Institute for European Environmental Policy

12 May 2016

Effective policy options for reducing environmental risks from pesticides in the UK

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Funded by RSPB

rspb

In collaboration with
Pesticide Action Network UK

PESTICIDE ACTION NETWORK UK

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The report should be cited as follows: Underwood, E. & Mole, N. (2016) Effective policy options for reducing environmental risks from pesticides in the UK. Report for RSPB UK. Institute for European Environmental Policy & PAN UK.

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Acknowledgements:
We thank the RSPB, and IEEP and PAN UK colleagues for their helpful comments and suggestions.

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Executive Summary

This report assesses to what extent key public and voluntary measures have achieved a reduction in pesticide impacts on the environment in the UK, in particular the Voluntary Initiative (VI). The report identifies options for policy intervention on pesticides in the UK, based on a review of current initiatives in other EU countries. The review focuses mainly on use by the agricultural sector but also refers to some initiatives in the public (local authority) and amenity sectors, and focuses on environmental impacts (not covering the impacts of pesticide use on human health and safety).

It should be noted that this report was written before the UK referendum on leaving the European Union, and analyses UK policy options in the framework of the EU legislation on pesticides and integrated pest management. Leaving the single market opens up a number of options for the UK to change the way it authorizes and governs the use of pesticides outside the EU legislative framework which are not covered in this report.

The UK's objective on the use of pesticides, as stated in the UK National Action Plan for the sustainable use of pesticides, is: '*to ensure that pesticides are used sustainably by reducing the risks and impacts of use on human health and the environment and encouraging the development and introduction of integrated pest management and of alternative approaches or techniques*.' This objective continues to be pursued mainly through voluntary or industry led approaches, underpinned by regulation relating to the correct and responsible use of pesticides. The Voluntary Initiative (VI) was launched in 2001 by the Crop Protection Association and agricultural and farmer organisations with the initial goal of minimising the environmental impacts from the use of pesticides, so avoiding the need for a pesticide tax (proposed by the government at that time). The VI has since shifted towards a drive to promote the responsible use of agricultural pesticides.

In the fifteen years since the VI was launched, the overall crop area being treated with herbicides, insecticides and fungicides and the number of treatments applied to most of the major crops in the UK has risen significantly. The total fungicide treatment area has increased by 43%, the total insecticide treatment area by 36%, and the total herbicide treatment area by 20% between 2000 and 2013. This indicates a large-scale environmental load and a heavy reliance on pesticide use in many crops, notably oilseed rape, winter wheat, potatoes and sugar beet. There is increasing scientific evidence that pesticides are partly responsible for declines in farmland bird populations, arable weeds, bees and other pollinators, other terrestrial and aquatic invertebrates, amphibians, and freshwater biodiversity. Certain pesticide groups are now documented in the peer-reviewed literature as posing threats to vital ecosystem services, such as pollination, natural pest control and nutrient recycling. Pesticides in drinking water continue to be a major regulatory compliance issue in the UK, mainly in England, as well as surface water contamination by specific 'problem' active ingredients.

The VI has played a role in improving pesticide use practices (establishing systems for inspection of spraying equipment, training of sprayer operations, etc) and developing responsibility in the agrochemical industry and end users. However, it is very difficult to attribute any quantifiable reduction in environmental impacts to the VI, for various reasons detailed in this review. Furthermore, the VI seems to be characterised by a belief that any risks can be adequately managed through promoting existing best practice, whilst opposing any new regulatory actions.

The EU Directive on Sustainable Use of Pesticides (SUD) provides the overall policy framework for addressing recognised environmental and human health risks and harm from over-reliance on pesticides in current practices. This review provides an overview and assessment of the successes and shortcomings of different policy measures and public and private sector initiatives in meeting the goals and 'spirit' of the SUD, in both the British and wider European contexts. No single policy option will be adequate to deliver sustainable agriculture and effectively tackle the overall impact of pesticides on the environment. More realistically, a suite of mutually supporting approaches needs to be developed, logically built to support overall objectives, such as a target to cut pesticide use by certain metrics over time. A policy package should make use of a number of different policy tools, such as regulation setting a baseline for pesticide authorisations and pesticide use that provides adequate environmental protection according to current research findings; research, training and information to support farmers in making changes; measures that counter the drivers of continued levels of reliance on pesticides; and positive incentives for continuous improvement in practice and uptake of Integrated Pest Management (IPM).

Good examples are provided in the Danish, French and Germany pesticide action plans, all of which are major agricultural producers sharing many similar characteristics with the UK farming context and constraints. For example, Denmark has announced that it will consider prohibiting pesticides found to exceed thresholds in surface or groundwater, and is providing substantial funding for enhanced actions to protect groundwater, primarily financed by the revenues from the new tax on pesticides. The Buffer Zone Law requires 10m buffer zones along all watercourses and larger lakes. Pesticide-free towns and villages are multiplying in France and Belgium, and both countries are phasing out pesticide use in public places. France and Germany have both targeted their pesticide national action plans to invest significantly in innovative extension efforts that will provide a large role to on-farm experimentation, demonstration and data collection. Italy offers an interesting example of the use of crop risk insurance to facilitate integrated pest management of maize.

The UK's pesticide policy, as implemented in practice, currently takes a short term approach by failing to adequately address the water pollution and damage caused by pesticides to biodiversity, ecosystem services and natural resources and its associated external costs. It is failing to support farmers to make the transition away from those current cropping systems that are so reliant on pesticide use. It is failing to learn from valuable experiences in reduction of pesticide risks, use and harm in EU neighbour countries, and their achievements in promoting robust and profitable Integrated Pest Management systems based on agro-ecological science. Nor is it encouraging useful dialogue with progressive players in food supply chains or supporting innovative partnerships for change.

The UK government continues to lack the sense of an urgent need to change, and shows a reluctance to use regulatory measures such as bans or restrictions on pesticide use or statutory restrictions in drinking water protection zones. The EU legal obligation to apply a comparative assessment to all pesticide active substances classified as candidates for substitution (CfS) provides an opportunity to replace some actives, currently a list of 77, that meet the criteria set out in the Plant Protection Products Regulation for CfS. These CfS are currently authorised active substances that raise concerns about certain of their properties, for example endocrine disrupting properties. The assessment may result in their replacement with substances that are of less concern. However, the UK government currently has no proactive position on how it will deal with the actives currently in use in the UK that are candidates for substitution. British farmers are already finding their toolbox of pesticides decreasing for a number of reasons, including pest, weed and disease resistance (such as the current challenge for arable farmers from blackgrass resistance to most approved herbicides). In comparison with their counterparts elsewhere in Europe, UK farmers enjoy almost no government support to help them adapt to changing EU regulatory requirements, access technical advice tailored to their individual farming enterprises or realise the economic benefits from growing and marketing more IPM and organic produce.

