repeated checks have shown that the quality of "advice" given to non-professional users has often failed to meet legal standards. Moreover, the distribution of pesticides through online channels has not been effectively regulated to date.

4.3.3. Article 7

In terms of measures taken to promote and facilitate information and awareness-raising for the general public, fourteen authorities responded to this question. However, no detailed information was provided in most of cases. Only one authority provided comprehensive information as follows:

- Initiative 1: improvement of the internet search engines of registered PPPs and disclosure of data linked to the authorised use and limitations, as well as risks reduction measures.
- Initiative 2: Operationalisation and maintenance of a Phytosanitary portal. The general public will be granted full access to all PPP related information, along with the associated risks, and pros and cons of using chemicals or non-chemical measure when protecting crops from pests.
- Initiative 3: Public disclosure of data on acute poisoning and chronic poisoning where available, particularly for the populations living in areas exposed to PPPs as well as for users of pesticides.
- Initiative 4: Monitoring of PPP poisoning cases in order to provide adequate and tailored information to users to improve the health protection of people.
- Initiative 5: Provision (upon requests) of information on PPPs applied in specific areas.
- Initiative 6: Obligation for users to announce the use of PPPs (type and manner of treatment) within a 24 hour time frame before the application.

4.3.4. Article 8

Regarding measures adopted in the Member States to monitor that professional users conduct regular calibration and technical checks of their pesticide application equipment, several authorities indicated that the initial training includes active exercises on the calibration and technical proficiency of sprayers. Following this, inspectors control the application of PPPs and visit farmers. This includes a check of the spraying equipment, and confirmation whether the PPP user only uses certified sprayers. Certification systems are also in place.

However, none of the national authority respondents provided information on any concrete measure to monitor that professional users conduct regular calibration and technical checks of their pesticide application equipment.

4.3.5. Article 9

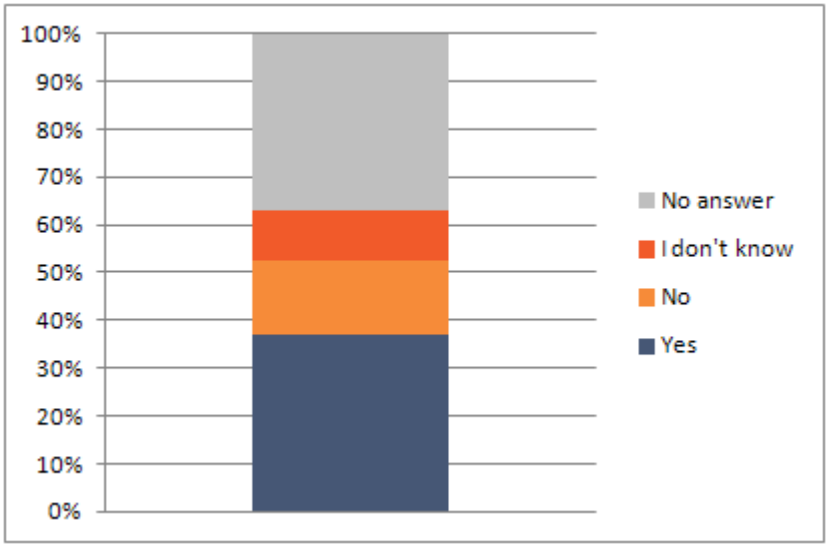
In line with Article 9 regulating aerial spraying, information was gathered with regard to the number of single requests for derogation received (and granted) since the Directive has entered into force.

Only 6 national authorities (out of 19) partially responded to this question. None of them agreed on being identified. Two authorities indicated that one derogation every year is granted, another authority specified that a derogation was granted for spaying over a total area of 66,217 ha (in 2017). Another respondent likewise mentioned that approximately 2,1% of agriculture land is yearly treated by aerial application.

4.3.6. Article 11

The survey findings with regard to the implementation of additional measures to protect the aquatic environment and drinking water which were not included in the NAP are discussed below.

Figure 21: Has your country implemented any additional measures to protect the aquatic environment and drinking water which were not included in the NAP? ? (National authorities n=19)



Source: Core team, 2018, based on results of a survey

National authority respondents report that within some MS regions, specific programs are underway aiming to improve the protection of the aquatic environment and drinking water. Measures undertaken are, for instance, the provision of specific advisory services on optimised risk management and on the reduction of pesticide application and adaptation of pest control techniques. In addition, there are several forms of private cooperation between farmers/farmer organisations and drinking water companies aiming to reduce the input of pesticide residues in ground water.

One national authority also noted that the undertaking of such measures is the responsibility of regional authorities. Therefore, national authorities have no information on regional plans that may be in place.

4.3.7. Article 13

With respects to the handling and storage of pesticides and treatment of their packaging and remnants, authorities report that, in general, there are numerous restriction and actions implemented in order to avoid contamination. For example, to avoid contamination by cleaning spraying equipment, new machines with cleaning tools and special cleaning places are said to be very useful. However, more investments are required support the greater spread of these practices. Likewise, regular training is necessary to raise awareness.

In other MS, national authorities declare not being aware of relevant activities undertaken at the regional level.

4.3.8. Article 14

With regard to encouraging producers, growers, advisors and other stakeholders to apply IPM principles, the replies varied. Several national authorities indicated that general principles of IPM have

been transposed in the national legal order. Some national authorities also pointed to the development of dissemination tools and activities (leaflets, booklets, manuals, periodic bulletins, web portals).

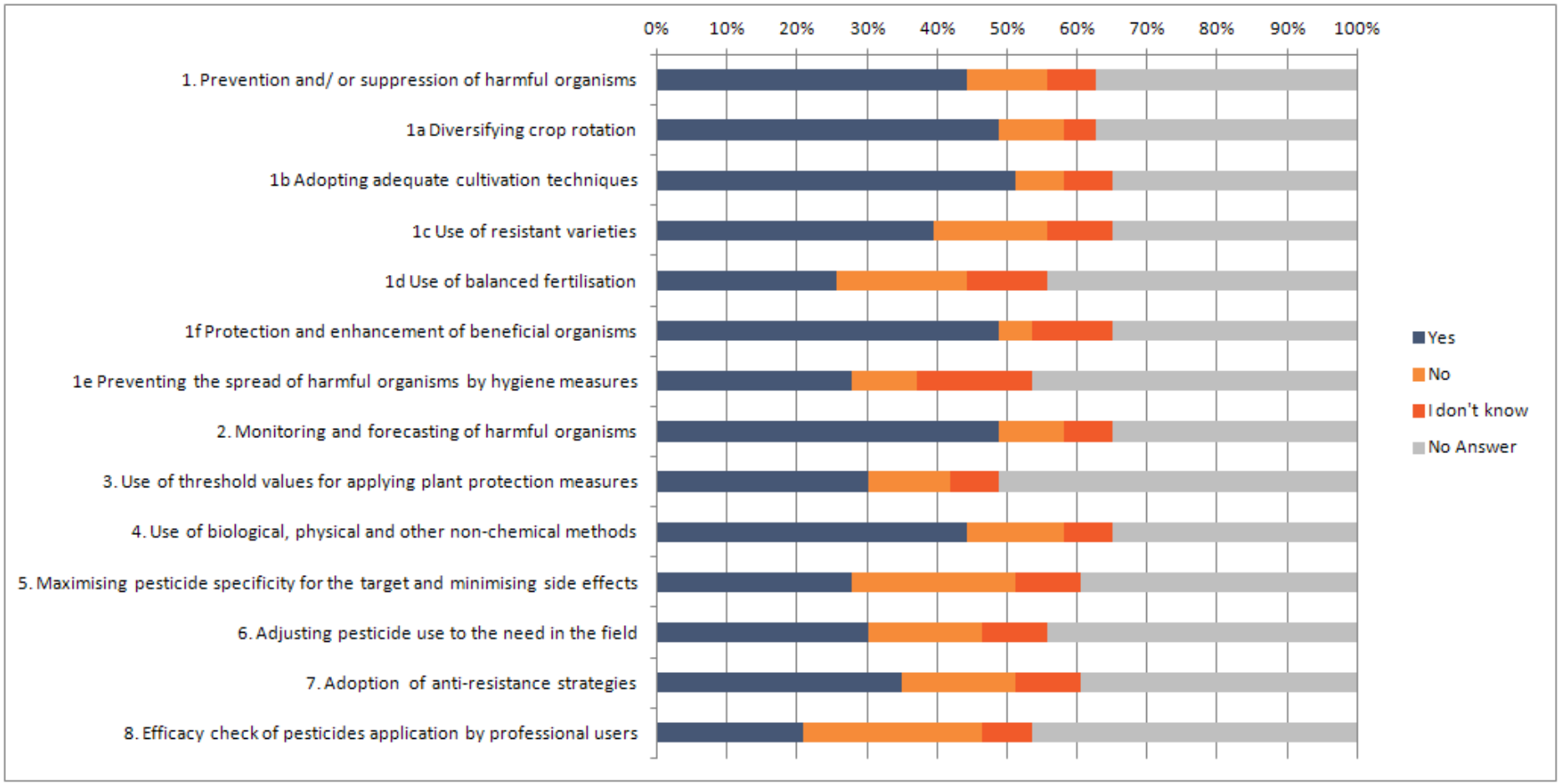
Only one national authority mentioned that the promotion of IPM has been undertaken through financial supports in the frame of agri-environmental management measures of the CAP.

As reported by most of the respondents, IPM is not one measure but a combination of measures. Likewise, the effectiveness of IPM measures varies to a great extent depending on weather patterns, soil types and other interactions. A systematic approach is thus required to address this topic area. To understand what to do and when to do it, further research is required to maximise effectiveness across a range of seasons/weather patterns.

Both types of respondents, national authorities and other stakeholders, consider that the three main priorities receiving most attention in their respective countries are 1) the diversification of crop rotation, 2) adapting cultural techniques, and 3) monitoring and forecasting of harmful organisms.

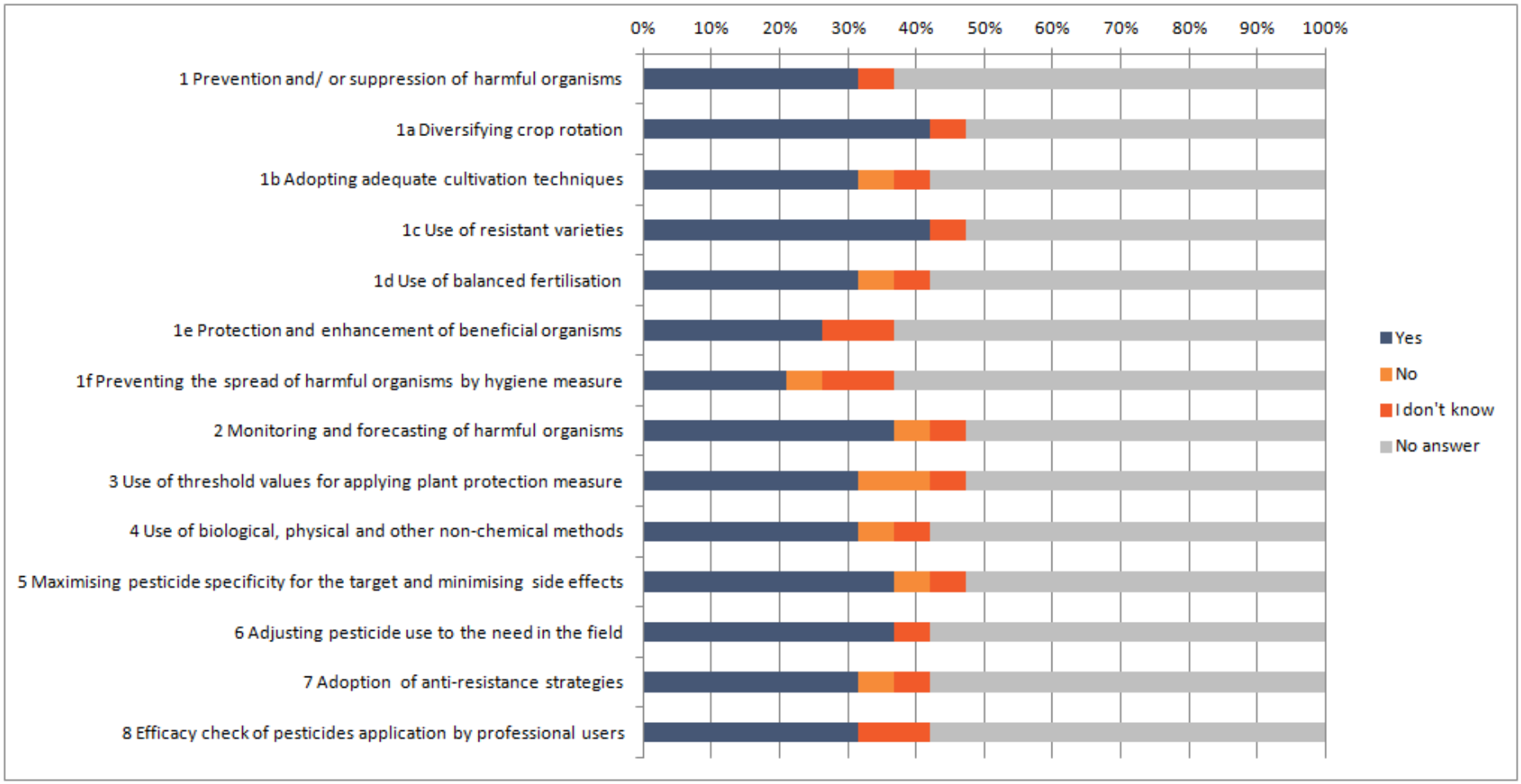
One health/environmental NGO is strongly is opposed to this ranking. To its opinion, from the day the SUD entered into force, most stakeholders have focused on anti-resistance strategies, with a focus on making sure that there is a broad arsenal of pesticides available for all (or at least for all major) crops. Diversification of crop rotations or other instruments for preventing/suppressing harmful organisms have never been given significant attention.

Figure 22: Considering all crops, indicate whether each of the eight IPM principles have received attention in your country, to your knowledge? – Other stakeholder survey



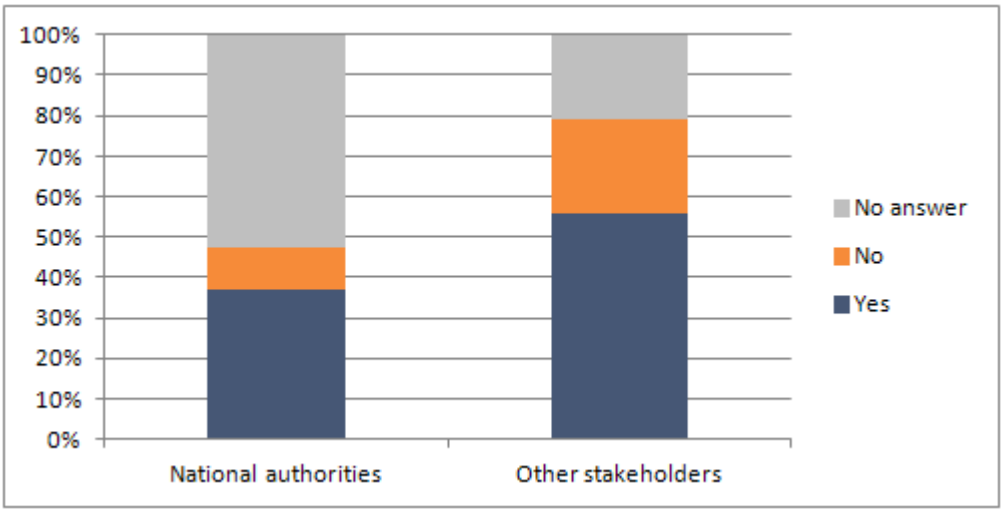
Source: Core team, 2018, based on results of a survey

Figure 23: Considering all crops, indicate whether each of the eight IPM principles have received attention in your country, to your knowledge? – National authority survey



Source: Core team, 2018, based on results of a survey

Figure 24: Have you developed IPM guidelines? (National authorities n=19; Other stakeholders n=43)



Source: Core team, 2018, based on results of a survey

Seven national authorities (37%) mentioned the development of IPM guidelines. However, no details were provided, with the exception of one MS that presented an interesting approach: a Certified System on IPM adopted on 850.000 ha of arable soil (voluntary IPM). This certified system is funded by the CAP under the second pillar.

Twenty-four stakeholders (mostly farmers associations and crop protection associations) have reported the development of several guidelines for specific crops or groups of crops.

For example, one user of PPPs from UK mentioned the Voluntary UK initiative. Another example is IBMA Global and COPA COGECA[61], both active at the EU level. These two stakeholders that have jointly developed and co-signed a roadmap of collaboration to help increase the availability of low-risk and biocontrol solutions. This roadmap is currently being updated and should become available imminently. The roadmap is a collaboration at the EU level across multiple crop sectors.

The main issues for the further development of new practices and the implementation of IPM are:

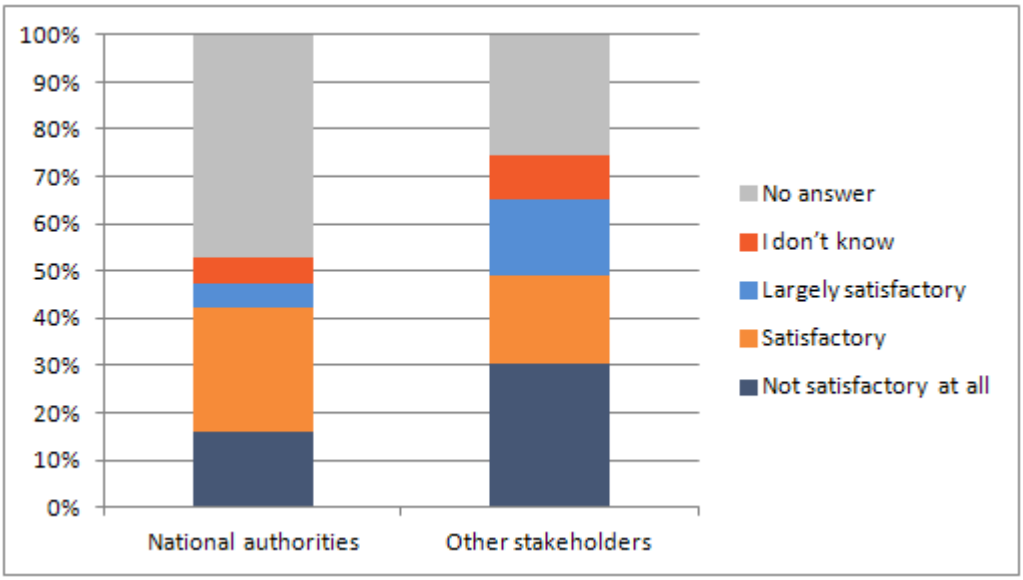
- Lack of willingness to change (...);
- Lobbying and political influence of the advisory services in most countries and the pesticides industry (...);
- Lack of trust in non-chemical alternatives (...)
- Lack of resources (...);
- How to deal with the potential risks associated to IPM (e.g. not meeting quality standards required by the processors) (...).
- High cost involved: IPM implementation may lead to higher costs and a potential decrease in yield. Lower input costs (e.g. pesticide savings) or higher product prices may not make up for the higher cost incurred by IPM methods and instruments (...).

