

Annex to decision II 3 during the government meeting held 11 April 2019, N2019/01607/SMF

Sweden's National Action Plan for the sustainable use of plant protection products for the period 2019–2022

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1 Introduction

This document constitutes Sweden's National Action Plan for the sustainable use of plant protection products in accordance with Directive 2009/128/EC establishing a framework for Community action to achieve the sustainable use of pesticides¹. The action plan comprises two parts. The first part, chapters 1–14, reviews objectives, actions and monitoring. Chapters 15–18 provide a background description of Swedish agriculture, the use of plant protection products and different control measures which Sweden uses in its efforts to reduce the risks involved and their use.

The action plan is valid until a new one is adopted.

1.1 Initial position and challenges

The European Parliament and Council decided in 2009 to adopt Directive 2009/128/EC establishing framework for Community action to achieve a sustainable use of pesticides. Under the Directive, Member States must reduce the risks and consequences entailed by using pesticides for human health and the environment. This is to be achieved by promoting the use of integrated pest management and other methods or techniques.

One of the key aspects of the Directive is for Member States to devise and adopt action plans. Each Member State must set out in the plan quantitative objectives, guide values, measures and timetables for reducing the risks associated with and impact of using plant protection products for human health and the environment. These plans must be reviewed at least every five years.

The Swedish Government adopted on 19 June 2013 a National Action Plan for the sustainable use of plant protection products for the period 2013–2017. The action plan's objectives were as follows:

- to reduce the risks to the environment and to health
- to bring the levels of plant protection products in surface water and groundwater down almost to zero in line with the Swedish Parliament's 'Non-toxic environment' environmental quality objective by 2020
- to ensure that residues of plant protection products in domestically grown vegetables are low and do not pose a risk to consumers
- to ensure that professional users of plant protection products are exposed to a low level of risk by taking safety measures and establishing appropriate working processes, and

¹Directive 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. (OJ L 309, 24.11.2009, p.71)

- to develop and use sustainable cultivation systems to a greater extent, including alternative methods and techniques, in order to reduce dependency on chemical plant protection products.

1.1.1 Monitoring the achievement of the objective

A brief description is provided below of how the objectives of the National Action Plan for the sustainable use of plant protection products for the period 2013–2017 have been fulfilled.

Objective of reducing the risks to the environment and to health

Sweden has reduced considerably its use of plant protection products per hectare, compared with the majority of countries in Europe. Therefore, the risks to human health and the environment from the use of plant protection products in Sweden are considered to be low. During the period 2013–2017, the environment and health risk index rose for several years only to then fall and rise again, which means that no clear trend can be discerned as yet. In addition, there has been a slight rise in organic production and new protection areas have been created to a greater extent than before. Furthermore, the use of mechanical protection against weevils has been increased within the FSC-certified forests, accompanied by an increase in the use of non-chemically treated seed.

It can also be shown that plant protection products are used to a very small extent in Sweden for stopping pre-harvest sprouting and controlling weeds less than 30 days before harvest in cereal crops. The use of growth regulators in crops other than rye has certainly increased in recent years, but is still very low in Sweden and was reduced during 2016.

Monitoring of the previous action plan by the Swedish Board of Agriculture highlighted that the use of non-chemically treated seed and mechanical protection of coniferous plants and trees have seen a positive development during the last 10 years. During the project monitoring the use of integrated pest management inside greenhouses and nurseries, it emerged that a high proportion of greenhouse growers use nematodes (roundworms), insects or arachnids to control pests. The affected industries have provided impetus for this development, but public players have also supported this effort.

Objective of bringing the levels of plant protection products in surface water and groundwater down almost to zero in line with the Swedish Parliament's 'Non-toxic environment' environmental quality objective by 2020

The Swedish Board of Agriculture has monitored and evaluated the action plan for the period 2013–2017. Monitoring indicates that certain active substances are often detected in aquatic environments, either at levels above the limit for drinking water or above safe levels for the environment. Overall, several of the subsidiary objectives concerning residues in aquatic environments are showing a positive trend. However, the objective of bringing the levels of plant protection products in surface water and groundwater down almost to zero is not being fulfilled at the moment. This is due to frequent discoveries which have been made of plant protection products in surface water above the guide value. Several of the active substances detected in the surface water are herbicides which are mainly used during autumn, mainly diflufenican. The risk of leakage is generally greater when treatment is carried out in autumn, compared to when

carried out in spring. In the groundwater and raw water, discoveries indicating that the overall levels exceed 0.5 µg/l have declined during the period 2014–2016.

Objective of ensuring that residues of plant protection products in domestically grown vegetables are low and do not pose a risk to consumers

Residues of active substances from plant protection products above the maximum permissible limit have only been detected in a single sample taken during the period 2014–2016. Therefore, the objective is deemed to be achieved with regard to domestically grown vegetables. There is no data available concerning the total intake of residues of plant protection products from key vegetables grown in Sweden and imported.

Objective of ensuring that professional users of plant protection products are exposed to a low level of risk by taking protective measures and establishing appropriate working processes

The overall assessment is that risks to professional users of plant protection products are diminishing as a result of both protective measures being taken to an ever-growing extent and of the growing awareness of the importance of appropriate working processes. However, it can be shown that there is still potential for improvement when it comes to using the correct spraying equipment. As requirements to carry out functional testing of sprayers (with some exceptions) were introduced in November 2016, it is reasonable to assume that the older/worst sprayers will be decommissioned during the next few years, which will help improve the chance of achieving the objective in this area.

Objective of developing and using sustainable cultivation systems to a greater extent, including alternative methods and techniques, in order to reduce dependency on chemical plant protection products.

The overall assessment is that this objective is being achieved. Sustainable cultivation systems for reducing dependency on chemical plant protection products, including integrated pest management, organic cultivation methods and the use of alternative methods and techniques, are being developed and used to an increasing extent. During a monitoring project carried out by the Swedish Board of Agriculture and Swedish Environmental Protection Agency in 2015, 86 per cent of the farms visited met the requirements for using integrated pest management. This is a high figure given that, from a legislative perspective, this was a new supervision area at that time.

1.1.2 Important measures which the Government has approved during the period 2013–2017

New restrictions and simplified examination procedure for reduced risks

During the period 2015–2017 the Swedish Government has adopted decisions concerning national restrictions, which will vitally help reduce the risks associated with using plant protection products:

- A ban on the use of chemical products which are fungicides for the post-harvest treatment of fruit and potatoes for human consumption. Growers in Sweden are already using alternative methods to treatment with chemical plant protection products. The ban means

that chemicals cannot start being used again on the relevant areas, pursuant to Chapter 2, Section 39b of the Swedish Pesticides Ordinance (2014:425). The ban on their use came into force in July 2015.

- A ban on killing harmful nematodes in the soil when cultivating crops intended for the production of food or feedstuffs. Growers in Sweden are already using alternative methods to treatment with chemical plant protection products in this area. The ban means that chemicals cannot start being used again on the relevant areas, pursuant to Chapter 2, Section 39a, paragraph 2 of the Swedish Pesticides Ordinance. The ban on their use came into force in July 2015.
- A ban on the use of chemical plant protection products to control plants in lakes, water courses, wetlands and other bodies of water, pursuant to Chapter 2, Section 39a, paragraph 1 of the Swedish Pesticides Ordinance. The ban on their use came into force in July 2015.
- Simplified authorisation for nematodes, insects and arachnids as a pesticide, with the aim of encouraging greater use of biological control. Pesticides containing nematodes, insects and arachnids ordinance (2016:402). This ordinance came into force in July 2016.
- A ban on the use of chemical plant protection products to stop pre-harvest sprouting or control weeds less than 30 days before harvest in grains intended to be used for food products. There is a risk that this use will result in high residue levels in the food products. They are no longer used by Swedish farmers. The purpose of the rules is to ensure that these products are not used again, pursuant to Chapter 2, Section 39a, paragraph 3 of the Swedish Pesticides Ordinance. The ban on their use came into force in March 2017.
- When applying several plant protection products which contain the same active substance on the same surface, users must ensure as far as possible that the application of the products does not exceed the terms for dosage and number treatments which apply to each of these products, pursuant to Chapter 2, Section 35a of the Swedish Pesticides Ordinance. The ban on their use came into force in March 2017.

Action made easier with a new pest management board

In 2017 the Swedish Government decided to give a broader assignment to the Plant Protection Board (as part of the Swedish Board of Agriculture), which brings together representatives of the authorities, businesses and interest groups. The purpose of the Board is to create conditions promoting greater dialogue between the authorities, industry and interest groups. The Plant Protection Board is intended to promote greater predictability in decisions related to plant protection products. The Board is meant to conduct dialogue and increase the knowledge about the socio-economic impact of the legislation's application. Increased access to plant protection products should not lead to an increase in the risks posed to either human health or the environment. Modern plant protection products and methods can have a better success rate, which can therefore also mean a lower environmental impact. Increased access to different plant protection products should not necessarily lead to an increase in the use of plant protection products, but it can serve as a way to achieve a tailored control method and provide the chance to avoid resistance-related problems.

1.1.3 Challenges for the sustainable use of plant protection products

Integrated pest management needs to be developed further

Integrated pest management plays a key role in achieving the objective of reducing the risks of using plant protection products. The use of integrated pest management involves preventive measures, such as well-planned crop rotation and appropriate cultivation techniques, choosing tolerant or resistant varieties, protecting and encouraging beneficial organisms.

Following a monitoring project in 2015, it was noted that 86 per cent of the farms checked used integrated pest management. Even though this figure should be considered high, in light of the fact that the requirements for integrated pest management had only come into force at the time of the monitoring project, the figures indicate that there are farmers who are not fully applying these principles. With the aim of ensuring that all farmers and growers in Sweden apply the Directive's principles for integrated pest management, a combination of actions will be taken, including monitoring, information, training, advice, the use of forecasting, warning and decision-support systems, and financial control measures. The Swedish Board of Agriculture is responsible for providing guidance on monitoring and, if necessary, for improving the opportunities to meet the Directive's requirements. See sections 3.1.2, 3.2.2, 3.3.2, 3.5.2 and 13.3 for more information.

Spraying equipment and functional tests

There is a risk of plant protection products leaking when filling and cleaning sprayers. A survey conducted by the Swedish Board of Agriculture in spring 2017 indicated that more than half of all sprayers had preparation filling mechanisms and rinsing tanks for cleaning the sprayer internally. Only 46 per cent of the sprayers checked were fitted with tank rinsing nozzles. To reduce the risks to human health and the environment, it is important to increase the proportion of sprayers fitted with equipment enabling them to be filled, emptied and cleaned without any risk of leakage. See sections 3.1.2, 3.4.2, 7.3.2 and 12.3 for more information.

Risks to aquatic organisms

The risk of aquatic organisms being affected by plant protection products in surface water has not diminished during the period 2014–2016. The proportion of samples where at least one plant protection product exceeds its guide value for protecting aquatic organisms has remained fairly unchanged as part of the national environmental monitoring programme (which is carried out in intensely farmed areas). In the past, point sources, such as spillage when cleaning a sprayer, carelessness or spraying on permeable surfaces have been considered to be the most significant source of all. As a result of advice provided and authorisation training courses, point sources are no longer considered to be the largest source, but it is rather the diffuse leakage which poses a problem. This leakage is more difficult to tackle with simple measures. Continuous development of knowledge is what is required to be able to adopt appropriate measures for reducing the risks to aquatic organisms. See sections 10.3.2 and 16.2 for more information.

Restriction on the non-professional use of plant protection products

The professional use of chemical plant protection products is carefully regulated. For instance, farmers must have special training in how to handle the products. In the case of non-professional use, there is no corresponding regulation in place and there can be a discrepancy in terms of how much knowledge users have and the factors which they need to take into account in order to minimise the risks. For example, it may be difficult for non-professional users to know how to deal with wind and expected precipitation. In addition, their use in private gardens means, to a larger extent, that people and pets may be exposed to risks. In order to protect the environment, people and animals from risks present during non-professional use of plant protection products, there is good reason to consider a national ban on non-professional use of plant protection products, with certain possible exceptions.

According to recital 17 of the Directive, the specific measures which Member States introduce for handling plant protection products should encompass non-professional users as there is a great risk of inappropriate handling of these products in this group due to a lack of knowledge. Therefore, the Swedish Government intends to introduce further restrictions on the non-professional use of chemical plant protection products. See also section 12.3.1.

Better protection needed for pollinating insects

Studies show that the number of pollinating insects is falling, both in terms of species and individual insects, which is occurring in Sweden as well as other parts of the world. A reduction in the number of pollinating insects has an adverse impact on agriculture, horticulture and biodiversity. The use of plant protection products has been highlighted as one of several factors potentially resulting in a reduction in the number of pollinating insects. With the aim of improving the situation for pollinating insects, the Government has therefore added a new objective to the action plan for the use of plant protection products which can be harmful to pollinating insects.

To avoid an adverse impact on agriculture, horticulture and biodiversity, various initiatives have been launched, on the whole, in relation to pollinating insects. The Government has tasked the Swedish Environmental Protection Agency with bringing together the activities which are currently being carried out in Sweden and with proposing further measures capable of reversing a negative trend. According to the Swedish Environmental Protection Agency's description of the assignment, the use of plant protection products poses a threat to pollinators, for instance, due to toxic effects, altered habitats and reduced access to food. The Swedish Board of Agriculture and Swedish Chemicals Agency have also initiated efforts to review this issue, which includes through collating information about the rules and use of these products and making it easily accessible, including an up-to-date list of all the plant protection products which are harmful to pollinating insects and possible actions. See sections 3.1.2, 3.6.2 and 14.4.2 for more information.

1.2 Directive on the sustainable use of pesticides

One of the key aspects of the Directive is for Member States to devise and adopt action plans. Under the terms of Article 4 of the Directive, each country must adopt a National Action Plan to establish their quantitative objectives, guide values, measures and timetables to reduce the risks and impacts of pesticide use on human health and the environment, as well as to encourage the introduction of integrated pest management and alternative methods. In the National Action Plans, the Member States must describe how they will implement the measures in Articles 5 to 15 of the Directive in order to achieve the Directive's objectives. The National Action Plans must also include indicators to monitor the use of plant protection products containing particularly dangerous active substances.

These plans must be reviewed at least every five years and Member States must ensure that the general public is offered the opportunity at an early stage to actually participate in the preparation of and changes to and review of the plans, as specified in Article 2 of Directive 2003/35/EC².

1.2.1 Restrictions and general definitions

The Directive may in future apply to all pesticides, but currently it only relates to plant protection products. Therefore, the National Action Plan only covers plant protection products. However, the term 'pesticide' is used to cover biocides and is also used where national legislation and the *acquis* use the term 'pesticide'.

The following terms are used in the report and have the meaning specified below:

Pesticide – a collective term in Chapter 14, Section 4 of the Swedish Environmental Code, which also covers plant protection products in accordance with the definition in Article 2(1) in Regulation (EC) No 1107/2009 on the placing of plant protection products on the market (Plant Protection Products Regulation)³ and biocidal products in accordance with the definition in Article 3(1)(a) in Regulation (EU) No 528/2012 concerning the making available on the market and use of biocidal products (Biocide Regulation)⁴.

Biopesticide – a biotechnical organism which, according to the definition in Chapter 14, Section 4 of the Swedish Environmental Code, has been produced specially to control pests and which wholly or partly comprises or contains nematodes, insects or arachnids.

² Directive 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 and amending with regard to public participation and access to justice Council Directives 85/337/EEC and 96/61/EC.

³ 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.

⁴ 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.

Biocidal product – as defined in Article 3(1)(a) in the Biocide Regulation. Examples include wood preservation products, rat poison and boat bottom paints.

Buffer zone – a zone of an adequate size to protect non-target aquatic organisms, which can be the equivalent to establishing fixed and customised safety distances when applying plant protection products.

Priority substances – substances under the terms of Article 16(2) in Directive 2000/60/EC establishing a framework for Community action in the field of water policy (Water Framework Directive) must be prioritised in terms of actions which need to be taken on the basis of any risk to or via the aquatic environment which is identified. Currently, 45 substances are included (listed in Annex X to the Water Framework Directive).

Guide values – a guide value is the highest concentration of a substance in water which is not expected to have negative effects on organisms in the water ecosystem.

Protected area – an area along the edge of a water course which is left overgrown, untreated and unfertilised and which can entitle the farmer or grower to financial compensation under the environmental compensation scheme in the Swedish Rural Development Programme for 2014–2020.

Safeguard zone – a zone next to surface water and groundwater which is used for the abstraction of drinking water and where pesticides cannot be used or stored.

Substances of Very High Concern (SVHC) – substances which are carcinogenic, mutagenic or reprotoxic are persistent, bioaccumulative and toxic (PBT substances), are very persistent and very bioaccumulative (vPvB substances) or have other especially dangerous properties which are considered to be as severe as those above, such as endocrine-disrupting properties. The candidate list of these SVHC substances for approval is published under the terms of Article 59(10) of the REACH Regulation⁶ on the website of the European Chemicals Agency (ECHA) (www.echa.europa.eu/sv/candidate-list-table). The candidate list is updated twice a year, in June and December, when new substances are added to it.

Specific pollutants – substances which are discharged in a substantial volume into a body of water under the terms of Annex VIII of the Water Framework Directive. A discharge in a substantial volume means a discharge involving such high concentrations to prevent a good ecological status being achieved by 2015. Specific pollutants must be taken into account when classifying ecological status. The water authority assesses which substances are discharged in a

⁵ Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for Community action in the field of water policy.

⁶ Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC.

substantial volume and establishes class boundaries for assessing the ecological status of these substances.

Water catchment protection area – an area established by a municipality or county council to protect a body of water which is important for the supply of drinking water.