This review recommends that the Government needs a more long term and proactive approach, facilitating the necessary resources and constructive stakeholder collaboration to support farmers on the transition to effective and sustainable pest management and broader crop and soil health strategies. It should set concrete targets, timetables and actions that not only reduce the environmental burden of pesticide use but promote reduced reliance on pesticides, phasing out priority Highly Hazardous Pesticides, as identified by PAN UK, and putting non-chemical methods, based on ecological principles, at the forefront.

1 Aim of the report

This report assesses to what extent the Voluntary Initiative in the UK has achieved its stated targets and objectives to reduce pesticide use and pesticide impacts on the environment, and whether those objectives were ambitious enough. We briefly review the current policy measures implemented in the UK, in particular those policies that require a reduction in the environmental impacts of pesticides. This is followed by a review of some of the policy approaches that have been adopted in other EU countries. Based on this evidence, we assess the need for policy intervention on pesticides in the UK.

The UK's current objective on the use of pesticides, as stated in the UK National Action Plan (NAP) for the sustainable use of pesticides, is: '*to ensure that pesticides are used sustainably by reducing the risks and impacts of use on human health and the environment and encouraging the development and introduction of pest management and of alternative approaches or techniques*.' This objective continues to be pursued mainly through voluntary or industry led approaches, underpinned by regulation relating to the correct and responsible use of pesticides (inspection of spraying equipment, training of sprayer operations, etc).

The report looks at some current policy mechanisms adopted in other EU countries and examines the evidence for their impact on pesticide use and the associated environmental outcomes. Based on this evidence, we built a SWOT (Strengths, Weaknesses, Opportunities and Threats) structure to assess certain policy options. Finally, the report provides conclusions and recommendations as to potential policy mechanisms to reduce the environmental impacts of pesticides in the UK. One policy option is excluded from this exercise. The report did not look at the implementation and possible policy objectives of a pesticides tax in the UK, nor the experiences of other countries with a tax, as this is covered by another report commissioned by RSPB.

This report uses the term 'pesticides' to mean plant protection products that protect crops or desirable or useful plants, according to the EU definition, and does not cover biocides, such as rodenticides or sheep dip. Pesticides (plant protection products) are used by the agricultural sector (on arable, grassland and horticultural crops), by the forestry sector, by public authorities (on public roads and other ways, public open spaces, parks etc), by the construction/maintenance industry, by the transport sector (along motorways, railways etc), and by the general public (in the home, gardens, allotments) and businesses (golf courses, sports and amenity areas etc). This review focuses mainly on use by the agricultural sector but also refers to some initiatives in the public (local authority) and amenity sectors. The report does not cover the impacts of pesticide use on human health and safety.

2 Assessing the need for intervention

This section evaluates the need for policy intervention by assessing the evidence for:

- whether pesticide use has declined in the UK since the Voluntary Initiative was launched,
- any reduction in impacts attributable to the Voluntary Initiative.
- any reduction in environmental impacts attributable to the policy framework other than the Voluntary Initiative,
- the extent to which current environmental impacts are not adequately being reduced by the policies in place.

The Voluntary Initiative was launched in 2001 and initially designed to last for a period of five years. It was reviewed in 2006[1] and a decision was taken to maintain the VI on a rolling two year basis. The overarching goal of the VI at its inception was to "minimise the environmental impacts from the use of pesticides". Based on the reviewed evidence, we assess to what extent the Voluntary Initiative has achieved its stated targets and objectives, and whether those objectives were ambitious enough. The VI was initially focused on agricultural use and then expanded to include the amenity sector, so the review focuses on these sectors.

2.1 Pesticide use and environmental impacts of pesticides in the UK

2.1.1 *Trends in pesticide use on agricultural land*

This section summarises data for the use of the principal pesticide groups (insecticides, fungicides, herbicides and molluscicides) and some individual active substances in terms of the agricultural area treated (in hectares) and the number of treatments in Great Britain for the period 2000 to 2013[2], corresponding to the period of the Voluntary Initiative.

Box 1: Pesticide usage statistics in the UK – weight vs treated area

Pesticide usage on agricultural land in the UK is estimated from information collected from a statistically derived, representative sample of farmers and growers regarding pesticides they applied to specific crops over the previous growing season or year, biennially for arable crops and every four years for horticultural crops. Statistics are available for the overall weight and number of treatments of all approved active substances applied to 23 crop types in Great Britain (England, Scotland, Wales) from 1990 onwards and in the United Kingdom from 2010 onwards. Use is expressed as the weight and total treated area of each active substance - the latter measures both the total spatial area treated and the frequency of treatments on a particular crop area.

There has been a large decrease in the weight of pesticides used in agriculture since 2000, but this provides little insight into environmental impact as almost half of this decrease is due to the reduction in use of sulphuric acid for potato desiccation. Furthermore, while the total weight of products used is one parameter for recording pesticide use it does not address the changing chemistry and associated issues such as the use of more potent but lower volume active substances. Consequently it is of rather limited use in assessing environmental impact. The impact of different substances varies greatly; consequently to the environment a

[1] Glass,C.R., Boatman,N.D., Brown,C.B., Garthwaite,D., Thomas,M. (2006) Evaluation of the performance of the Voluntary Initiative for pesticides in the United Kingdom. Report Number P3OG1001.

[2] All figures are taken from https://secure.fera.defra.gov.uk/pusstats/mygraphindex.cfm

greater weight of a less potent active substance applied to a crop could in principle and in practice pose less risk than a lower weight application of a more potent active substance. The substance concerned is critical. This section presents the statistics on area treated and number of treatments, as they are relevant whilst underlining that these are also not a direct indicator of pesticide impact, as an increase in the area treated is not necessarily detrimental if it is associated with a move to more environmentally benign pesticides. The total area of crop treated with pesticides is measured cumulatively for each application, so that five applications in a year on a hectare are measured as 5 ha treated area.

The **total area of crop treated with pesticides** increased from 59.1 million ha to 78.2 million ha between 2000 and 2013, an increase of 76%. Between 2000 and 2013 in Great Britain:

- the total area treated with fungicides increased from 27.3 million ha in 2000 to 39.2 million ha in 2013, an increase of 11.9 million ha treated area or 43%
- the total area of crop treated with insecticides increased from 5.08 million ha to 6.92 million ha, an increase of 1.84 million ha treated area or 36%
- the total area treated with herbicides increased from 20.3 million ha to 24.3 million ha, an increase of 4 million ha treated area or 20%

These trends primarily indicate that the number of applications per crop has increased rather than that there has been a spatial increase in the overall treated area, as the total cropped area (including fallow but excluding permanent grassland and woodland) in the UK[3] has remained broadly constant between 2000 and 2013 at around 4.6 million ha[4].