National authorities indicated that there is no concrete monitoring system in place in their respective country with regard to the implementation of the IPM principles.

[61] Available at http://www.ibma-global.org/upload/documents/a2ibmacopacogecacollaborationroadmap201415.pdf

Overall, most of respondents (national authorities and other stakeholders alike) consider that the implementation of IPM is not satisfactory enough.

Figure 25: In your opinion, do you consider that the application of IPM measures in your sector/country is… (options listed in the figure below) (National authorities n=19; Other stakeholders n=43)



Source: Core team, 2018, based on results of a survey

Having said this, the large majority of other stakeholders and national authorities are not in favour of modifying the list of the eight IPM principles. In their opinion, any revision of the legislation should aim to make implementation of the eight general principles more controllable. In addition, any new principles should include those for which on-farm adoption is easy to assess.

Figure 26: Do you think that the list of the eight general principles should be revised? (National authorities n=19; Other stakeholders n=43)

Source: Core team, 2018, based on results of a survey

4.3.9. Article 15

The responses to the survey questionnaire are too few to provide an overall picture of the national situation with respect to the development and implementation of risk indicators.

The 2017 Commission report includes findings and conclusions as follows:

24 MS included risk indicators in their NAP using a range of approaches. Of the six MS visited, both DK (Pesticide Load Index) and NL (Environmental Indicator for Pesticides) use a single high-level indicator to capture trends in the risks associated with pesticides. On the other hand, SE (national risk index for health and the environment and the toxicity index) and DE (risk index for aquatic non-target organisms and risk index for terrestrial non-target organisms) both use two high level indicators. The Danish, Dutch and Swedish national risk index and both German indices are broadly comparable in that they are calculated based on pesticide sales and the intrinsic properties of the products sold. The Swedish toxicity index shows the incidence of pesticides detected in aquatic environments and is based on the actual findings of pesticides in a small number of water courses.

DK, DE and SE also have a range of sector specific indicators such as the number of Maximum Residue Level (MRL) breaches in food detected in pesticide residue monitoring programmes. PL has no single high-level indicator but uses a series of sector specific indicators, such as the number of MRL breaches, while Italy has not yet established any indicators. SE is the only one of the six MS monitoring trends in the use of specific active substances. They measure trends in the use of pendimethalin because of its bio-accumulative and persistent properties. Further bentazone use is monitored because of the frequency of its detection in Swedish groundwater at levels above 0.1µg/l. Finally, pyrethroid insecticides are also monitored due to findings in surface water monitoring in 2010. Sales of pesticides containing these active substances have remained broadly unchanged over the last eight years, except for pendimethalin containing products, which are no longer authorised. DE is the only MS to have indicators to measure the yield increases associated with pesticide use, through measuring the difference in yield between untreated and treated crops and an area efficiency indicator i.e. the cultivated area required to produce one tonne of a crop.

The 2017 Commission report further lists examples of good practices, but does not conclude on the correct implementation of indicators.

4.4. Additional remarks

The following main additional remarks on the implementation of the SUD as a whole have been made by national authorities which responded to the survey.

Firstly, the Commission should survey the real implementation of IPM at MS level.

Secondly, a significant reduction in the use of plant protection products at European level will only be achieved by progressively changing the agricultural model in place. Focusing on the use of pesticides is not enough (as shown by the lack of evolution of the amount of pesticides sold each year in Belgium despite all of the measures taken), because the use of PPP is inherent to conventional farming systems. Measures at the EU level must therefore be taken to promote emerging production models, ones which are more sustainable and respectful for the environment.

4.5. Conclusions on the surveys' findings

The two survey questionnaires have been completed by a wide range of stakeholders representing different professional and thematic areas (health/environmental NGOs, users of PPPs, manufacturers

of both chemical and non-chemical, and competent authorities). The information that has been collected provides a reliable data set to enable a meaningful analysis of the implementation of the Directive. However, when looking at the respondent categories, the number of respondents of national authorities is relatively low (19 entries in total), in addition only 11 national authorities identified a Member State which they represented.[62]

As an introduction, several national authorities have highlighted the fact that the Directive covers an area which was not previously regulated. It is the first time, and unique worldwide, that the EU has developed a regulatory framework for the use phase of pesticides, with a focus on risk reduction. Therefore, National Action Plans were completely new in many MS and thus the implementation of the provisions of the Directive have to be evaluated carefully considering the lag phase between the development of these associated new systems and the observation of concrete results. For the same respondents, the Directive's role was observed as a key driver in ensuring that different ministries and stakeholders, in all MS, discuss the use of pesticides and methods for risk reduction. The Directive was further reported to encourage that MS follow harmonised provisions and requirements and thus gain common knowledge related to risk reduction, as well as achieving an increased awareness among professional users.

Relevance: The outcome of the two surveys confirms that the objectives of the Directive 2009/128/EC remain valid. This general conclusion was shared between authorities and other stakeholders. National authorities noted that keeping the objectives of the Directive is important in order to achieve results and have a basis for monitoring and discerning follow-up. Hence, it was felt that the sets the foundation for encouraging further improvements in sustainable pesticide use. Other stakeholders provided a more critical reflection on the objectives, despite their positive recognition of the measures to achieve risk reduction, and National Action Plans. Their criticism is mainly related to the insufficient implementation of IPM and non-chemical approaches.

The majority of respondents, being national authorities or other stakeholders, consider that there is no need to modify the legislation at this stage. However, national authorities that advocated for a review of the objectives also mentioned that any legal changes shall be based on an assessment of the achieved results. Some stakeholders (across both categories) emphasised that the objectives of the Directive should be updated with a stronger focus on concrete measurable results and progress achieved. This was especially reported with regard to setting quantitative risk and use reduction targets and timetables, the implementation of optimal approaches to IPM, prioritising the uptake of non-chemical alternatives, reinforcing unbiased communication and awareness raising to the wider public, scientific support for the identification of alternative methods, developing new relevant technologies, and finally establishing increased political and governmental support for innovation within low-risk alternatives.

Health/environmental NGOs generally consider that the objectives of the Directive should be updated. They state that an additional objective aiming at *"reducing dependency on pesticide use"* should be added. The aim of *"reducing dependency on the use of pesticides"* is mentioned several times in recitals and in Articles 4 and 15 in the Directive 2009/128/EC. However, it is not reflected sufficiently in the general objectives. Finally, the majority of respondents from national authorities, and all categories of other stakeholders, have expressed concerns with regard to the lack of reliable instruments and monitoring tools to measure or assess the progress, as well as the potential high costs, associated with the development and implementation of such comprehensive monitoring systems.

[62] For two Member States, two entries each were registered and six national authority respondents did not identified themselves.

Coherence: National authorities considered that the level of overall coherence with other policy areas is rather high, in particular in the areas of environment, maximum residues limits (MRLs), PPP regulation, food and feed safety, food and feed security, agriculture, consumer protection, and public health. The implementation (of the other legislation) is in line with the objectives set out in the SUD. The coherence between implementation and the objectives of the legislation on climate change was reported as particularly high. A lower coherence was observed with respect to the legislation concerning fertilisers and chemicals.

Other stakeholders considered the objective of the Directive as coherent with consumer protection, public health, environment, MRLs, PPP regulation, food and feed safety, agriculture. They reported less coherence for internal market, biocides, and chemicals. Respondents reported similarly on the coherence of the implementation of the Directive. On the other hand, this was not observed regard to energy legislation, where the most incoherence was reported. A higher rating of coherence concerning the implementation of the legislation on chemicals was observed, but a lower coherence on the implementation of Regulation (EC) No 1107/2009.

Among other stakeholders, there is consensus that biocide legislation is lacking coherence regarding the objectives and the implementation of the SUD. The same stakeholders also identified the unsatisfactory implementation of Regulation (EC) No 1107/2009 as a hindrance for coherence of the objectives and implementation of the Directive, especially with respect to the authorisation of low- risk products and promoting their importance for IPM.

The same stakeholders criticise the vague overall objectives of the NAPs. They further identified their very general focus on the approaches to risk reduction and measuring impacts. In their opinion, this impedes the achievement and efficacy of the overall objectives of the Directive.

Effectiveness: The majority of national authorities and other stakeholders, albeit not all, considered the implementation of national provisions for IPM as moving in a good direction. This was reported even in light of only a very few concrete and generalizable results having been observed to date on the impact of the different provisions, particularly with respect to IPM. Users of PPPs consider that IPM is not sufficiently known even if progresses can be observed. IPM is an approach built for crop specific management. Therefore, guidelines and management practices must be further developed and disseminated per MS and crop, or crop category, with the support of advisory services. Health/environmental NGOs consider that Farm Advisory Services (FAS) and the CAP should more strongly incorporate IPM approaches. The incentives, including the development of monitoring tools, advisory services and knowledge transfer mechanisms, for growers to change their practices are considered insufficient by authorities and health/environmental NGOs. The promotion of alternative approaches and techniques, through the Directive, is considered positive by authorities but inefficient by stakeholders (users of PPPs and health/environmental NGOs). In particular, the availability of economically viable alternative methods is a key issue. This issue is largely dependent on specific conditions of use and technical/scientific knowledge. Science and advisory services require resources and time to develop tailor-made and efficient pest control solutions. Similarly, the current slow state of approval of low-risk substances via Regulation (EC) No 1107/2009 is seen as a major impediment by grower associations.

National authorities also consider that there are insufficient incentives in place for growers to change their practices, as they are habituated to the use of a set of well-known chemical substances. They are therefore hesitant to use other pest control systems which have not always proven their efficacy in the field.

In general terms, there is a significant difference in the opinions of other stakeholders and national authorities on the implementation of Articles 5 to Article 15 of the Directive.

National authorities, users, and manufacturers of PPPs generally consider that significant progress has been made with regard to the obligations of training (Article 5). On the other hand, health/environmental NGOs consider that the quality of these trainings is inadequate to achieve concrete results and contribute meaningfully to the objective of risk reduction.

Health/environmental NGOs also pointed out issues mainly with regard to the implementation of Articles 10 (information to public), 11 (specific measures to protect the aquatic environment), and 14 (IPM). In their opinion, the efforts for the protection of the aquatic environment should be increased and methods for measuring impacts should be developed. On the contrary, national authorities consider that the implementation of the provisions of these Directive articles is in good standing. Notwithstanding their positive assessment, several authorities also identify difficulties in implementation. This was linked to the efforts and costs required for setting up the administrative structures necessary for implementation and for the development of methods for measuring impacts. Most of the provisions were efficiently implemented and contribute to risk reduction, even though indirectly via grower training, reducing spray drift via better calibration and improving technical status of sprayers, sales of pesticides, safe handling and proper storage and disposal of pesticides. Awareness raising for growers and the provision of information for public are areas are still approached by classical dissemination tools such as websites, factsheets and events. The impacts of such actions remains unknown.

Implementation of Article 14 is also assessed differently by national authorities and other stakeholders. Despite the overall positive evaluation, authorities mention the aspect of missing technical motivation and financial incentives at the European level as a factor hindering the proper implementation of this Directive's requirement. The complexity of the approach, and the individual farming situations, exacerbate the effective monitoring and evaluation of IPM uptake. This opinion is shared by users of PPPs and complemented by the observation that the development and adherence to uniform guidelines is difficult and does not respond to the great variability of production situations present across the EU. They argue for a more supportive environment enabling sustainable crop protection strategies, including agro-ecological practices.

Efficiency: The different categories of other stakeholders, as well as the large majority of national authorities, have highlighted that resources (personal capacities and budget) required for the proper implementation of the Directive are lacking. Several national authorities have highlighted that costs are high for a full and effective implementation of the Directive. The same respondents reported that the main issues are related to the proper development of alternative methods (research funding is lacking) and implementation of IPM. Manufacturers of PPPs consider that, in general terms, enough resources are devoted to the implementation of the Directive. On the other hand, these respondents quoted that in a range of Member States resources at the official extension service level have been constantly reduced which undermines appropriate training intensity and coaching. Such actions strongly limit the capacities for direct (farm level) advice, especially of small holder farmers.

EU added value: The majority of the respondents reported that there was added value linked to the implementation of the SUD in terms of supporting Member States' in achieving national health, environment and market objectives related to pesticide use. No respondents reported that Member States would achieve better results without the SUD in place at the EU level.

In summary, there is a large consensus among stakeholder and authorities that the Directive brings added value in the long term. It provides guidance towards risk reduction and significantly contributes to achieving a level playing field to further reduce the risk from pesticide use as well as diminishing the discrepancies of the approaches followed across individual Member States.

5. Case studies

Three in-depth case studies have been conducted in order to gather specific information addressing the research activities of level B. Three other research activities were discarded, deemed as irrelevant by the core team. Justification for not conducting those level B research activities are provided in section 5.4.

Case study 2 and 3 relied on the collection of information at the MS level. Within this, interviews of national authorities as well as other stakeholders were conducted. On the other hand, case study 1 relies entirely on a literature review and on the core team members expertise. Further information the case study approach is presented in appendix 8.1.6.

5.1. Case study 1: Development of harmonised risk indicators

5.1.1. Background

Directive 2009/128/EC, in Article 4 (1), states that MS should include risk indicators (sometimes just called indicators) in their NAP. According to the Article 4 (1), risk indicators are intended to be used to *"monitor the use of plant protection products containing active substances of particular concern, especially if alternatives are available"*. Recital 20 of Directive 2009/128/EC indicates that harmonised risk indicators should have a broader application than just monitoring *"active substances of particular concern"* as it states that *"it is necessary to measure the progress achieved in the reduction of risks and adverse impacts from pesticide use for human health and the environment. Appropriate means are harmonised risk indicators that will be established at Community level. Member States should use those indicators for risk management at national level and for reporting purposes, while the Commission should calculate indicators to evaluate progress at Community level. Statistical data collected in accordance with the Community legislation concerning statistics on plant protection products should be used."* This need is reflected in Article 15 (1) of the Directive which indicates that *"harmonised risk indicators as referred to in Annex IV shall be established"*. Annex IV of the Directive had not been developed at the time of entry into force of the SUD. At present, harmonised risk indicators are still not available, however work in this area is in progress. The European Commission (DG SANTE) has been drafting a proposal which after public consultation will be sent to a vote. This is expected by the end of year 2018.

Many MS have developed national risk indicators. Generally seen, within this, MS have taken two different approaches. One approach is the simple and straightforward use of descriptive indicators reflecting direct effects of pesticide use (e.g. pesticides in surface and ground water and pesticide residues in food) or indirect effects (e.g. number of farmland birds believed to reflect the effect on biodiversity/food web). UK is an example of a MS that has decided on this approach and currently has a list of 36 descriptive indicators. DE has also developed a suite of specific indicators that measure progress towards reaching the specific targets of the NAP. In DE, the results are summarised and published every year as the German Plant Protection Index.

A weakness of most descriptive indicators is that they do not explicitly provide an explanation as to why trends are positive or negative. For example, monitoring of pesticides in surface and ground water typically follows a pre-determined sampling procedure and results are summarised and presented as numbers of positive/negative samples and/or number of exceedances. The monitoring results cannot easily be correlated to actual pesticide use because pesticide use data is not available at a local scale. Descriptive indicators therefore provide only a rough overview. For many of the indicators the results can be influenced by annual variations in climatic conditions as well as changes in

pest and disease pressure. It can be anticipated that while the effects of severe restrictions in pesticide use such as removal of specific compounds will be picked up by the descriptive indicators, the more subtle effects arising from the adoption of IPM will not.

Other MS have developed risk indicators based on models that assess the risk, or potential risk, for each active substance. This is the second general approach taken by MS. By combining this information with pesticide use data, risks can be calculated at field, farm, regional or national level. In contrast to descriptive indicators, the objective of model-based indicators is to estimate the effects of specific changes in pesticide use on the overall risks. Some of the model-based risk indicators summarise the information into a single high-level indicator aggregating all of the effects into one value. This is the case with the Pesticide Load (PL) in DK and the Dutch Environmental Indicator for Pesticides (NMI). While others estimate risks for specific environmental compartments and target organisms, such as SYNOPS in DE.

While descriptive indicators may be well suited for monitoring risks within areas of specific concern, it cannot be extended to cases of assessing overall trends in risks, comparing risks across MS, or addressing the differences in agricultural systems (for example conventional vs IPM). In these cases, descriptive indicators fall short of taking into account regional differences in issues such as climate and cropping systems. For this purpose, model-based risk indicators are required. In the following sections the model-based indicators used in DK, NL and DE are presented. Based on findings, the considerations and requirements for the development of a harmonised risk indicator are discussed.

5.1.2. Model-based national risk indicators

In the following, three examples of model-based risk indicators are presented:

- The Dutch Environmental Indicator for Pesticides (NMI),
- SYNOPS and
- Pesticide Load (PL).

The three examples were selected because they 1) have been in use for some years now and 2) represent different approaches.

Dutch Environmental Indicator for Pesticides (NMI)

The NMI is very similar to the HAIR approach but has been adapted to Dutch conditions, in particular, concerning surface water and soil type. NMI only considers the environmental effects of pesticides. The NMI uses the principle of relating predicted environmental concentrations (PEC) to Ecotoxicological Effect Concentrations or Environmental Concern Concentrations. The NMI contains a variety of models used to calculate emissions to the air, ground water, surface water and neighbouring areas. Based on the emission values, PEC values are calculated taking pesticide fate in the environment into account. PEC values are then compared to the Environmental Concern Concentrations. These could be either toxicity values, like ED50/LD50 doses for non-target organisms, or maximum permissible concentrations in specific environmental compartments like the atmosphere or ground water. Potential effects are expressed as Environmental Indicator Units calculated as the ratio between the PEC and the Environmental Concern Concentrations values.

Pesticide use data is collected at a national scale while information on pesticide use pattern in crops originates from farm surveys conducted in 1998, 2004 and 2008. Although the underlying concept of calculation apply to single applications, NMI calculations are performed for grid cells of 100 ha. This is because the lack of detailed information on pesticide use does not allow for calculations at field level. Thus, the NMI fits best at the national scale but can also be applied at a regional scale. However, in this case, results are expected to be less accurate.

For more details see Linden et al. (2008) and Kruijne et al. (2011).