Plant protection product – as defined under the terms of Article (2)(1) in the Plant Protection Product Regulation. This includes products which comprise or contain active substances intended for any of the following applications:

- a) To protect plants and plant products from all pests and prevent attacks from them, unless the main aim of using these products is considered to be related to hygiene rather than to protecting plants and plant products.
- b) To influence the life processes of plants, e.g. substances which influence their growth in a different way to nutrients.
- c) To preserve plant products' sustainability if these substances or products are not subject to special Community rulings on preservatives.
- d) To destroy unwanted plants or parts of plants, except for algae, unless the products are used in the soil or water to protect plants.
- e) To check or prevent the unwanted growth of plants, except for algae, unless the products are used in the soil or water to protect plants.

1.2.2 Public authorities responsible for implementing the National Action Plan

Several public authorities are responsible for transposing the Directive into Swedish legislation and for ensuring that its objectives are achieved.

The Swedish Board of Agriculture, as the administrative authority for agriculture, has the task of actively promoting a competitive food production industry, based on care for the environment and high standards of animal welfare for the benefit of consumers. This agency is responsible for training and licensing which is required for the professional use of plant protection products, as well as for providing guidance on the use of plant protection products within agriculture and horticulture. The Swedish Board of Agriculture makes decisions regarding authorisation and licences for using plant protection products in a professional context, integrated pest management, documentation requirements (spraying logbook) and compulsory functional testing of spraying equipment. The Board's organisation includes regional plant protection centres which provide advisors and growers offering a knowledge base and advice to help tailor the use and reduce the risks involved with chemical control. The Swedish Board of Agriculture is an authority which is responsible for the environmental objective system, whose tasks should include adopting measures aimed at minimising agriculture's impact on the environment as far as possible.

The Swedish Chemicals Agency evaluates applications for licences permitting the sale and use of pesticides, known as product approval, under the terms of the Pesticide Ordinance. As part of product approval, the conditions which apply when the product is being used are indicated. All approved pesticides are entered in a database known as the pesticide register. This agency is also responsible for the operational monitoring of the placing of pesticides on the market and for providing supervisory guidance to Sweden's municipalities with regard to controlling distributors of pesticides and to how the general public should handle the products. The Swedish Chemicals Agency is responsible for informing, supporting and cooperating with farms, authorities and others concerned about pesticides. The agency compiles every year statistics for quantities of pesticides sold and is responsible for monitoring and evaluating the environmental quality objective set by the Swedish Parliament: Non-toxic environment.

The Swedish Environmental Protection Agency is the administrative authority for the environment and for activities relating to the climate and air, soil, biodiversity, contaminated areas, the ecocycle and waste, environmental monitoring and research. The Swedish Environmental Protection Agency plays a central role in environmental activities, which involves promoting, supporting and coordinating the implementation of environmental policies. This agency issues regulations on the application of plant protection products in the external environment and is responsible for providing guidance on monitoring under the Swedish Environmental Code. The Swedish Environmental Protection Agency is also responsible for providing guidance on monitoring all uses of plant protection products other than those within agriculture, horticulture and forestry. This means liability for providing guidance on the professional use of plant protection products, for instance, on golf courses and railroads. The Swedish Environmental Protection Agency is also responsible for testing nematodes, insects and arachnids as a means of pest control.

The Swedish Agency for Marine and Water Management is responsible for coordinating water-related activities (sea- and freshwater) and for long-term planning of the marine environment. The agency's key responsibility is for providing guidance on tasks involving the setting up and management of water catchment protection areas with relevant regulations. This agency also provides guidance on monitoring with regard to matters affecting the water catchment protection areas and to the protection of groundwater.

Sweden's National Food Agency runs a programme for monitoring pesticide residues in food. This agency also issues regulations relating to requirements for the production and provision of drinking water.

The Swedish Work Environment Authority makes decisions regarding safety and work environment regulations when handling and using chemical pesticides.

Geological Survey of Sweden (SGU) is responsible for the environmental objective system, as well as for monitoring the environmental quality objective for Good-quality groundwater. SGU makes decisions about regulations in parts relating to groundwater.

The Swedish Forest Agency is responsible for providing guidance on monitoring matters relating to forestry and for making decisions about regulations on the application of certain provisions in the Pesticide Ordinance concerning the use of plant protection products on forest land.

2 National Action Plan

2.1 Objectives for the period 2019–2022

The objectives of the action plan are as follows:

Objective 1: to reduce the risks to the environment and to health.

Objective 2: to gradually reduce the levels of plant protection products in surface water and groundwater down almost to zero, in line with the Swedish Parliament's 'Non-toxic environment' environmental quality objective.

Objective 3: to ensure that residues of plant protection products in domestically grown vegetables will continue to be low and that the risks to consumers will continue to diminish overall.

Objective 4: to reduce the risks for professional users of plant protection products by taking protective measures and establishing appropriate working processes.

Objective 5: to develop and use sustainable cultivation systems to a greater extent in order to reduce dependency on chemical plant protection products. The intense use of chemical plant protection products should be reduced, with an increase in the proportion of the organically farmed area being one way of achieving this. Developing sustainable cultivation systems includes, for instance, alternative methods and techniques, choice of varieties, tillage methods, crop rotation and other preventive measures.

Objective 6: to limit the use of plant protection products which are harmful to pollinating insects so as to minimise the risks.

The overall objective of the National Action Plan is to bring about a decline in the risk trend. The action plan's aim is to improve sustainable pest management further by developing and implementing integrated pest management measures and sustainable cultivation systems.

The measures in the action plan will focus on achieving the objectives and on targeted activities based on the specified risks involved in using plant protection products and opportunities for reducing these risks. The focus is on narrowing down the risks to health and the environment, so that measures are taken in areas where the problems are greatest. The work currently being carried out based on the Water Framework Directive provides, for instance, important data for identifying surface water and groundwater where residues of plant protection products are present.

In order to make further progress towards reducing the risks of using plant protection products and to counteract the trend of a steady decline in the number of plant protection products available, measures are needed to promote alternatives to chemical plant protection products.

In previous action plans, the involvement of businesses in this process has been important for the outcome. This type of involvement by businesses, research centres and other players is also important in this continuing process.

For instance, businesses both took part in and acted as the driving force behind projects such as ‘Safe plant protection’, which was effective in communicating the results of research and information about legislation and the safe use and handling of plant protection products to farmers and other users.

The long-term aim is for the use of plant protection products to be cost-effective, environmentally friendly and socially sustainable. One way for us to achieve this is by fulfilling the ‘Non-toxic environment’ environmental quality objective and the generation goal. This also means a competitive agricultural industry where plant protection products will be used in accordance with the current market regulations and for the foreseeable future.

The Swedish Government presented in early 2017 a food strategy to be used as the basis for devising food policy up until 2030. The overall objective of the food strategy is to establish a competitive food chain where overall food production increases, while relevant national environmental objectives are achieved, with the aim of generating growth and employment and contributing to the sustainable development of the whole country.

Chapter 3 describes in greater detail the action plan’s objectives, measures for achieving the objectives which have been set and how the objectives will be monitored.

2.2 Previous action plans supporting the sustainable use of plant protection products

When work began on the action programme in Sweden in the mid-1980s, the focus was on reducing the use of chemical plant protection products. This effort produced good results and there was a fall in the average sales of plant protection products between 1981 and 1985 when 4 385 tonnes of active substances were sold. In 2017, 1 497 tonnes of active substances were sold. This amounts to a reduction of 66 per cent. The majority of this decrease can be attributed to a reduction in use.

The current activities taking place mainly focus on reducing risks. This can involve a range of measures, such as modified doses, improved handling procedures, compulsory protective equipment, protection for operators and ensuring that application equipment is in proper working order. The previous action plan for the period 2013–2017 was the sixth in the series of action programmes and plans since the mid-1980s. From a longer-term perspective, the health and environmental risks, expressed as an indicator, have reduced significantly. Compared with the base year 1988, the health and environmental risks calculated for 2015 fell by 31 and 69 per cent respectively. Compared with an average harvest for the period 1988–1992, the harvest for the period 2013–2017 was around three per cent higher. At the same time, during the years 1990 to 2017, the area of arable land in Sweden has reduced from 2 844 600 hectares to 2 568 300 hectares, corresponding to a reduction of 10 per cent. In other words, the outcome has been a smaller proportion of arable land, a lower volume of active substances and an increase in harvest per hectare.

The starting points for the objectives of the later action programmes have included helping achieve the national environmental quality objectives. Since the Directive came into force, the focus has been on Articles 5–15 of the Directive. Other activities, such as offering advice, information and training courses, together with research, trials and development activities were important in

previous action programmes. They still have an important role to play in controlling the downward trend in terms of risk. The use of integrated pest management and alternative methods or techniques is in keeping with the activities which have already been carried out as part of previous action programmes and plans in Sweden. The use of integrated pest management involves preventive measures, such as well-planned crop rotation and appropriate cultivation techniques, choosing tolerant or resistant varieties, protecting and encouraging beneficial organisms. The activities of the Swedish Board of Agriculture, which include providing forecasts and warnings for major pests, evolved as part of the earliest action programmes. Its advisory activities are vital even today. There has been a gradual development in terms of monitoring and communicating the results of research and trials or of running courses and providing information and training material. Advisory organisations which make their knowledge available to professional users of plant protection products are informed about the results of these activities.

2.2.1 Evaluation for the action plan for period 2013–2017

The purpose of the National Action Plan for the sustainable use of plant protection products 2013–2017 was to reduce the risks to health and the environment.

In recent years, there has been increase in the cultivation of crops which have a greater dependency on chemical plant protection products, such as winter crops. As a result, weed control in the autumn has become more common. By the same token, there has been a rise in the number of hectare doses as additional weed treatment is very often required in the spring. At the same time, there has been a decline in the cultivation of spring-sown oilseed crops and sugar beet, which produces worse crop rotation in some regions, with greater pressure from pests. The oilseed crops which are still being cultivated require more intensive control methods as the process of treating the seeds has been replaced by a number of control methods carried out in the field. This trend has also meant a reduction in the cultivation of crops which are treated to a lesser extent, such as pastureland, green fodder and oats. Planting crops without ploughing or reduced use of tillage have also become more common, which can, in some cases, increase the need for pest control. However, both these cultivation methods offer other benefits, such as increased carbon storage and a lower incidence of run-off and, therefore, a lower risk of nutrients leaking.

In short, there are several different reasons as to why the number of hectare doses has increased, such as crop cultivation which has a greater dependency on chemical plant protection products, a resistance problem with pests and weeds, which ensures that low-dose products are being dropped and that using one active substance is being replaced by mixtures of several active substances.

Even though the number of hectare doses has risen, no reflection of this has been observed with a corresponding rise in the environmental and health risk index. Given that there has also been an increase in production and a decrease in the area used as arable land, this indicates an agriculture sector which is becoming increasingly more efficient and a reduction in risks in relation to the volume of agricultural produce output. The Swedish Chemicals Agency's activities involving approval of plant protection products mean that the active substances containing the worst properties for the environment and health have gradually disappeared from the Swedish market. At the same time, in recent years (2017–2018), a number of plant protection products containing active substances with severe properties, which are candidate substances for substitution, have been approved for the Swedish market. Many other activities carried out by agencies, farms and agricultural cooperatives have helped raise awareness of the risks to the environment. This applies

to activities in such areas as authorisation courses, providing advice and information, tailored control methods, using integrated pest management and carrying out functional tests on sprayers.

The toxicity index does not show any reduction during the period in terms of the risk from using plant protection product in agriculture affecting aquatic organisms. If anything, a slightly growing trend is observed during the years when measurements were taken, even though a high or low occurrence of individual active substances has caused trend variations for individual years. The annual variation, which may be caused by factors such as the weather, dominant crops, the presence of pests or weeds, which in itself gives rise to a high or low occurrence of certain substances, makes it difficult to see any clear trend. For this reason, it is important to monitor the trend over a longer period to observe any long-term changes in the use of plant protection products and the general trend in agriculture, such as changes to the regulatory environment.

Organic farming is on the rise, as is the number of new protection areas being created. The creation of protection areas seems to be influenced by the opportunity for compensation as part of the Rural Development Programme. The area under organic production is growing, but the conversion rate has been slowing down in recent years. The number of hectares of agricultural land which have been converted or are in the process of being converted were 577 200 hectares in 2017, which is equivalent to more than 19 per cent of the total area of agricultural land.

There has been a gradual rise in the use of non-chemically treated seed, while plant protection products are being used to a lesser extent to stop pre-harvest sprouting and control weeds less than a month before harvest. The proportion of non-chemically treated seed being used has risen over the last 10 years. Up until 2012 most of the non-chemical treatment of the seed was of a biological nature, but there has been an increase in the use of thermal seed treatment in recent years, accompanied by a sharp drop in the volume of seed treated biologically. The use of non-chemical treatment of seeds grew from 30 to more than 60 per cent in the period 2013–2016, mainly in the form of thermoseed treatment. The use of heat treatment is likely to grow further as more seed establishments install the relevant equipment. However, it is important to remember that this type of seed treatment cannot completely replace the use of chemical treatment as it is not effective against all types of diseases.

The use of growth regulators in crops other than rye has certainly increased until 2014 as it has been permitted in Sweden since 2011, but the use of these products is still low in Sweden.

The use of mechanical protection against weevils has seen an increase, especially within the certified forests.

The results from the national environmental monitoring programme for the period 2002–2014 indicate that several active substances from plant protection products exceed their guide value in surface water every year. In recent years active substances from herbicides, fungicides and insecticides have exceeded the relevant guide value. The proportion of surface water samples containing at least one active substance at or exceeding its guide value has remained fairly constant. The guide values should not be regarded as limits or environmental quality standards.

The discoveries of plant protection products in groundwater are dominated by discoveries of substances which are no longer used. Viewed over three decades, the overall levels which exceed 0.5 µg/l have decreased in groundwater and water samples. The substances detected are dominated by substances which are no longer allowed to be used in Sweden and were mainly used outside agriculture.

There is no compilation of data for drinking water samples in Sweden. The municipal waterworks which take their drinking water from the surface water obtain it from larger supplies and carry out checks on their water to ensure that the limit is not exceeded. The levels found in some wells are falling.

Residues of plant protection products in vegetables grown in Sweden above the limit have mostly been found in one to two samples per year during the period 2013–2016. The proportion of samples containing residues exceeding residues of active substances from plant protection products vary between 0.27 and 0.53 per cent. Residues in Swedish apples reached a maximum of 38 per cent of the limit. In the case of Swedish strawberries, traces of pesticide were found in 29 out of 30 samples (97 per cent), whereas the levels were generally low in relation to the limits. In the case of Swedish vegetables, the proportion of samples not containing residues was 64 per cent. No levels above the limit were found in any samples of wheat, with no residues found at all in 96 per cent of samples. None of the samples of Swedish rye contained any pesticides above the limits, but residues below the threshold limits were found in a total of 43 per cent of the samples, primarily being residues of products used to reduce stalk height. Looking at crops grown in Sweden, strawberries and apples are the ones containing the highest number of pesticides in the same sample. The highest number featured in a sample of strawberries containing residues from seven pesticides. In total, two per cent of the crops grown conventionally in Sweden contained five or more different substances. Seventy per cent of the samples contained no residues at all and 15 per cent contained residues of one substance.

Risks to users of plant protection products are low. According to a survey from 2015 everyone using plant protection products in a professional capacity stated overall that they wear protective equipment and 94 per cent replied that they had procedures aimed at minimising the risks.

Sustainable cultivation systems are being developed and used to a greater extent. The Swedish Board of Agriculture carried out a monitoring project in 2015, along with the Swedish Chemicals Agency, involving the use of integrated pest management in Swedish agriculture. This monitoring project was primarily aimed at municipal environmental inspectors who carry out operational monitoring of agricultural activities. One highlight of the results was that 99 per cent of those applying plant protection products in a professional capacity had valid authorisation to do so, which tallied with the results from the Swedish Chemicals Agency's monitoring project in 2011.

2.3 Monitoring and evaluation

The Swedish Board of Agriculture is the authority responsible for coordinating and managing the work on the action plan and for organising its monitoring and evaluation. The Board must submit to the Swedish Government proposals for the changes to the plan which are deemed necessary. An annual review meeting will take place among all the agencies involved, with the aim of spotlighting the activities carried out and flagging any problems relating to the set objectives. Every two years, businesses and other stakeholders should be invited to take part in an

in-depth dialogue about the work on the action plan and given the opportunity to express their views. The plan must be monitored and evaluated at least every five years.

2.4 Participation of the public, industry and interest groups

Since autumn 2014, the opportunity has been available for private individuals, organisations and farms to submit views about the National Action Plan using a form available on the Swedish Board of Agriculture's website. The Swedish Board of Agriculture has presented its proposal for the National Action Plan to interest groups and industry associations, other agencies, the Swedish University of Agricultural Sciences (SLU) and advisory organisations for professional users. The general public has also had a chance to express their views.

3 Objectives, actions and monitoring

This chapter describes the objectives of the action plan, the actions needed to achieve them and the necessary monitoring activities based on indicators or other monitoring metrics. The end of the chapter contains summaries of indicators and actions, along with links to the various objectives.

3.1 Risks to the environment and health

3.1.1 Objective 1

To reduce the risks to the environment and to human health.

3.1.2 Actions

The following actions are expected to contribute to achieving the objective:

- Increasing the proportion of agricultural land farmed organically through activities such as providing information, advice and an environmental compensation scheme.
- Increasing the area featuring protection areas through activities such as providing information, advice and an environmental compensation scheme.
- Training, information and advice aimed at reducing the risks involved with autumn treatments using herbicides.
- Training, information and advice aimed at reducing the risks involved with using plant protection products which are toxic to bees on crops that are attractive to pollinators.
- Training, information and advice, as well as guidance on carrying out self-monitoring with regard, for instance to safe handling and storage of plant protection products, and on using technical aids, disposal of hazardous waste and the use of protective equipment.
- Training, information and advice on integrated pest management, for example, preventive measures, tailored use and application of alternative methods and techniques and the same applying to the use of growth regulators in cereals.
- Better information about products and their use with the aim of improving the application and handling of plant protection products.
- Further development of guidance on monitoring for county councils and municipalities with the aim of reducing the impact from using plant protection products.