The area of organically farmed crop land in the UK (including land in conversion), at 3.8% of the total cropped area, is too small to have a distinguishable influence on the overall pesticide use statistics. The organic crop area has increased slightly from 0.17 million ha in 2002 to 0.18 million ha in 2013, but since the peak of 0.24 million ha in 2008 it has consistently declined[5].

Trends in specific pesticide groups associated with negative environmental impacts

Increase in pyrethroid insecticide use, decrease in organochlorine, organophosphate and carbamate insecticide use

Pyrethroids are the most widely used insecticide group, accounting for 91% of the insecticide-treated area of arable crops (excluding seed treatments) in 2012[6]. The total area treated with pyrethroid insecticides has risen between 2000 and 2013 by 1.38 million ha, including pesticides containing cypermethrin, lambda-cyhalothrin, esfenvalerate, alpha-cypermethrin, tau-fluvalinate, zeta-cypermethrin, deltamethrin and bifenthrin. Cypermethrin currently accounts for 31% of the insecticide-treated arable area, and

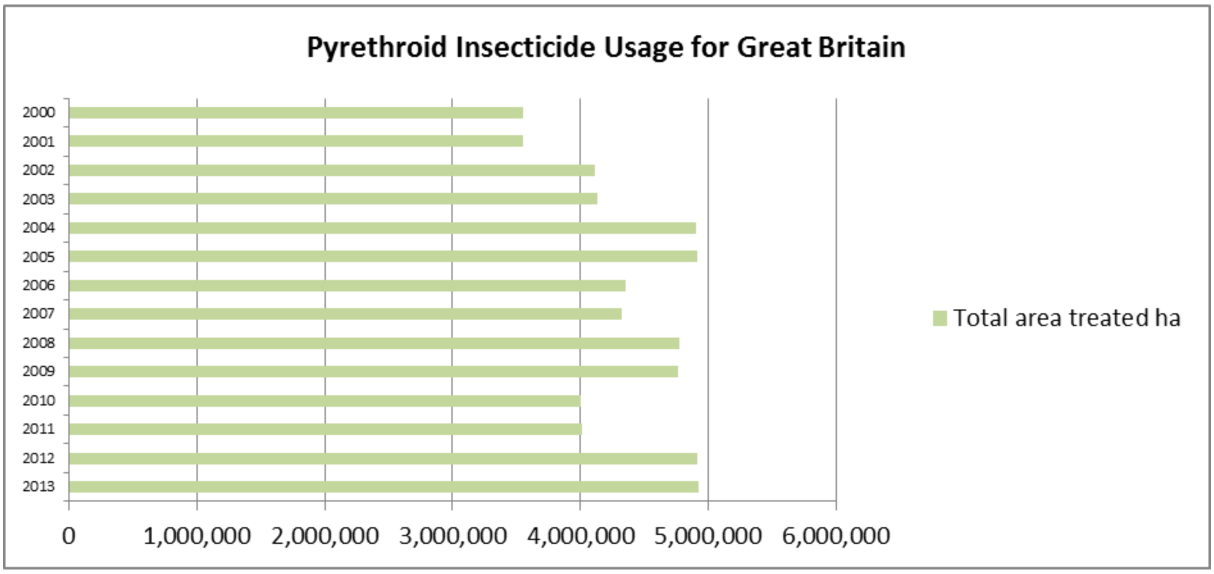
[3] NB crop area statistics were available for the UK only, so it was assumed that the trends on the relatively small crop area in Northern Ireland did not differ significantly from the overall trends and that therefore the trends for the UK are broadly equivalent to the trends for Great Britain. Figures according to agriculture statistics reported by DEFRA available at https://www.gov.uk/government/statistical-data-sets/agriculture-in-the-united-kingdom

[4] The area fluctuates from year to year, in relation to the proportion of area under temporary grassland or fallow.

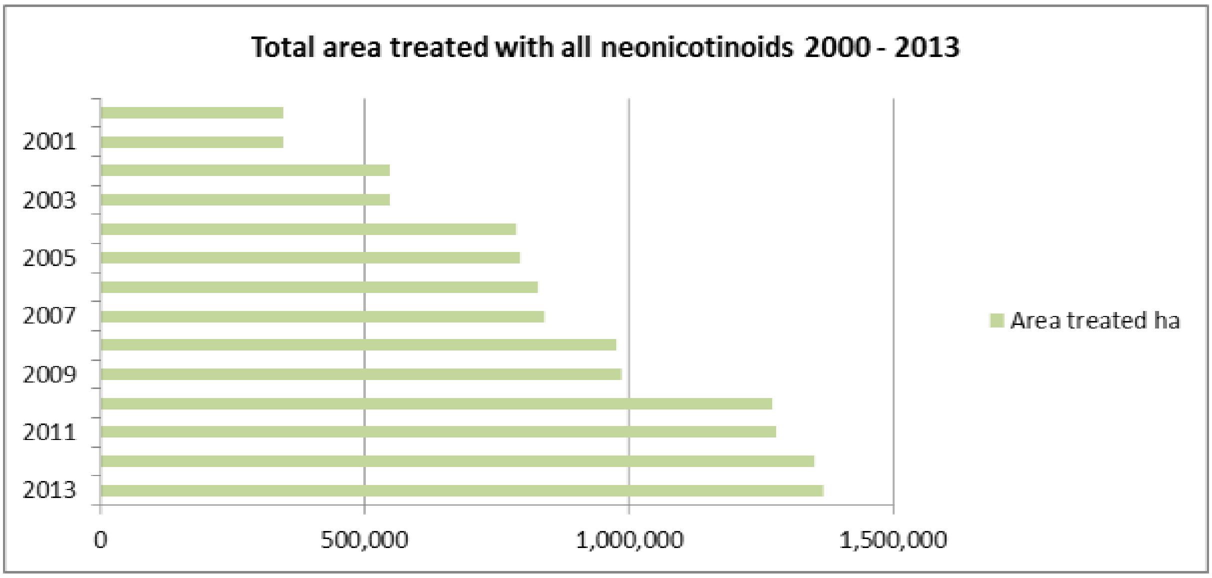
[5] No statistics are available before 2002. Defra Organic farming statistics 2013 at https://www.gov.uk/government/collections/organic-farming

[6] Garthwaite et al (2012) Pesticide usage survey report 250. Arable crops in the United Kingdom 2012. Food & Environment Research Agency, York, UK.

lambda-cyhalothrin for 31%[7]. In 2000, the same two pyrethroids accounted for 55% (cypermethrin) and 16% (lambda-cyhalothrin) of the insecticide-treated arable area[8]. Over the same period, the total area treated with organophosphate insecticides (mainly chlorpyrifos and dimethoate) has fallen by 0.36 million ha, and the use of carbamate insecticides (mainly pirimicarb) has fallen by 0.49 million ha, mainly in the last few years. Organochlorine pesticide use had substantially decreased by 2000 and has almost completely stopped since 2002. These decreases are primarily due to the withdrawal of many or most of the active substances in these chemical groups at the EU-level (see section below).