SYNOPS

As mentioned above, DE uses a suite of specific indicators, mostly descriptive, that measure progress towards reaching the specific targets of the NAP. One of those indicators is SYNOPS, which is actually a model-based risk indicator that, similar to NMI, calculates risk indices on the basis of pesticide use data, exposure scenarios and inherent properties of the pesticides. In the context of the German NAP, SYNOPS is used for calculating pesticide exposure of soil and surface water, based on a "worst case" scenario, allowing for the assessment of the risks to terrestrial and aquatic non-target organism. The pesticide use data applied in the model originates from various sources including growers' organisations.

Recently, SYNOPS has been further develop and, in addition to the original version of SYNOPS, now named SYNOPS-Trend, two new applications SYNOPS-GIS and SYNOPS-WEB are available. Both models incorporate geographical information and climatic information and can calculate risk scenarios based on specific application scenarios.

For more details see Gutsche & Strassemeyer (2007), Strassemeyer et al. (2017) and Strassemeyer & Golla (2018).

Pesticide Load (PL)

The Pesticide Load, used in DK, is a single high-level risk indicator summarising the accumulated risk into one figure. In reality, however, the PL consists of three sub-indicators: one for human health, one for pesticide fate and one for ecotoxicology. The sub-indicator for health effects is based on the risk phrases on the product label, i.e. it mainly reflects risks associated to operator exposure. The pesticide fate sub-indicator is based on three input parameters: the half-life in soil, the bioaccumulation factor and the SCI-GROW index. Pesticide Load for ecotoxicology is calculated on the basis of the toxicity values (e.g. ED50 or NOEC) of the active ingredients for acute toxicity to mammals, birds, fish, daphnia, algae, aquatic plants, earthworms and bees and chronic toxicity to fish, daphnia and earthworms. PL uses the information on fate and toxicity of pesticide active ingredients that can be found in the Pesticide Property DataBase (PPDB)[63]. For the fate and ecotoxicology sub-indicators the most harmful pesticide active ingredient registered in Denmark within each input parameter has been defined as the reference active ingredient, and is allocated the maximum number of PL points. The number of PL points for all other active ingredients are expressed relative to the reference active ingredient. Pesticide use data needed to calculate the PL comes from farmers spray records. Since 2011, it has been compulsory for farmers to upload data on pesticide use and area for each crop they are cultivating to a website hosted by the competent authority, i.e. in contrast to other MS very detailed pesticide use data is available in DK.

Trends in risk can be depicted either for the aggregated indicator, for the sub-indicators or for one or more of the input parameters, e.g. toxicity to bees. For regulatory purposes, PL values at the national level are used. However, because of the very detailed information on pesticide use, PL maps can also be produced depicting risks at the regional or local scale. It should be stressed that the PL, in contrast to NMI and SYNOPS, does not estimate exposure scenarios or relates exposure to toxicity; it merely reflects the inherent risks of the pesticides. Also, mitigation measures, such as buffer zones or restrictions in use, are not considered. PL, in contrast to the NMI and SYNOPS, can be considered an estimate of the potential rather than the actual risk of pesticide use.

[63] https://sitem.herts.ac.uk/aeru/ppdb/en/

PL was developed with a dual purpose, as a pesticide risk indicator and as a basis for taxation of pesticides, which explains the high level of transparency and unambiguity in the calculations of Pesticide Load points. For more details on the Pesticide Load see Kudsk et al. (2017).

5.1.3. Discussion and conclusions

The usefulness of model-based risk indicators depends on the reliability and robustness of the underlying models and the quality of the pesticide use data.

In both NMI and SYNOPS, the underlying principle of the models is a comparison of estimated PEC values to the acceptable concentrations in the various environmental compartments. Estimation of the PECs is not trivial and detailed information on aspects such as. field conditions, crop conditions, application scenarios and pesticide fate are required for accurate estimates. Nonetheless, Strassemeyer et al. (2017) demonstrated that this is possible, as they were able to model very accurately the concentration of pesticides in surface water originating from pesticide use in an agricultural catchment over a four-year period. For a national assessment, achieving this level of accuracy is not realistic. Instead a "worst case" scenario, as seen in DE, or a grid approach, as seen in NL, can be applied.

Adapting the PEC models in NMI and SYNOPS and incorporating information on specific local conditions, such as soil types or application scenarios, would be a daunting task and is not deemed a realistic scenario for a harmonised risk indicator. In contrast, the approach adopted in PL, where risk scenarios are based solely on the inherent properties of the pesticides and actual exposure is not considered, could more easily be adopted in other MS. Both NMI/SYNOPS and PL can be expected to pick up effects on risks of changes in pesticide use pattern, like shifting to more benign pesticides or reducing pesticide use due to the adoption of IPM measures. However, disregarding exposure means that PL will not pick up risk reductions arising from risk mitigation initiatives such as establishing buffer zones, using low-drift spray technology or imposing restrictions in the timing of application.

A further simplification of the model-based approach is to use a rating system (categorical approach), as was done with the Norwegian Pesticide Risk Indicator (NPRI). For human health, NPRI classifies products into four risk classes (low, medium, high and very high risk) according to the risk phrases on the label. Environmental risk is assessed by adding up scores for effects on earthworms, bees, birds, aquatic organisms, mobility and leaching potential, persistence, bioaccumulation and a score for formulation type. Based on the accumulated score, NPRI classifies products into three environmental risk classes. By combining the information on human health and environmental risk, PPPs for professional use are categorised into 5 groups. The 5 groups are assigned values from 0.5 to 9. Like PL, NPRI was developed with the dual purpose as a risk indicator and as the basis for taxation of pesticides. Like the PL, a risk indicator adopting a categorical approach will not pick up the effects of risk mitigation measures. Furthermore, adopting a categorical approach means that substitution of PPPs with a high score with PPPs with a low score will significantly affect the overall risk score. Conversely, reductions in the use of products with a low score will only have a minor effect. For example, the effect of substituting a PPP with a score of 9 by one with a score of 0.5 on 1 ha will be equivalent to halving the use of a PPP with a score of 0.5 on 36 ha. Thus, a categorical approach could effectively monitor *"the use of plant protection products containing active substances of particular concern"* as stated in Article 4(1) but not the risk reductions associated with a wider adoption of IPM.

Another important aspect to consider regarding the development of harmonised risk indicators is the access to pesticide use data. Regulation (EC) No 1185/2009 concerning statistics on pesticides requires MS to report total sales of each active substance every year. Once every five years, MS shall compile statistics on the use of pesticides for selected crops (choice of the MS) for a reference period

of 1 year. MS can choose the reference period at any time of the five-year period and the choice can be made independently for each selected crop.

The poor quality, irregularity and lack of uniformity of pesticide use data that the provisions laid out in Regulation (EC) No 1185/2009 will most likely result in a great impediment to the potential benefits of developing harmonized risk indicators. Comparison between MS may not be possible because data will originate from different crops and years. Experiences from MS with access to annual pesticide use data have shown that pesticide use can vary significantly between years due to variation in disease and pest pressure. Hence, three-year moving averages have shown to be a better approach to assess trends in pesticide use and risk than annual values. This is not only due to the natural variation in disease and pest pressure, but also because pesticides sales can be affected by legislative issues such as a forthcoming ban of a pesticide.

Adopting advance risk models like NMI and SYNOPS for a harmonised risk indicator to be used in all MS is not a realistic scenario considering the time and resources that would be needed to develop these models. Furthermore, considering the quality of the pesticide use data that will be available it would also make no sense, as the quality of the input determines the output. If the level of ambition of a harmonised risk indicator is restricted to monitoring *"the use of plant protection products containing active substances of particular concern"* a simple categorical approach, like the one used in NPRI, is in keeping with the quality of the available pesticide use data. However, in the long-term ambitions should be increased concerning both the complexity of the risk models and the quality of pesticide use data. In the absence of this, harmonised risk indicators cannot monitor and support the adoption of IPM and low risk practices.

5.2. Case study 2: Limitation and ban of usage of pesticides in specific areas

In order to assess the implementation of the Directive with regard to a limitation and ban of the usage of pesticides in specific areas, case studies in five Member States (AT, ES, DK, FI, FR and UK) have been undertaken. The case studies are based on interviews with competent authorities and relevant stakeholders. The implementation of the Directive addresses the usage of pesticides at a broader scale by considering the adverse impact of pesticides on human and environmental health. Further, the different degree of exposure such as the direct by operators, and indirect to residents, bystanders and the general public is taken into account. Directive 2009/128/EC states clearly that each MS should ensure that the use of pesticides is minimised or prohibited in these specific areas.

With regard to the implementation of measures respective to the provisions of Article 12 for the reduction of pesticide use or risks in specific areas, the majority of the interviewees applies the definition of specific areas from the SUD in the NAP. Only ES laid down a unique definition and implemented related provisions via national decrees. Specific areas cover, in addition to the areas mentioned in the SUD, drinking water abstraction zones, areas for specific aquatic species for commercial interests, and non-agricultural areas such as areas for infrastructure services[64]. In addition, fields dedicated to plant or to cultivate seeds and reception centres are covered by those decrees. AT also includes provision for wetlands, specific meadows, areas along forests and water courses and measures for the protection of foraging bees.

[64] i.e. non-urban areas, included railways, networks for irrigation pipelines, power lines as well as industrial areas such as areas of restricted access, e.g. power plants or other industrial facilities which require an area without vegetation

In the majority of MS, pesticide use is generally allowed in areas used by the public or by vulnerable groups, such as public parks and gardens, sports and recreation grounds, school grounds and children's playgrounds and in the close vicinity of healthcare facilities. Risk assessments according to the provisions of Regulation (EC) No 1107/2009 provide the conditions for the use of plant protection products. With regard to the authorised products, there is no special consideration for "specific areas", i.e. as a category of its own. The majority of examined MS comply with these provisions and therefore do not ban use of pesticides in these areas (ES, FI, AT, UK, DK). All MS state that, in general, the use of authorised plant protection products should be reduced and biological control measures are to be preferred. Contrary to other MS, France enforced the "Labbé" law, which bans pesticide use in parks, on roads and walking paths and in the forests accessible to the public since the 1st of January 2017. Only cemeteries and sports grounds are exempted from the ban. For other specific areas the provisions of the authorisation apply.

Although not having adopted as strict provisions as those in FR, some MS regulate certain pesticide use in specific areas above the standard provisions of authorisation. For example, ES has very detailed regulation in this aspect. A national decree specifies a list of pesticides that are not allowed in areas used by the public or by vulnerable groups. In FI, in addition to the limitations on the use of any pesticides set by the criteria for authorisation, the methods of applying PPPs are also considered and will also determine whether risk mitigation measures are required. In addition, some products are not allowed for use in playgrounds, kindergarten and school grounds. In DK, the requirements for risk assessment concerning areas used by children were sharpened. This led to the ban of use for specific pesticides. The Golf Order limits the use of pesticides on golf courses. Municipalities also have the opportunity to impose special restrictions. Beyond the general approach in AT, the use of PPPs is forbidden especially in residential or agricultural areas. This is particularly the case if the health of neighbours or other residents is impaired, or if it poses a risk of affecting the plants or plant products growing on adjacent land. Some provinces in AT discuss the ban on pesticide use in the vicinity of publicly accessible sports, leisure and children's playgrounds, parks and gardens and in the outdoor area of hospitals, nursing homes, schools, kindergartens and other child care facilities.

The provisions of Article 12 related to environmental issues are approached by the examined MS in coherence with the general provisions of the authorisation process in Regulation (EC) No 1107/2009. The use of pesticides in the areas defined under the Water Framework Directive (WFD) or other areas in accordance with the provisions of the Natura 2000 legislation[65] is legal. It has to comply with the restriction either from the authorisations of pesticides or the respective Directives. This is the way most of the interviewed MS approached this subject. ES mentions that pesticides are rarely used in conservation areas and there is no specific evaluation on the use of pesticides conducted by every farmer. The procedure is similar to the one described for specific public areas. In FI, there is no categorical ban on use of pesticides in specific areas, although there is a limited number of approved chemicals available for use in these areas, including limitations on the use (e.g. every 3rd year). There are further limitations (defined in the authorisation process) especially regarding the ground water areas important for drinking/household water, but there is no absolute ban. Other provisions originate from related legislation (e.g. rural development and agricultural production, Finnish water regulation) and also specify the limitations.

In AT, the use of pesticides is generally permitted unless the conditions of authorisation (e.g. "no application in water protection and sanctuaries.") or water and nature conservation regulations provide for restrictions or prohibitions. In addition there are bans on the use of plant protection: i) in wetlands, scattered and sparsely vegetated meadows or dry areas and adjacent three-meter wide

[65] Directive 2009/147/EC on the conservation of wild birds and Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora.

strips of land, ii) adjacent to forest or the upper edge of surface waters three-meter wide land strips, iii) with respect to the protection of bees on flowering plants and in places where bees actively forage. In these cases the use of bee-friendly crop protection products is required. Other restrictions set out in the authorisation of the plant-derived plant protection products, their classification as potential bee-risk must be taken into account. The prohibition also excludes the use of plant-borne pesticides in the period between the end of the daily bee flight and 11 pm at a distance of more than 30 m from apiaries, provided pesticide use is authorised otherwise.

In the interviewed countries, the provisions with regard to areas used by the general public or by vulnerable groups comply with the authorisation process and no additional approvals for pesticide use in the before mentioned areas are implemented, except for the UK. In UK, the Health and Safety Executive (HSE) authorises pesticides for use in "amenities". This means. within authorised PPPs, specific active substances are authorised for use in amenities. According to domestic regulation, the lowest practical frequencies of use are promoted.

In AT regional authorities can grant approvals for small regional areas (NUTS-3 region level) and emergency situations. AT emphasises that on the level of the provinces the limitation on the use of authorised plant protection products is a difficult legal process, since an act of the provinces does not generally allow the repeal of a federal act (authorisation). The competence of the countries is limited to the use, which is why it is necessary to explain exactly why an approved PPP should not be used in a well-defined and demarcated area or only to a limited extent and to justify the different specificities of the area compared to the rest of Austria. The biggest problem with this is the geographic delineation in nature. It would be much simpler not to allow certain pesticides in general for school, kindergarten and hospital gardens and parks.

The authorisation for pesticide use in the areas falling under the WFD or other areas in accordance with the provisions of the Birds[66] and Habitats[67] Directives adhere to the conditions of Regulation (EC) No 1107/2009. Additional national provisions are laid down in some MS. However, these follow the same approach as that for the use of pesticides in areas used by the public (as described in the previous chapter). The use of pesticides is permitted within the scope of the approval conditions, unless restrictions under water law and nature conservation legislation provide for additional restrictions or prohibitions. In UK, voluntary measures have shown to increase engagement in such a way, that very good results in terms of safe and sustainable pesticide use have been seen across areas.

Approaches to ensuring that preference is given to low- risk and biological control measures are currently not very well specified in the investigated MS. The case study did not reveal any specific national incentives, which could promote low-risk and biological control measures, except the taxation system in DK. Most of the measures focus on education and training as well as applying IPM in a general sense. Within this, advisory support and guidance are one of the means most cited by MS. For example, ES requires the owners of concerned public areas to engage a specialist on IPM who is registered in the National Registry of Advisors of the Ministry of Agriculture. A contract binds the IPM advisor to the whole process. This starts with the identification of the risk and selection of the required treatment, to establishing a registry and finally to conducting an evaluation. According to the Guidelines on IPM prepared by the Ministry of Agriculture, preference is given to the use of non-chemical and less hazardous pesticides.

Finnish interviewees mention that guidance, farm advisory services and training, limiting sale of most (400 out of 460) products to professional users only, are vital in ensuring that the lowest risk

[66] Directive on the conservation of wild birds (2009/147/EC)

[67] Directive on the conservation of natural habitats and of wild fauna and flora (92/43/EEC)

chemicals are used. Within the Rural Development Programme and its agri-environmental measures, farm advisory measure play an important role in promoting integrated and biological control measures. In addition, the cost of approval for biological and low-risk products is lower than for others and might foster the application for authorisation of the product groups.

In UK, a number of voluntary schemes are established that encourage sustainable pesticide practices and promote IPM in both agriculture and in amenities. The Voluntary Initiative has a number of stewardship programmes in place which emphasise responsible pesticide use and the principles of IPM. These programmes cover a range of areas including habitats conservation, water protection (i.e. the H2O campaign, Water Aware, Catchment Sensitive Farming, and Think Water on oilseed rape herbicides), and general awareness raising. Through the Voluntary Initiative, the Amenity Forum promotes responsible pesticide use in amenities (i.e. for landscaping service providers, etc.). This forum, in addition to other activities, promotes an assurance scheme which provides training on pesticide use best practices including IPM. While, on the other hand, the Red Tractor provides one of the largest farm assurance schemes in agriculture. These stewardship programmes and assurance schemes include a system for evaluation and audits. The National Farmers Union, and other bodies, collaborate with these initiatives to ensure farmers are aware of best practice, the services available and the opportunities for training. Mandatory certification for spray operators and mandatory equipment testing is also in place.

Through its taxation system, DK has allocated higher taxes for more harmful pesticides. Using this approach, DK has set up a financial incentive for shifting toward lower risk (and therefore less taxed) pesticides.

The interviewed countries refer to the general approach of risk reduction which is implemented via the NAP and Regulation (EC) No 1107/2009 as a means of risk mitigation. This includes with respect to pesticide use risk in public areas. UK refers to the principles of the SUD. In Addition, UK has a "Red Tractor Assurance Scheme", which has become UK's biggest farm and food standards scheme, covering issues including animal welfare, food safety, traceability and environmental protection. Red Tractor requires members of their assurance scheme to keep IPM journals, and to prove continued competencies by attending training and workshops. A similar scheme is available in amenities through the Amenity Forum. Although, this scheme does not have the same level of awareness by consumers and community members. As of now, participation in both areas of assurance schemes is not mandatory. There is some push to change this within amenities, making participation mandatory in the future. Presently, some local authorities are inserting a requirement for amenity assurance membership into their public procurement documents, however this continues to be observed in a limited number of cases.

For the protection of human health, namely workers, re-entry periods to recently treated areas apply which result from the approval process. Furthermore, MS cover these subjects in training and education programs in specific modules on work hygiene, health and safety (FI). In ES, Article 35 of the Royal Decree 1311/2012 relates to the protection of the workers of the areas recently treated with pesticides. The article establishes that workers should not access these areas until the treated crops are completely dry and respecting the re-entry time schedules for every type of crop. The person in charge of the treatment should inform the workers about the timeframe and conditions required to re-enter the area. This individual should also inform third parties by placing visible signs, in particular if the pesticides are not low-risk. In these cases, the sign should also make reference to this fact.