3.1.3 Monitoring

In order to monitor the overall objective, progress in a number of key areas will be used as a basis for measurement. The national risk index for the environmental quality objective 'Non-toxic environment' – a risk index for health and the environment and a toxicity index – will be used. See Chapter 14 for more details. In addition to the index, several key indicators will also be monitored, such as organically cultivated agricultural land, protection areas, non-chemical treatment of seeds and mechanical protection of coniferous plants. There is no one indicator more important than the others, but the overall picture provided should be used for monitoring. The indicators to be monitored are as follows:

- The National risk index for health and the environment.
- The toxicity index.
- The proportion of agricultural land under organic cultivation.
- The number of farms with protected areas and the total size of the protected areas.
- The proportion of coniferous plants with mechanical protection.
- The proportion of seeds not treated chemically.
- The proportion of greenhouse growers who use nematodes, insects and arachnids as a means of pest control.
- The proportion of the area sown in autumn which is treated with herbicides during autumn.
- The proportion of crop plants in flower which are treated with substances toxic to bees.
- The use of growth regulators in cereal crops other than rye.
- The use of plant protection products to stop pre-harvest sprouting or to control weeds in cereal crops less than one month before harvest in cereal crops.
- Statistics on the sales of products containing the active substances diflufenican, bentazone, glyphosate, MCPA, metribuzin and various neonicotinoids.
- Statistics on substances identified as candidate substances for substitution.
- The proportion of boom and air-assisted sprayers which are equipped in such a way that they can be easily and carefully cleaned without polluting the environment.
- The proportion of boom and air-assisted sprayers which are equipped in such a way that they can be easily and accurately filled with plant protection products.

- The proportion of professional users who fill up their spraying equipment in an appropriate location.

3.2 Residues in surface water, groundwater and drinking water

3.2.1 Objective 2

To gradually reduce the levels of plant protection products in surface water and groundwater down almost to zero, in line with the Swedish Parliament's 'Non-toxic environment' environmental quality objective

Objective 2 is supplemented by the following goals:

	Goal	Comment
Surface water	The level of individual active substances must not give rise to any harmful effects in the aquatic environment. This means that the level in surface water must not permanently exceed a guide value for the active substance.	The guide value is the highest concentration of each active substance which is not expected to cause any harmful effects to organisms in the aquatic environment.
Raw water for drinking water (both surface water and groundwater)	1. It must not be possible to detect levels from the current and future use of plant protection products.	Raw water for drinking water means both public and private drinking water. The fact that it must not be possible to detect the levels means in practice that the detection limit must apply to every individual substance, but must be no more than 0.025 µg/l.
	2. The proportion of existing raw water with levels from the previous use of plant protection products must be reduced.	In order to achieve the first goal, the actions should primarily be focused on preventing residues of plant protection products from contaminating raw water. The choice of raw water supply will be decisive in achieving the second goal. It will only be possible to distinguish between previous and current use if a meaningful distinction can be made at substance level. As the current findings

	Goal	Comment
Boom and air-assisted sprayers	Boom and air-assisted sprayers must be equipped in such a way that they can be easily and carefully cleaned without polluting the environment.	in groundwater supplies are dominated by substances which form part of previously banned products, this may be a realistic approach. This applies mainly to atrazine and metabolites of atrazine and dichlobenil.

3.2.2 Actions

The following actions are expected to contribute to achieving the objective:

- Increasing the proportion of agricultural land farmed organically through activities such as providing information and advice and an environmental compensation scheme.
- Increasing the area featuring protection areas through activities such as providing information and advice and an environmental compensation scheme.
- Training, information and advice aimed at reducing the risks involved with autumn treatments using herbicides.
- Training, information and advice, as well as guidance on carrying out self-monitoring with regard, for instance, to safe handling and storage of plant protection products, and on using technical aids, disposal of hazardous waste and the use of protective equipment.
- Training, information and advice on integrated pest management, for example, preventive measures, tailored use and application of alternative methods and techniques and the use of growth regulators in cereals.
- Better information about products and their use with the aim of improving the application and handling of plant protection products. See Chapter 13 Integrated pest management.

- Further development of guidance on monitoring for county councils and municipalities with the aim of reducing the impact from using plant protection products. See Chapter 13 Integrated pest management.

3.2.3 Monitoring

Monitoring changes in the levels of plant protection products which exceed the guide values or limit in surface water, on the basis of samples and analyses as part of the system of environmental monitoring (primarily the national environmental monitoring programme in four typical areas with a large proportion of agricultural land).

- The toxicity index.
- The proportion of agricultural land under organic cultivation.
- The number of farms with protected areas and the total size of the protected areas.
- The proportion of the area sown in autumn which is treated with herbicides during autumn.
- The proportion of boom and air-assisted sprayers which are equipped in such a way that they can be easily and carefully cleaned without polluting the environment.
- The proportion of professional users who fill up their spraying equipment in an appropriate location.
- The proportion of professional users who have procedures which minimise health and environmental risks when filling up their sprayers.
- The proportion of professional users who store plant protection products in an acceptable manner.

3.3 Residues in domestically grown vegetables

3.3.1 Objective 3

To ensure that residues in domestically grown vegetables will continue to be low and that the risks to consumers will continue to diminish overall.

3.3.2 Actions

The following actions are expected to contribute to achieving the objective:

- Increasing the proportion of agricultural land farmed organically through activities such as providing information and advice and an environmental compensation scheme.

- Training, information and advice on integrated pest management, for example, preventive measures, tailored use and application of alternative methods and techniques and the use of growth regulators in cereals.
- Better information about products and their use with the aim of improving the application and handling of plant protection products (See Chapter 13 Integrated pest management).

3.3.3 Monitoring

- Monitoring the change in intake of residues of plant protection products from domestically grown vegetables and in terms of residues in important vegetables, including cereals.
- The proportion of agricultural land under organic cultivation.
- The proportion of greenhouse growers who use nematodes, insects and arachnids, and biological products as a means of pest control.
- The use of growth regulators in cereal crops other than rye.

3.4 Risks for users of plant protection products

3.4.1 Objective 4

To reduce the risks for professional users of plant protection products by taking protective measures and establishing appropriate working processes. The overall objective comprises the following goals:

- All professional users of plant protection products must use the required protective equipment.
- Anyone filling a sprayer with plant protection products must have procedures which minimise the health risks.
- Boom and air-assisted sprayers must be equipped in such a way that they can be easily and accurately filled with plant protection products.

3.4.2 Actions

The following actions are expected to contribute to achieving the objective:

- Training, information and advice, as well as guidance on carrying out self-monitoring with regard, for instance, to safe handling and storage of plant protection products, and on using technical aids, disposal of hazardous waste and the use of protective equipment.

Better information about products and their use with the aim of improving the application and handling of plant protection products.

- Further development of guidance on monitoring for county councils and municipalities with the aim of reducing the impact from using plant protection products.

3.4.3 Monitoring

- The proportion of professional users who use compulsory protection equipment.
- The proportion of professional users who have procedures which minimise the health risks when filling up their sprayers.
- The proportion of boom and air-assisted sprayers which are equipped in such a way that they can be easily and accurately filled with plant protection products.

3.5 Sustainable cultivation systems to be developed

3.5.1 Objective 5

Sustainable cultivation systems should be developed and used to a greater extent in order to reduce dependency on chemical plant protection products. The intense use of chemical plant protection products should be reduced, with an increase in the proportion of the organically farmed area being one way of achieving this. Developing sustainable cultivation systems includes, for instance, alternative methods and techniques, choice of varieties, tillage methods, crop rotation and other preventive measures.

3.5.2 Actions

The following actions are expected to contribute to achieving the objective:

- Increasing the proportion of agricultural land farmed organically through activities such as providing information and advice and an environmental compensation scheme.
- Training, information and advice on integrated pest management, for example, preventive measures, tailored use and application of alternative methods and techniques and the use of growth regulators in cereals.
- Better information about products and their use with the aim of improving the application and handling of plant protection products. See Chapter 13 Integrated pest management.

3.5.3 Monitoring

- The proportion of agricultural land under organic cultivation.

- The proportion of coniferous plants with mechanical protection.
- The proportion of seeds not treated chemically.
- The proportion of greenhouse growers who use nematodes, insects and arachnids as a means of pest control.
- The use of growth regulators in cereal crops other than rye.
- The project monitoring the application of integrated pest management and other parts of the Directive.

3.6 Use of plant protection products which are harmful to pollinating insects

3.6.1 Objective 6

To tailor the use of plant protection products which are toxic to pollinating insects so as to minimise the risks.

3.6.2 Actions

The following actions are expected to contribute to achieving the objective:

- Training, information and advice on the pollinators' vulnerability and the opportunities for adapting cultivation for their benefit.
- Better product and user information about plant protection products which can be toxic to pollinating insects.

3.6.3 Monitoring

- The proportion of crop plants in flower which are treated with plant protection products which are toxic to pollinating insects.

3.7 Summary of indicators and actions for relevant objectives

All the indicators and their link to the various objectives are presented below.

Objective 1: To reduce the risks to the environment and to human health.

Objective 2: To bring the levels of plant protection products in surface water and groundwater down almost to zero in line with the Swedish Parliament's 'Non-toxic environment' environmental quality objective by 2020

Objective 3: To ensure that residues in domestically grown vegetables will continue to be low and that the risks to consumers will continue to diminish overall.

Objective 4: To ensure that professional users of plant protection products are exposed to a low level of risk by taking protective measures and establishing appropriate working processes.

Objective 5: To develop and use sustainable cultivation systems to a greater extent in order to reduce dependency on chemical plant protection products.

Objective 6: To limit the use of plant protection products which are toxic to pollinating insects so as to minimise the risks.

Indicator	Obj. 1	Obj. 2	Obj. 3	Obj. 4	Obj. 5	Obj. 6
National risk index for health and the environment	x					
Toxicity index	x	x				
Proportion of agricultural land under organic cultivation	x	x	x		x	x
Number of farms with protected areas and the total size of the protected areas	x	x				
Proportion of coniferous plants with mechanical protection	x				x	
Proportion of seeds not treated chemically	x				x	
Proportion of greenhouse growers who use nematodes, insects and arachnids as a means of pest control	x		x		x	
Proportion of the area sown in autumn treated with herbicides during autumn	x	x				
Proportion of crop plants in flower treated with plant protection products which are toxic to pollinating insects	x					x
Use of growth regulators in cereal crops other than rye	x		x		x	
Use of plant protection products to stop pre-harvest sprouting or to control weeds in cereal crops less than one month before harvest	x					
Proportion of boom and air-assisted sprayers which are equipped in such a way that they can be easily and carefully cleaned without polluting the environment	x	x				
Proportion of boom and air-assisted sprayers which are equipped in such a way that they can be easily and accurately filled with plant protection products	x			x		

Indicator	Obj. 1	Obj. 2	Obj. 3	Obj. 4	Obj. 5	Obj. 6
Proportion of professional users who fill up their spraying equipment in an appropriate location	x	x				
Presence of levels of plant protection products which exceed the guide values or limit in surface water, groundwater and drinking water		x				
Sales statistics for products containing the active substances diflufenican, bentazone, glyphosate, MCPA, metribuzin and various neonicotinoids	x					x
Presence of residues of plant protection products in domestically grown vegetables			x			
Proportion of professional users who use compulsory protective equipment				x		
Proportion of professional users who have procedures which minimise health and environmental risks when filling up sprayers		x		x		
Proportion of professional users who store plant protection products in an acceptable manner		x		x		
Report from project monitoring the application of integrated pest management and other parts of the Directive					x	

All the actions and their link to the various objectives are presented below.

Action	Obj. 1	Obj. 2	Obj. 3	Obj. 4	Obj. 5	Obj. 6
Actions in accordance with the Directive	x	x	x	x	x	
Increasing the proportion of agricultural land farmed organically through activities such as providing information and advice and an environmental compensation scheme	x	x	x		x	x
Increasing the area featuring protection areas through activities such as providing information and advice and an environmental compensation scheme	x	x				
Training, information and advice aimed at reducing the risks involved with autumn treatments using herbicides	x	x				
Training, information and advice aimed at reducing the risks involved with using plant protection products which are toxic to bees on crops that are attractive to pollinators	x					x
Training, information and advice on the pollinators' vulnerability and the opportunities for adapting cultivation for their benefit						x
Training, information and advice, as well as guidance on carrying out self-monitoring with regard, for instance, to safe handling and storage of plant protection products, and on using technical aids, disposal of hazardous waste and the use of protective equipment	x	x		x		
Training, information and advice on integrated pest management, for example, preventive measures, tailored use and application of alternative methods and techniques and the use of growth regulators in cereals	x	x	x		x	x
Better information about products and their use with the aim of improving the application and handling of plant protection products (see Chapter 13 Integrated pest management)	x	x	x	x	x	x
Further development of guidance on monitoring for county councils and municipalities with the aim of reducing the impact from using plant protection products	x	x		x		x

4 Training (Article 5)

4.1 Requirements of the Directive

Article 5 contains requirements for training all professional users, distributors and advisors. They must have access to appropriate training which should comprise both basic and advanced training courses.

The training must be designed to ensure that participants acquire sufficient knowledge regarding the training material listed in Annex I to the Directive, taking account of their different roles and responsibilities. There must be a training certification system where the certificate confirms that sufficient knowledge has been acquired. The system must include requirements and procedures for issuing, renewing and withdrawing training certificates.

4.2 National application

The regulations which govern training requirements include the Swedish Pesticides Ordinance (2014:425), the Swedish Board of Agriculture's regulations on authorisation to use plant protection products (SJVFS 2014:35) and the Swedish Chemicals Agency's pesticide regulations (KIFS 2000:3).

When a plant protection product is approved according to the Plant Protection Product Regulation, the Swedish Chemicals Agency must assess, in accordance with Chapter 2, Section 8 of the Swedish Pesticide Ordinance, the health and environmental risks posed by the product in relation to the area of application and assign it to an authorisation class. The product should be assigned to

- Class 1 if specific knowledge about how to handle the product safely is required due to the risks posed when using it
- Class 2 if specific knowledge about how to handle the product safely is required for other reasons and the product should not be assigned to Class 1
- Class 3 if the product should not be assigned to Class 1 or 2.

According to Sections 18 and 19 of the same chapter, plant protection products in authorisation classes 1 and 2 may only be used by professional users with a licence. One condition for obtaining a licence is that the user has passed a training course with an approved result. Training courses are also open to advisors and others who use plant protection products.

According to Chapter 2, Section 1 of the Swedish Pesticides Ordinance, the Swedish Board of Agriculture is the agency responsible for training courses and licences for the use of plant protection products in areas such as agriculture, forestry, horticulture, parks, play areas, as well as sports and recreation grounds. However, the Swedish Board of Agriculture has appointed the county council as the body responsible for providing the majority of the training courses. Nevertheless, the Swedish Board of Agriculture is responsible for training on treatment with plant protection products and on treating individual saplings in forestry plantations. The responsible

authority can commission other players to contribute to the courses. The Swedish Chemicals Agency is mainly responsible for training distributors, which is why since the 2014/2015 academic year, the Agency has been offering training courses for distributors. The Swedish Chemicals Agency is the responsible authority and the county council provide the courses. Plant protection products are also used to a certain extent in and around warehouse premises and storage areas. In these cases, the Public Health Agency of Sweden is responsible for training and licences. The Swedish Work Environment Authority is responsible for any other use.

Users who have undergone a training course have authorisation to use plant protection products for five years. This authorisation must be renewed by taking an advanced training course. Users can lose their authorisation under certain circumstances by having their personal licence withdrawn.

According to the Swedish Pesticides Ordinance, the training course curricula must contain the subject areas specified in Annex I to the Directive. Annex I contains, for instance, all relevant legislation regarding pesticides and their use, integrated pest management, the hazards and risks associated with pesticides, and how to identify and control them. The courses must provide sufficient knowledge on the training subjects. The course curriculum which the Swedish Chemicals Agency has decided on for distributors has the same content as the Swedish Board of Agriculture's curriculum for basic courses.

4.3 Actions

No other actions are deemed necessary.

4.4 Impact on the achievement of the objectives

Implementing the article is expected to help achieve the objectives of the action plan in the following manner:

Objective	Impact on objective
To reduce the risks to the environment and to health	++
To bring levels of plant protection products in surface water and groundwater close to zero in the long term (within a generation)	++
To ensure that residues in domestically grown vegetables will continue to be low and not pose risks to consumers	++
To reduce the level of risks for users of plant protection products	++
To develop sustainable cultivation systems and ensure that all growers use integrated pest management or organic cultivation	++

5 Requirements for sales (Article 6)

5.1 Requirements of the Directive

Under the terms of Article 6, every Member State must ensure that distributors have sufficient staff in their employment holding a certificate. These people must be available at the time of any sale to provide adequate information to customers with regard to pesticide use, health and environmental risks and safety instructions to manage those risks. Micro distributors selling only products for non-professional use may be granted an exemption if they meet certain requirements. The provisions relating to micro distributors and the requirements that they must meet will be determined by each Member State.

The Member States must take the necessary measures to restrict sales of pesticides authorised for professional use to persons holding a certificate.

The Member States must require distributors selling pesticides to non-professional users to provide general information regarding the risks for human health and the environment. The Member States may require pesticide producers to provide this information.

5.2 National application

Requirements concerning the provision of plant protection products are regulated in the Swedish Pesticide Ordinance and the Swedish Chemicals Agency's pesticide regulations. According to Chapter 2, Section 26 of the Pesticide Ordinance, distributors may supply plant protection products on the market only if one of the distributor's staff has a valid training certificate and if the relevant person with the certificate is available during the sale to answer questions about using plant protection products, such as health and environmental risks when using these products and actions to take to manage the risks.