Neonicotinoid insecticide use on oilseed rape, maize and cereals



[7] ibid

[8] Garthwaite & Thomas (2003) Pesticide usage survey report 171. Arable crops in Great Britain 2000. Central Science Laboratory, York, UK.

The total area treated with neonicotinoids (including seed treatments) has increased from zero before the first introduction in 2000 to 1.37 million ha in 2013. Oilseed crops make up 39% of the neonicotinoid treated area and cereals 38%. These figures do not include the impact of the EU ban on use of certain neonicotinoids on flowering crops which applied from December 2013.

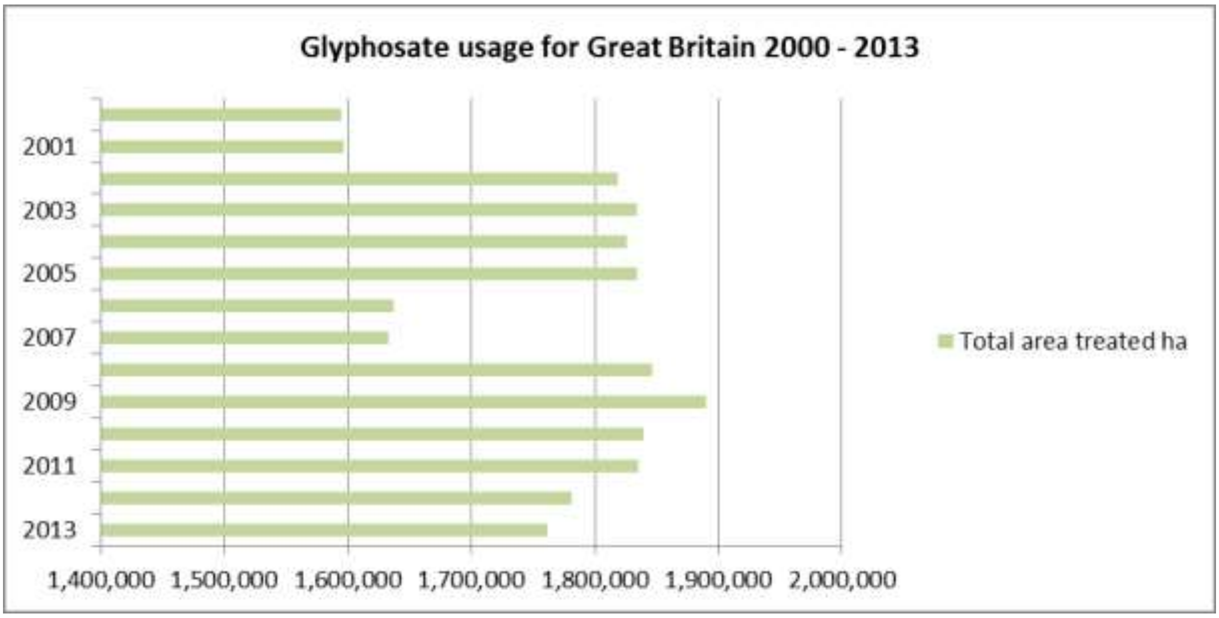
Box 2: Neonicotinoid insecticides

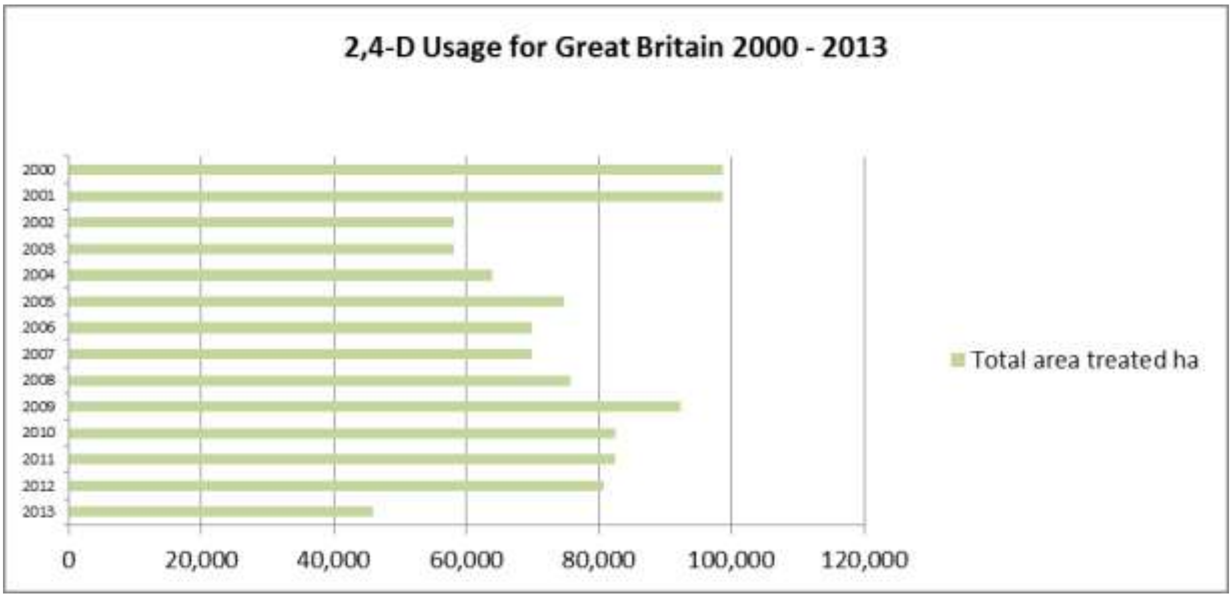
Neonicotinoids are systemic pesticides and are used as seed treatments and foliar sprays, mainly on oilseed rape, maize and cereals. Five active substances have been approved in the EU (before their temporary suspension at the end of 2013). In the UK, imidacloprid was approved in 2000 (though it was used since 1994 on imported seed), thiamethoxam and thiacloprid in 2007, clothianidin in 2008, and acetamprid in 2011. Clothianidin and thiamethoxam seed treatments have now largely replaced imidacloprid, whilst thiacloprid and acetamiprid are primarily used as foliar sprays. Neonicotinoids are a class of insecticide introduced to replace the older organophosphate and carbamate insecticides, and in particular gamma HCH-based[9] (organochlorine) seed treatments. Compared to these older chemistries neonicotinoids are less toxic to birds and mammals but have their own set of toxicity issues for non-target insect species, particularly pollinating insects including bees. A new suite of environmental issues has developed due to the inadequacy of the risk assessment system to accurately address this new mode of action not previously seen in older chemistries. In particular the risk assessment failed to take into account new routes of exposure for non-target species and the effects that these could have (see section 2.2.4).