Some of the interviewed MS have enforced specific measures with regard to the protection of areas which relate to the WFD. For example in FI, the land is divided into three categories, depending on their importance as a source of ground water. The Finnish ground waters are further divided into different classes according to their importance as a source of household water. There are specific

limitations related to the use of given pesticides in different ground water areas. Digitised maps[68] for farmers showing the different water areas are also available. Some pesticides cannot be used in areas which are the most important sources of ground water. Additionally, the number of pesticides that can be used in the important ground water areas is limited and there are buffer zones specified (marking distance to wells and water bodies). The Rural Development Programme sets buffer zones and set-asides which help in improving the state of waters. In DK, according to the WFD, there are areas where municipalities can impose special restrictions. A stakeholder organisation from DK raised the point that in relation to the WFD not all requirements have been implemented. Broad provisions on groundwater for drinking water and deposits exist, whereas the upper groundwater is not monitored.

UK has taken a more voluntary approach, encouraging engagement at all stakeholder levels including industry. There are legal requirements in place requiring the certification of spray operators, and equipment testing, which is conducted on an annual basis. Thus the National Register or Sprayer Operators (NRoSO) fulfils an important role – members collect points in the Continuing Professional Development (CDP) each year. This demonstrates their knowledge of legislative changes and best practice. Membership with NRoSO is required for many farm assurance schemes in the UK. This is further required frequently within supermarket protocols. NRoSO membership cards serve as a guarantee that pesticide application will meet SUD requirements since members have been required to complete relevant competency programmes and obtain certificates. NRoSO is managed for the Voluntary Initiative (VI) by City & Guilds. The National Sprayer Testing Scheme (NSTS) ensures the implementation of requirements for the proper functions of sprayers as to avoid unwanted impacts on the environment. NSTS-tested sprayers are a requirement of many UK farm assurance schemes and supermarket protocols as well as satisfying the sprayer testing requirements of the Sustainable Use Directive. NSTS is managed by the Agricultural Engineers Association for the VI. There are about 20 stewardship groups/programmes established on water, bees, best practice with metaldehyde slug pellets and nematicide. Among them is Catchment Sensitive Farming, which offers free advice and training to reduce diffuse pollution from agriculture and provides information on how to make claims for grants under the Countryside Stewardship Water Capital Grants Scheme.

In relation to the Birds and Habitats Directives, no specific measures were reported by the interviewed MS in the frame of the implementation of the SUD. However, it can be assumed that relevant measures are implemented via other national acts and legislation directly referring to the respective Directives. For example, in ES current policy measures intend to achieve a more significant integration in the sector of agriculture and to participate more actively in the tools promoting the further conservation of biodiversity. ES is preparing a "Conservation of Pollinators Plan" that includes the use of pesticides as a key element. In DK, there have been political discussions on introducing a total ban, which mainly focused on the use of fertilizers. This has not come into force. Instead some NATURA 2000 areas are managed by the Nature Agency which is part of the public agreement and therefore does not use pesticides. In addition, in the so-called "Section 3" natural areas, pesticides used should not be more harmful than those previously applied. Furthermore, as part of the risk assessment for pesticides used in Section 3 areas there are special distance requirements secured, e.g. spraying distance requirements is often 10 m from these areas. AT has particular measures with a focus on bee protection. In these cases, pesticide use must be in agreement (announcement at least 2 days before use) with any beekeeper operating within 3 km of the treatment area.

The responses indicate that in the examined countries there are no detailed monitoring schemes established which focus directly on the specific areas with respect to human exposure and areas

[68] https://paikkatieto.ymparisto.fi/arcgis/rest/services/Vipu/VipuVesistot/MapServer

which are used by the general public. Examined MS, rather, refer to the overall risk reduction monitoring systems in place. In ES a reference is made to advisors' tasks related to the evaluation of the risk reduction measures and monitoring the success or impact of the measures in specific areas in the NAP. It includes indicators on the use of pesticides, as well as indicators of distribution. Indicators related to the inspections to centres, inspections of the farm registers and controls on health surveillance, are also applied.

In FI there is comprehensive monitoring and analysis of pesticide residues in alimentary products by the Finnish Agency for Food Safety. Different bodies that monitor the actions related to pesticide risks are organised in the 15 Centres for Economic Development, Transport and the Environment, which are responsible for regional implementation of several government policies (e.g. Rural Development Policy). These centres further monitor the use of pesticides especially related to agriculture. A lot of the controls (and correction measures) related to the incorrect use of pesticides are related to the Rural Development Programme controls since the agri-environmental and organic production measures cover most of the agricultural land in Finland, and are controlled regularly. These include limitations and guidance on pesticide use. The most harmful substances in the Finnish setting are old pesticides (atrazine etc.), which still appear in soil and water. The glyphosate-containing products, which were already approved, will be re-assessed within a year. Other information on pesticide use is generated from the feedback from, or questions by, professional users. Indications provided by the public are also taken into account. Health and safety inspectors of the Regional State Administrative Agencies perform controls and monitor the correct use of protective gear and other aspects of the work environment. Employers are required by law to protect employees of chemical exposure. The training materials related to health and safety in pesticide use are freely available on the internet. Controls are regionally established. Different controls are in place related to the action and groups in question. For example, in the case of pesticide application on a golf course, the instruments and proper protection of those spreading pesticides would be the responsibility of one authority.

In AT, appropriate pesticide use is monitored as part of the inspections of the labour inspectorate.

UK relies on several sources of data to assess pesticide use and risk reduction. This includes national audits and checks, monitoring supported through the VI and the various stewardship programmes and assurance schemes in place. Rural Development Programme controls are also relied upon where relevant. An annual report *"on the impact and sustainable use of pesticides"* is published by the Pesticides Forum, a group comprised of a range of stakeholders. This report looks at 32 indicators taken from sources such as auditing, surveying, pesticide residue testing in drinking water, in soil, and in food products. The surveying for pesticide use is structured through on-site visits, during which the surveyor goes through the practices undertaken by the farmer to ensure that data collection is accurate. This process includes verifying that the operators are trained and certified, the equipment is tested, IPM plans are made, among other aspects.

Compliance with the overall proper use of plant protection products is to be monitored by the district administration authorities in AT. To ensure the success and impact of the support measures within the ÖPUL (Austrian agri-environmental schemes) reference is made to the ÖPUL evaluation reports of the Federal Ministry for Sustainability and Tourism (BMNT). The Danish Environmental Protection Agency (EPA) monitors how many kg of active ingredients are sold in DK.

MS refer in their NAP to the provisions of the respective directives and the EU regulations. This includes considerations that the WFD or other areas in accordance with the provisions of the Birds and Habitats Directives are respected. In the interviewed MS, no additional monitoring mechanisms were in place within the NAP focusing solely on these legislations. For example FI mentions controls related to the Rural Development Programme implementation, where appropriate. The UK emphasises that pesticides are used in these areas when necessary, and in line with the aforementioned EU

directives, they further mention that local areas may have local approaches and rules which are respected. Awareness raising is also an important element to reducing risks. For example, the UK the tool "what's in your backyard" allows farmers to find their parcels and identify whether they are in risk areas for runoff, or damage to wildlife or ecosystems.

The implementation of measures with regard to the WFD are more closely monitored. The Finnish Environmental Institute (SYKE) monitors the implementation of the WFD, however the interviewee emphasises that there should be more funds for the monitoring process. In DK, the National Monitoring Programme for Water Environment and Nature (NOVANA) is responsible in this topic area. As part of Groundwater Monitoring (GRUMO), the water supply companies carry out tests in three types of drilling samples (groundwater, one for waterworks drilling rigs where analyses can often not measure diluted contamination and environmental drillings at point sources, e.g. at landfill sites). The chemical data is reported to the National Geological Survey of Denmark and Greenland (GEUS). Within the aim of water protection, the Directive helps the EPA to keep environmental standards at a high level. Although the limit values of 0.1 mg/l date back to a decision made in the 1980s, the Directive is significant to maintaining the EU limit value. However, with new analytical systems, measurements can be made as finite as 0.01 mg.

A stakeholder expresses the opinion that for some pesticides, the limit value is currently too high. For example, with respect to insecticides near watercourses. In these cases, the limit value should be lowered and there should be fixed limit values for watercourses. In UK, a mix of national and regional institutions are responsible for the monitoring activities based on the restrictions laid down by the HSE. There are significant restrictions that are determined based on water catchments. However, in some cases pesticides are necessary, for example with knotweed. Water companies and water catchment managers are in charge of testing water, and this information is used to develop guidelines – in particular for sensitive catchment areas those where pesticide contamination was determined as an issue. However, in general, for granting authorisation for pesticide use per area, EU guidelines are used. Furthermore, local areas may determine, with the help of local water companies, or local authorities, the need to apply certain pesticides in a given area. This is then requested of the HSE, and considered on that level for authorisation.

5.2.1. Discussion and conclusions

The case study indicates that the six examined MS follow the definition of specific areas from the SUD in their NAPs. Further, some MS may incorporate different issues which relate to provisions on the protection of drinking water, natural areas or also non-agricultural land. Pesticide use is generally allowed in areas used by the public or by vulnerable groups, such as public parks and gardens, sports and recreation grounds, school grounds and children's playgrounds and in the close vicinity of healthcare facilities, in the majority of investigated MS countries. Risk assessments according to the provisions of Regulation (EC) No 1107/2009 provide the conditions for the use of plant protection products. Authorisations of pesticides with regard to the use in amenities, with particular limitations on the frequencies and types of areas of use, are conducted based on risk reduction measures.

The provisions of Article 12 related to environmental issues are approached by MS in coherence with the general provisions of the authorisation process in Regulation (EC) No 1107/2009. The use of pesticides in the areas defined under the WFD or other areas in accordance with the provisions of the Birds and Habitats Directives is legal and has to comply with the restriction either through the authorisations of pesticides or the directives in question.

All MS follow the general approach that the use of authorised plant protection products should be reduced as much as possible and that biological control measures, without the use of plant protection products, are to be preferred. However, the NAPs themselves do not contain detailed measures for risk reduction, but rather relate to the respective directives. However, some MS regulate certain

conditions differently, in addition to the provisions of the regulation. For example, a national decree specifies a list of pesticides that are not allowed in areas accessed by the public or by vulnerable groups, methods of spreading and spraying technologies can be considered or pesticide use is forbidden especially in residential or agricultural areas, if the health of neighbours or other residents is impaired. The ban of pesticides in public areas is being discussed in AT.

The implementation of risk reduction measures mainly focuses on the proper use of pesticides, which is the responsibility of the user. Therefore education and training for pesticide users, with dedicated modules on worker protection, health and safety, are considered equally important to the protection of the environment. The measures for water protection are particularly well developed. Cooperation with detailed measures are in place between the concerned stakeholders at the local, regional, as well as national level. In relation to the Birds Directive and Habitats Directives, no specific measures were reported by the interviewed MS in the frame of the implementation of the SUD. However, it can be assumed that relevant measures are implemented via other national acts and legislation directly referring to the respective Directives.

The approaches to ensuring that preference is given to low-risk and biological control measures are currently not very well specified in the investigated MS. The majority of MS refer to the authorisation process and the conditions of use. There are no incentive mechanisms in place, which promote low-risk and biological control measures, except a taxation system in one MS (DK). Lists of particular pesticides restricted in given areas and contexts is also in place in some MS.

The results of the interviews indicate that there are no detailed monitoring schemes established which focus directly on specific areas with regard to areas which are used by the general public. Exposure in these areas, is also not monitored. This observation can be explained by the complexity of the topic. On the other hand, the monitoring systems for water quality are well developed. Official controls provide a frame to ensure the correct use of pesticides, and also workers' protection.

Overall it can be concluded that the examined MS are on the right track to implementing risk reduction measures via diverse provisions such as training, sprayer testing and calibration, awareness rising and voluntary stewardship schemes. It has to be mentioned that the authorisation of pesticides provides a general framework that is followed, a further ban (or reduction of use) of pesticides in specific areas is sometimes argued at the MS level. On the other hand, especially with respect to the protection of the environment, the synergies between the different dossiers could be better exploited.

5.3. Case study 3: Impacts of the use of pesticides on drinking water

This case study aims at establishing the economic, social and environmental impacts of the use of pesticides on drinking water over the last ten years. The analysis is based on findings from case studies that were conducted through interviews and a literature review, which have been performed in six MS (CZ, DE, DK, FI, IE, and the NL) during the summer of 2018.

As a first step, this report presents the background information related to the protection of drinking water and the EU interventions in this field. Secondly, the various activities put in place by national authorities, in each of the six MS examined, are reported. Finally, an analysis is presented on how each of these MS estimate the impacts of the presence of PPPs in drinking water in their territory.

Literature findings highlight that several factors affect pesticide pollution in water. The main ones being drainage, treatment surface, application rate, and rainfall as summarised by the Safe Drinking Water Foundation (SDWF) that states that *"Farmland is often well drained and natural drainage is often*

enhanced by land drains. Water from excessive rainfall and irrigation cannot always be held within the soil structure. Therefore, pesticides and residues (as well as nitrates and phosphates) can be quickly transported to contaminate ground water and fresh water supplies over a large geographical area. Pesticides such as residual herbicides applied to hard surfaces like concrete or tarmac (i.e. garden pathways and driveways) have nothing to be absorbed by and are particularly vulnerable to movement into water courses and non-target areas, especially after rainfall. These risks are greatly reduced when a pesticide is applied to soil. Hence, pesticides in water can often be the result of non-agricultural usage" (SDWF, 2018). With respect to application rate, the more a pesticide is applied, the longer a significant concentrations remain in the environment. The SWDF indicates that last main factor affecting pesticide pollution of water is rainfall: *"High levels of rainfall increase the risk of pesticides contaminating water. Movement into water courses occurs by washing directly from pest and target areas into drains after rainfall. It can also occur within the soil structure by displacement of pesticides from absorption sites by water and on treated soil which has moved into waterways through soil erosion"* (SDWF, 2018).

The issue of the presence of hazardous chemical substances in drinking water is addressed by several EU legislative acts[69] of which the main instruments related to PPPs are those of the WFD [70]. The WFD, which came into force in 2000, established a framework for the assessment, management, protection and improvement of the quality of water resources across the EU with main aim to ensure that a sufficient quantity of good-quality water is available for both people's needs and the environment.

Monitoring of water quality (surface and groundwater) is performed by MS per identified river basins. In its recent 2018 report[71]; the European Environment Agency concludes that improvements have been made in monitoring and assessment as the quantity and quality of the available evidence on the status and pressures has grown significantly. However, with regard to the chemical status of surface water, the European Environmental Agency (EEA) report concludes that *"in the second river basin management plans (RBMPs), 38% of surface water bodies are in good chemical status, while 46% have not achieved good chemical status, and for 16% their status is unknown. Since the publication of the first RBMPs, Member States have made progress in tackling priority substances, leading to a reduction in the number of water bodies failing to meet standards for substances such as priority metals (cadmium, lead and nickel) and pesticides."* With respect to groundwater quality, the report adds "In the EU, 74% and 89% of the area of groundwater bodies, respectively, is in good chemical and quantitative status. Nitrates are the main pollutant, affecting over 18% of the area of groundwater bodies. In total, 160 pollutants resulted in failure to achieve good chemical status. Agriculture is the main cause of groundwater's failure to achieve good chemical status, as it leads to diffuse pollution from nitrates and pesticides."

Recital 15 of Directive 2009/128/EC highlights that *"the aquatic environment is especially sensitive to pesticides. It is therefore necessary for particular attention to be paid to avoiding pollution of surface water and groundwater by taking appropriate measures, such as the establishment of buffer and safeguard zones or planting hedges along surface waters to reduce exposure to spray drift, drain flow and run-off. The dimension of the buffer zones should depend in particular on soil characteristics and pesticides properties, as well as agricultural characteristics of the area concerned"*. These needs are addressed in Article 11 of the Directive which requests that Member States adopt appropriate measures to protect the

[69] The EU legislation on water quality includes several main legislations: Directive on Integrated Pollution Prevention and Control (IPPC), the Nitrate Directive, the Urban Waste Water Treatment Directive, the Shellfish Waters Directive, the Dangerous Substances Directive, the Bathing Waters Directive, the Drinking Water Directive and the Water Framework Directive.

[70] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy

[71] Available at : https://www.eea.europa.eu/publications/state-of-water

aquatic environment and drinking water supplies from the impact of pesticides[72]. Measures shall include *"the establishment of buffer zones to protect non-target aquatic organisms and safeguard zones for surface and groundwater used for the abstraction of drinking water, where pesticides must not be used or stored"* (Article 11 para 2.c).

During the interviews the details related to the implementation of buffer zones and the protection of waterways have been investigated.

In IE, each pesticide product has a buffer zone. The lowest (default) buffer is 1m. For higher risk products the buffer ranges between 5-10m. The buffer zone also depends on the crop, therefore, a given pesticide may have a buffer of up to 20m with certain crops. The buffer zones are based on mutual recognition and follow the same thresholds as in the EU. The buffer zones are not expected to be any greater, or any smaller, than what the product specifications mention. There may be slight variations in national application due to crop differences, but these would only differ vary slightly. No additional buffer zones are added. Water is tested at the extraction sites to ensure that there has been no unsafe contamination. In addition, the SUD set down safeguards based on drinking water extraction mounts. In Ireland these are based on the amount of water extracted from each point. Safeguards also range in size, and can be 5m down to 1m. Safeguards are being reviewed on a national level, and they may be updated to increase flexibility when low spray nozzles are used. Statutory Instrument (S.I. No. 155 of 2012) may contain more information as it is the national regulatory instrument for the SUD.

In DK, there are rules in place for buffer/safeguard zones of 2, 5, 10 and 20 metres. For fruit growing it is up to 50 metres. According to national regulation it is possible to reduce the buffer/safeguard zone from 10 m to 2 m when using approved drift-reducing spraying technology. The Danish EPA has written this into the Executive Order, and rules have been laid down in a guidance document.

In CZ, the protection zones of water resources, formerly known as the hygienic protection zones, have functioned historically. The zones are also divided into degrees of protection. Currently, they are being updated to make the information publicly available to all interested subjects. However, the question concerns the effectiveness of the current setting. It is found that although protective zones are defined, and some PPPs are excluded from use, there are still findings that pesticides are present in water sources and limits are being exceeded. A reported issue is the difference in the behaviour of each active substance once in the soil. This implies that when two different PPPs are applied in a given soil type, one substance may permeate into the ground and enter waterways, while the other may not. The problem in the Czech Republic is the lack of a differential approach for individual substances, and this is what the protection zones or specific areas should be defined for. Protection zones, without a differential approach in pesticide use, does not achieve its desired results. Presently, a protection zone is valid for all farming operations in a given area. It is legislatively defined by the Water Act, and not the legislation on pesticides.