A plant protection product assigned to Class 1 or 2, according to Chapter 2, Section 28 of the Pesticides Ordinance can only be handed over to someone with a user licence or who has a member of staff who has a user licence, or else who is considering passing the product on further and has a member of staff with a valid training certificate.

Furthermore, requirements are set out in Chapter 2, Section 29 of the Pesticides Ordinance, stating that anyone handing over plant protection products to non-professional users must provide information about the risks to human health and the environment associated with using plant protection products. The information must include in particular details about hazards, exposure, correct storage, handling, application and safe disposal, as well as about low-risk alternatives.

5.3 Actions

No other actions are deemed necessary.

5.4 Impact on the achievement of the objectives

Implementing the article is expected to help achieve the objectives of the action plan in the following manner.

Objective	Impact on objective
To reduce the risks to the environment and to health	++
To bring levels of plant protection products in surface water and groundwater close to zero in the long term (within a generation)	++
To ensure that residues in domestically grown vegetables will be low and not pose risks to consumers	++
To reduce the level of risks for users of plant protection products	++
To develop sustainable cultivation systems and ensure that all growers use integrated pest management or organic cultivation	++

6 Information and awareness-raising (Article 7)

6.1 Requirements of the Directive

According to Article 7(1), Member States must take measures to inform the general public and to promote and facilitate information and awareness-raising programmes and the availability of accurate and balanced information relating to pesticides for the general public, in particular regarding the risks and the potential acute and chronic effects for human health, non-target organisms and the environment arising from their use, and to the use of non-chemical alternatives.

According to Article 7(2), Member States must put in place systems for gathering information on acute poisoning incidents caused by pesticide, as well as chronic poisoning developments where available, among groups which may be exposed regularly to pesticides such as operators, agricultural workers or persons living close to pesticide application areas.

6.2 National application

Swedish government agencies such as the Swedish Board of Agriculture, the Swedish Chemicals Agency, the Swedish Environmental Protection Agency and the Swedish University of Agricultural Sciences have extensive information about plant protection products on their websites. The information includes processes for approving plant protection products, the risks to health and the environment of using plant protection products, applying plant protection products in a responsible way and alternatives to chemical plant protection products.

The poisons information centres, which the Swedish Medical Products Agency is responsible for, collect information about the risks, symptoms and treatment of acute poisoning caused by medicines, chemical substances, plants, fungi and animals. They also have information about almost 100 000 chemical products, including plant protection products. In cases of poisoning, the Swedish health service contacts the poisons information centres to obtain information about appropriate treatment. The poisons information centres compile statistics about these poisoning cases.

6.3 Actions

The authorities involved must continually update information via the relevant channels with the aim of meeting the general public's need for access to accurate and balanced information, including about the use of non-chemical alternatives.

6.4 Impact on the achievement of the objectives

Implementing the article is expected to help achieve the objectives of the action plan in the following manner.

Objective	Impact on objective
To reduce the risks to the environment and to health	++
To bring levels of plant protection products in surface water and groundwater close to zero in the long term (within a generation)	0
To ensure that residues in domestically grown vegetables will be low and not pose risks to consumers	0
To reduce the level of risks for users of plant protection products	+
To develop sustainable cultivation systems and ensure that all growers use integrated pest management or organic cultivation	+

7 Inspection of equipment in use (Article 8)

7.1 Requirements of the Directive

Article 8 states that all Member States must ensure that pesticide application equipment in professional use is subject to inspections at regular intervals. The interval between inspections should not exceed five years until 2020 and should not exceed three years after this date. The inspections must demonstrate that the equipment satisfies the relevant requirements listed in Annex II of the Directive, in order to achieve a high level of protection for human health and the environment. Equipment which meets the requirements in the harmonised standards established in accordance with the Directive will be presumed to comply with the requirements in Annex II. Under the terms of the Directive, exemptions are possible in certain cases.

According to Article 8(5), professional users should carry out regular calibrations and technical checks of the pesticide application equipment.

7.2 National application

Requirements regarding the inspection of application equipment are regulated in the Swedish Pesticides Ordinance and in the Swedish Board of Agriculture's regulations and general advice (SJVFS 2016:23) on reviewing, function testing and approving professional application equipment for plant protection product. Sweden has a system from 26 November 2016 which ensures that no sprayers are used professionally, which have not passed function testing. The system for voluntary function testing previously available has been converted to a mandatory system.

According to Chapter 2, Section 52 of the Pesticides Ordinance, equipment can only be used for professional application of plant protection products if the equipment's operator can prove that it has been approved by the Swedish Board of Agriculture. According to Chapter 2, Section 54, the Swedish Board of Agriculture's approval is based on a Swedish or foreign function testing report or approval from an EU or EEA country. Approval is granted for three years from the date when the sprayer underwent function testing.

There are two requirements enabling sprayers to be approved. Firstly, the relevant items specified in Section 7 and Appendix 2 to the Swedish Board of Agriculture's regulations and general advice on reviewing, function testing and approving equipment for the professional distribution of plant protection products, are required. Secondly, the equipment meets requirements according to the same conditions. The provisions implement Annex II of the Directive. Function testing must adhere to the harmonised standards SS-EN-ISO 16122 or to an equivalent method, according to Section 8 in the same regulations. Fixed and partially movable sprayers are currently tested according to SS-EN-ISO 16122, but in the case of sprayer types which the testers have already experienced, such as boom and air-assisted sprayers, the test is also approved according to the previously applicable standard SS-EN 13790 part 1 and 2. They are considered to meet equivalent requirements according to Section 8 of the Swedish Board of Agriculture's general advice.

Equipment used for professional application of plant protection products must be in good working order, fit for purpose and properly calibrated, as specified in Chapter 2, Section 51 of the Swedish Pesticides Ordinance. These requirements must be monitored via an annual review and, in the case

of application equipment used outside, the review must be carried out before the equipment is used for the first time in the calendar year, according to Section 4 of the Swedish Board of Agriculture's regulations and general advice on reviewing, function testing and approving equipment for the professional application of plant protection products. A review must be carried out for other application equipment at least once every calendar year. The annual review must include content specified in Appendix I to the same regulations. This information will also be provided in the training courses on how to use chemical plant protection products.

Apart from the inspections arising from the Directive, repairs can be carried out, just as in the previous voluntary system. Similarly, there is also the opportunity to provide information and advice to spray equipment operators. This includes information about calibrating the sprayer. The function tester can also hand out printed information. In order to ensure that the information is provided in an effective way, it is recommended that the owner or operator of the sprayer is present during the test.

7.2.1 Exemptions to the function test requirement

The sprayers which have been exempted from the approval requirement appear in Section 6 of the Swedish Board of Agriculture's regulations (SJVFS 2016:23). New sprayers are exempted for three years after purchase, including handheld and knapsack sprayers whose use and maintenance requirements are dealt with in the authorisation training course on how to use chemical plant protection products. The following application equipment is also exempted from the approval requirement:

- application equipment for forestry machinery for treating tree stumps
- application equipment for treating plants using dipping for subsequent planting
- equipment for treating seeds
- contact applicators, releasers and other equipment which transfers the plant protection product directly to the object being treated through contact, and
- fogging unit.

7.3 Actions

7.3.1 Assessment of equipment exempted from function test requirement

The Swedish Board of Agriculture has provided the Swedish Institute of Standards, SIS, with a grant for starting work on establishing a Swedish standard for a function test for treatment equipment. When this work has established a standard, a new assessment should be made as to which equipment will be exempted from the requirement for approval. It generally takes around three years to develop a new standard.

7.3.2 Information campaign to ensure that only approved spraying equipment is used

The Swedish Board of Agriculture will launch an information campaign in early 2020 to highlight that only application equipment which has been inspected and approved should be used professionally, in keeping with the regulations. The aim of this action, along with the ongoing monitoring, is to ensure that only application equipment which has been inspected and approved will be used professionally, in keeping with the regulations. According to Section 6 of the Swedish Board of Agriculture's regulations and general advice on reviewing, function testing and approving equipment for the professional application of plant protection products, certain application equipment is exempted from the inspection and approval requirement.

7.4 Impact on the achievement of the objectives

Implementing the article is expected to help achieve the objectives of the action plan in the following manner.

Objective	Impact on objective
To reduce the risks to the environment and to health	++
To bring levels of plant protection products in surface water and groundwater close to zero in the long term (within a generation)	++
To ensure that residues in domestically grown vegetables will be low and not pose risks to consumers	++
To reduce the level of risks for users of plant protection products	++
To develop sustainable cultivation systems and ensure that all growers use integrated pest management or organic cultivation	0

8 Aerial spraying (Article 9)

8.1 Requirements of the Directive

Under the terms of Article 9, the Member States must designate the authorities competent for establishing the specific conditions by which aerial spraying may be carried out, for examining requests, for making public information on crops, areas, circumstances and particular requirements for application where aerial spraying may be allowed.

8.2 National application

According to Chapter 14, Section 7 of the Swedish Environmental Code, the application of pesticides from aircraft is prohibited, which also includes drones. With regard to plant protection products, the Pesticides Ordinance offers the possibility of an exemption from the ban if there are exceptional reasons for this and providing that the requirements featuring in Article 9 of the Directive are met.

The cases of aerial spraying of pesticides in Sweden in recent years have been restrictive and have been limited to biological products (*Bacillus Thuringiensis*). Exemptions have been granted for spraying plant protection products (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).

8.3 Actions

No other actions are deemed necessary as the process used in practice to decide on exemptions from the ban on aerial spraying of pesticides is considered to be compatible with Article 9 of the Directive

8.4 Impact on the achievement of the objectives

Implementing the article is expected to help achieve the objectives of the action plan in the following manner.

Objective	Impact on objective
To reduce the risks to the environment and to health	++
To bring levels of plant protection products in surface water and groundwater close to zero in the long term (within a generation)	++
To ensure that residues in domestically grown vegetables will be low and not pose risks to consumers	+
To reduce the level of risks for users of plant protection products	++
To develop sustainable cultivation systems and ensure that all growers use integrated pest management or organic cultivation	0

9 Information to the public (Article 10)

9.1 Requirements of the Directive

Under the terms of Article 10, the Member States can include provisions in their National Action Plans for informing people who could be exposed to spray drift. This is also described in Article 31(4)(b) of the Plant Protection Product Regulation which states, with regard to the content of a product approval, that countries can introduce requirements covering: 'the obligation before the product is used to inform any neighbours who could be exposed to the spray drift and who have requested to be informed'.

9.2 National application

Requirements to inform the public are regulated in the Pesticides Ordinance, the Swedish Environmental Protection Agency's regulations (NFS 2015:2) on applying and certain other ways of handling plant protection products and the Swedish Forest Agency's regulations and general advice (SKSFS 2016:2) on using plant protection products on forestry land. Anyone intending to apply plant protection products to areas which are accessible to the public must advise about this no later than one week before application, providing such details as the date of application and the affected area. However, the duty to inform does not apply if the product is being applied to arable land or in the case of point treatment if it can be carried out without any risk to health and the environment.

9.3 Actions

No other actions are deemed necessary.

9.4 Impact on the achievement of the objectives

Implementing the article is expected to help achieve the objectives of the action plan in the following manner.

Objective	Impact on objective
To reduce the risks to the environment and to health	++
To bring levels of plant protection products in surface water and groundwater close to zero in the long term (within a generation)	+
To ensure that residues in domestically grown vegetables will be low and not pose risks to consumers	0
To reduce the level of risks for users of plant protection products	0
To develop sustainable cultivation systems and ensure that all growers use integrated pest management or organic cultivation	0

10 Specific measures to protect the aquatic environment and drinking water (Article 11)

10.1 Requirements of the Directive

Under the terms of Article 11 of the Directive, measures must be taken to protect the aquatic environment and drinking water supplies from the impact of pesticides. These measures must support and be compatible with the relevant provisions of the Water Framework Directive and the Plant Protection Product Regulation. Preference must be given to pesticides which are not classified as dangerous for the aquatic environment and to the most efficient application techniques. The measures must include establishing appropriately-sized buffer zones for the protection of non-target aquatic organisms and safeguard zones for water used for the abstraction of drinking water, where pesticides must not be used or stored. Applications on or along roads, railway lines, very permeable surfaces or other infrastructure close to surface water or groundwater or on sealed surfaces with a high risk of run-off into surface water or sewage systems must be eliminated or reduced.

10.2 National application

The Pesticides Ordinance includes a provision in Chapter 2, Section 34(1), which requires anyone considering using plant protection products in their professional capacity to give preference to products which are not dangerous to the aquatic environment. There is also a general obligation in Sweden to choose less dangerous chemicals if alternative products are available (known as the product choice principle in Chapter 2, Section 4 of the Swedish Environmental Code). The Centre for Chemical Pesticides (CKB) at the Swedish University of Agricultural Sciences (see Chapter 16) provides support in terms of advising which substances can pose a higher or lower risk to the environment, by producing and communicating information about the environmental effects of chemical pesticides. Professional users are also obliged to use the best possible techniques, as specified in Chapter 2, Section 3 of the Swedish Environmental Code. Help with choosing the best technique is provided in the training course on the use of plant protection products, in the form of information on spraying techniques and opportunities for reducing spray drift.

According to the Pesticides Ordinance and the Swedish Environmental Protection Agency's regulations on applying and certain other ways of handling plant protection products, anyone handling pesticides must determine and observe the safe distances needed to protect water supplies, lakes and water courses and surrounding land, taking into consideration the circumstances. A safe distance is the distance which must be maintained from surrounding areas when spraying, cleaning equipment or handling pesticides in other ways in order to protect these areas from being unintentionally sprayed with pesticide due to spray drift or soil transport. The minimum fixed safety distances which should be observed outside are as follows: two metres to open ditches, as well as to gullies and drainage wells, six metres to lakes and water courses, and 12 meters to drinking water wells. Apart from these minimum distances, when determining safety distances, special

consideration must be given to the ambient temperature and wind conditions, the extent of the area to be sprayed in the direction of the wind, the type of soil and ground structure and the gradient of the ground to the surrounding area on the site where spraying is intended to take place. Consideration must also be given to the pesticide's properties, the surrounding area's sensitivity to the product and the accuracy of the application method used. The public authorities have produced guidelines and advice to help users determine the necessary distances

The Swedish Environmental Protection Agency's regulations (NFS 2015:2) on applying and certain other ways of handling plant protection products contain a ban on the professional use of plant protection products without a licence in the sections of a water catchment protection area designated as a water supply zone, a primary (internal) protection area and a secondary (external) protection area. However, an exemption from the provision means that the general obligation to have a licence does not apply to water catchment protection areas which have been set up after 1 January 2018 or to water catchment protection areas whose protection regulations have been modified after 1 January 2018. In the case of water catchment protection areas which are set up or modified after 1 January 2018, an assessment needs to be made at a local level about whether it is necessary to have a compulsory licence for using plant protection products, which is governed in this case by the protection regulations for the relevant water catchment protection area.

The handling of plant protection products in water catchment protection areas can also be regulated by water protection regulations. These regulations are issued on the basis of Chapter 7, Section 22 of the Swedish Environmental Code. The ordinance on water quality management (2004:660) includes specific requirements relating to bodies of water which are or can be used as drinking water supplies. A water catchment protection area with appropriate regulations may be established by the county council or municipality to protect water supplies. Dividing the water catchment protection area into different zones (generally 2–3) allows the regulations for the water catchment protection area to be adapted to the needs of each zone. This can involve a ban on applying or handling pesticides or the need for a licence or a notification inside each zone. A licence can be linked to certain conditions. The regulations can cover both professional and private handling and use.

Professional use of plant protection products on very permeable or sealed surfaces, such as a courtyard, is restricted by Section 40 of the Pesticides Ordinance due to a licence being required from the municipal committee. This also applies to the professional application of plant protection products along roads. If the aim of the professional application of plant protection products is to prevent the spread of invasive foreign species, for instance, notification only needs to be given to the municipality. The application of plant protection products along railway lines needs to be notified to the municipality.

The municipality is entitled under Swedish law to have access to the registers kept by farmers, as specified in Article 67(1) of the Plant Protection Product Regulation. The general public can access the register by contacting the municipality. Drinking water providers are obliged to monitor the water for pesticides which can be assumed to occur in a water supply. If necessary, drinking water providers may request to receive information about which plant protection products are used in proximity to the water supply.

10.3 Actions

10.3.1 Advice on protecting aquatic environments

Traces of pesticide, including above the limit, are frequently found for drinking water and for individual and municipal groundwater supplies. The traces found in groundwater predominantly include substances which are no longer permitted to be used and have mainly been used outside agriculture. The traces found in surface water comprise more often substances which are currently approved and used in cultivation. This indicates that the handling and application of plant protection products must be continuously improved so as to reduce the risks of using and handling these products. The 'Focus on Nutrients' advisory project under the Swedish Board of Agriculture will continue to be involved in protecting water.

The Swedish Board of Agriculture intends to continue to allocate resources to the information and training campaign 'Safe plant protection'. The 'Safe plant protection' campaign began in 1997 and aims to improve the handling and application of plant protection products in Swedish agriculture, forestry and horticulture in order to reduce the risks to health and the environment. This information and training campaign is run throughout Sweden and has aroused a great deal of interest. It is run by the Federation of Swedish Farmers (LRF) in collaboration with the Swedish Board of Agriculture, the Swedish Environmental Protection Agency, the Swedish Chemicals Agency, the Swedish Work Environment Authority, Lantmännen (one of the largest groups in food, energy and agriculture in Scandinavia) and Svenskt Växtskydd (the Swedish plant protection industry association). The fact that many different organisations are involved in the issue of safe handling and application of plant protection products means that farmers are receiving information from a number of different sources about how important these issues are. The goal is to reach out to the majority of people who use plant protection products, offering tips, ideas and knowledge about the safe and prudent handling of these products. The campaign also aims to provide information about new legal requirements governing the application of plant protection products. The aim is to cause the lowest possible environmental impact through the use of plant protection products in Sweden. This means that no detectable levels of plant protection products should be found as a result of farms' operations in lakes, water courses or groundwater (<http://sakertvaxtskydd.se/>).