Increase in glyphosate herbicide use and decrease in 2,4-D in agriculture

Glyphosate and 2,4-D are very widely used broad-spectrum herbicides that are used in agriculture to clear weeds before sowing and in the pre-emergence period in spring and autumn, to desiccate crops before harvest, and to control weeds in perennial crops. Overall use of the herbicide glyphosate in agriculture has risen from a total treated area of 1.59 million ha in 2000 to 1.76 million ha in 2013, a 9% increase in treated area. This has not been a steady increase but has risen and then fallen back again, with a spike in 2009 coinciding with the re-establishment of arable crops on former set-aside fallow. Glyphosate is also the most widely used pesticide in the amenity and home and garden sector, but data for comparing the use of glyphosate across sectors are not available. Over the same period, the total agricultural area treated with 2,4-D in Great Britain has fallen from 98,725 ha in 2000 to 45,832 ha in 2013, a decrease of 53%.

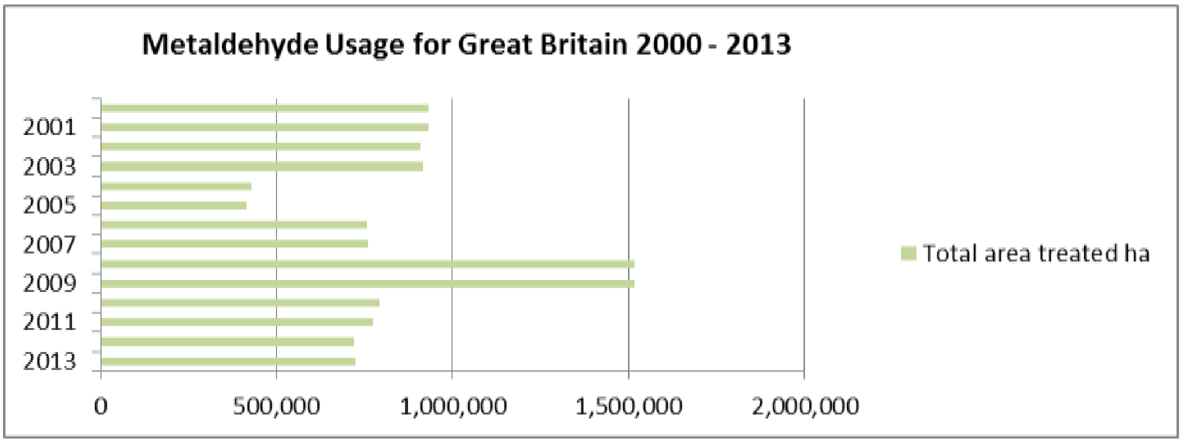
[9] gamma-hexachlorocyclohexane is also known as lindane





Decreasing trend in metaldehyde molluscicide use and increase in ferric phosphate use

Metaldehyde usage for Great Britain between 2000 and 2013 has decreased from a treated area of 930,743 ha to 723,938 ha, a decrease of 22%. However, there are still serious concerns about its presence in water. Metaldehyde is the leading cause of non-compliance with water quality standards in the UK (see section 2.2.3), and it is currently very difficult and expensive to remove it from raw water. The weather is an important influence on slug pest pressure and there are spikes in usage related to weather conditions, in particular the wetness in 2008 - 2009.



Ferric phosphate pellets were introduced in 2005 as an alternative to metaldehyde and their use has increased to 40,178 ha treated in 2013. Ferric phosphate does not significantly affect water quality, is not generally considered to be toxic to wildlife and is approved for use in organic agriculture under some circumstances.[10] UK water companies are undertaking a number of initiatives to encourage ferric phosphate use (see section 2.4.4).

Trends in pesticide use on particular crops

Notable increase in fungicide use frequency on cereals

Cereals, and mainly winter **wheat**, account for the major part of the pesticide treated area and volume used in the UK because of their dominance in the UK crop mix[11]. Fungicide use on cereals currently accounts for 69% of the total crop pesticide-treated area in Great Britain (29.44 million ha). Over 60% of wheat crops are now treated three or more times with fungicides, compared to once or twice in the early 2000s. The area treated more than four times has risen from less than 2% in 2000 to almost 7% in 2013, with a peak in 2012 when disease pressure was particularly high. Over 28 different fungicide active substances were applied to wheat in 2012, with most widespread use being made of the azole group and chlorothalonil[12]. There is, however, a recent decline in the use of chlorothalonil[13], one of the leading causes of non-compliance with water quality standards in the UK (see section 2.2.3).

The increasing trend in fungicide use frequency has arisen through a combination of disease susceptible varieties occupying much of the wheat area and an exclusive reliance on fungicides to control pathogens. Several fungal pathogens have developed resistance to fungicides, resulting in increasing applications and higher doses, and increasing use of

[10] https://www.soilassociation.org/LinkClick.aspx?fileticket=x0IweHZblN8%3D&tabid=353

[11] During the period since 2000 the overall proportion of cereals in the UK cropped area has declined by 7%, but cereals remain the dominant UK crop on nearly two thirds of the cropped area, with a notable spike in wheat area in 2008, due to the ending of the set-aside requirement.

[12] Garthwaite et al (2012) Pesticide usage survey report 250. Arable crops in the United Kingdom 2012. Food & Environment Research Agency, York, UK.

[13] Garthwaite et al (2012) Pesticide usage survey report 250. Arable crops in the United Kingdom 2012. Food & Environment Research Agency, York, UK.

fungicide mixtures[14]. For example, farmers are using azole fungicides more frequently and at higher doses against septoria blotch *Zymoseptoria tritici*, because it is increasingly insensitive to these fungicides[15]. Prothioconazole was introduced in 2006 for use as seed treatment and foliar spray on cereals and oilseeds and is now the most widely used fungicide; resistance is present in several cereal diseases[16]. There is increasing evidence of the negative impacts of certain fungicides on freshwater biodiversity (see section 2.2.4).