In DE, the goal of the NAP is to establish buffer zones in hot-spot areas. According to a federal interim progress report, it has been accomplished to the tune of 47%. This is combined with other activities, such as risk reduction by following the guidelines in terms of distances between sprayed areas and surface water. This distance depends on the active ingredient used. Depending on the active ingredient, the dimensions of the buffer zone may be altered if spray reducing techniques are used. The minimum dimension of the buffer zone is 1m at the federal level. However, the states (Länder) may have set different (higher) minimum standards as different laws and guidance documents have been established by the federal authorities and those of the states. Buffer zones are established in the risk

[72] These measures have to be compatible with relevant provisions of Directive 2000/60/EC and Regulation (EC) No 1107/2009

assessment of the active ingredient and vary according to each active ingredient. The procedures are very complex. No harmonised guideline exist as the active ingredients differ in terms of the level of toxicity. The buffer zones also apply to sustainable PPPs with no or a minimal ecological footprint. In addition, one has to differentiate between buffer zones established under water resource law (Wasserrecht) and others established for a specific active ingredient. These are sweepingly established varying between 1m and 10m. The latter depends on the active ingredient itself, and its corresponding authorisation based on its toxicological profile.

In FI, there is a long tradition of protecting ground water. Namely, the 1960 Finnish Water Act[73] established the prohibition of polluting ground water. Also, it established safeguard zones around waterworks. Finland has been divided into three zones according to the importance of ground water as a source of drinking/household water. There are specific requirements on the use of pesticides related to the first zone (most important for drinking/household water). There is also a prohibition on place on using certain pesticides. Further, there is a requirement for buffer zones for each pesticide (defined in the approval process). The CAP greening measures require buffer zones as well. The dimensions are defined in the approval process. They therefore depend on the properties of the pesticides (and the method of spreading).

When it relates to the obligation of planting trees and hedges, the findings of the case studies read as follows.

In IE, nothing in particular has been initiated.

The same situation is observed in DK and FI. This has not been a priority in these two Member States. One Danish NGO interviewee stated that it has not been necessary to undertake such actions, unlike in the NL where the country experiences challenges in protecting canals. This could be explained by the fact that DK does not use surface water for drinking water, but rather mainly groundwater.

In CZ, planting permanent grassland stripes close to water sources is being used mainly to protect soil from erosion. These measures also help with pesticide contamination. However, the main emphasis remains on putting in place anti-erosion measures. Pesticides issues are addressed only as a second priority.

In DE, the German NAP foresees the establishment of buffer zones, permanently covered by vegetation, along water surface bodies. However, no concrete measures have been implemented connected to the Directive at the federal level. The Länder have implemented heterogeneous measures. Individual projects have been set up on a voluntary basis, generally in the framework of agri-environmental programmes.

In terms of other activities that have been put in place since the entry into force of the SUD, interviewees have reported the following interesting initiatives.

In IE, apart from buffer zones, authorities have introduced "stripes" which is a programme that encourages the use of low-risk (low-flow) nozzles. If these nozzles are used, then in some specific cases the buffer zone can be reduced. This is similar to what has been done in UK. In addition, IE launched a collective action called the National Pesticide Drinking Water Action Group. This action group includes representatives from water utility companies, advising services, the environmental protection agency, chemical companies, chemical retailers, amenity users (such as golf course owners etc), other water protection groups, and citizen representatives. The aim of this action group is to achieve water regulation compliance, to raise awareness, to provide information on best practice, to identify and fill policy gaps, as well as to ensure environmental protection. On these objectives, the action group

[73] Available at: https://www.finlex.fi/en/laki/kaannokset/1961/en19610264_19910629.pdf

helps to identify priorities – specifically where pesticide content in the waterways have exceeded limits. When this was introduced, four catchment areas were identified. However, after one year of activities by the action group, simply through raising awareness and increasing monitoring, pesticide contamination in water has decreased. Now only one of the four priority catchments remains problematic. These catchment areas do not only serve to raise awareness, they also serve as an important knowledge development exercise to build a more complete picture of pesticide cycles. Through in-depth investigation, soil types and the propensity of given soil types to lead to pesticides entering waterways, as well as the impacts of water patterns on pesticide contamination, are explored. If this approach had not worked in reducing the presence of pesticides in the catchment areas, then buffer zones would have been increased in these areas.

In DK, the EPA has initiatives in place to support local authorities in the places where drinking water is used. The plans provide tools for municipalities and water supply networks. Municipalities produce the action plans in this area.

In DE, additional voluntary initiatives, not conducted by states or the federal government, are in place between water works and growers in particular areas. No data is available to date. An interesting initiative consists of the reduction of concentrated incidences of PPP application. This is another priority in which research, the industry, and farmers are working together. A product of this cooperation has been the H2OW-H2OK campaign, a sensitisation campaign on the application of PPP. Under the NAP, a working group has been established including representatives from water sources, industry (PPP), and agricultural businesses. In this working group, comprehensive solutions are discussed. The monitoring and investigation of findings in small surface water bodies are also foreseen in the NAP.

In DK, awareness of pesticides has existed since the 1980s. In 1998-99, two reports[74] led to the establishment of an action plan. This action plan also intended to lay out and define pesticide-sensitive areas. A research program that would provide a scientific basis for this (KUPA) was launched in 2000-01. KUPA is now partly completed, and in the latest strategy the relaunch of the initiative is foreseen, but there are no concrete steps taken to date. Additionally, there are Danish special rules which are in place to determine the limit values for metabolites in water. These special rules have existed for several decades and can be explained by the water supplies in Denmark being generated almost 100% from groundwater, when most of other Member States use surface water.

It is also worth mentioning the German initiative facilitating cooperation between farmers and water sourcing companies with the objective of 1) reducing the use of hazardous PPPs facilitated by subsidies paid to farmers by water sourcing companies and 2) investigating the circumstances of threshold exceedances (accident or incorrect use).

In FI, the project MaaMet, financed by the Ministry of Agriculture, was initiated by the Finnish Environmental Institute in 2007. The project monitors the presence of nutrients and pesticides in ground water as requested by EU legislation. It also provides frequent and comparable information on pesticides in groundwater. The main approach for improving water quality, used in this project, is the training and advisory of municipal waterworks. In addition, there is a detailed action plan for cases where the concentration of pesticides in drinking water was observed at a higher level than is permissible. In these instances, methods such as the closure of one/several wells, diluting the concentration with clean water from other wells, and carbon filtering are being used.

[74] Report by the Committee for Drinking Water, which led to the determination of buffer zones, and the report from the investigation of the phasing out of pesticides

With respect to the measurement of impacts related to the presence of pesticides in drinking water, interviewees mentioned that very few socio-economic and environmental studies have been performed to date to assess impacts of PPPs on human health and on the environment. In most cases, MS assess impacts based on the results of their monitoring programmes. If pesticides concentrations are lower than established thresholds, then they consider that there is no negative impact on human health nor the environment, as these thresholds have been defined with respect to the potential hazards and risks.

The main reasons that have been reported by the large majority of interviewees to justify the lack of impact assessments are:

(1) the externalities and the causalities are difficult to assess,
(2) the quantification of costs related to i.e. biodiversity (e.g. the loss of biodiversity) is difficult,
(3) the effects depend on the individual active ingredients used and therefore will have to be ingredient-based,
(4) the threshold values are clearly defined and monitored. The impacts on human health and the environment are researched during the risk assessment processes in the application. Thus, if thresholds are exceeded, the effects are well known. As long as the thresholds of the active ingredient are not exceeded, risks to human health and environment are negligible.
(5) during cost-benefit analyses, the benefits of using PPPs should be taken into account (e.g. resilience against pests and thereby a more reliable harvest). These benefits are, also very difficult to quantify,
(6) socio-economic impacts of the use of PPPs may not be visible for a long period of time, therefore in order to perform an accurate analysis, studies should consider large data sets of more than 20 years during which degradation process and timing should be included. These data sets do not exist.

A last comment made by a national authority to justify the absence of socio-economic analysis is simply "because such studies are not explicitly requested in the application process".

To the knowledge of an interviewee form national authorities, the only socio-economic study, suggested to the research team, related to the subject matter is the German Federal Environment Agency (UBA) study in 2017 called "Estimation of costs and benefits related to the treatment of raw water (cost points quantified: treatment costs, benefits of training farmers...)"[75]. However, the study only analyses the drinking water treatment costs incurred by water providers which arise from agricultural activities and focusses, in particular, on the issue of mainly nitrates and to a lesser extent on PPP levels.

5.3.1. Discussion and conclusions

The case studies indicate that buffer zones have been established in the six studied MS with differences related to the size of these zones. The buffer distances are set-up per substance based on its toxicological profile.

On the contrary, findings of the research highlights that very few activities and programmes have been established with respect to the planting of trees and hedges bordering surface waters. When existing, these projects are of voluntary nature.

[75] UBA, 2017 – Quantifizierung der landwirtschaftlich verursachten Kosten zur Sicherung der Trinkwasserbereitstellung available at : https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/2017-05-24_texte-43-2017_kosten-trinkwasserversorgung.pdf

Most of interviewees from the 6 MS examined have indicated that the monitoring programmes in place are efficient and that progress has been made as demonstrated by the second report on monitoring activities of the RBMPs recently published by the EEA. For the same interviewees, performing socio-economic and environmental studies to quantify impacts is hardly feasible for several reasons. To a certain extent, it is further seen as not required. Indeed, the threshold values are clearly defined and monitored. The impacts on human health and the environment are researched during the risk assessment processes in the application. Thus, if thresholds are exceeded, the effects are well known. As long as the thresholds of the active ingredient are not exceeded, risks to human health and environment are negligible and, therefore, there is no need to enter into extensive socio-economic impact studies for which concrete and reliable assessment methodologies do not exist.…

5.4. Additional case studies: Justification and rationale

Three additional case studies were foreseen in the Technical Specifications of the study, namely:

- Mapping and evaluating the usage of pesticides;
- Development of a set of common EU-level guidelines; and
- Development of a set of EU-level prescriptive and assessable criteria for IPM implementation

These case studies have not been conducted and the underlying reasons are presented below.

5.4.1. Case study 4: Mapping and evaluating the usage of pesticides

The Technical Specifications of the study mention that particular attention should be devoted to mapping and evaluating the usage of pesticides across the EU according to their exact specifications of use as authorised according to Regulation (EC) No 1107/2009 for purposes other than authorised. This mapping should then include lists of the uses of given PPPs which are not authorised by the authorities (example: pre-harvest crop desiccation instead of using the product as authorised).

In order to carry out this research, the core team had planned to launch a case study in different Member States. The case study was intended to be drafted based on interviews with competent authorities, agricultural advisors and the agrochemical industry. Each of these three types of actors have been contacted to initiate the discussion and organise the data collection process.

Very early in the set-up of the case study, and during the first inquiries, the core team was informed of the difficulties of such a mapping by all actors with whom this issue was discussed. The main reasons expressed by several competent authorities and stakeholders is descried below.

It happens in practice that PPPs are used for other usages than those authorised. For example, a herbicide which may be officially authorised on an oil seed crop may be selective on a genetically related crop for which no authorisation has been issued. Such practices exist, however there is no inventory of such use is kept. In the past, agricultural advisory services (technical institutes, cooperatives, etc.) provided recommendations to farmers under the full responsibility of famers in their technical bulletin. These types of recommendations seem to have become less common. Even if there is no evidence of these uses, the habits may have remained. Again, there is no clear evidence of this as no inventory exists. In addition, advisory services and farmers/producers would not provide any written information on these usages as they are technically considered illegal.

Having received this feedback during the first interviews performed for this case study, we arrived at the position that the required mapping was not possible.

5.4.2. Case study 5: Development of a set of common EU-level guidelines

In the frame of the research level B the consortium was tasked with providing a list of good practices and a set of common EU level guidelines for successful IPM implementation.

IPM is a dynamic approach with an emphasis on regional and even local production conditions. The general principles of IPM as laid down in Annex III of Directive 2009/128/EC are the result of intensive collaboration of scientists and practitioners and reflect the chronological decision-making process adopting IPM. The crop- or sector-specific guidelines, which are currently being developed in MS, give further guidance and underpin the general principles of IPM.

The development of IPM guidance is not conceptually new. During the last decade a large amount of research has been undertaken bringing together knowledge and coordinating research and advisory activities in order to further enhance the cross-border exchange of expertise on IPM (e.g. ENDURE, PURE, C-IPM, IWMPRAISE). Based on the outcomes of these networks, it became apparent that knowledge exchange is indeed beneficial in IPM, especially with respect to the improvement of technical methods and tools. These projects demonstrated that a direct "import" of practices is not always possible and often requires adaptation to the regional agro-climatic conditions.

The purpose of promoting IPM is to ensure sustainability and to reduce the risks associated with the use of pesticides. However, not in all cases does this imply a reduction of pesticide use. The IPM principles aim at promoting environmental benefits as well as ensuring high quality agricultural production. Hence, detailed pesticide use information is required, which enables the MS to estimate risks which can underpin the uptake of IPM and demonstrate achievements in risk reduction.

EU-level guidance, which would inherently require generalisation across climatic zones and cropping systems, would not reflect the dynamics and diversity on the farm and field level. Overall, growers would not benefit from such guidance, but rather would be driven to seek detailed advice elsewhere. Thus, well-developed and trusted advisory systems that can deliver excellent IPM advice continue to be required to truly support and enhance IPM implementation, rather than a common set of EU-level guidelines.

On the basis of these arguments, the core team agreed at the present time that there is little added value to developing EU-guidance on the general principles of IPM, and decided to omit this case study.

5.4.3. Case study 6: Development of a set of EU-level prescriptive and assessable criteria for IPM implementation

Following an in depth discussion among the consortium core group members, it was observed that all experience, hitherto, with IPM implementation has revealed that IPM will only be successful if the local climatic, cropping and social-economic conditions are thoroughly considered. Even if considering an identical crop, different climates will affect IPM issues. For example, in a warm climate water management issues are crucial, this is very different from IPM in a humid and cold climate where nutrient management may be most important considerations.

In addition, relatively simple constructions such as tunnels make a big difference to IPM compared to the same crop grown in an open field. In other words, "one size does not fit all" and "EU-level prescriptive and assessable criteria" are not appropriate. MS should rather be encourage to work with farmers, advisors and other stakeholders in adopting the overall generally accepted IPM principles locally, on a crop by crop basis. This approach already takes place in some MS, where crop specific guidelines are being developed.

Another aspect to consider, if such EU-level criteria were developed, is the issue of enforcement. It would be very difficult, if not impossible, not to mention costly, to check whether farmers are adopting these criteria. There would certainly be numerous situations where this will not be possible. This would introduce a system of justifying exceptions and granting derogations, which would further complicate implementation. Only highly qualified people can decide whether deviations from the criteria are justified, therefore, the enforcement of such an approach would certainly be a challenge.

All in all, taking into consideration these different points, the consortium considered that it was not possible, nor desirable, to develop this set of EU-level criteria and therefore decided to omit this case study.

6. Conclusions and recommendations

This section firstly presents the general conclusions of the research work which consisted in two main tasks:

(1) An evaluation of the implementation (transposition, application and enforcement) of the SUD against the standard set of evaluation criteria (relevance, coherence, effectiveness, efficiency, EU added value). As part of this evaluation, the study likewise focuses on the implementation of IPM principles, as described in the SUD. The conclusions of the evaluation are subsequently presented in section 6.1.
(2) Three additional research activities were covered by means of three case studies.

The conclusions on each of the three case studies conducted are subsequently presented in section 6.2. Another three research activities[76], suggested in the Technical Specifications, were not investigated for issues of feasibility and appropriateness as described under section 5.4.

In light of these general conclusions of the research, several practical recommendations to improve the implementation of the Directive are then proposed under Section 6.3.

6.1. Conclusions on the evaluation of Directive 2009/128/EC on the sustainable use of pesticides and the implementation of the IPM principles

As a side note, the core team highlights that the Directive covers a policy area which was not previously regulated. It is the first time that the EU developed a regulatory framework related to the use phase of pesticides with the focus on risk reduction. This is something which is unique worldwide. Similarly, NAPs on the implementation of the Directive were completely new in the large majority of MS. Therefore, the implementation of the provisions of the Directive have to be evaluated carefully taking into consideration these specificities.

Consideration also needs to be placed on taking into account the lag phase between the development of these associated new systems and the expectance of observable results.

Furthermore, the EU legislative framework on pesticides ("the pesticides package") covers a wide range of dimensions. This includes the mechanisms for placing of PPPs on the market, guidelines for the sustainable use of pesticides, the monitoring of pesticide residues in food, and complementary legislations ensuring the proper functioning of the pesticide package. Evaluating one piece in this jigsaw requires a consideration of the wider system within which it operates. Similarly, enforcing policy measures in one area requires collaboration across the legislative framework. Therefore, in undertaking this study, wherever possible these links were considered.

Taking into account the aforementioned considerations, the following paragraphs present the general conclusions on the implementation of the SUD and of the IPM principles against each of the evaluation criteria.

[76] (i) Mapping and evaluating the usage of pesticides across the EU according to their exact specifications of use as authorised according to Regulation (EC) 1107/2009 concerning the placing of plant protection products (PPPs) on the market. (ii) Developing a set of common EU-level IPM guidelines (following guidance practices at national level). (iii) Developing a set of EU-level prescriptive and assessable criteria that would support the proper implementation of IPM.

Relevance: The majority of respondents, being authorities or other stakeholders, considered that the objectives of the SUD are still relevant to current needs, and that there is no major need to modify the legislation at this stage. Health and environmental NGOs highlighted that the objectives of the Directive should be updated by adding an objective aimed at "reducing dependency on pesticide use". This is something not sufficiently reflected in the current general objectives. The same NGOs add that Farm Advisory Services and the CAP should more strongly consider IPM approaches.

Coherence: Authorities considered that the level of overall coherence with other legislation is rather high, in particular in the areas of environment, MRLs, PPP regulation, food and feed safety, food and feed security, agriculture, consumer protection, and public health. Other stakeholders consider the objective of the Directive as coherent with consumer protection, public health, environment, MRLs, the rules on placing PPPs on the market, food and feed safety, agriculture and less coherent for internal market, biocides, and chemicals.

With regard to the coherence related to the enforcement and implementation of the other pieces of legislation, authorities considered that coherence between the implementation and the objectives for the legislation on climate change is especially high, but less coherent with respect to the legislation concerning fertiliser and chemical legislation. Other stakeholders reported high coherence concerning the implementation of legislation on chemicals, but a lower coherence in the implementation of Regulation (EC) No 1107/2009 and of the energy regulatory framework. The current slow state of approval of low-risk substances via Regulation (EC) No 1107/2009 is seen as a major impediment by grower associations.