10.3.2 Guide values for plant protection products in surface water

The results of the Swedish Environmental Protection Agency's environmental monitoring in intensively farmed areas show that active substances from plant protection products often occur at measurable levels in Swedish surface water. The fact that a substance can be detected in water using sensitive analysis methods does not necessarily mean that it will cause harm to aquatic organisms. In order to evaluate the risk of exposure, the levels which are measured must be considered in relation to the toxicological effect of the substance on different aquatic organisms.

The guide values for levels of plant protection products in surface water are intended as effect-based thresholds. They are based on current knowledge of the maximum level a substance can reach in water without any negative effects on the ecosystem being expected. Guide values are primarily established to help with interpreting data from environmental monitoring programmes and with monitoring the 'Non-toxic environment' environmental quality objective. The purpose of the guide values is to make it easier to carry out general assessments of the environmental status

and to evaluate results from environmental monitoring programmes. Therefore, they should not be regarded as limits or environmental quality standards. In other words, they are not legally binding values resulting in criminal liability or the need to take action if they are exceeded.

The proportion of samples where at least one plant protection product exceeds its guide value for protecting aquatic organisms has remained fairly constant and has been around 41 per cent as part of the national environmental monitoring programme, which is carried out in intensely farmed areas. In the past, point sources, such as spillage when cleaning a sprayer, carelessness or spraying impermeable surfaces have been the most significant source of all. In Sweden agencies and advisory organisations have been actively involved for a long time in offering advice and authorisation courses as a way of resolving this situation. This work has produced good results, but needs to continue the whole time and is being carried out, for instance, through the 'Safe plant protection' and 'Focus on Nutrients' campaigns.

As a result of advice provided and authorisation training courses, it is rather the diffuse leakage of substances which now accounts for the larger proportion of problems affecting the environment. This leakage is more difficult to tackle with simple measures. There is knowledge available and more research going on into which leakage paths are the most significant. For example, recent knowledge has shown that loamy soils seem to pose a greater risk of leakage to surface water than soils which have a coarser texture. Surface water is mainly found to contain plant protection products whose use is permitted nowadays. They are the same substances which are repeatedly detected with a high frequency (with levels above the limit for drinking water or their guide values), regardless of whether measurements are taken from the typical areas for the national environmental monitoring programme, in other screen studies or regional and local measurements are used. Work is continuing, based on an assignment which the Swedish Environmental Protection Agency was commissioned with by the Government, on carrying out a more in-depth analysis into why these substances repeatedly seem to pose a problem and to propose further actions than those already ongoing in an attempt to rectify the problem.

The guide values should be updated regularly when new data emerges. It is vitally important to have guide values for all substances being analysed so that we can be sure that we have sufficiently low detection limits and that the right substances are being highlighted as posing a problem. This also means that the toxicity index used both as an indicator for the environmental quality objective 'Non-toxic environment' and for monitoring the action plan's objectives will be based on the guide values. If the guide values are not correct, an incorrect index value will therefore be used. The best solution would be for harmonised guide values to be established at EU level when new active substances are approved or retested. At national level the process for establishing grounds for assessment in the case of specific pollutants offers an opportunity to establish an alternative to the guide values currently used. The Swedish Environmental Protection Agency, Swedish Agency for Marine and Water Management and Swedish Chemicals Agency must cooperate with the water authorities (the five county councils which are water authorities) to come up with an idea for the best way of establishing comparable guide values at a national level for surface water.

10.3.3 Water management and monitoring surface and groundwater supplies

The water authorities are required, based on the Water Framework Directive, to monitor surface and groundwater supplies, which stipulates the minimum action EU countries must take in terms of water quality. Water management activities are run on the basis of six-year management cycles. A cycle is launched with water sources being mapped based on existing monitoring activities. The

material is then used to assess and classify the state and impact of the water, establish quality standards and which actions need to be taken to achieve good water quality. The water authorities are responsible for establishing environmental quality standards for water. In some cases, these quality standards may mean higher water quality standards than the environmental quality standards stipulated by the EU Framework Directive.

The threshold limits for groundwater, i.e. the level of an individual active substance (including relevant metabolites, decomposition and reaction products) must be lower than 0.1 µg/l and the total of the levels of the individual active substances in a sample must be lower than 0.5 µg/l. This is the environmental quality standard stipulated by the EU groundwater directive (2006/118/EC)⁷. This is the highest permissible level which must not be exceeded. This is the standard which applies in Sweden, provided that a lower value is not justified for protecting a drinking water resource or a groundwater-dependent ecosystem. Groundwater can, for instance, be of major significance to the ecosystems which it supplies water to, making them groundwater-dependent ecosystems. This means that an individual groundwater source can be assigned an environmental quality standard which is lower than the limits specified above if it is considered necessary, for instance, to protect an ecosystem which is dependent on the quality of the groundwater or the level to be maintained.

Action programmes under the Water Framework Directive contain certain actions linked to the use of plant protection products. For example, actions should be specifically targeted at the areas where the environmental quality standards for water are not achieved. This is how the action programmes reinforce the efforts promoting a sustainable use of plant protection products. The Swedish Board of Agriculture and county councils have been tasked as part of the Swedish action programmes to devise skill-development and advisory activities as part of the Swedish Rural Development Programme with a view to reducing the impact from the use of plant protection product in the areas where there is a risk that water environmental quality standards cannot be monitored due to such an impact.

10.3.4 Water from individual wells

Around 1 million people permanently receive their water from an individual well and up to a further 1 million receive their water supply from individual wells for part of the year. Knowledge about the presence of plant protection products in individual wells is an area which needs to be developed.

The national environmental monitoring programme and sampling of groundwater carried out in Sweden is specifically intended nowadays to analyse the presence of plant protection product residues in agricultural land.

⁷ Directive 2006/118/EC of the European Parliament and of the Council of 12 December 2006 on the protection of groundwater against pollution and deterioration.

10.4 Impact on the achievement of the objectives

Implementing the article is expected to help achieve the objectives of the action plan in the following manner.

Objective	Impact on objective
To reduce the risks to the environment and to health	++
To bring levels of plant protection products in surface water and groundwater close to zero in the long term (within a generation)	++
To ensure that residues in domestically grown vegetables will be low and not pose risks to consumers	0
To reduce the level of risks for users of plant protection products	0
To develop sustainable cultivation systems and ensure that all growers use integrated pest management or organic cultivation	+

11 Reduction of pesticide use or risks in specific areas (Article 12)

11.1 Requirements of the Directive

Article 12 of the Directive states that Member States must, having due regard for the necessary hygiene and public health requirements and biodiversity or the results of relevant risk assessments, ensure that the use of pesticides is minimised or prohibited in certain specific areas. It also states that the specific areas in question are:

- a) areas used by the general public or by vulnerable groups as defined in Article 3 of Regulation (EC) No 1107/2009, such as public parks and gardens, sports and recreation grounds, school grounds and children's playgrounds and in the close vicinity of healthcare facilities
- b) protected areas as defined in Directive 2000/60/EC⁸ or other areas identified for the purposes of establishing the necessary conservation measures in accordance with the provisions of Directives 79/409/EEC⁹ and 92/43/EEC¹⁰
- c) recently treated areas used by or accessible to agricultural workers.

These provisions enable the Member States to restrict or minimise the use of plant protection products in specific areas without the need to justify this using risk assessments

11.2 National application

According to Section 40 of the Swedish Pesticides Ordinance, a licence from the municipality is required before pesticides can be applied on a professional basis to the grounds of pre-schools and schools or to public playgrounds. Pesticides are used very little in these areas. A licence is also required for the professional use of plant protection products on open areas around apartment blocks, in parks and gardens which the public has access to and on sports and recreation grounds. Applications for licences must be assessed on the basis of what is known as the 'product choice principle', which means that, if several products are available, the product which is least dangerous to human health and the environment must be chosen.

⁸ 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.

⁹ Council Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds.

¹⁰ Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora, also referred to as the Habitat Directive.

In order to use plant protection products on a professional basis on road areas to prevent the spread of invasive species or other species covered by control regulations and within areas with a continuous area exceeding 1 000 square metres where the general public can move around freely, notification must be given to the municipality, in accordance with Section 41 of the Pesticides Ordinance. Anyone intending to apply plant protection products to areas which are accessible to the public must advise about this no later than one week before application, providing such details as the date of application and the affected area. The obligation to provide information does not apply when spraying arable land or in the case of point treatment, if there is no risk to human health and the environment.

In Sweden Natura 2000 areas are protected under the terms of the Swedish Environmental Code and are all classified as being of national interest. Anyone wishing to carry out activities or take measures which could have a significant impact on the environment in a Natura 2000 area (Chapter 7, Section 28a of the Swedish Environmental Code) requires a licence. Using plant protection products can constitute an activity of this kind. This also applies to actions taken outside a Natura 2000 site which could affect the site. Sweden has listed around 4 000 Natura 2000 sites with a total area of around 6 million hectares or roughly 15 per cent of the total area of Sweden. Very little cultivated agricultural land is found in Natura 2000 areas.

Employers are obliged to inform their employees about the risks involved in their work. They must also ensure that the employees have sufficient training and sufficient knowledge to avoid the risks present in the work environment. Employees must, for their part, follow the specified safety instructions. Employers must ensure that only employees who have been adequately instructed have access to areas where there is an obvious risk to health. Employers must take all the necessary measures to prevent employees from being exposed to ill-health.

11.3 Actions

No other actions are deemed necessary.

11.4 Impact on the achievement of the objectives

Implementing the article is expected to help achieve the objectives of the action plan in the following manner.

Objective	Impact on objective
To reduce the risks to the environment and to health	++
To bring levels of plant protection products in surface water and groundwater close to zero in the long term (within a generation)	+
To ensure that residues in domestically grown vegetables will be low and not pose risks to consumers	0
To reduce the level of risks for users of plant protection products	0
To develop sustainable cultivation systems and ensure that all growers use integrated pest management or organic cultivation	0

12 Handling and storage of pesticides and treatment of their packaging and remnants (Article 13)

12.1 Requirements of the Directive

Under the terms of Article 13, the Member States must take the necessary measures to ensure that the following operations by professional users and, where applicable, by distributors do not endanger human health or the environment. They are:

- a) Storage, handling, dilution and mixing of pesticides before application.
- b) Handling of packaging and remnants of pesticides.
- c) Disposal of tank mixtures remaining after application.
- d) Cleaning of the equipment used after application.
- e) Recovery or disposal of pesticide remnants and their packaging in accordance with EU waste legislation.

In addition, the Member States must take all necessary measures regarding pesticides authorised for non-professional users to avoid dangerous handling operations. These measures may include use of pesticides of low toxicity, ready-to-use formulations and limits on the sizes of containers or packaging.

The Member States must also ensure that storage areas for pesticides for professional use are constructed in such a way as to prevent unwanted releases. Particular attention must be paid to the location, size and construction materials.

12.2 National application

Requirements regarding the handling and storage of remnants of pesticides, packaging and remnants are regulated in the Pesticides Ordinance, the Swedish Environmental Protection Agency's regulations (NFS 2015:2) on applying and certain other ways of handling plant protection products and the Swedish Chemicals Agency's regulations (KIFS 2008:2) on using chemical products and biotechnical organisms. Chemical products posing a hazard to health and the environment are required to be stored in such a way as to avoid risks to health and the environment and prevent access to them by any unauthorised person. They must be kept away from small children and kept quite separate from products intended for consumption.

Plant protection products used for professional application must be stored in a bunded area or bunded container with a facility for collecting leaks or spills.

Activities involving the dilution, mixing and filling of plant protection products and cleaning outside equipment used to apply plant protection products must be carried out in a place suited to this purpose. Products must not be handled in this way on road areas, gravel surfaces and other very permeable surfaces, on asphalt or concrete surfaces or other sealed materials which have no facility for collecting the plant protection product. There are fixed safety distances which must be observed when activities such as dilution, mixing, filling and cleaning outside are performed in close proximity to aquatic environments such as drainage wells and lakes.

Specific regulations apply to handling hazardous waste. Waste is regarded as being hazardous when it is explosive, flammable, caustic, infectious or toxic to humans or the environment. The remnants of chemical which have properties of this kind are classified as hazardous waste. This also applies to plant protection products. How hazardous a plant protection product and, therefore, its remnants and its packaging are, depends entirely on the substances that it contains. The classification of waste plays a decisive role in determining how a number of environmental provisions are applied. One function of classification is to form the basis for the safe disposal of waste under the terms of the Swedish Waste Ordinance (SFS 2011:927).

The Swedish Work Environment Authority is responsible for ensuring compliance with work environment legislation. This agency is involved in reducing the exposure risks for users of plant protection products. Specific information and training initiatives have been introduced to ensure that more sprayer operators use appropriate protective equipment and good practices when handling plant protection products. The Swedish Work Environment Authority has cooperated on a project with the Swedish Board of Agriculture and the Federation of Swedish Farmers to improve the work environment by making greater use of technical aids and to increase the use of protective equipment. A basic concept has been drawn up which describes the personal protective equipment that is appropriate when handling plant protection products. The basic protection methods are explained in the published material, which also describes personal protective equipment suitable for different types of plant protection product handling, for example when using a boom sprayer, in greenhouses, for knapsack or handheld sprayers and blowers. The aim is to provide information about which protective equipment is adequate in most cases and to make the information easy for users to understand. The information material has been very well received both by users and suppliers of personal protective equipment, technical equipment and plant protection products. Instructors who provide training for professional users and function testers of agricultural sprayers have also been provided with the material so that they can pass on knowledge within the area as part of their work.

The Swedish Board of Agriculture intends to continue to allocate resources to the 'Safe plant protection' campaign, which is a training campaign aimed at improving the handling of plant protection products in Swedish agriculture, forestry and horticulture. The goal is to reach out to the majority of people who use plant protection products, offering tips, ideas and knowledge about the safe and prudent handling of these products. Another example showing where the industry is involved, is driving development and has taken the initiative is the company Svensk Ensilageplast Retur (SvepRetur). This is a non-profit industry association for recycling plastic used in agriculture. Companies which are members of the Swedish plant protection industry association are connected to SvepRetur's collection and recycling system for plastic packaging. Users of plant

protection products do not need to pay an additional charge to leave their emptied and cleaned packaging at designated collection points.

When approving plant protection products, the Swedish Chemicals Agency assigns the products to three different classes: Class 1, 2 and 3. Professional users can use products from all classes. Non-professional users can only use Class 3 products. A product cannot be assigned to Class 3 if it needs to be handled particularly carefully due to risks to health or the environment or if it contains a candidate substance for substitution. The same requirements also apply to plant protection products delivered in the form of concentrate, which need to be diluted before use, unless they are products posing a particularly low risk.

12.3 Actions

12.3.1 Restriction on the plant protection products which may be used by non-professionals

In its report issued in May 2017 following a government assignment relating to restricting the non-professional use of chemical plant protection products in Sweden, the Swedish Chemicals Agency stated its intention to restrict this kind of use to products whose entire constituent active substances are low-risk substances according to the EU's definition.

12.3.2 Better work environment

The Swedish Work Environment Authority needs to continue to disseminate information about risks in the work environment from the use of plant protection products and about how these risks can be reduced, for example by implementing good practices for handling and applying plant protection products. The importance should be highlighted of using technical aids, such as preparation filling mechanisms, tank rinsing equipment, rinsing tanks etc. and protective equipment, such as gloves, protective eyewear and clothing, and the choice of material, and of how to clean, store and replace them. This is done by means of giving advice, providing courses and publishing information.

12.3.3 Assessing how effective biobeds are in Swedish conditions

A biobed is designed to be conducive to high microbial activity, which helps break down plant protection products. To ensure the biobed achieves its maximum effectiveness, it needs to be created in the right place, be scaled to the correct size and be well tended. In order to be regarded as a biobed under the terms of the Swedish Environmental Protection Agency's regulations (NFS 2015:2) on applying and certain other ways of handling plant protection products, the biobed must be maintained so that it retains its function as a biobed. There is a limited amount of knowledge about what effect the biobeds used in Sweden actually have in terms of reducing leakage of plant protection products. Several environmental inspectors have commented that they have doubts about some biobeds functioning as intended. According to earlier information, there should be around 1 500 biobeds in use.

The Swedish Environmental Protection Agency's regulations state that the fixed safety distances of 30 m between a place used for dilution, mixing and filling, and certain important protective objects are halved if products are being handled on a biobed. Therefore, it is important to assess whether biobeds are effective in general for Swedish conditions and develop a methodology for this.

12.4 Impact on the achievement of the objectives

Implementing the article is expected to help achieve the objectives of the action plan in the following manner.

Objective	Impact on objective
To reduce the risks to the environment and to health	++
To bring levels of plant protection products in surface water and groundwater close to zero in the long term (within a generation)	++
To ensure that residues in domestically grown vegetables will be low and not pose risks to consumers	0
To reduce the level of risks for users of plant protection products	++
To develop sustainable cultivation systems and ensure that all growers use integrated pest management or organic cultivation	0

13 Integrated pest management (Article 14)

13.1 Requirements of the Directive

Integrated pest management plays a key role in achieving the objectives for reducing the risks of using plant protection products. In the Directive, integrated pest management is defined as:

‘Careful consideration of all available plant protection methods and subsequent integration of appropriate measures that discourage the development of populations of harmful organisms and keep the use of plant protection products and other forms of intervention to levels that are economically and ecologically justified and reduce or minimise risks to human health and the environment. Integrated pest management emphasises the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms.’

The requirements which the Member States have to fulfil are given in Article 14 and include, in brief, the following points:

- Member States must establish or support the establishment of the necessary conditions for the implementation of integrated pest management. Professional users must have at their disposal information and tools for pest monitoring and decision-making, as well as advisory services on integrated pest management.
- Member States must ensure that all professional users of plant protection products apply the general principles of integrated pest management.
- Member States must encourage the implementation of crop- or sector-specific guidelines for integrated pest management. But this is done on a voluntary basis.