Large increase in pesticide-treated area and pesticide use frequency on oilseed rape

Oilseed crops, principally **oilseed rape**, have doubled in area to 16% of the UK cropped area between 2000 and 2013. Over the same period, the pesticide-treated area has increased by 258%. A much greater percentage of the UK oilseed crop is now receiving more than one treatment of insecticide, herbicide and fungicide than in 2000. In particular:

- Almost 75% of the oilseed crop is now treated three or more times with **fungicides**, compared to 15% in 2000. The area of oilseed crop that receives no fungicide treatment at all has fallen from over 35% in 2000 to 5% in 2013. Oilseed rape pollen and also wildflower pollen collected by bumblebees on and near crops was found to contain fungicides carbendazim, boscalid, tebuconazole, flusilazole and metconazole at concentrations up to 73 nanogram/gram (ng/g) (David et al 2016[17]).
- Around 35% of the oilseed crop is now treated three or more times with **insecticides** (including seed treatments), compared to 10% in 2000. The area of oilseed crop that receives no insecticide treatment at all has fallen from around 30% in 2000 to 20% in 2013.
- **Neonicotinoid** use on oilseed crops has increased from a small area following the introduction of imidacloprid in 2000 to a treated area of 529,204 ha in 2013. Neonicotinoid seed treatments seemed initially to be a positive development that could reduce the overall use of pesticides and exposure by reducing the need for foliar spraying in the first growing months. A statistical analysis of pesticide data confirms that farmers using neonicotinoid seed treatments have reduced their autumn insecticide spraying on oilseed rape, but spraying during the oilseed rape flowering period has not decreased (Budge et al 2015[18]).
- **Pyrethroid** insecticide usage on oilseed crops in Great Britain over the same period increased in area by 1.33 million ha or 255%. As some imidacloprid and clothianidin oilseed rape seed treatments are co-formulated with the pyrethroid beta-cyfluthrin, increasing neonicotinoid use is linked to increasing pyrethroid use. Pyrethroid

[14] http://cereals.ahdb.org.uk/publications/2013/september/10/consequences-of-intensive-fungicide-use-or-integrated-disease-management-for-fungicide-resistance-and-sustainable-control.aspx

[15] Paveley, N. (2015) Problems with resistance in the UK and how to minimise resistance build-up. Presentation at PLantekongres 2015. https://www.landbrugsinfo.dk%2FPlanteavl%2FPlantekongres%2FFiler%2Fpl_plk_2015_show_51_Neil_D_Paveley.pdf

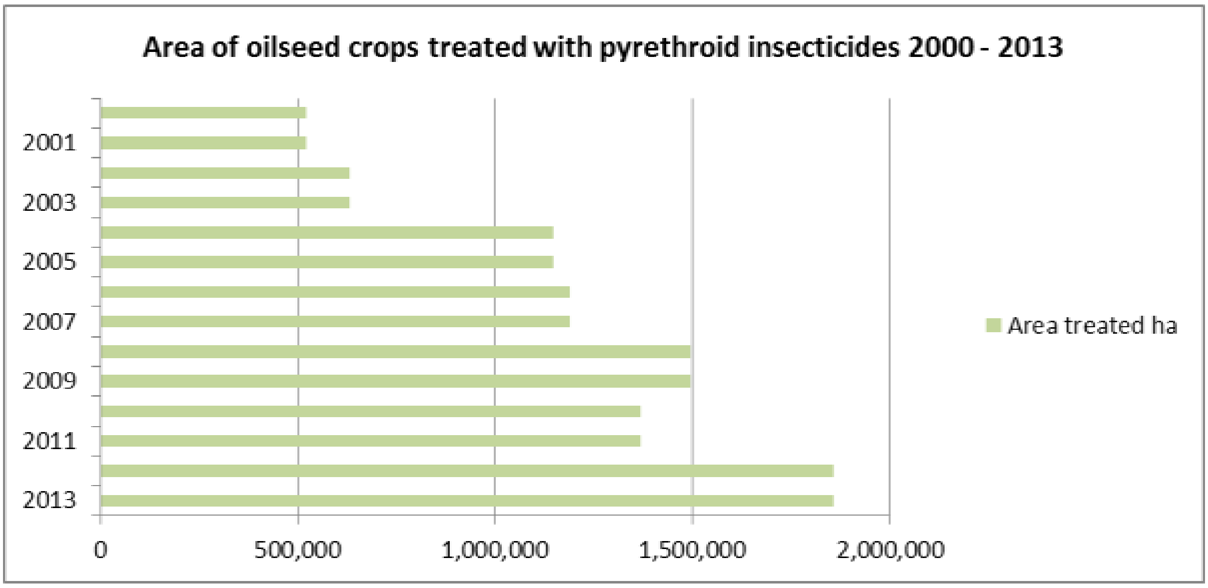
[16] http://cereals.ahdb.org.uk/media/329351/john_lucas_201312168241.pdf

[17] David, A, Botías, C, Abdul-Sada, A and Goulson, D (2016) Widespread contamination of wildflower and bee-collected pollen with complex mixtures of neonicotinoids and fungicides commonly applied to crops. Environment International No 88, pp169-178.

[18] Budge, G E, Garthwaite, D, Crowe, A, Boatman, N D, Delaplane, K S, Brown, M A, Thygesen, H H and Pietravalle, S (2015) Evidence for pollinator cost and farming benefits of neonicotinoid seed coatings on oilseed rape. Scientific Reports (Nature) No 5 (Article number: 12574), -doi:10.1038/srep12574.

resistant populations of oilseed pollen beetles are now widespread[19] and resistance in cabbage stem flea beetles[20] is becoming more common.

- 27.8% of the oilseed crop is now treated three or more times with **herbicides**, compared to 10.8% in 2000. The area of oilseed crop that receives no herbicide treatment at all has fallen from over 35% in 2000 to 5% in 2013. Herbicides used on oilseed rape before and after sowing in autumn are among the principal causes of water quality standard failures (see section 2.2.3).
- The area of oilseed crop treated with **molluscicide** has doubled, from 0.19 million ha in 2000 to 0.38 million ha in 2013.



No noticeable decrease in pesticide treated area on other crops

- The **maize** area, almost all planted to forage maize with a very small area of sweetcorn, has expanded from 2% to 4% of the UK cropped area between 2000 and 2013. Correspondingly, the fungicide- and herbicide-treated maize area has almost doubled over the same period.
- **Potatoes** are the crop with the highest intensity of pesticide applications in the UK, primarily due to the very high frequency of fungicide applications. The UK potato area declined from 4% to 3% of the UK cropped area between 2000 and 2013. Over the same period, the pesticide-treated potato area in Great Britain has increased from 3.5 million ha to 4.5 million ha.
- The **sugar beet** area has declined from 4% to 3% of the UK cropped area between 2000 and 2013. Over the same period, the pesticide-treated area of beet crops in Great Britain has increased from 2.43 million ha to 2.67 million ha. Sugar beet receives a high frequency of herbicide applications due to its susceptibility to weeds.
- **Horticulture** crops (of which 1% are grown in greenhouses) have remained constant on 3% of the UK cropped area between 2000 and 2013, with a slight decrease in area principally due to the loss of traditional orchards, and a slight increase in vegetables

[19] http://cereals.ahdb.org.uk/media/176640/is18-monitoring-and-control-of-pollen-beetle-in-oilseed-rape.pdf
[20] http://www.rothamsted.ac.uk/news-views/update-pyrethroid-resistance-cabbage-stem-flea-beetles

and soft fruit in glasshouses and polytunnels (temporary cover). Over the same period, pesticide use on top fruit (mainly apples and pears) and hops has increased from 0.596 million ha treated area in 2000 to 0.611 million ha treated area in 2013, whilst the pesticide-treated area of soft fruit remained more or less constant but then increased by 42% between 2009 and 2013.