Effectiveness: The majority of authorities and other stakeholders, with the exception of health and environmental NGOs, consider that the objectives of the legislation have not yet been achieved, but that progress has been made in many of the Member States. Therefore, based on findings, it appears that things "are moving in a good direction". Even if only a few concrete results have been observed to date on the impact of the different provisions. This is particularly the case with IPM. The same respondents highlighted the lack of available tools for measuring the progresses of the implementation IPM. Authorities, health/environment NGOs and farmers themselves consider that IPM is not sufficiently understood by farmers. This could be assessed as a factor hindering the proper implementation of IPM and hence its effectiveness. IPM is an approach developed for crop specific management. According the conclusions based on this evaluation study, guidelines and management practices for IPM should be further developed and disseminated per MS, crop and climactic region, with the support of advisory services. Incentives for growers to change their practices are considered insufficient by authorities and health/environmental NGOs. The promotion of alternative approaches and techniques, through the Directive, is considered positive by authorities but inefficient by stakeholders (farmers and health/environmental NGOs). For them, advisory services and researchers are inadequately involved in searching for alternative methods. According to these respondents, authorities should be much more proactive than what has been observed to date. They should work to initiate and implement the changes necessary to improve the agricultural production paradigm. With respect to the effectiveness of IPM, the availability of economically viable alternative methods is a key issue. Science and advisory services require resources and time to develop tailor-made and efficient control solutions. The development of alternative methods may take time; therefore, a proactive approach is necessary.

The Member States having shown leadership in putting pesticide use reductions, timetables and measures at the forefront of their NAPs also faced delays in the implementation. For the assessment of the implementation of IPM, a standardised approach is particularly difficult because IPM implied that growers have flexibility in the decision-making process. In addition, the ambitions and capacities applied across MS vary greatly.

Efficiency: Non-governmental stakeholders, as well as most of the respondents from authorities, have highlighted that resources (personal capacities and budget) required for the proper implementation of the Directive are lacking. Little information with respect to the current budget devoted to the implementation of the SUD is available. Several authorities have highlighted that the costs are high for the full and effective implementation of the Directive. The same respondents reported that the main issues are related to the proper development of alternative methods (research funding is lacking) and implementation of IPM. Manufacturers of conventional chemical pesticides consider that, in general terms, adequate resources are devoted to the implementation of the Directive. On the other hand, they stated that in a range of Member States resources at official extension service level have been constantly reduced. This has been felt to undermine training services and strongly limit the capacities for the provision of direct farm level advice.

EU added value: The majority of respondents reported that there was added value linked to the implementation of the SUD in terms of supporting Member States' in achieving national health, environment and market objectives related to pesticide use. No respondents reported that Member States would achieve better results without the SUD in place at the EU level. The Directive's role was observed as a key driver in ensuring that different ministries and stakeholders, in all MS, discuss the use of pesticides and methods for risk reduction, follow harmonised provisions and requirements, and thus gain common knowledge related to risk reduction, as well as achieving an increased awareness among professional users.

6.2. Conclusions on the case studies

The concluding remarks on each of the three case studies read as follows.

The Development of a set of harmonised risk indicators that are still to be adopted by the Commission

The SUD, in Article 4(1), clearly states that MS should include risk indicators in their NAP. Article 15(1) in the SUD indicates that the Commission shall establish harmonised risk indicators but that MS, even with harmonised risk indicators being available, are encouraged to continue to use national risk indicators or adopt other appropriate indicators. At present, harmonised risk indicators are not available, however work in this area is in progress. The Commission (DG SANTE) has recently drafted a proposal on risk indicators that should be voted on by Member States during the fall of 2018.

Literature shows that MS have taken two different approaches to developing risk indicators. One is the simple and straightforward approach using descriptive indicators reflecting the direct and/or indirect effects of pesticide use. Direct effects include pesticides in surface and ground water and pesticide residues in food. Indirect effects include examples such as the number of farmland birds believed to reflect the effect on biodiversity and food web. Literature findings add that a weakness of most descriptive indicators is that they do not explicitly provide an explanation as to why risks increase or decrease.

Other MS have developed risk indicators based on models that calculate the risk or potential risk for each active substance. Through combining this information with pesticide use data, risks can be calculated at the field, farm, regional or national level. In contrast to descriptive indicators, the objective with the model-based indicators is, precisely, to estimate the effects of changes in pesticide use on overall risks. Three examples of model-based risk indicators are the Dutch Environmental Risk Indicator, SYNOPS used in Germany and the Pesticide Load used in Denmark.

The usefulness of model-based risk indicators depends on the reliability and robustness of the underlying models and the quality of the pesticide use data. In NMI and SYNOPS, the underlying principle of the models is a comparison of the Predicted Environmental Concentrations to the acceptable concentrations in the various environmental compartments. In contrast, in Poland risk scenarios are based solely on the inherent properties of the pesticides, and actual exposure is not considered. A further simplification is a rating system (categorical approach), as was conducted with the Norwegian Pesticide Risk Indicator. With this indicator, the pesticides for professional use are categorised into 5 groups and each group is given a fixed score. The potential value of model-based approaches as risk indicators to predict the impact of changes in pesticide use decreases with their simplicity.

Similarly, the other aspect to consider regarding the development of harmonised risk indicators is access to pesticide use data. Regulation (EC) No 1185/2009 concerning statistics on pesticides requires MS to report total sales of each active substance every year. More detailed information on pesticide use in specific crops is only required once every five years. Poor quality and lack of uniformity of pesticide use data is a significant impediment considering the potential benefits of developing harmonised risk indicators.

Assessing the implementation of the Directive with regard to the limitation and ban of usage of pesticides in specific areas by Member States

Findings from the case study interviews in six Member States (ES, FI, AT, UK, DK and FR) covering different geographical areas, and representing different types of agricultural production, indicate that the definition of specific areas has been adopted by MS. Some MS further added provisions for the protection of drinking water, natural areas and also non-agricultural land.

Pesticide use is authorised in areas used by the public such as gardens, along the roads, on train tracks and in golf courses. It is further authorised in areas used by vulnerable groups such as sports and playgrounds, or areas in the vicinity of hospitals. The same applies for specific areas related to the protection of water, conservation of wild birds and conservation of natural habitats.

According to the provisions of Regulation (EC) No 1107/2009, risk management provides the conditions for the use of plant protection products including restrictions that are in line with the relevant directives (WFD), Habitats Directive, Birds Directive). The United Kingdom approves PPP use, with particular limitations on the frequencies and types, in amenities. In DK, a ban of specific PPPs was introduced in areas visited by children. The use of PPPs is further limited on golf courses and municipalities can impose specific additional restrictions. ES has a national list of PPPs in place that are not allowed in areas used by the public or by vulnerable groups. Furthermore, methods of spreading and spraying technologies are required to adhere to local rules. If not, pesticide use is forbidden in specific residential or agricultural areas. Discussions on the ban of pesticides in public areas are ongoing in DK.

Although all case study participants follow the general approach that the use of plant protection products should be reduced as much as possible and biological control measures are to be preferred, the NAPs do not contain detailed measures for risk reduction. Rather, they often relate to the respective directives. Risk reduction measures in the NAP mainly focus on the proper use of pesticides. Therefore, specific training for users dedicated to worker protection are considered equally important for risk reduction. This includes not only mandatory sprayer testing, but also participation in voluntary schemes. The mechanisms for water protection include detailed measures of the concerned stakeholders from local to national level. In relation to the Birds Directives and Habitats Directive, only Denmark reported that in some NATURA 2000 areas and in a bird conservation area there is no pesticide use.

The approaches to ensuring that preference is given to low-risk and biological control measures are currently not very well specified in the investigated MS. The only specific incentive mechanisms reported were a taxation system favouring low risk pesticides.

The case study results indicate that with respect to human exposure among the general public, there are no direct monitoring schemes established. However, official controls check the correct use of pesticides, worker protection, and residues in feed and food. Furthermore, the monitoring systems in place for water quality are well developed.

Overall it can be concluded from the case study that the examined MS are on the right track to implementing risk reduction measures via diverse provisions. On the other hand, especially with respect to the protection of the environment, the synergies between the different dossiers could be better exploited.

Establishing the various (economic, social and environmental) impacts of the use of pesticides with a particular focus on impacts on drinking water over the last ten years

The issue of the presence of hazardous chemical substances in drinking water is addressed by several EU legislative acts, of which the main instruments related to PPPs is the Water Framework Directive 2000/60/EC. The WFD, which came into force in 2000, established a framework for the assessment, management, protection and improvement of the quality of water resources across the EU with the main aim of ensuring that a sufficient quantity of good-quality water is available for both people's needs and the environment.

Monitoring of the quality of water (surface and groundwater) is performed by MS per identified river basins. The European Environment Agency recently concluded[77] that improvements have been made in monitoring and assessment since the quantity and quality of the available evidence on the status of water sources, and pressures to increase monitoring, have grown significantly. The EEA added that, with respect to the chemical status of surface water, *"Member States have made progress in tackling priority substances, leading to a reduction in the number of water bodies failing to meet standards for substances such as priority metals (cadmium, lead and nickel) and pesticides"*. With regard to groundwater water status, 74% and 89% of the area of surface water and groundwater bodies, respectively, are in good chemical status and available in adequate quantities. Agriculture is identified as one of the main causes of the failure of achieving good chemical status of groundwater, as it results in nitrate and pesticide pollution.

The case study indicates that buffer zones have been established in the six studied MS (Czech Republic, Denmark, Finland, Germany, Italy, The Netherlands) with differences related to the size of these zones. The buffer distances are set up per substance based on its toxicological profile.

On the contrary, findings of our research highlight that very few activities and programmes have been established with regard to the planting of hedges at the borders of surface water, which aims to decrease exposure to drain flow, run-off, and spray drift. When existing, these projects are of a voluntary nature.

Most of the interviewees from the 6 MS under study have indicated that the monitoring programmes in place are efficient. They have further stated that progress has been made in ensuring water quality, something also demonstrated by the second report on the monitoring activities of the River Basin Management Plans recently published by the EEA.

[77] Available at: https://www.eea.europa.eu/publications/state-of-water

For the same interviewees, performing socio-economic and environmental studies to quantify impacts is not feasible for several reasons. To a certain extent, it is also felt that this is not required. Indeed, the threshold values of pesticide presence are clearly defined and monitored. The impacts on human health and the environment are researched during the risk assessment processes in the application for approval of active substances and registration of PPPs. Thus, if thresholds are exceeded, the effects are well known. As long as the thresholds of the active ingredient are not exceeded, the risks to human health and environment are reported to be negligible. Therefore, it is felt that there is no need to enter into expensive socio-economic studies for which concrete and reliable assessment methodologies do not exist.

6.3. Recommendations

This chapter presents a list of recommendations based on the findings and conclusions of the several analytical tools used during this research (literature review, NAP review, surveys and case studies).

The evaluation of the various measures implemented under the current Directive indicates that, the relevance and EU added value of the policy is recognised by the majority of authorities and non-governmental stakeholders. This was found in the context of an area which was not previously regulated.

Taking into account that only a few concrete results and impacts of the different provisions on PPP risk reduction have been observed to date, contrasting opinions were expressed with respect to the effectiveness and the efficiency of the policy. These range from reporting a quite limited effectiveness related to the implementation of the provisions of the Directive, to positions indicating that progress has been made but does not yet show measurable results. One explanation for this observation may be that since many of these measures rely on changes in farming practices, time is required for the adoption of new practices and for the related impacts and results to be set in motion. This relates to the issues associated with the implementation of IPM. Indeed, IPM is a dynamic system strongly depending on variable agro-climatic conditions as well as individual farmer knowledge, which compounds the complexity required for its monitoring.

Findings suggest that IPM should aim at *"reducing the dependence of pesticides"*. This is corroborated by health and environmental NGOs. Respondents asserted that the addition of pesticide reduction as an overall goal or principle within the Directive should be undertaken. Firstly, this would result in the increased relevance of IPM to farmers. Secondly, this sends a clear signal to both pesticide users and NGOs that alternative methods to pesticides should be applied.

Findings suggest there is sufficient room within structure of the current Directive to improve implementation. The identified weaknesses of the framework for pesticide policies points to the need to improve the implementation of the current provisions, rather than revising the legislation.

On this basis, recommendations for promoting the optimal implementation of the provisions of the Directive and the optimal implementation of IPM are proposed.

Recommendations for promoting the optimal implementation of the Directive

- National authorities should take on a leadership and proactive role in the practical implementation of the SUD provisions. NAs should not limit themselves only to national transposition and control mechanisms, but rather introduce into legislation local solutions that go beyond transposition of the Directive. Authorities should further prepare analyses covering whether the technical, operational and financing conditions are sufficiently met to support the proper implementation of the Directive. This extends to IPM

implementation and other provisions of the Directive. Where issues are identified, appropriate action should be taken in a timely manner.

- MS should seek out collaboration between the relevant national authorities and stakeholders and further exploit the provisions of related regulatory frameworks (e.g. Water Framework Directive, Birds and Habitats Directives). In doing so, attention should be paid on the overall aim of the SUD to ensure agricultural production and at the same time ensure risk reduction.
- Improving the relationships focusing on information exchange across MS and between experts, is highly recommended. This should focus in particular on good practice, and agronomic innovation. Along the same lines, the Commission should reinforce the activities of its expert committee and launch additional training activities under the Better Training for Safer Food initiative[78].
- With respect to NAP revision, attention should be paid to the inclusion of measurable objectives, quantitative targets. MS should further focus on strengthening the alignments between targets, measures, and indicators. This will subsequently enable a smooth evaluation process. This particularly applies to areas where the NAPs have been weakest, such as environmental issues.
- The NAPs should include timeframes and targets for their measures even in areas where the Directive does not directly specify these requirements. For example, with respect to many of the environmental topic areas.
- MS should agree on more ambitious and uniform objectives on the collection of pesticide use data, than what is currently in place.
- Model-based harmonised risk indicators should be developed on the foundation of the same algorithms across MS. In order to enable their calculation, robust pesticide use information must be available.
- The models for harmonised risk indicators be should be based on models already existing. Alternatively, in order to properly monitor the reduction of impacts of PPPs, they can be based according to environmental compartment.
- National experts and/or national risk assessment agencies should be responsible for the calculation of risk indicators.
- The Commission and MS should supplement the model-based harmonised risk indicators with simple descriptive indicators. These indicators should be calculated on a regular basis by national authorities to demonstrate whether progresses are made.

Recommendations for promoting the optimal implementation of IPM

- National authorities should acknowledge that enhanced uptake of IPM takes time and that sustainable results cannot be expected over a short period. Long-term measures and policies with respect to IPM are required. This includes the expected impacts of IPM on agricultural systems and agricultural production.
- The general public should be informed by authorities that changing the crop protection paradigm is a long term objective requiring investments. It cannot be achieved instantaneously.
- The information flow between stakeholders (researchers, growers, producers, advisors, authorities) requires improvement, and coordination.

[78] Better Training for Safer Food (BTSF) is a Commission **training initiative** covering food and feed law, animal health and welfare and plant health rules.

- IPM guidelines should be disseminated by experts and extension offices as widely as possible. An ERA NET[79], or a similar platform, should be re-established.
- It should be recognised that IPM guidelines are a moving target, requiring innovation and re-evaluation on a regular basis. Ongoing, funded, research in IPM is required.
- National multi actor platforms working toward the development of crop specific IPM guidelines is required. Users of PPPs (growers and producers) should have a leading role in these platforms. The operational groups of the agricultural European Innovation Partnership (EIP-AGRI) should be considered. Their appropriateness for these working groups should be assessed.
- National authorities, together with advisors, experts and academic researchers, should ensure that each of the eight IPM principles are fully addressed in the NAPs.
- An important element of current policies needs to be the advancement of research and development, including the systems approach of IPM, should be supported by current policies and MS. The EU has set an example by launching a number of calls on IPM related topics in Horizon 2020. Support should continue in this direction and be amplified. Apart from a few exceptions, MS have not followed suit and dedicated funding for IPM research and implementation. These efforts should be improved as IPM will not be successful without solid nationally based research in place.
- Independent advisory services are necessary to promote IPM at the national level and require appropriate funding.
- IPM is often associated with increased costs and risks. These risks and costs should therefore be offset through subsidies, insurance, and financial and market incentives for growers to shift to IPM.

Additional practical recommendations from the case studies

- Based on national criteria, MS should identify specific areas which require particular attention with respect to the protection of human health and the environment. The identification of these areas could require derogations with regard to limitation of authorised PPPs and the promotion of low-risk pesticides or the use of alternative methods.
- The use of PPPs could be subject to national or regional reporting or specific approvals (e.g. in municipalities) in order to closely monitor their uses.

The responsibility over developing and implementing each of the individual recommendations, as well as the manner through which the recommendations address each of the identified shortcomings and weaknesses in the implementation of the Directive, are depicted in the table below. Further, the priority assigned to each recommendation and the requirement for further assessment are also highlighted.

[79] The ERA-NET instrument under Horizon 2020 is designed to support public-public partnerships in their preparation, establishment of networking structures, design, implementation and coordination of joint activities as well as topping up of single joint calls and of actions of a transnational nature.

Table 12: Key recommendations, responsibilities and their contribution to overcome the identified weaknesses of the Directive

Recommendation	Priority	Leadership	Involvement	Addressed weakness	Need for further assessment
Overall proper implementation of the Directive					
National authorities should take a lead and proactive role in the practical implementation of the SUD provisions	1	National Authorities	Authorities, public advisory services	Implementation, effectiveness, efficiency	
MS should seek better collaboration between the various national authorities	1	National authorities	Authorities	Implementation, coherence, effectiveness	To analyse optimisation of the implementation plans together with any other national authority for common goals and objectives
Improving the relation and information exchanges (good practices) across Member States and national experts	2	National authorities	Authorities, researchers, advisory services, users of PPPs	Implementation, effectiveness	
MS need to put dedicated attention to the identification of quantitative goals and focus on strong alignment between targets, measures and appropriate indicators	2	National Authorities	Authorities, researchers	Implementation, effectiveness, relevance	
MS need to agree on more ambitious and uniform objectives on the collection of pesticide use data	1	EC & National Authorities	Authorities	Implementation, effectiveness	
Model-based harmonised risk indicators based on the same algorithms should be identified from the currently developed ones	3	EC & National Authorities	Authorities, researchers	Implementation, efficiency	Additional research is required to fine tune the selected model based HRIs to allow use by each MS
EC and MS should supplement the model-based harmonised risk indicators with simple descriptive indicators.	1	EC & National Authorities	Authorities	Implementation, efficiency	

Recommendation	Priority	Leadership	Involvement	Addressed weakness	Need for further assessment
Overall proper implementation of the IPM					
Improve the information flow to stakeholders	2	National authorities	All actors	Implementation, effectiveness, efficiency	
National authorities should communicate on the fact that enhanced uptake if IPM takes time	2	National authorities	Authorities, researchers, advisory services	Implementation, effectiveness	
Promote the establishment of national multi actor platforms to develop crop by crop IPM measures	2	National authorities	Authorities, researchers, advisory services, users of PPPs		
National authorities, together with experts and research, should monitor that each of the eight IPM principles are correctly addressed.	2	National authorities	Authorities, researchers, advisory services, users of PPPs		
Independent advisory services are necessary to promote IPM at national level	2		Authorities, researchers, advisory services		Leadership needs to be defined.
Financial incentives for growers to move from chemical pesticides to alternative methods are required	2	National authorities	Authorities, users of PPPs		Best approach (type of incentive, financial sources) to be defined
Protection of specific areas					
MS should, based on national criteria, identify specific areas which require particular attention as regards to the protection of human health and the environment	3	National authorities	Authorities	Implementation, effectiveness, efficiency	
The use of PPPs can be subject to national or regional reporting or specific approvals	2	National Authorities	Authorities		

Note: priority: 1:high, 5:low

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8. Appendix

8.1. Methodological approach

8.1.1. Approach to the general literature review

For the purpose of this study, the literature review is divided into two components – the general literature review and the national action plan review.