The general principles of integrated pest management are described in Annex III of the Directive and include:

- Taking preventive measures or providing support for them.
- Decisions on plant protection measures should be taken after monitoring in the field and, if possible, should be based on reliable threshold values.
- The use of pest management measures must be tailored to the situation in question. Firstly, methods other than chemical methods should be chosen. When a chemical method is used, its use must be restricted, the most targeted product must be selected and the risk of resistance must be taken into consideration.
- The benefit of the plant protection measures taken should be monitored on the basis of the records kept.

13.2 National application

Requirements concerning integrated pest management are regulated in the Swedish Pesticide Ordinance and the Swedish Board of Agriculture's regulations and general advice (SJVFS 2014:42) on integrated pest management. It is stated in the Swedish Board of Agriculture's regulations and general advice that anyone considering using plant protection products must, first of all, use preventive methods for controlling pests, weeds and anything else justifying pest management action. Appropriate methods and tools must be used, when such are available, to monitor harmful organisms. The pest management actions chosen must be based, as far as possible, on the results of monitoring activities. Anyone who needs to adopt pest management actions must restrict their use of plant protection products and other efforts to what is necessary and choose methods which are suitable both in the long and short term, and select sustainable biological, physical or other non-chemical methods if they produce a satisfactory control effect. Users must also use plant protection products which are as target-specific as possible and have the minimum possible undesirable effects for health and the environments, and deploy, as far as possible, strategies against pesticide resistance. Anyone who has used plant protection products must analyse as far as possible the benefit derived from using plant protection products, based on the records kept.

Sweden has been applying the principles of integrated pest management for some years, with a focus on the need for preventive measures, using forecasting, warning and decision-support systems, tailored use of plant protection products, employing alternative methods and techniques and evaluating the measures which have been taken. Projects which develop knowledge about reducing the risks of using plant protection products and which support the introduction of integrated pest management have been going on in Sweden for a long time. Specific initiatives have been taken to develop a knowledge base covering integrated pest management and alternative methods and techniques. In the future, precision cultivation using GPS control, remote analysis or other techniques will probably be much more common. Research is currently being conducted in several different areas. Actions which currently contribute to the low usage of plant protection products, involving both organic production and integrated pest management, include not only information, training and advisory activities, but also financial control measures, such as environmental compensation for organic production and a tax on pesticides.

In Sweden, access to plant protection products for 'minor' use, where they are used on crops which are grown on a small scale or for restricted areas of application, is highly restricted in some cases. A project run by the Federation of Swedish Farmers, classed as a minor-use project, is producing information which makes it possible to apply for approval for the small-scale use of plant protection products.

A digital knowledge library based on integrated pest management golf courses and green spaces has been developed by STERF (Scandinavian Turfgrass Environment Research Foundation). STERF provides information on various relevant issues relating to golf courses and green spaces on its website, along with sector-specific guidelines.

13.3 Actions

A combination of actions will be taken, including supervision, information, training, advice, the use of forecasting, warning and decision-support systems, and financial control measures, for example initiatives as part of the Rural Development Programme to promote organic production, in order to ensure that all farmers and growers in Sweden apply the principles of integrated pest management or grow crops based on the principles of organic production.

13.3.1 Monitoring provisions on integrated pest management

The Swedish Board of Agriculture must continue to run projects for monitoring integrated pest management and other parts of the Directive, also with a view to making it easier to review the application of integrated pest management and, if necessary, improve the opportunities for implementing the Directive's requirements.

13.3.2 Information, training and advice

The Swedish Board of Agriculture must implement measures to increase users' expertise in integrated pest management by providing information, training and advice on the subject. These measures will give professional users easy access to information and knowledge about integrated pest management.

One prerequisite for implementing integrated pest management is to provide knowledge to the industry. Knowledge about, for example, diagnosing different types of pests and understanding their biology is essential in order to be able to tailor the control measures. There is a variety of knowledge requirements and, therefore, information and advice will be offered in different ways, which will also see the growing use of apps and web-based tools. Information and advice about the use of plant protection products is provided in the form of skills development with an environmental focus as part of the Rural Development Programme. A more detailed description is provided of this in Chapter 16. The Swedish Board of Agriculture is also responsible for ensuring that training and advice on pest management strategies and preventive measures is provided.

The plant protection centres play a coordinating role in terms of providing advice and fulfil an important function when it comes to disseminating knowledge. Their activities, which include managing forecasting and warning systems (see below), producing control strategies and disseminating knowledge to advisors in different forms, are key to the application of integrated pest management. A more detailed description is provided of this in Chapter 16.

The training which is mandatory for all professional users of plant protection products is instrumental in increasing their skills. One of the days of the basic training course for professional users deals with integrated pest management. This day must also be offered as a standalone course for those users who have already undergone the basic training. Training must be available to people who carry out control measures themselves, to those who hire other people to carry out control measures and to those who are involved in the decision on control measures in some other

way. Information campaigns are needed to encourage these last two categories of people to take part in training.

13.3.3 Forecasting and warning system

The work on the forecasting and warning system and the subsequent tailoring of pest management measures to meet requirements are very important. Methods and ways of working need to be reviewed on an ongoing basis to ensure that they are up-to-date and being used as effectively as possible. This applies to the forecasting and warning system, the information systems and control strategies. The forecasting and warning system monitors around 1 000 fields throughout Sweden, recording the presence of pests during the growing season. The results of the most recent inventories are compiled and appropriate control strategies are devised. These results are reported on an ongoing basis to local advisors by telephone, in status reports and in plant protection newsletters for farmers, with the aim of giving both advisors and users of plant protection products appropriate and rapid information which is tailored to the current situation during the cultivation season. The data which has been collected is available in a database. The crops, the geographical locations and the parameters which are monitored are continuously evaluated and modified. A further development to the system has been introduced in 2017 so that the project can provide location-specific advice. The new system is due to have extended web-based GIS (Geographical Information System) offering extensive options for combining collected data with other internal and external GIS-compatible data. This provides new options for presenting forecasts and warnings with greater precision, which are adapted locally to every farmer's needs. This comes under the Swedish Board of Agriculture's remit.

As part of its forecasting and warning activities, the Swedish Board of Agriculture is involved in developing further risk values, forecast models and control thresholds. The control thresholds apply mainly to insects. Work is underway to develop additional control thresholds. Risk values and different forecasting models or decision-support systems are primarily used for fungal diseases. There is a major requirement to produce new models and develop existing ones further. Validating foreign systems for use in Swedish conditions is also an important task.

13.3.4 Crop-specific guidelines

The Swedish Board of Agriculture has produced crop-specific guidelines for 10 agricultural and horticultural crops to give professional growers and farmers guidance on how integrated pest management can best be applied. The guidelines need to be updated regularly so as to take into account the latest knowledge on, for instance, available forecasting and control methods. The guidelines will be available on the Swedish Board of Agriculture's website and information about them will also be provided during training courses for professional users and advisers. Further guidelines will be produced, with ongoing efforts to identify which crops are most in need of them.

13.3.5 Knowledge base

In order to achieve the objective of using integrated pest management, a knowledge base is required for this in the form of research activities, trials and development work. Both applied research (including testing) and research and development of a more fundamental nature are required. A number of areas have been identified where additional knowledge must be developed and disseminated, such as control thresholds, preventive measures, cultivation systems which combine different ways of controlling plant protection problems using both chemical and non-chemical methods, more detailed biological knowledge of different plant protection problems and the development of systems which provide decision support before plant protection measures are taken. More fundamental knowledge is needed in areas such as new cultivation systems and changes in existing systems, the actual cost to the environment of plant protection measures and the effects of plant protection products on individual organisms and ecosystems. Calculations over several years which demonstrate the profitability of new crop rotations or cultivation systems are required in order to ensure that they gain acceptance among farmers.

The areas which have been identified as targets for further measures correspond with those in many other countries and the descriptions of the problems which they have. A continuous supply of new knowledge is needed to be able to make successful progress with integrated pest management.

A review of the knowledge requirement in the golf sector was carried out by STERF in 2010. This showed that there is a need for more knowledge in a number of areas, including grass varieties with high resistance to disease, weed control with a minimal use of chemical plant protection products, the ideal methods for fertilising and watering and the financial consequences of introducing integrated pest management. The trial and development programme was reviewed in 2016 and now covers the period 2016–2021.

13.3.6 Product and user information

The information on the packaging of plant protection products plays a key role in their correct use. It is important that the information is easy to find and understand, both for farmers and advisors. The conditions of use for plant protection products also form part of cross-compliance in the common agricultural policy. A working group with representatives from such agencies as the Swedish Board of Agriculture, Swedish Chemicals Agency and Swedish Environmental Protection Agency, along with representatives from business have held regular meetings since the end of 2016 to discuss and express their views about conditions of use, both from a risk perspective and in terms of the impact on cross-compliance. It also provides advice to farms. The working group should continue its efforts in this area. In order to make the information clearer and the labels easier to read, the design must be reviewed. For example, proposals for a label template could be submitted. It would also be possible to specify which MoA group (Mode of Action, i.e. the active substance's) the plant protection product belongs to, in order to make it easier to apply resistance strategies.

13.3.7 Approval of nematodes, insects and arachnids as control methods

The availability of biological plant protection products is an important means of reducing dependency on chemical plant protection products and applying integrated pest management.

The ordinance on pesticides containing nematodes, insects and arachnids (2016:402) came into force on 1 July 2016. The Swedish Environmental Protection Agency is responsible for testing species which are suitable to be used for pest control. In the new system it is species, not products which are going to be tested. When a species has been approved, anyone who wishes to can introduce and release the species. Approval must be subject to conditions, for instance, the use of this method is restricted to greenhouses for environmental reasons. Basically, approval will not have a time limit set on it, but it will be reviewed if new information comes to light about any adverse environmental impact. A species can be approved either based on the applications received or by the Swedish Environmental Protection Agency's own testing of species featuring on the EPPO list (List of biological control agents widely used in the EPPO region, appendix I), which has been drawn up by the international plant protection organisation EPPO (European and Mediterranean Plant Protection Organisation). The new system must make it easier to introduce on the market nematodes, insects and arachnids used for pest control, while reinforcing protection for biodiversity.

13.4 Impact on the achievement of the objectives

Implementing the article is expected to help achieve the objectives of the action plan in the following manner.

Objective	Impact on objective
To reduce the risks to the environment and to health	++
To bring levels of plant protection products in surface water and groundwater close to zero in the long term (within a generation)	+
To ensure that residues in domestically grown vegetables will be low and not pose risks to consumers	+
To reduce the level of risks for users of plant protection products	+
To develop sustainable cultivation systems and ensure that all growers use integrated pest management or organic cultivation	++

14 Indicators (Article 15)

14.1 Requirements of the Directive

It is necessary to track the progress made in reducing the risks and adverse effects of the use of plant protection products on human health and the environment. Under the terms of Article 15, Member States must calculate harmonised risk indicators, as referred to in Annex IV, by using statistical data collected in accordance with EU legislation concerning statistics on plant protection products. However, there are currently no harmonised indicators available. This means that existing national indicators or other appropriate indicators may continue to be used.

Member States must identify trends in the use of certain active substances. Similarly, they must identify priority items, such as active substances, crops, regions or methods of use, which require particular attention or good practice which can be used, for instance, in order to fulfil the purpose of the Directive in reducing the risks and impacts of pesticide use on human health and the environment. Member States must also encourage the development and introduction of integrated pest management and of alternative methods or techniques for reducing dependency on the use of pesticides.

Notification of the results of the evaluations must be given to the Commission and this information must be made available to the public. The Commission must calculate risk indicators at an EU level in order to assess risk trends from pesticide use.

14.2 National risk indicators and other monitoring methods

In an attempt to produce a clear description of the changes in risks over time, two national indicators are used: the health and environmental risk index and the toxicity index. These indexes are used as indicators in the Swedish environmental objective system to monitor the 'Non-toxic environment' environmental quality objective. The indexes are calculated annually by the Swedish Chemicals Agency. As these indexes do not completely take into account all factors affecting the total risk picture and have limitations in that, for instance, they do not take into account the size of areas where different crops are grown, which means that these indexes are supplemented by a number of other indicators. See Chapter 3.

14.2.1 Risk index for health and the environment

Since 1997, Sweden has used the national risk index for health and the environment to monitor national action plans for plant protection products. The indicators are based on a simple points system. Points for the intrinsic properties of each active substance and for a number of exposure factors for a representative plant protection product are added together. The total number of points is then multiplied by the number of applications per year of each substance, which is calculated on the basis of the quantity of the substance sold each year and its recommended dose per hectare. The aim is to highlight trends in potential risks over time, not to quantify the risks.

These risk trends are then compared with the total number of hectare doses each year. The three data series are indexed with 1988 as the base year (index for 1988 = 100) in order to highlight the relative change over time¹¹.

Risk index for plant protection products 1988–2017
Hectare doses
Environmental risks
Health risks

Figure 1. Risk index for plant protection products in Sweden 1988–2017, broken down into the health and environmental risk index and hectare doses. Source: Swedish Chemicals Agency.

The fluctuations which can be observed in 1994/1995, 1999/2000, 2003/2004, 2008/2009 and 2014/2015 are examples of occasions where sales do not reflect the actual use in the same year and, therefore, do not represent the risks either. This may be a result, for instance, of hoarding activities caused by the announcement of tax rises on plant protection products.

From a longer-term perspective, the health and environmental risks, expressed as an indicator, have reduced significantly. Compared with the base year 1988, the reductions in the health and environmental risk index figures are 63 and 33 per cent respectively.

Viewed again from a longer-term perspective, the reduction in the figures for the environmental and health risks has been accompanied by an increase in the harvest yields per hectare. Between 1990 and 2017, an upward trend has been observed for several cereal crops, most obviously of all for crops sown in autumn.

¹¹ www.kemi.se/bekampningsmedel/vaxtskyddsmedel/riskindikatorer-for-vaxtskyddsmedel

kg/hectare
Winter wheat
Rye
Winter barley
Winter rye wheat

Figure 2. Harvest yields per hectare for cereal crops sown in autumn 1990–2017

14.2.2 Toxicity index

The toxicity index or PTI (Pesticide Toxicity Index) is used as a simple means of calculating the change over time in levels of substances in aquatic environments in relation to the guide value. The index shows how the risks of harm to aquatic organisms have changed over time. It is a compilation of the analysed levels of plant protection products measured in water courses in four small agricultural areas in relation to the guide values for these substances. A guide value is the highest level of the substance found in surface water which can be expected to have no adverse effects.

Index

Plant protection products in surface water

Figure 3. *The toxicity index for measured levels of plant protection product residues in surface water. The index shows the trend for the combined levels of plant protection product residues in relation to the guide values for the substances (the index for 2002 is 100). Source: Swedish Environmental Protection Agency, Environmental objectives portal.*

The indicator shows how the potential risk of harm to aquatic organisms has changed over time. Based on the index calculations, no reduction is observed during the relevant period. Possibly a slight rising trend can be seen during the years when the measures were taken. However, high or low levels of individual substances have caused trend variations in individual years. It is therefore important to monitor the trend over a long period to reflect long-term changes made to regulations, the use of plant protection products and general developments in the agricultural sector.

14.2.3 Additional monitoring

The national health and environmental risk index indicators and the toxicity index are supplemented with other specific monitoring metrics used to track the achievement of the objectives in the action plan, e.g. organically farmed agricultural land. These monitoring metrics are described in more detail in Chapter 3.

14.2.4 Statistics

Statistics about the quantities of products sold and used and the way in which they were used provide important information for monitoring developments in the area in terms of the risks associated with using and handling plant protection products. An EU regulation concerning statistics on pesticides has been in force since 2009. The Swedish Chemicals Agency is the authority responsible for compiling statistics on the quantities of plant protection products sold and used.

14.3 Trends in the use of certain active substances

Monitoring the action plan for the period 2013–2017 highlighted that certain active substances are often detected in aquatic environments, either at levels above the limit for drinking water (0.1 µg/l) or above its guide value. Research has shown that certain plant protection products, mainly neonicotinoids, have an adverse impact on pollinators, especially wild bees. Based on the monitoring results for the previous action plan for the period 2013–2017, the trends in the use of the following active substances will be monitored:

- Bentazone is one of the active substances contained in plant protection products, which have now been approved, detected most frequently among the samples of groundwater taken.
- Glyphosate is often detected at levels above the drinking water threshold limit in surface water.
- MCPA has been measured during the national environmental monitoring programme (2002–2014) above its guide value in more than five per cent of all surface water samples and is one of the substances which are detected most often at levels above their guide value.
- Diflufenican has been measured during the national environmental monitoring programme (2002–2014) above its guide value in 13 per cent of all surface water samples and is the substance which is detected most often at levels above its guide value. Diflufenican is also identified as a candidate substance for substitution.
- Metribuzin has been measured during the national environmental monitoring programme (2002–2014) above its guide value in more than five per cent of all surface water samples and is one of the substances which have been detected most often at levels above their guide value. Metribuzin is also identified as a candidate substance for substitution.
- All neonicotinoids. Thiacloprid and imidacloprid, which feature in the neonicotinoids group, are among 10 substances which have been detected most often at levels above their guide values for surface water during the national monitoring programme in the period 2002–2012. Thiacloprid exceeded its guide value in around four per cent of the samples, while imidacloprid did so in around three per cent of the samples. Thiacloprid is also identified as a candidate substance for substitution. This group of substances can also have a negative impact on pollinators, especially wild bees.

The public authority responsible for compiling annual statistics on the quantities of these active substances sold is the Swedish Chemicals Agency. The Swedish Board of Agriculture is required to report on trends in use over time.

14.4 Identified priorities which require specific attention

As was mentioned in section 14.3.1, certain active substances are often detected in aquatic environment at levels either above 0.1 µg/l or above their guide value. There are also certain plant protection products which have a negative impact on pollinators. This means that the environment and human health are faced with a real danger and, for this reason, the two areas below have been selected as priorities requiring specific attention.