2.1.2 ***Amenity use of pesticides***

It is estimated that approximately 5% by weight of all pesticides used in the UK are used for amenity purposes, including infrastructure, industrial, public authorities, residential, turf and golf uses[21]. There are no comparable annual usage figures available for the amenity sector, so it is not possible to draw any conclusions about whether pesticide use in the amenity sector has increased or decreased since the launch of the Voluntary Initiative in 2000. A survey of six amenity pesticide use areas (golf, industrial, infrastructure, public authorities, residential and turf) gives a snapshot of usage patterns in 2012.[22] The data are taken from interviews with manufacturers, distributers, contractors and other users in order to obtain estimates for use, so the information might not be inclusive of all uses.

The survey recorded a total pesticide-treated area of 299,158 ha. Herbicide usage accounted for 92% of the amenity area treated with pesticides, with fungicides on 4.9% of the area treated and insecticides including molluscicides on 2.8% of the treated area.[23] Six broad-spectrum herbicides and a selective broad-leaved weed herbicide account for 88% of the area treated[24], of which glyphosate is the most widely used active substance, accounting for 38% of the total treated area. 32 other active substances were reported, which were all used on less than 2% of the treated area.

Whilst it is clear that the overall use of amenity pesticides is far lower than that of agricultural pesticides there are concerns over the impact they are having on contamination of water (see below). Their use could be an important contributing factor to failures in meeting the requirements of the Water Framework Directive.[25] There is a recognised need for the amenity sector to improve pesticide use practises particularly in the areas of handling, storage and disposal.[26]

[21] http://www.publications.parliament.uk/pa/cm200405/cmselect/cmenvfru/258/25808.htm
[22] https://secure.fera.defra.gov.uk/pusstats/surveys/documents/amenity2012v2.pdf
[23] https://secure.fera.defra.gov.uk/pusstats/surveys/documents/amenity2012v2.pdf
[24] Glyphosate, dicamba, MCPA, MCPP, 2,4-D, diflufenican, glyphosate-trimesium
[25] http://www.harper-adams.ac.uk/research/project.cfm?id=87
[26] http://www.cropprotection.org.uk/media/79124/pesticides_forum_annual_report_2013.pdf

2.1.3 Pesticides in water in the UK

UK compliance with WFD standards on pesticides in water

Pesticide policy is being driven by EU legislation on allowable pesticide levels in water. Pesticides in drinking water sources continue to be a regulatory compliance issue in the UK, mainly in England, with regular non-compliance with the EU Water Framework Directive[27,28] (see Box 3).

- 24% of England's surface Drinking Water Protected Areas (DrWPAs) are currently at risk of failing to meet the EU Water Framework Directive objectives due to contamination resulting from the use of pesticides. 1.4% of Scotland's surface water DrWPAs are currently classified as at risk of deterioration due to pesticides, with sporadic occurrences in other areas. The overall pesticide risk to Welsh DrWPAs is currently assessed as low.

Box 3: Legislative framework on pesticides and water quality

The EU Water Framework Directive (WFD) (Directive 2000/60/EC) requires that there must be no upward trend in pollutants in drinking water sources and groundwater. The WFD also requires the achievement of good chemical status for all water bodies in order to protect the ecosystem (for those water bodies which are surface waters), including compliance with thresholds for certain pesticide active substances identified at the EU level as priority substances with Environmental Quality Standards (EQS)[29]. The WFD also sets out requirements for monitoring. Member States can identify additional pesticide active substances as River Basin 'Specific Pollutants' with their own EQS for surface and groundwater. The EU Groundwater Directive (Directive 2006/118/EU[30]) sets a default maximum concentration of every active substance or pesticide relevant metabolite at 0.1 µg/l (ie 0.1 parts per billion) if there is no defined EQS; and a maximum total[31] pesticide concentration including the pesticide relevant metabolites, degradation and reaction products of 0.5 µg/l (ie 0.5 parts per billion). The EU Drinking Water Directive (Council Directive 98/83/EC[32]) sets Maximum Allowable Concentrations of 0.1 µg/l for any pesticide and 0.5 µg/l for total pesticides in drinking water at the tap irrespective of toxicity.

Pesticides also continue to trigger failures of environmental standards in water bodies.

- In England and Wales, 11 surface water bodies currently fail 'good status' because of pesticides[33]. There are no current failures in Scotland, though 39 different active substances are being detected.

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27 Pesticides Forum (2014) Pesticides in the UK. The 2014 report on the impacts and sustainable use of pesticides. http://www.cropprotection.org.uk/media/95281/pesticides-forum-2014-annual-report.pdf

28 Pesticides Forum (2013) Pesticides in the UK. The 2013 report on the impacts and sustainable use of pesticides. http://www.pesticides.gov.uk/Resources/CRD/Migrated-Resources/Documents/P/PesticidesintheUK2013_Aug14.pdf

29 Pesticide active substances listed in the EU Priority Substances Directive (Directive 2013/39/EC updating Directive 2008/105/EC) include: 2,4-D, bifenox, chlorpyrifos, cypermethrin, dimethoate, isoproturon, linuron, quinoxyfen (currently used in the UK), and diuron, diazinon, mecoprop, trifluralin (not approved in the EU and/or UK).

30 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

31 'Total' means the sum of all individual pesticides detected and quantified in the monitoring procedure, including their relevant metabolites, degradation and reaction products.

32 http://ec.europa.eu/environment/water/water-drink/legislation_en.html

33 http://www.cropprotection.org.uk/media/95281/pesticides-forum-2014-annual-report.pdf

- 5% of groundwater bodies in England and Wales fail WFD 'good status' because of the presence of pesticides. No Scottish groundwater bodies are currently failing due to pesticides, though various active substances have been detected.

Certain pesticide active substances are repeat offenders but remain approved in the UK. The main pesticides which result in failures of water quality standards are those applied to autumn sown crops, particularly oilseed rape and cereals. Metaldehyde caused 88 (17%) of drinking water protection zones to be at risk of failing drinking water standards in 2013[34]. A small group of herbicides used on oilseed rape, cereals and grassland (including MCPA, propyzamide, carbetamide, mecoprop-P, and chlorotoluron) cause the majority of the remaining compliance risk. Some herbicides are finding their way into water as a result of amenity use, such as 2,4-D, MCPA, and glyphosate, whilst the presence of some active substances in water is due to veterinary uses on livestock.