This section tackles *the general literature review,* which summarises and presents the main findings from the literature relevant to understanding the state-of-play of the performance of the Sustainable Use of Pesticides Directive. More specifically, the general literature review, involves a consideration of all relevant academic literature on the topic, evaluation reports, audit reports, reports delivered by Member States according to their *reporting* obligations, stakeholder publications, pertinent grey literature (such as news articles), and applicable quantitative data available from existing databases (such as Eurostat). The regulatory framework, including a review of all legislative documents with strong links to the Directive, and international agreements on pesticide use and sale, will be considered to describe the wider legislative context of the Directive. The selection of relevant legislation will be foremost based on the Directive, specifically, the list of complementary EU legislation provided under recital (3). Literature results will serve to enrich the list of EU regulation identified, where possible.

Together, these sources will be applied to tell the story of the implementation of the Directive to date, primarily what is known about its transposition and application (i.e. Directive implementation[80]), as well as complementary information on the enforcement of the Directive, the proposed strengths and weaknesses observed in practice, and the suspected policy trajectories of the Directive in the future. Integrated pest management will receive particular attention throughout the literature review, as the promotion of IPM techniques to reduce pesticide-use risk is a focal point of the Directive, and the literature on this theme carries an appropriate richness and depth. Finally, findings on the progress (development and implementation) of Harmonised Risk Indicators, referred to in Article 15 of the Directive, will be presented.

8.1.2. Approach to the NAP Literature review

The second segment of this section is the National Action Plan literature review. This review covers the entirety of the EU28 and focuses on extracting relevant information from the National Action Plans via the use of the literature review grid. Collecting information from the NAPs is of utmost importance as those documents, required by the Directive (Article 4), form an integral part of the MS' overall strategy for regulating, communicating, fostering and inspiring approaches challenging today's agricultural dependency on pesticides.

The NAP literature review extracts information from each MS's initial NAP published. All documents were centrally retrieved from the EC's webpage[81] on April 20th, 2018. While the few NAP revisions available are not taken into account in the NAP review itself, the NCA survey includes questions on whether such update is available and on the content of the update.

The NAP literature review seeks to extract information from each NAP against each one of the specific requisites as stipulated in Article 4 of the Directive. For instance, elements concerning the NAP

[80] European Parliament. DG Internal Policies. (2013) *Tools for Ensuring Implementation and Application of EU Law and Evaluation of their Effectiveness*. Brussels

[81] https://ec.europa.eu/food/plant/pesticides/sustainable_use_pesticides/nap_en

time span, who drafted the NAP and which stakeholders were involved in the drafting are all collected. Information, provided in the NAP, on how each article of the Directive is approached, in each MS, is likewise extracted The information collected is analysed in section 3.

8.1.3. Approach to the online surveys

Two surveys were conducted; one targeted in particular NCAs as well as other relevant national authorities while the other focused on other relevant stakeholders (i.e. non-governmental bodies).

Survey methodology: selection procedure

The following sub-sections detail the identification procedure of the potential respondents and their selection. For both surveys, the aim was to collect information from a geographically diverse sample, as to ensure the representativeness of the collected data, in addition to providing a comprehensive picture on the implementation of the Directive across the European Union. Both surveys were disseminated in parallel (over the course of one month, in May 2018)

(a) National authorities – NCA – Selection Criteria

The national authorities' survey is directed at ministries and comparable public authorities and bodies which are in charge of implementing the Directive across all Member States, at the time of the study. The goal of the survey is to collect the opinion and status of the respective public body representatives on the implementation of the Directive in a format which allows a comparative analysis to be conducted. In terms of geographical spread, all national competent authorities across the EU28 are classified as potential participants in the survey.

In order to address this geographical criteria, contact details of potential participants are collected via desk research. Contact information lists of previous projects conducted by the Ex-Post Evaluation Unit of EPRS were also used. A database of potential participants is drawn up via the merging of the aforementioned contact lists. The database includes the contact information of persons in departments working in the implementation of the Directive. This information includes: names, e-mail addresses, department information (such as name of the ministry), and where possible, telephone numbers. The latter, telephone numbers, remain rare in the data base due to limits in their public availability.

The database is subsequently *cleaned* to ensure that the remaining addresses are valid and the correct departments are targeted. This step entails a preliminary scanning of the database by the project team, as to identify and assess the severity of remaining data gaps, as well as obvious errors in the contact information (such as mistyped email addresses). Subsequently, the database is assessed by the project experts, to add contact details of any potentially missing national competent authorities.

An inclusionary criterion in this contact database is first and foremost considered, it pertains to whether the public body is in fact responsible for the implementation of the Directive. In addition, the public body must be in the position to produce accurate and relevant answers to the survey. This entails the inclusion of relevant departments as primary contact points, as opposed to entire ministries. This increases the likelihood of collecting relevant answers. In the introductory text of the survey, the participant is asked to forward the survey to other departments they deem could provide helpful input in the survey, as to collect complementary information.

(b) Other Stakeholder – Selection Criteria

The second survey, targeting other stakeholders, aims to collect information on the implementation of the Directive from relevant stakeholder organisations, which implement or comply with the relevant legal requirements, or are affected by the requirement implementation. The targeted stakeholders can be differentiated into three distinct categories: growers (i.e. users of PPP), the producers of PPP, and other NGOs, which have activities related to health and environment safety and/or the productions of foodstuffs. As mentioned above, professional stakeholder organisations are targeted in this step of the analysis, as opposed to individual stakeholders. Furthermore, it is necessary to include a geographically diverse representation of stakeholders, as to achieve full coverage of the EU28. Primary organisations of interest are EU trade associations, national associations (notably, farmers' cooperative, environmental associations). In addition, NGOs lobbying for environmental and health protection and safety and active at European and national level are also included. The reason for categorising stakeholders and including the groups according to their typology is to maximise the overall response rate.

The following table presents, an overview of the targeted groups (National authorities and other stakeholders) and the criteria applied for their selection.

Table 13: Survey participants' categories and selection criteria

	Selection criteria				Comments
	Geographic representativeness	Status/ relevance of the institutions/organisations to the Directive	Voice or influence/ publications on the subject matter/publicly known involvement	Consultation experience/ previous contributions in public consultations	Specifications on the targeted groups
Group 1: National authorities					Public institutions only
NCA	+++	+++	+	+	Institutions in charge of the Directive implementation and enforcement. Includes (Federal) Ministries, Government Agencies, Boards or other authorities in charge.
Other relevant national or regional bodies	+	+	+	+	Institutions active in direct or indirect. Includes official advisors or councillors providing consultation for NCAs (input merged with NCA entries)
Group 2: Stakeholders					Private bodies, interest groups, non-governmental organisations
PPPs users/grower organisations	+++	+++	+++	+++	Mostly farmers associations
Manufacturers of PPPs	+++	+++	+++	+++	This category also includes individual companies as well as producers associations or any other organisations which would support PPP producers (interest groups and pesticides lobbies)
Health/environmental NGOs	+++	+++	+++	+++	Includes national as well as pan-European organisations active in the field of environmental or public health protection.

Source: Core team, 2018

8.1.4. National Authorities survey – Questionnaire

Identification and Confidentiality	
1 – Identification – Please, indicate the name of your competent authority and your position. Anonymity is guaranteed in both cases.	Free text
2 – Confidentiality – Please select one of the following options	Radiobuttons
	. My/our contribution can be directly published with my organisation information (I consent to publication of all information in my contribution in whole or in part including the name of my organisation, and I declare that nothing within my response is unlawful or would infringe the rights of any third party in a manner that would prevent publication). . My/our contribution can be directly published provided that my organisation remain(s) anonymous (I consent to publication of any information in my contribution in whole or in part (which may include quotes or opinions I express) provided that this is done anonymously. I declare that nothing within my response is unlawful or would infringe the rights of any third party in a manner that would prevent publication. I am aware that I am solely responsible if my answer reveals accidentally my identity. . My/our contribution cannot be directly published but may be included within statistical data (I understand that my contribution will not be directly published, but that my anonymised responses may be included in published statistical data, for example, to show general trends in the response to this consultation) Note that your answers may be subject to a request for public access to documents under Regulation (EC) No 149/21
Legislative Objectives – Relevance	
3 – Are the original objectives addressed by Directive 29/128/EC still relevant to current needs? (Reducing risks and impacts of pesticides on human health, reducing risks and impacts of pesticides on the environment, promoting the use of integrated pest management, promoting the use of alternative approaches or techniques such as non-chemical alternatives to pesticides)	SC list with comment
	Yes/No/I don't know
4 – Do you consider that these objectives should be updated in order to reflect the current needs?	SC list with comment
	Yes/No/I don't know
Legislative Objectives – Coherence	
5 – Are the objectives of Directive 29/128/EC, in your opinion, coherent with other pieces of EU legislation?	Array (Yes/No/I don't know) with comment
	. Agriculture

Identification and Confidentiality	
	. Food and feed security . Food and feed safety . Plant protection products Regulation . Maximal residues of pesticides in food and feed . Chemicals . Biocides . Fertilising material . Energy/bio-energy . Environment . Climate change . Public health . Consumer protection . Internal market . Other
6 – Is the implementation of Directive 29/128/EC, in your opinion, coherent with other pieces of EU legislation?	Array (Yes/No/I don't know) with comment
	. Agriculture . Food and feed security . Food and feed safety . Plant protection products Regulation . Maximal residues of pesticides in food and feed . Chemicals . Biocides . Fertilising material . Energy/bio-energy . Environment . Climate change . Public health . Consumer protection . Internal market . Other
Legislative Objectives – Effectiveness	
7 – In general terms, to what extent does the implementation of Directive 29/128/EC, via the respective national provisions, allow its objectives to be achieved? Please use a scale of 1 (implementation fully allows the objectives to be achieved) to 5 (implementation does not allow the objectives to be achieved).	Array (5 point choice) with comment
	. Reducing risks and impacts of pesticides on human health . Reducing risks and impacts of pesticides on the environment . Promoting the use of integrated pest management . Promoting the use of alternative approaches or techniques such as non-chemical alternatives to pesticides

Identification and Confidentiality	
8 – Have the objectives of Directive 29/128/EC, listed below, been met?	multiple SC Questions with comments, see below
– Reducing risks and impacts of pesticides for human health	SC list with comment
	Yes/No/Partially/I dont know
– Reducing risks and impacts of pesticides for the environment	SC list with comment
	Yes/No/Partially/I dont know
– Promoting the approach of integrated pest management	SC list with comment
	Yes/No/Partially/I dont know
– Promoting the use of alternative approaches or techniques such as non-chemical alternatives to pesticides	SC list with comment
	Yes/No/Partially/I dont know
9 – Please assess the implementation the following specific provisions of Directive 29/128/EC? Please elaborate on the questions related to the provisions which have had an impact on you/your activity.	multiple SC Questions with comments, see below
– Article 5 -Training	SC list with comment
	Yes/No/Partially/I dont know
– Article 6 – Restriction for sales of pesticides	SC list with comment
	Yes/No/Partially/I dont know
– Article 7 – Information and awareness-raising	SC list with comment
	Yes/No/Partially/I dont know
– Article 8-Inspection of equipment in use	SC list with comment
	Yes/No/Partially/I dont know
– Article 9-Aerial spraying	SC list with comment
	Yes/No/Partially/I dont know
– Article 1-Information to the public	SC list with comment
	Yes/No/Partially/I dont know
– Article 11- Specific measures to protect the aquatic environment	SC list with comment
	Yes/No/Partially/I dont know
– Article 12- Reduction of pesticide use or risks in specific areas	SC list with comment
	Yes/No/Partially/I dont know
– Article 13-Handling and storage of pesticides	SC list with comment
	Yes/No/Partially/I dont know
– Article 14- IPM	SC list with comment
	Yes/No/Partially/I dont know
– Article 15 paragraph 2- Indicators	SC list with comment
	Yes/No/Partially/I dont know

Identification and Confidentiality	
– Article 17-Penalties	SC list with comment
	Yes/No/Partially/I dont know
– Article 19-Fees and charges	SC list with comment
	Yes/No/Partially/I dont know
Legal Objectives – Efficiency	
1 – Do you consider that sufficient resources are devoted to the implementation of the measures of the National Action Plan?	Free text
11 – Do you consider that the implementation of the obligations of Directive 29/128/EC leads to: Too high enforcement costs	SC list with comment
	Yes/No/I don't know
12 – Too high administrative costs (administrative burden). If you consider that the implementation of the Directive leads to high administrative costs, how could these costs be reduced?	SC list with comment
	Yes/No/I don't know
Legislative objectives – European added value	
13 – To what extent has Directive 29/128/EC resulted in added value with regards to the objectives pursued that could not be achieved at national level or in other international fora? Please use a scale of 1 (Directive 29/128/EC has added high value) to 5 (Directive 29/128/EC has not added any value).	Array (5 point choice)
	. Reducing risks and impacts of pesticides on human health . Reducing risks and impacts of pesticides on the environment . Promoting the use of integrated pest management . Promoting the use of alternative approaches or techniques such as non-chemical alternatives to pesticides
14 – Do you think the EU level is adequate for regulating the use of pesticides in agriculture?	SC list with comment
	Yes/No/I don't know
– If no, what would be the argument for a national regulation on that matter?	Free text
– If yes, what are the arguments for harmonisation at EU level?	Free text
Information Article 4 – National action plan (NAP)	
15 – Have you initiated the first revision of your NAP? If yes, please name the revised goals, provisions or new focus areas of your revised NAP and explain why revision took place.	SC list with comment
	Yes/No/I don't know
16 – What is the timeline of your revised NAP?	Free text

Identification and Confidentiality	
17 – In your country, are there any additional activities linked to the sustainable use of pesticides which are not mentioned in your NAP? If yes, please describe these actions and explain how they contribute to the objective of the Directive 29/128/EC?	SC list with comment
	Yes/No/I don't know
18 – Have you planned to add additional activities in your NAP the upcoming years? If yes – which ones?	SC list with comment
	Yes/No/I don't know
19 – What is the overall/annual budget allocated to the implementation of the NAP in your country? Has that budget evolved over years? (Provide figures to comply with different articles of the directive whenever possible)	Free text
2 – Is there any general mechanism for monitoring accountability and controlling the implementation of the NAP?	SC list with comment
	Yes/No/I don't know
21 – Who is responsible for monitoring accountability and controlling the implementation of the NAP?	Free text
22 – Is the public informed (and how) about the NAP implementation results?	SC list with comment
	Yes/No/I don't know
Article 5 – Training	
23 – Who provides the required trainings?	MC List
	. Competent authority . Private organisation . Public organisation . Other
24 – Is the competence of trained persons assessed (re-evaluated) and repeatedly checked (in what frequency)?	SC list with comment
	Yes/No/I don't know
Article 6 -Requirements for sales of pesticides	.
25 – Which measures are in place in your country to restrict sales of pesticides authorised for professional use to persons holding a certificate?	Free text
26 – What are the measures taken in your country to monitor that distributors provide sufficient information of risks and impacts of pesticides to non-professional users?	Free text
Article 7 – Information and awareness-raising	
27 – What are the measures taken to promote and facilitate information and awareness-raising for the general public?	Free text
– 1) pesticide acute poisoning incidents?	Free text
– 2) chronic poisoning developments?	Free text

Identification and Confidentiality	
Article 8 – Inspection of equipment of use	
29 – What measures have been adopted in your country to monitor that pesticides application equipment satisfies the relevant requirements listed in Appendix II?	Free text
3 – What measures have been adopted in your country to monitor that professional users conduct regular calibration and technical checks of their pesticide application equipment?	Free text
Article 9 – Aerial spraying	.
31 – Has your country allowed the use of aerial spraying by means of derogation? If yes, please list the derogations and describe the conditions.	SC list with comment
	Yes/No/I don't know
32 – What measures have been adopted in your country to verify that conditions allowing the granting of derogations, as listed under Article 9 paragraph 2, are met?	Free text
33 – How many single requests for derogation have been received with regards to aerial spraying since the directive is in force? How many of these have been granted?	Free text
Article 11 – Specific measures to protect the aquatic environment and drinking water	
34 – Has your country implemented any additional measures to protect the aquatic environment and drinking water which were not included in the NAP? If yes which ones?	SC list with comment
	Yes/No/I don't know
Article 12 – reduction of pesticide use or risks in specific areas	
35 – What measures have been implemented by your country ensuring that the use of pesticides is minimised or prohibited in certain specific areas?	Free text
Article 13 – Handling and storage of pesticides and treatment of their packaging and remnants	
36 – What measures have been taken in your country to ensure that measures listed in article 13 paragraph 1 do not endanger human health or the environment?	Free text
37 – What measures have been taken by your country regarding pesticides authorised for non-professional users to avoid dangerous handling operations?	Free text
38 – What measures have been implemented by your country to monitor that storage areas for pesticides for professional use are constructed in such a way as to prevent unwanted releases?	Free text

Identification and Confidentiality	
Article 14 – Integrated pest management (IPM)	
39 – How do you encourage producers/growers, advisors and any other stakeholder to adopt IPM principles?	Free text
4 – Have you set specific programmes to encourage farmers to implement to IPM principles?	SC list with comment
	Yes/No/I don't know
41 – In your opinion, which of the eight IPM principles have received most attention (in terms of incentives, supportive programmes or knowledge transfer) in your country regarding crops?	Array (Yes/No/I don't know)
	1. Prevention and/or suppression of harmful organisms . 1a Crop rotation . 1b Adequate cultivation techniques . 1c Use of relevant resistant varieties . 1d Use of balanced fertilisation . 1e Preventing the spread of harmful organisms by hygiene measures . 1f Enhancement of ecological infrastructure 2. Monitoring of harmful organisms 3. Use threshold values for applying plant protection measures 4. Use of biological, physical and other non-chemical methods 5. Target specific choice of pesticides 6. Limiting interventions to necessary levels 7. Application of anti-resistance strategies 8. Efficiency check of pesticides application by professional users
42 – Which general activities have been initiated in your country by official bodies to promote the use of IPM measures?	Free text
43 – Have you developed IPM guidelines? If yes, are these national or regional guidelines?	SC list with comment
	Yes/No/I don't know
44 – In your opinion, what are the hindering and facilitating factors influencing the on-farm implementation of the IPM principles?	Free text
45 – In what manner is the implementation of the IPM principles monitored in your country?	Free text
46 – In your opinion, do you consider that the application of IPM measures in your sector/country is:	SC list with comment
	Not satisfactory at all Satisfactory Largely satisfactory I don't know