14.4.1 Herbicide treatments in autumn

Carrying out weed control in autumn is often more effective than carrying out treatment in spring. But treatments in autumn pose an increased risk of the plant protection products leaking due to the fact that there is very often more precipitation and the weather is more unsettled. The soil profile also very often contains more water than is the case during later parts of spring and summer. Several of the active substances detected in the surface water at levels above 0.1 µg/l or above the guide value are herbicides, which are mainly used during the autumn. Therefore, herbicide treatments in autumn are designated as a priority area. The aim is to reduce the traces of active substances found in surface water by means of training, information and advisory activities.

14.4.2 Use of plant protection products which are harmful to pollinating insects

The use of plant protection products has been highlighted as one of a combination of factors threatening bees. Nowadays, around a third of the 285 species of wild bee in Sweden are under threat. As plant protection products are used which are harmful to pollinating insects with crop plants in flower, additional protection measures need to be taken to protect pollinating insects. This may involve, for instance, beehives which are located in fields being removed or covered up. Plant protection products which are harmful to pollinating insects are those with labels displaying conditions of use for protecting pollinating insects or with a different message stating that the product is harmful to pollinating insects. As part of the government assignment being carried out by the Swedish Environmental Protection Agency, which involved mapping and proposing pollination initiatives, a need was identified for reviewing how information about plant protection products which are harmful to pollinating insects can be made more easily accessible. Therefore, the Swedish Board of Agriculture and Swedish Chemicals Agency have also initiated efforts to review this issue, which includes through collating information about the rules and use of these products and making it easily accessible, including an up-to-date list of all the plant protection products which are harmful to pollinating insects. Better information can be expected to result in more effective advice and a reduction in the time spent by farmers, and better compliance with regulations. The aim is to restrict the use of plant protection products which are harmful to pollinating insects and to reduce the risks for pollinating insects by means of training, information and advice.

14.5 Good practices which are an example of how to fulfil the Directive's purpose

Monitoring the action plan for the period 2013–2017 showed that a positive trend had developed during the last 10 years in terms of using non-chemical treatment of seeds and mechanical protection of coniferous plants.

During the project monitoring the use of integrated pest management inside greenhouses and nurseries, it emerged that a very high proportion of greenhouse growers use nematodes, insects and arachnids for pest control. The change in use of the three applications below has come about with support not only from society, but also without any requirements stipulated by law. The industry has been the driving force for this and taken the initiative. Therefore, these examples have been chosen to use as an example of good practice for fulfilling the Directive's purpose.

The use of chemical plant protection products was low or non-existent in the following areas, even before the Directive came into force:

- Growth regulation in cereals other than rye
- Stopping pre-harvest sprouting or controlling weeds in cereal crops less than one month before harvest in cereal crops intended for the production of food or feedstuffs.

This situation has been instrumental in reducing the risks and impact which the use of plant protection products can entail for human health or the environment. Sweden still identifies these methods of use as good practice which can be used, for instance, in order to fulfil the purpose of the Directive in reducing the risks and impacts of pesticide use.

14.5.1 Non-chemical treatment of seed

Tailored treatment is carried out in Sweden in the case of an existing infection, which means that a check is made for the presence of various diseases and if this presence is higher than the established limit, the relevant batch of seed is treated. A treatment or product has different effects on different diseases. Currently, there are no non-chemical treatments available for certain diseases which produce a sufficiently good effect, such as loose smut of barley and wheat, as well as dwarf bunt of wheat. But, in the case of the most common seed-borne diseases affecting cereals, either biological treatment or heat treatment is effective. Biological treatment involves the seed being treated, for instance, with bacteria such as *Pseudomonas chlororaphis*, while heat treatment involves the seed being 'pasteurised' with warm, moist air. Monitoring the 2013–2017 action plan showed that the non-chemical treatment of seed is on the rise, with the main reason being for this trend that heat treatment is carried out at several large seed establishments.

It is hoped that more seed establishments will install equipment for carrying out heat treatment on seed and that the technology will make further advances to include seed for more crops.

14.5.2 Mechanical protection of coniferous plants

The weevil is financially the most costly insect in terms of doing damage to Sweden's forests. It eats the bark of newly planted plants, which can result in them dying. Therefore, when re-establishing coniferous forests, some form of protection is used, which involves either treating the plants with insecticide or different forms of mechanical protection. Statistics from FSC Sweden (Forest Stewardship Council) and its members indicate that there was a considerable reduction in treating coniferous plants with insecticide in FSC-certified forests between 2010 and 2014 in favour of using mechanical protection when re-establishing coniferous plants. Forestry certification systems and the certificate's restrictions on treatment with insecticide are the most likely reason for helping reduce treatment with insecticide. Significant progress has been made in forestry management without using chemical plant protection products against weevils, but there are still major differences of opinion between field owners and forestry companies, as well as regional differences. It is hoped that more field owners and forestry companies will use mechanical protection rather than chemical products.

14.5.3 Control method using nematodes, insects and arachnids in greenhouse cultivation

The project monitoring the handling of plant protection products and integrated pest management in greenhouses and nurseries, which was implemented in 2016, shows that the use of useful creatures is widespread in greenhouse cultivation in Sweden nowadays. The useful creatures used in this are various nematodes, insects and arachnids. Examples of where these creatures are used include controlling fungus gnats with nematodes and for controlling leaf-miner flies with parasitoid wasps. In the monitoring project 79 per cent of 118 greenhouse growers replied that they use nematodes, insects and arachnids as a control method. The aim is to ensure a further reduction in the use of chemical plant protection products in greenhouses and replace them with alternative control methods, including the use of nematodes, insects and arachnids. With a view to achieving this goal, a new regulation has been introduced for nematodes, insects and arachnids being used as a pesticide to make it easier to test pesticides containing these creatures and launch them on the market.

14.5.4 Growth regulation in cereals other than rye

The level of use of growth regulators in cereals is still very low in Sweden compared with the situation in the rest of the EU. Residues of products used to reduce stalk height are also detected much more seldom in Swedish cereals. Problems with lodged grain, with reductions in ear breaking and stalk breaking can otherwise be dealt with via different preventive actions, such as selecting types which are resistant to lodging, sowing time, seed density, fertiliser and careful treatment of harmful fungal diseases. The Swedish Board of Agriculture's guidelines on growing winter wheat states that the need for growth regulation has declined significantly in recent years thanks to new varieties. The fact that there has been an improvement in stalk strength as a characteristic in

the varieties of cereals grown nowadays is confirmed in the annual variety checks compiled by the Swedish University of Agricultural Sciences (SLU). The aim is to achieve a low use of growth regulators in cereal crops other than rye. As part of the Swedish Board of Agriculture's advice and guidance on integrated pest management, the focus should still be on limiting the need to use chemical plant protection products when it comes to growth regulation in cereals, except for rye, in keeping with the Board's regulations and general advice on integrated pest management (SJVFS 2014:42).

14.5.5 Stopping sprouting and controlling weeds before harvest in cereal crops

Cereals can be treated less than 30 days before harvesting for two reasons: to combat couch grass more effectively than is possible when treated after harvesting and to stop grains sprouting because this will make harvesting easier. Plant protection products may be used to stop pre-harvest sprouting if large amounts of rain fall just before harvesting, which can lead to large quantities of lodged cereals, weeds growing through the crop and the risk of ears sprouting. This type of situation makes harvesting very difficult and has an adverse impact on the quality of the harvest.

The Swedish Government decided in February 2017 to ban the use of plant protection products for stopping pre-harvest sprouting and weed control in cereals intended to be used for food as there is a risk of high levels of residues ending up in the food after such a use. The aim of the rules is to ensure that this use is not repeated.

There are currently no plant protection products approved for stopping pre-harvest sprouting and weed control in Sweden. During those years when an exemption has been granted in Sweden for stopping pre-harvest sprouting in cereals under difficult harvesting conditions, the harvest has only been used for purposes other than food production, for example, feedstuffs. The aim is to ensure that the use of products to stop pre-harvest sprouting in cereals for feedstuffs remains low.

15 Crop production in Sweden, use of plant protection products and residue levels

15.1 Brief description of crop production in Sweden

According to statistics from 2016 (JO 10 SM 1701), the total area of agricultural land was 3 032 000 hectares of which the largest proportion, 85 per cent or 2 579 600 hectares, was arable land. There is an uneven distribution of agricultural land across Sweden. The area of land in 38 of Sweden's 290 municipalities comprises at least 40 per cent agricultural land, with 23 of these municipalities located in Skåne and seven in Västra Götaland County. The area of land in 88 of the municipalities comprises less than five per cent agricultural land. For instance, all the municipalities in Västernorrland County and Norrbotten County are included among these municipalities.

Grassland and green fodder are the largest crop group and 37 per cent of agricultural land was used for them in 2016. Cereals are grown on almost just as large an area (1 019 600 hectares), accounting for 34 per cent. Grazing land accounted for 15 per cent of agricultural land. A total of six percent of agricultural land was fallow. The remaining agricultural land was distributed as follows: rape and turnip rape, three percent; legumes and other arable land, two percent each, and potatoes and sugar beet, one per cent each. In some areas smaller crops such as fruit and garden crops are common and important crops. Among the cereals, wheat was the largest crop with 451 200 hectares and more than 83 per cent of the area of wheat was winter wheat. Barley is the second largest cereal crop, with just six per cent of the barley area comprising winter barley. Oats were the third largest cereal crop, covering an area of 180 900 hectares.

The total number of farms which have agricultural land is gradually falling. In 2016 this figure was 61 900. Farms in Sweden use, on average, 43 hectares of arable land. Farms in Gotland County use the most hectares on average (64 hectares), while farms in Kronoberg County have the fewest number of hectares on average (21 hectares). In 2016 there were almost 7 000 farms in Sweden which used more than 100 hectares of arable land. Around 50 per cent of these farms were distributed across four counties: Skåne, Västra Götaland County, Östergötland and Uppsala.

In the horticultural sector, almost 13 000 hectares are used for growing crops outdoors, with two thirds, roughly 8 500 hectares given over to kitchen gardens. Growing fruit and berries takes up almost 1 700 and more than 3 000 hectares respectively, with around 2.8 million m² being grown in greenhouse production. Skåne and the other southern counties largely dominate the horticultural sector, accounting for 75 per cent of crops grown outdoors. The number of farms growing crops outdoors is roughly 2 000, which is half the number since the early 1990s.

15.2 Change in use of plant protection products in Sweden

The use of plant protection products in horticulture accounts for just around three per cent of the total use in the agricultural sector, which means that it will not be mentioned separately in the following text. However, it is important to note that in some types of production of horticultural products, plant protection products may be used extensively. This is the case, for instance, for a number of subsequent harvests of fast-growing vegetables in the same area, for weed control in slow-growing vegetables outdoors or for fungal control within fruit-growing. In some parts of horticultural production, the use of biological control methods completely predominates, such as in greenhouses for vegetables and tunnels for berries.

The most recent user survey was conducted in 2010. At that time, almost half the farms in Sweden with more than 5.0 hectares of arable land used some form of chemical plant protection product, including glyphosate, which is a total pesticide (SCB MI 31 SM 1101¹²). The results of an equivalent study carried out by Statistics Sweden in 2006 on behalf of the Swedish Board of Agriculture were similar. Of the total area of arable land in the country, 81 per cent belongs to farms which use plant protection products. However, there are significant differences between farms of different sizes. Large farms generally used plant protection products to a greater extent than smaller farms. Of the farms with more than 200 hectares of land, 90 per cent used plant protection products, while the figure for farms with less than 20 hectares was only eight per cent.

In total, 47 per cent of the entire area of crops in 2010 was treated with plant protection products. The percentage of the land treated with these products varied significantly between different regions, depending on the intensity and type of farming methods. Less than 10 per cent of land in Norrland was treated, which is due to the large area of pastureland that is given either very little treatment or none at all. In addition, the climate in northern Sweden is less favourable to fungal diseases and insects than it is further south. A larger percentage of the land is treated in southern Sweden. In Skåne, where many crops requiring treatment are grown, such as sugar beet, potatoes and oilseed crops, almost 60 per cent of the total amount of plant protection products was used there in 2010.

The total volume of herbicides, fungicides and insecticides used in agriculture in 2010 was 853 tonnes, compared with 817 tonnes in 2006. The quantity of active substances used per hectare of treated land has remained largely unchanged at 0.75 kg. The use of total weed killers (glyphosate), which kill all plants, for example when treating stubble after harvest or to open up fallow land, and where catch crops have been grown or pastureland to allow a new crop to be sown, was around 400 tonnes in 2010.

A survey of farmers' behaviour was carried out in order to allow measures to be targeted more effectively. The study showed in 2010 that the percentage of farmers who fill agricultural spraying equipment in their farmyard, where there is a major risk of leakage into surrounding land and water courses, had fallen from 16 per cent in 2006 to five per cent in 2010. A total of 26 per cent of users filled sprayers in biobeds or other biologically active land. This was most common on farms with larger yards. Only one per cent of farms admitted that sprayer operators did not use any protective

¹² www.scb.se/statistik/MI/MI0502/2009I10/MI0502_2009I10_SM_MI31SM1101.pdf

equipment at all. Similar questions were asked in a survey presented to those attending advanced courses to be able to obtain authorisation to use plant protection products during the 2016–2017 academic year. A total of more than 1 100 attendees from 15 counties completed the survey. The results have been used when monitoring the 2013–2017 action plan. The survey results show that six per cent fill the sprayer in their farmyard, while nine per cent say that they fill the sprayer on a flagstone or other sealed surface without a collection tank. Biobeds or other biologically active land are used by 29 per cent when filling the sprayer. Only five people out of more than 1 100 replied that they do not use any protective equipment at all.

The consumption of plant protection products in Sweden during the 2009–2010 growing season was 0.39 kilograms of active substances per hectare of arable land. If the fact that only a certain proportion of Swedish arable land is sprayed is taken into consideration, the average use is 0.75 kg/ha.

The extent to which plant protection products are used depends on a number of factors, the most important one being the type of crops being grown. Some crops normally require a more extensive use of plant protection products than others. This depends, for instance, on how competitive the crop is and which pests are posing a threat. Changes in the pests' biology or behaviour can also influence the use of chemical plant protection products. If access to plant protection products is reduced, this might entail a greater risk of resistance, which is likely to result in less effective preparations being used to compensate for a weak impact.

There are significant differences in the levels of use between different countries. Figure 4 shows the difference between sales in a number of different EU countries and Norway. The figure illustrates that the quantity sold per hectare of agricultural land in Sweden is at a relatively low level. Compared with Finland, for instance, the quantity of plant protection products sold in Sweden, amounting to 0.72 kg/ha, is roughly half the figure for Finland with 1.43 kg/ha, Denmark with 1.61 kg/ha and Germany with 2.62 kg/ha.

Figure 4. Sales of plant protection products in European countries in 2013, measured in kg per hectare of agricultural land. Source: EEA Environmental indicator report 2016.

Looking at how the sales of plant protection products have changed within European countries (Figure 5), Sweden still seems to be in a good position, showing a decline in sales of around three per cent between 2014 and 2016, compared with 2011–2013.

Figure 5. *Percentage change in pesticide sales per country. Source: EEA Environmental indicator report 2018.*

Some changes have been made to the Swedish Pesticides Ordinance which affect the use of plant protection products for certain purposes. It is now the case that anyone applying several plant protection products containing the same active substance to the same surface must, as far as possible, ensure that the application of the product does not exceed the dosing conditions and the number of treatments for a single one of these plant protection products. Chemical plant protection products must not be used either:

1. to control plants in lakes, water courses, wetlands and other bodies of water
2. to control harmful nematodes in the soil when cultivating crops intended for the production of food or feedstuffs
3. to stop pre-harvest sprouting and control weeds earlier than 30 days before harvest when growing grains intended to be used for food products.

15.3 Residues in imported and domestically grown vegetables

In 2016 Sweden's National Food Agency analysed around 530 substances in a total of 1 733 random samples of fresh, frozen or processed foods, originating from Sweden, the EU or a country outside the EU. Among the samples 1 485 comprised conventionally grown food and in the case of 248 samples, the food was produced organically. A total of 45 of the 1 733 samples (2.6 per cent) exceeded the EU harmonised limits.

In 2016 no cases were identified of any suspected unauthorised use of pesticides in the domestically grown produce. In the case of crops grown in Sweden, strawberries and apples are the ones containing the highest number of pesticides in the same sample. A sample of strawberries contained a maximum of six substances. In total, three per cent of the crops grown conventionally in Sweden contained five or more different substances. Seventy per cent of the samples contained no residues at all and 14 per cent contained residues of one substance.

Over time, foods from outside the EU have most commonly exceeded the limits. In recent years, a reduction is being observed in the proportion of foods from countries outside the EU exceeding the limits, except for an increase in 2016. In the case of fruit and vegetables from countries outside the EU, the proportion of samples exceeding the limits has fallen from 13 per cent in 2009 to 4.4 per cent in 2016.

Down the years, Swedish crops have less frequently exceeded the limits in terms of substance level, with only one case per year. In fact, in 2016 no products grown in Sweden were found to have exceeded the substance limits. See Figure 6.

The proportion of fruit and vegetables on the Swedish market which have exceeded the limits has risen slightly in the last year for imported products. But, based on a historical comparison, the level can still be considered as being low. One reason for this is that producers are better informed nowadays about which laws and regulations apply to pesticides when trading in the EU. In addition, buyers of fruit and vegetables impose stringent requirements in terms of suppliers adhering to EU regulations.

Based on the levels found in fruit and vegetables and the knowledge we have nowadays, the National Food Agency considers that the safety margins are so wide that they also cover any combination effects and that pesticide residues do not pose any long-term health risk.