Identification and Confidentiality	
47 – Do you observe variability of the application of IPM measures across crops or sectors? If yes, in which sectors/crops and how do you explain it?	SC list with comment
	Yes/No/I don't know
48 – Do you think that the list of the eight general principles should be revised? If yes, why and how so?	SC list with comment
	Yes/No/I don't know
Article 15 – Risk indicators	
49 – Has your country developed national indicators? If yes, which indicator(s) have been developed?	SC list with comment
	Yes/No/I don't know
5 – What data is used to populate these indicators? How is the data collected in your country?	Free text
Additional remarks/issues	
51 – If you wish, please provide additional comments you would like to raise, either in relation to the questions asked in this survey, or with regards to other relevant issues	Free text
52 – Also, if you deem it important, please express your recommendations for improvement of the implementation of the Directive at national level	Free text

8.1.5. Other stakeholders survey – Questionnaire

Identification and Confidentiality	
Q1 Identification – Please, indicate your country you are based in, the name of your organisation and your organisation's scope of activities. Anonymity is guaranteed in both cases.	Free text
Q2 Identification – Please indicate your stakeholder category	SC list with comment
	. manufacturers of plant protection products . users of plant protection products . health/environment NGOs . other (please specify)
Q3 Confidentiality – Please select one of the following options	radio
	. My/our contribution can be directly published with my organisation information (I consent to publication of all information in my contribution in whole or in part including the name of my organisation, and I declare that nothing within my response is unlawful or would infringe the rights of any third party in a manner that would prevent publication). . My/our contribution can be directly published provided that my organisation remain(s) anonymous (I

Identification and Confidentiality	
	consent to publication of any information in my contribution in whole or in part (which may include quotes or opinions I express) provided that this is done anonymously. I declare that nothing within my response is unlawful or would infringe the rights of any third party in a manner that would prevent publication. I am aware that I am solely responsible if my answer reveals accidentally my identity. . My/our contribution cannot be directly published but may be included within statistical data (I understand that my contribution will not be directly published, but that my anonymised responses may be included in published statistical data, for example, to show general trends in the response to this consultation) Note that your answers may be subject to a request for public access to documents under Regulation (EC) No 149/21
Legislative Objectives – Relevance	
Q4 Are the original objectives addressed by Directive 29/128/EC still relevant to current needs? (Reducing risks and impacts of pesticides on human health, reducing risks and impacts of pesticides on the environment, promoting the use of integrated pest management, promoting the use of alternative approaches or techniques such as non-chemical alternatives to pesticides)	SC list with comment
	Yes/No/I don't know
Q5 Do you consider that these objectives should be updated in order to reflect the current needs?	SC list with comment
	Yes/No/I don't know
Legislative Objectives – Coherence	
Q6 Are the objectives of Directive 29/128/EC, in your opinion, coherent with other pieces of EU legislation?	Array with comment (Yes/No/I don't know)
	. Agriculture . Food and feed security . Food and feed safety . Plant protection products Regulation . Maximal residues of pesticides in food and feed . Chemicals . Biocides . Fertilising material . Energy/bio-energy . Environment . Climate change . Public health . Consumer protection . Internal market . Other

Identification and Confidentiality	
Q7 Is the implementation of Directive 29/128/EC, in your opinion, coherent with other pieces of EU legislation?	Array with comment (Yes/No/I don't know)
	. Agriculture . Food and feed security . Food and feed safety . Plant protection products Regulation . Maximal residues of pesticides in food and feed . Chemicals . Biocides . Fertilising material . Energy/bio-energy . Environment . Climate change . Public health . Consumer protection . Internal market . Other
Legislative Objectives – Effectiveness	
Q8 In general terms, to what extent does the implementation of Directive 29/128/EC, via the respective national provisions, allow its objectives to be achieved? Please use a scale of 1 (implementation fully allows the objectives to be achieved) to 5 (implementation does not allow the objectives to be achieved).	Array (5 point choice) with comment
	. Reducing risks and impacts of pesticides on human health . Reducing risks and impacts of pesticides on the environment . Promoting the use of integrated pest management . Promoting the use of alternative approaches or techniques such as non-chemical alternatives to pesticides
Q9 Have the objectives of Directive 29/128/EC, listed below, been met?	multiple SC Questions with comments, see below
Reducing risks and impacts of pesticides for human health	SC list with comment
	Yes/No/Partially/I don't know
Reducing risks and impacts of pesticides for the environment	SC list with comment
	Yes/No/Partially/I don't know
Promoting the approach of integrated pest management	SC list with comment
	Yes/No/Partially/I don't know
Promoting the use of alternative approaches or techniques such as non-chemical alternatives to pesticides	SC list with comment
	Yes/No/Partially/I don't know

Identification and Confidentiality	
Q1 Please assess the implementation the following specific provisions of Directive 29/128/EC? Please elaborate on the questions related to the provisions which have had an impact on you/your activity.	multiple SC Questions with comments, see below
Article 5 -Training	SC list with comment
	Problematic/Not problematic/I don't know
Article 6 – Restriction for sales of pesticides	SC list with comment
	Problematic/Not problematic/I don't know
Article 7 – Information and awareness-raising	SC list with comment
	Problematic/Not problematic/I don't know
Article 8-Inspection of equipment in use	SC list with comment
	Problematic/Not problematic/I don't know
Article 9-Aerial spraying	SC list with comment
	Problematic/Not problematic/I don't know
Article 1-Information to the public	SC list with comment
	Problematic/Not problematic/I don't know
Article 11- Specific measures to protect the aquatic environment	SC list with comment
	Problematic/Not problematic/I don't know
Article 12- Reduction of pesticide use or risks in specific areas	SC list with comment
	Problematic/Not problematic/I don't know
Article 13-Handling and storage of pesticides	SC list with comment
	Problematic/Not problematic/I don't know
Article 14- IPM	SC list with comment
	Problematic/Not problematic/I don't know
Article 15 paragraph 2- Indicators	SC list with comment
	Problematic/Not problematic/I don't know
Article 17-Penalties	SC list with comment
	Problematic/Not problematic/I don't know
Article 19-Fees and charges	SC list with comment
	Problematic/Not problematic/I don't know
Legal Objectives – Efficiency	
Q11 Do you consider that sufficient resources are devoted to the implementation of the measures of the National Action Plan?	Free text
Q12 Do you believe that the implementation of the obligations of Directive 29/128/EC leads to excessively high administrative costs (administrative burden)?	SC list with comment
	Yes/No/I don't know

Identification and Confidentiality	
Q13 If you consider that the implementation of the Directive leads to high administrative costs, how could these costs be reduced? Please give reasons if you consider that the implementation of the Directive leads to low administrative costs.	Free text
Legislative objectives – European added value	
Q14 To what extent has Directive 29/128/EC resulted in added value with regards to the objectives pursued that could not be achieved at national level or in other international fora? Please use a scale of 1 (Directive 29/128/EC has added high value) to 5 (Directive 29/128/EC has not added any value).	Array (5 point choice)
	. Reducing risks and impacts of pesticides on human health . Reducing risks and impacts of pesticides on the environment . Promoting the use of integrated pest management . Promoting the use of alternative approaches or techniques such as non-chemical alternatives to pesticides
Q15 Do you think the EU level is adequate for regulating the use of pesticides in agriculture?	SC list with comment
	Yes/No/I don't know
If no, what would be the argument for a national regulation on that matter?	Free text
If yes, what are the arguments for harmonisation at EU level?	Free text
Information Article 4 – National Action Plan (NAP):	
Q14 To your knowledge, are there any additional activities linked to the sustainable use of pesticides which are not mentioned in your NAP?	SC list
	Yes/No/I don't know
If yes, please describe the main five actions and explain how they contribute to the objective of the Directive 29/128/EC.	Free text
Q15 Is there in place any general mechanism for monitoring accountability and controlling the implementation of the NAPs?	SC list with comment
	Yes/No/I don't know
Q16 Who is responsible for monitoring accountability and controlling the implementation of the NAPs?	Free text
Q17 Is the public informed (and how) about the NAP implementation results?	SC list with comment
	Yes/No/I don't know

Identification and Confidentiality	
Article 6 – Requirements for sales of pesticides	
Q18 Which measures are in place in your country (in the region/country/country-group you are active in/of which you represent actors) to restrict sales of pesticides authorised for professional use to persons holding a certificate?	Free text
Article 14 – Integrated Pest Management (IPM)	
1) Tailor and apply IPM principles?	Free text
2) Implement IPM principles?	Free text
Q2 In your opinion, considering all crops, which of the eight IPM principles have received most attention in your country/to your knowledge?	Array with comment (Yes/No/I don't know)
	1. Prevention and/or suppression of harmful organisms . 1a Diversifying crop rotation . 1b Adopting adequate cultivation techniques . 1c Use of resistant varieties . 1d Use of balanced fertilisation . 1f Protection and enhancement of beneficial organisms . 1e Preventing the spread of harmful organisms by hygiene measures 2. Monitoring and forecasting of harmful organisms 3. Use of threshold values for applying plant protection measures 4. Use of biological, physical and other non-chemical methods 5. Maximising pesticide specificity for the target and minimising side effects 6. Adjusting pesticide use to the need in the field 7. Adoption of anti-resistance strategies 8. Efficacy check of pesticides application by professional users
Q19 Which global activities have been initiated in your country by official bodies to promote the use of IPM measures?	Free text
Q2 Have you developed IPM guidelines for the sector(s) you are active in?	SC list
	Yes/No/I don't know
If yes, are these guidelines national ones? Crop specific ones?	Free text
Q21 In your opinion, what are the main problems or factors limiting the application of the IPM principles?	Free text
Q22 In your opinion, do you consider that the application of IPM measures in your country is:	SC list with comment
	. Not satisfactory at all . Satisfactory . Largely satisfactory

Identification and Confidentiality	
	. I don't know
Q23 Do you observe variability across crops?	SC list
	Yes/No/I don't know
If yes, how do you explain it?	Free text
Q24 Do you believe that the list of the eight principles should be revised?	SC list
	Yes/No/I don't know
If yes, why and how so?	Free text
Additional remarks/issues	
Q25 If you wish, please provide additional comments you would like to raise, either in relation to the questions asked in this survey, or with regards to other relevant issues	Free text
Q26 Also if you deem it important, please express your recommendations for improvement of the implementation of the Directive as transposed in the national law and especially the IPM principles	Free text

8.1.6. Approach to the case studies

Case studies are conducted with the aim of providing specific in-depth information addressing selected level B research activities. Based on the Technical Specifications, Table 14 lists the aspects which were considered for the case studies. The core team concluded that several research activities were not feasible or relevant for a case study approach.

Table 14: Overview of the level B research activities and core team decisions

Level B research task 1 and 2	Core team decision & approach followed
Case Study 1: Developing a set of draft harmonised risk indicators that are still to be adopted by the Commission (Article 15)	Literature review based
Case Study 2: Assessing the implementation of the Directive with regard to limitation and ban of usage of pesticides in specific areas by Member States (Article 12)	Examine measures taken and planned by MS in their NAP Assess the current implementation of Article. 12 based on surveys findings Conduct interviews to refine the previous findings in six selected MS (case study countries: DK, FI, AT, UK, ES, FR)
Case Study 3: Establishing the various (economic, social and environmental) impacts of the use of pesticides, and in particular its impact on drinking water over the last ten years. (Article 11)	Examine the MS's approach in addressing Article. 11 in their NAP Mirror these observations against the surveys respondents' comments Conduct interviews of relevant stakeholders to better grasp the types and level of impacts on the use of pesticides, on drinking water, in six selected MS (case study countries: CZ, DE, DK, FI, IE, NL)

Level B research task 1 and 2	Core team decision & approach followed
Case study 4: Mapping and evaluating the usage of pesticides across the EU according to their exact specifications of use as authorised according to Regulation (EC) 1107/2009 concerning the placing of plant protection products on the market (uses of plant protection products for other purposes than authorised, as for example pre-harvest crop desiccation instead of using the product as prescribed by the regulator).	After deliberation, the core team concluded that this case study could not be carried out. A detailed justification of the core team's rationale is presented in section 5.4.1
Case Study 5: Developing a set of common EU-level guidelines (following successful guidance practices at national level) for the various IPM principles that would underpin the proper IPM implementation. The feasibility of achieving greater benefits by focussing on concentration rather than volume should be further assessed, as well as whether the practices in the aforementioned Member States can be "transferred" to other MS with similar results.	After deliberation, the core team concluded that this case study could not be carried out. A detailed justification of the core team's rationale is presented in section 5.4.2.
Case Study 6: Developing a set of EU-level prescriptive and assessable criteria that would support the proper implementation of IPM.	After deliberation, the core team concluded that this case study could not be carried out. A detailed justification of the core team's rationale is presented in section 5.4.3.

Source: Core team, 2018, based on information specified in the Technical Specifications

Countries selected for CS 2 and CS 3, execution and outcome

The selection of countries is based on two sets of criteria/elements:

1.a A balanced geographical representation along the North/South and East/West axis
1.b A balanced representation of countries within each EU authorization zone (see Figure 27 below)
2.a Findings of the NAP review and survey analysis
2.b Experts knowledge on the MS vis-à-vis the specific case study subject matter.

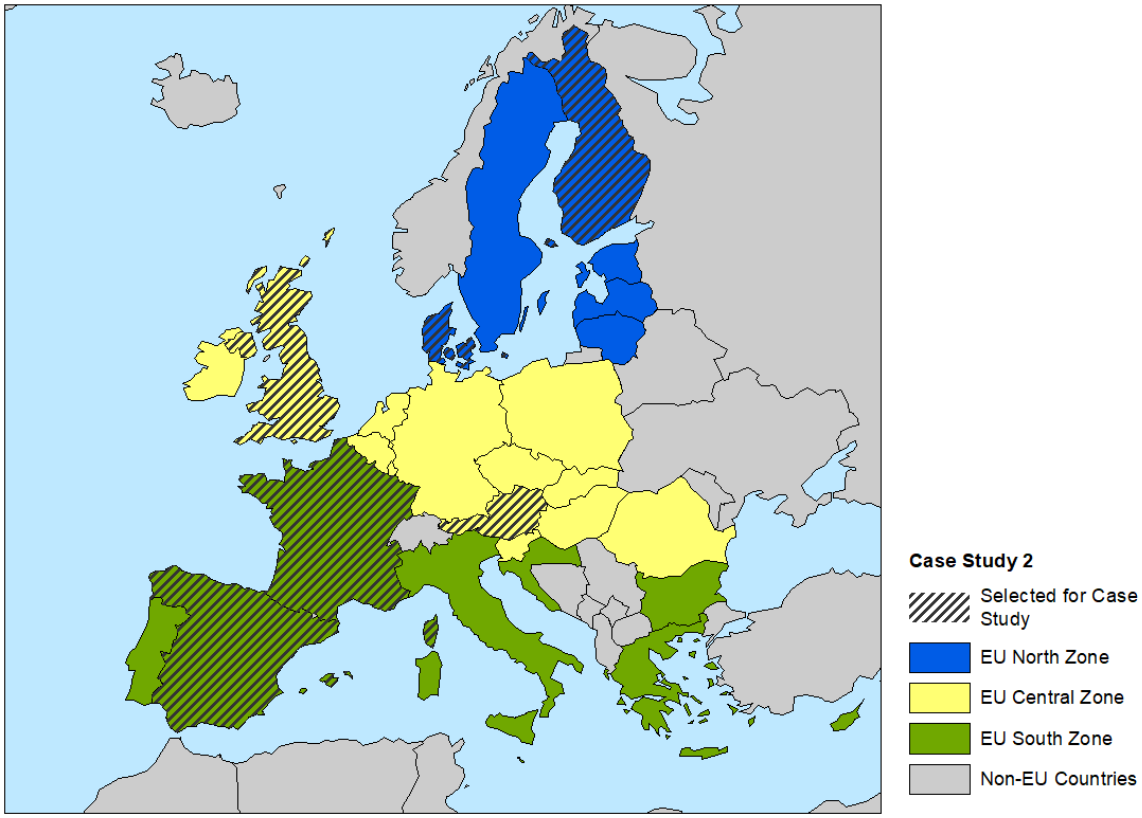
Based on these section criteria, the following countries have been selected:

Table 15: Case study: selected countries

#	CS short	Level B Research activities	Research scope	Countries selected
CS2	Specific areas	Assessing the implementation of SUD with regard to limitation and ban of usage of PPPs in specific areas	data collection at MS level required	North zone: DK, FI Central zone: AT, UK South zone: ES,FR
CS3	Water	Impacts of pesticides on drinking water	data collection at MS level required	CZ, DE, DK, FI, IE, NL,

Source: Core team, 2018

Figure 27: EU Authorization Zones and Case study 2 countries



Source: Core team, 2018 based on information from Regulation (EC) No 1107/2009

Crucial elements of case studies execution are:

(1) Identification of potential interviewees – as for the identification of survey target groups, the case studies interviewees will fall under the same categories.
(2) Instructions for experts conducting case studies – in order to ensure the approaches followed by national team experts are comparable, they are instructed on the same manner on how to collect and process information.
(3) Reporting of data collection and analysis – as mentioned, different methods for presenting the collected data and outcome of the analysis may be applied. Results are presented as short reports of e.g. 4-5 pages.

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The first part of this assessment, an opening analysis prepared within the European Parliamentary Research Service, presents an analysis of the main results of an external study concerning the implementation of Directive 2009/128/EC establishing a framework for Community action to achieve the sustainable use of pesticides. This part also looks at the position and opinions of the European Parliament.

The second part contains an externally commissioned study evaluating the implementation of Directive 2009/128/EC. The study covers the implementation of the directive as a whole. Furthermore, it concentrates on the implementation of the integrated pest management principles in individual Member States. In addition, it provides an analysis concerning the development of harmonised risk indicators, limitation and banning of pesticide use in sensitive specific areas, and the impact of the use of pesticides on drinking water. The analysis is accompanied by recommendations on how to improve the implementation processes.

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