Limits exceeded 2000–2016
Sweden
EU (except Sweden)
Third country

Figure 6. *Incidences where limits for 2000–2016 were exceeded in fruit and vegetables. Source: National Food Agency.*

16 Activities for reducing the risks to the environment and health

16.1 Advice and information

Advice and information on using and handling plant protection products takes the form of skills development activities within the Rural Development Programme. The measures comprise regional activities carried out at the Swedish Board of Agriculture's plant protection centres. Activities also take place as part of county skills development programmes, which the county councils are responsible for. The activities within the Rural Development Programme take the form of individual advice, courses, field walks, demonstration crops and printed information. 'Safe plant protection' is an information and training campaign which is part of the Rural Development Programme and involves cooperation between businesses and Swedish public authorities in order to improve the handling of plant protection products. The target groups for the activities are farmers and advisors, among others. The environmental advice and information have had a major impact and form an important part of the ongoing measures to reduce the risks from using plant protection products.

All professional users of plant protection products must undergo mandatory training which covers issues relating to the use of plant protection products, techniques, the work environment and other relevant areas.

16.1.1 County councils' advisory services

County councils are responsible for the environmental advisory measures (skills development) which are adopted by each county as part of the Rural Development Programme. The counties carry out activities such as providing individual advice, sometimes in the context of the 'Focus on Nutrients' advisory project, courses, field walks and demonstration crops. The aims of these activities include helping to tailor better and reduce the use of plant protection products, improving how the products are handled from a health and environmental perspective, emphasising the importance of the technique used in achieving the treatment results and highlighting opportunities for reducing spray drift.

Advice targeted at organic production also forms part of the county councils' advisory services. The aim is to support the growth of organic production. The advisory service provides in-depth knowledge about the need for preventive measures, such as crop rotation, choice of varieties, mechanical weed control, the importance of good drainage and liming etc.

Most of the activities aimed directly at farmers are managed by the county councils. They then purchase services where external expertise is required from other bodies, such as Hushållningssällskapen (Swedish Rural Economy and Agricultural Societies) in the various counties.

Each county council decides which measures are important in each county and they are described in the strategy for the Rural Development Programme drawn up by each county. This means that

counties with more crop production and a greater use of plant protection products generally focus more on activities in this area and adapt them to the county's requirements.

16.1.2 Plant protection centres

The plant protection centres form part of the Swedish Board of Agriculture's regional activities and operate in five locations in southern and central Sweden. They have a coordinating role in the advisory service provided. The aim of what they do is to ensure that crops are grown in an environmentally friendly way, while also making them competitive at an international level. Important aspects of the plant protection centres' work include managing forecasting and warning activities, producing control strategies and advisory material, taking part in courses and conferences, providing information about preventive measures, as well as participating in trial and development activities. Their work also involves plant protection and weed issues in agriculture and horticulture, together with application systems and handling techniques.

The goal is for chemical control measures to be tailored to the specific requirements of each situation. In other words, control measures are implemented if the damage is considered to be greater than the cost of the control measures. This allows the measures to be tailored to the requirements and spraying for safety's sake (known as 'insurance spraying') to be avoided. Forecasting and warning activities play a key role in enabling control measures to be tailored. In practical terms, this involves carrying out an inventory of around 1 000 fields with different agricultural crops every week using established procedures. The data from the weekly inventories is compiled and analysed on an ongoing basis. The subsequent results are then provided to advisors and retailers. Every week a teleconference meeting is held for advisors and retailers during which the results are presented and relevant control strategies are established. The recommendations are then passed on to farmers via a plant protection newsletter available on the Internet or sent by e-mail or text message. Forecasting and warning activities in their current form have been taking place since 1987. As a result, a large volume of data is available in a database. The information in the database can be used to compare the impact of pests between different years and also to follow long-term trends relating to the climate etc.

The work on control strategies involves annual updates to the recommendations on suitable preparations, treatment times, doses etc. The information is available in printed form and on the Internet

In addition to chemical control activities, the plant protection centres also work in different ways with preventive measures. This includes providing information about suitable crop rotations, choices of variety and other cultivation methods, which can reduce the need for chemical controls, and initiating and supporting a variety of research and development projects

The plant protection centres' work makes an important contribution to providing advice on chemical control methods and is highly effective. Because the plant protection centres' work covers several fundamental areas of the integrated pest management concept, it is crucial to the concept's implementation.

16.1.3 Regional activities relating to organic production

The Swedish Board of Agriculture provides support in terms of offering advice on organic production with the aim of increasing the amount of land under organic cultivation. These activities include running courses for advisors, producing information material and supporting regional advisory services in the area. The regional offices coordinate and help by providing advice in each region. The advisors at the regional offices are also experts in different areas and can provide advice throughout the country as part of their role.

16.1.4 'Safe plant protection'

'Safe plant protection' is an information and training campaign which aims to improve the handling of plant protection products in Swedish agriculture. This campaign was called 'Focus on plant protection' for a period.

The 'Safe plant protection' campaign covers the entire country. The assessment is that the campaign has had a positive impact on the environment and is helping reduce the environmental and health risks involved in agriculture.

16.2 Trials and development activities and centres of expertise

16.2.1 Trials and development activities

Trials and development projects which focus on reducing the risks involved in the use of plant protection products are financed primarily by the Swedish Farmers' Foundation for Agricultural Research (SLF). Since 2009 efforts have focused on integrated pest management and alternative control methods. The projects cover a range of different areas, including tailoring chemical control methods for a specific pest, studies on how to prevent leakages of plant protection products into water courses and the development of biological control methods etc.

The Swedish Board of Agriculture also provides financing for trials and development projects which focus on reducing the risks involved with plant protection products, applying integrated pest management, methods and techniques which are alternatives to chemical plant protection products and organic production.

Therefore, there are a number of projects in progress which aim to reduce the risks of plant protection products and dependency on them, and to apply integrated pest management. The results of these projects will be important starting points for training, advice and information intended for users in order to expand the use of integrated pest management on an ongoing basis, to apply alternative methods and techniques and to reduce the risks of using plant protection products for people and the environment. A knowledge base is still urgently needed in this area.

16.2.2 Centre for Chemical Pesticides

The Centre for Chemical Pesticides (CKB) was established at the Swedish University of Agricultural Sciences (SLU) in 2006 and acts as a collaboration forum for researchers at SLU and interested parties outside the university within the field of chemical pesticides. The CKB mainly focuses on the application and environmental impact of plant protection products used in agriculture. It does this through its activities in the areas of chemical analysis expertise, environmental monitoring, biological effects, models, pathways and actions. The CKB also focuses a great deal on cooperation and training, which involves providing information via its website and other channels, offering expert support to public authorities and other stakeholders in society and arranging training courses on the use of pesticides and the environment in general, also using the risk assessment tools the CKB develops. The aim of its activities is to develop knowledge which allows impacts on the environment to be described and predicted in a reliable way and actions to be taken to contain the environmental impact of chemical plant protection products within acceptable limits.

16.2.3 Centre for Biological Control

The Centre for Biological Control (CBC) is a new centre which was launched as part of the Swedish University of Agricultural Sciences (SLU) in 2012. Its work focuses on controlling pests with living organisms, with the aim of contributing to the sustainable use of biological natural resources. Biological control methods offer a great deal of potential for limiting the effects of harmful organisms in agriculture, horticulture, forestry, livestock farming and aquaculture. For example, there are applications along the entire crop production chain from sowing to the end product. The CBC carries out its own research, but also endeavours to collaborate with other researchers in the field of sustainable control methods. Close cooperation with stakeholders, such as growers, farms, public authorities and other organisations is also an important part of its work.

16.2.4 Centre for Organic Food and Farming

The area of activity of the Centre for Organic Food and Farming (EPOK) covers the whole food system, from production to consumption. The EPOK cooperates with researchers, advisors, farmers, decision-makers, business representatives, consumer organisations and students. It is also a hub promoting knowledge and communication. The EPOK is based at the Swedish University of Agricultural Sciences (SLU) and its tasks include:

- Providing practical, sound knowledge from a number of different perspectives leading to the sustainable development of organic farming
- Helping to ensure that research into organic farming promotes the development of agriculture as a whole
- Encouraging dialogue between researchers and society about organic farming and ensuring that research results are made available quickly

- Contributing to increased international collaboration on research into organic farming
- Coordinating and initiating training about organic farming on a contract basis in order to meet demand.

16.3 Promoting organic production

The aim of organic production is to use natural resources, such as energy, land and water, in a way which is sustainable in the long term. Other goals are high levels of biodiversity and concern for animal welfare. The characteristic features of organic production include:

- the management of pests and weeds
- the way in which nutrients are supplied to crops
- a particular focus on animal welfare.

In organic farming, preventive measures are the main method of combating pests and weeds, such as varied crop rotation, tillage methods and resistant varieties. Chemical plant protection products are only used to a small extent in organic production as only a few products are authorised. As part of the assignment, the Swedish Environmental Protection Agency, Swedish Chemicals Agency and Swedish Board of Agriculture also consider that a higher proportion of organic farming can be expected to reduce the use of problematic chemical plant protection products in agriculture, which will ultimately reduce the risks for pollinating insects.

Organic farming has been constantly growing in Sweden by about 10 percentage points between 2005 and 2017. This corresponds to an increase of almost one percentage point per year. In 2017 there were 577 200 hectares of agricultural land already converted or in the process of being converted to organic production. This is equivalent to more than 19 per cent of the total area of agricultural land in Sweden.

The Swedish Government is taking a number of measures to promote organic production, including environmental compensation, skills development and the provision of advisory services, information and training as part of the Swedish Rural Development Programme for the period 2014–2020. The Swedish Board of Agriculture provides advice on organic production (see above).

Comprehensive measures have been put in place to promote the development of knowledge about organic production in the form of research, trials and development activities. The providers of the financing for this include the Swedish Research Council Formas (which specialises in research into the environment, agricultural sciences and spatial planning) and the Swedish Board of Agriculture. Measures have also been taken to stimulate the market for organic produce.

16.4 Monitoring plant protection products in aquatic environments and drinking water

16.4.1 National environmental monitoring programme for pesticides

As part of the agricultural component of the national environmental monitoring programme, studies have been carried out since 2002 into the environmental impact of using plant protection products. The studies are being carried out by the Department of Aquatic Sciences and Assessment at the Swedish University of Agricultural Sciences (SLU), which was commissioned by the Swedish Environmental Protection Agency. The results are being processed further by the Centre for Chemical Pesticides (CKB). The results of the environmental monitoring activities form the basis for assessing whether the environmental quality objectives are being met, as well as for the plant protection product indicator in surface water (toxicity index). Similarly, the results are also relevant for monitoring the actions which have been taken to reduce the risks of using plant protection products.

The environmental monitoring of plant protection products covers streams in four small catchment areas (800–1700 hectares), representing four large agricultural regions in Sweden. The catchment areas are in Skåne, Halland, Östergötland and Västergötland. They are described as ‘typical areas’ because they can be considered to be a typical area in the region. All typical areas comprise around 90 per cent arable land. Farmers in typical areas are interviewed every year about their production to examine which crops are being grown and which plant protection products have been used during different times of the year. The environmental monitoring programme also includes two slightly larger rivers in Skåne, a station on Söderåsen where rainwater and air samples are taken from and, since 2009, also a station for rainwater in Aspvreten, which is on the east coast.

All analyses are carried out by an accredited laboratory and samples of surface water, groundwater and rainwater are analysed for around 130 substances. Roughly 70 substances are analysed in the air samples and nearly 50 substances are analysed in the sediment. The substances to be analysed are selected based on how many substances are used in the typical areas if the substance has properties which make it volatile, and how toxic the substance is. All the Water Framework Directive’s priority substances which are plant protection products are included in the analyses.

The levels of plant protection products in water courses vary during the year, with the highest levels very often occurring during the early summer when control measures are applied the most intensively. Plant protection products are primarily transported during the winter because of the higher level of water discharge during this period. Low levels of plant protection products are also found in precipitation. A considerable proportion of the substances detected in precipitation are now banned in Sweden (and some of them are also banned in the EU), which indicates that these substances are being transported a long distance across national borders.

The Swedish Environmental Protection Agency has therefore been commissioned with carrying out in-depth monitoring and analysis of those active substances in plant protection products for which the safe levels are often exceeded in the surface water surrounding the arable land or which are found very frequently.

16.4.2 Monitoring plant protection products in drinking water

Drinking water suppliers, which are generally municipalities or municipally-owned companies, are responsible for supplying drinking water to consumers which meets the quality requirements of the National Food Agency's regulations on drinking water (SLVFS 2001:30). The pesticides which may occur in a water supply, surface water and groundwater must be analysed. Water supplies which are used for the abstraction of drinking water and which are categorised in terms of a risk of impact from ongoing activities must be subject to operational monitoring under the terms of the Water Framework Directive. The monitoring results can be used to track risks from using plant protection products and to take actions to reduce their impact.

17 Environmental policy objectives

The overall objective of Sweden's environmental policy is to pass on to the next generation a society in which the major environmental problems have been resolved, without causing increased environmental and health problems outside Sweden's borders. This objective, which is known as the generation goal, provides direction for the environmental policy and acts as a guideline for environmental activities at all levels of society.

The overall objective is accompanied by 16 national environmental quality objectives which are formulated on the basis of the environmental impact that the natural world can withstand and which describe the state of the environment that these efforts intend to bring about. Milestone targets identify the steps on the road to achieving the environmental quality objectives and the generation goal. They are intended to explain the changes needed in society to enable us to achieve the environmental quality objectives and the generation goal.

Public authorities, such as the Swedish Board of Agriculture, Swedish Environmental Protection Agency, Swedish Agency for Marine and Water Management, Swedish Chemicals Agency, Swedish Forest Agency and the Geological Survey of Sweden, are responsible for legislation relating to the use of plant protection products and also for the environmental objectives:

- A varied agricultural landscape
- A rich diversity of flora and fauna
- A non-toxic environment
- Good-quality groundwater
- A balanced marine environment, flourishing coastal areas and archipelagos
- Zero eutrophication
- Flourishing lakes and water courses
- Sustainable forests

It is mainly the 'Non-toxic environment' environmental objective which is affected by the use of plant protection products, but consideration must also be given to other objectives listed above when dealing with plant protection products. In addition, there are objectives which come under the remit of individual authorities. For instance, the Swedish Environmental Protection Agency is also responsible for coordinating all the environmental objective monitoring activities.

The Swedish Government re-established the Swedish Environmental Council in 2014 as a platform for taking more action and engaging in a more intense way at every level of society in order to achieve Sweden's environmental objectives. The Swedish Environmental Council presents on 1 March every year actions which the authorities undertake to implement, with the aim of increasing the rate of the effort to achieve the environmental objectives. The Council is made up of

heads of 17 public authorities which are strategically important to the requirements for achieving the generation goal and environmental quality objectives.

A project is currently being run on safety distances and zones as part of the Swedish Environmental Council's work. This is being carried out by the Swedish Board of Agriculture, in cooperation with the Swedish Chemicals Agency, Swedish Environmental Protection Agency, Swedish Agency for Marine and Water Management, Swedish Forest Agency and the county councils. There are many different protection areas and safety distances which farmers must observe in relation to water courses and ditches. These areas also have several other purposes, including reducing the environmental impact from plant protection products and plant nutrients which are applied to the fields and increasing biodiversity. The requirements for different types of areas and distances vary as they have been drawn up with different purposes and in different contexts. Farmers often find the many different rules complicated, thereby making it easy for them to make mistakes. Therefore, it is appropriate to simplify the regulations and their application. Lack of clarity about how the rules should be applied plays a role in this situation where joint monitoring by the public authorities is required.

As another example of actions being taken, the Swedish Chemicals Agency is working along with the Swedish Board of Agriculture to facilitate the process for approving low-risk plant protection products in Sweden. This work is intended to result in lower environmental and health risks in the agricultural sector.

The link to organic production is favourable to objectives relating to the effects of using plant protection products, but also to several of the other environmental objectives. Anyone switching to organic crop or livestock farming will receive via the 2014–2020 Rural Development Programme compensation for switching to organic production.

18 Food strategy objectives

The Swedish Government's food strategy is based on creating more jobs, sustainable growth and values such as an open landscape and dynamic countryside, by adopting a strong competitive approach throughout the whole food chain. A long-term food strategy must help ensure that the potential for the whole Swedish food chain is fully tapped.

The overall objective of the food strategy must be to have a competitive food chain where there is a rise in the total volume of food production, while achieving the relevant national environmental objectives, in order to generate growth and employment and boost sustainable development throughout the country. The increase in production, both conventional and organic, should meet consumer demand. A rise in production could help increase the degree of food self-sufficiency. Any vulnerability in the food chain must be reduced.

This means greater and sustainable food production for both the Swedish and foreign market, which can help boost growth and create more jobs throughout the country. The food strategy must also create better opportunities for consumers to make an informed choice.

The activities involving land-based business, rural areas and food must help create good conditions promoting work, growth and welfare in every part of the country. Green businesses must be dynamic and contribute to action on climate change and ensure that natural resources are used sustainably. Rural areas need to be dynamic and active in order to achieve this. Green businesses are often highlighted as an important aspect of rural enterprise.

The aim for the strategic area of Rules and conditions must be to devise rules and conditions which support the objective of establishing a competitive, sustainable food chain where production is increasing. This can be achieved through appropriate taxes and charges, simplifying rules, easing the administrative burden and other actions aimed at reinforcing competitiveness and profitability.

Therefore, it is essential to obtain an overall picture of the effects on the environment of changes in the availability of plant protection products, and not only the direct effects. It is important that the effects on other objectives are described and taken into consideration. New control strategies can lead to the increased use of plant protection products, for example as a result of products being removed from the market and replaced by less effective products. The agricultural landscape and biodiversity can be adversely affected by changes in cultivation or by cultivation coming to an end. Environmental problems could arise in other countries if Swedish crop production is replaced by production which causes a greater adverse environmental impact.

It is important to ensure that each action has an overall positive effect. Actions which counteract or compensate for the negative effects of plant protection products may need to be adopted, as may measures to develop alternative ways of managing the relevant plant protection problems.