2.1.4 Pesticide impacts on wildlife and biodiversity

Pesticides have negative impacts on wildlife through both direct toxic effects and indirect effects through impacts on the food chain and habitats, for example by decreasing the abundance and diversity of weeds and insects. Pesticide use has also facilitated structural changes in agriculture that have indirect negative impacts on wildlife, notably reduced crop diversity within and across fields, simplified crop rotations, denser stands of cereals and less grassland and legumes. The evidence for broad impacts of pesticides in the UK was described when the Voluntary Initiative was launched (Plumb & Bromilow 2001[35], Marshall et al 2001[36]) and in various reviews in the 15 years since (eg Marshall et al 2003[37], Boatman et al 2004[38], Defra 2005[39], Morris et al 2005[40], Frampton et al 2007[41], Bright et al 2008[42]),

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[34] http://www.pesticides.gov.uk/Resources/CRD/Migrated-Resources/Documents/P/Agenda%20item%204%20Simon%20Crabbe%20PF%2018%20June%202014%20Water.pdf

[35] Plumb, R.T. & Bromilow,R.H. (2001) Pesticides and Birds: A report on the evidence for changes in farmland bird populations and the proposals for a pesticide tax. HGCA Research Review No 46. http://cereals.ahdb.org.uk/media/288205/rr46-final-project-report.pdf

[36] Marshall,J, Brown,V., Boatman,N., Lutman,P., Squire,G. (2001) The impact of herbicides on weed abundance and biodiversity. PN0940. http://www.pesticides.gov.uk/guidance/industries/pesticides/topics/publications/research-reports/the-impact-of-herbicides-on-weed-abundance-biodiversity

[37] Marshall, E J P, Brown, V K, Boatman, N D, Lutman, P J W, Squire, G R and Ward, L K (2003) The role of weeds in supporting biological diversity within crop fields. Weed Research No 43 (2), pp77-89.

[38] Boatman, N D, Brickle, N W, Hart, J D, Milsom, T P, Morris, A J, Murray, A W A, Murray, K A and Robertson, P A (2004) Evidence for the indirect effects of pesticides on farmland birds. Ibis No 146 (s2), pp131-143.

[39] DEFRA (2005) Assessing the indirect effects of pesticides on birds. Report by Central Science Laboratory, Game Conservancy Trust, RSPB & Department of Zoology, University of Oxford. PN0925. Department of Environment, Food and Rural Affairs, UK. http://randd.defra.gov.uk/Document.aspx?Document=PN0925_2486_FRP.pdf

[40] Morris, A J, Wilson, J D, Whittingham, M J and Bradbury, R B (2005) Indirect effects of pesticides on breeding yellowhammer (*Emberiza citrinella*). Agriculture Ecosystems and Environment No 106 (1), pp1-16.

[41] Frampton, G K and Dorne, J L C M (2007) The effects on terrestrial invertebrates of reducing pesticide inputs in arable crop edges: a meta-analysis. Journal of Applied Ecology No 44 (2), pp362-373.

[42] Bright, J A, Morris, A J and Winspear, R (2008) A review of indirect effects of pesticides on birds and mitigating land-management practices. RSPB Research Report No 28. RSPB, UK. https://www.rspb.org.uk/Images/bright_morris_winspear_tcm9-192457.pdf

and is not repeated here. In this section we highlight some recent research findings of pesticide impacts on wildlife in Europe. Reviews at the EU level have recently been carried out by EFSA reviewing impacts on insects and other arthropods (EFSA 2015[43]) and by the German Environment Agency reviewing impacts on birds and mammals (Jahn et al 2014[44]) and plants (Schmitz et al 2015[45]).

Pesticides and farmland birds

In 2001 it was judged that there was not sufficient evidence to prove links between pesticide use and bird species for which declines have been recorded in the UK, because any effects could not be separated from the many other changes involving agriculture (Fuller, 2000[46]; Plumb & Bromilow 2001[47]). However, since 2001 a considerable amount of research has been carried out providing strong evidence of indirect effects of pesticide use on farmland birds through impacts on food and habitat availability, summarised in a report in 2008 (Bright et al 2008[48]). It is more difficult to attribute direct effects of pesticides to bird mortality in the field (Millot et al 2015[49]), other than poisonings by rodenticides or slug pellets and deliberate poisonings of birds of prey.

Examples of some recent findings:

- Insect sampling in arable crop fields and margins over two years in three different locations in England found that the Grey Partridge chick-food index in all crops was only a half or less of the level required to ensure that chick survival is sufficient to maintain population abundance (Holland et al 2012[50]).
- A survey of wildlife in winter cereal fields across Europe found consistent negative effects of insecticide and fungicide use on the species diversity of plants, carabids and ground-nesting farmland birds (Geiger et al 2010[51]).

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[43] EFSA (2015) Scientific Opinion addressing the state of the science on risk assessment of plant protection products for non-target arthropods. EFSA Journal No 13 (2), 3996.

[44] Jahn, T, Hötker, H, Oppermann, R, Bleil, R and Vele, L (2014) Protection of biodiversity of free living birds and mammals in respect of the effects of pesticides. Umweltbundesamt (Federal Environment Agency), Germany. https://www.umweltbundesamt.de/publikationen/protection-of-biodiversityof-free-living-birds

[45] Schmitz, J, Stahlschmidt, P and Brühl, C A (2015) Protection of terrestrial non-target plant species in the regulation of environmental risks of pesticides. Umweltbundesamt, Germany. http://www.umweltbundesamt.de/sites/default/files/medien/378/publikationen/texte_20_2014_protection_of_terrestrial_no-target_plant_species_1.pdf

[46] Fuller, R. J. (2000). Relationships between recent changes in lowland British agriculture and farmland bird populations: an overview. In Ecology and Conservation of Lowland Farmland Birds. N. J. Aebischer, A. D. Evans, P. V. Grice & J. A. Vickery (Eds). 5-16, BOU Tring.

[47] Plumb, R.T. & Bromilow,R.H. (2001) Pesticides and Birds: A report on the evidence for changes in farmland bird populations and the proposals for a pesticide tax. HGCA Research Review No 46. http://cereals.ahdb.org.uk/media/288205/rr46-final-project-report.pdf

[48] Bright, J A, Morris, A J and Winspear, R (2008) A review of indirect effects of pesticides on birds and mitigating land-management practices. RSPB Research Report No 28. RSPB, UK. https://www.rspb.org.uk/Images/bright_morris_winspear_tcm9-192457.pdf

[49] Millot,F., Berny,P., Decors,A., Bro,E. (2015) Little field evidence of direct acute and short-term effects of current pesticides on the grey partridge. Ecotoxicology and Environmental Safety 117: 41-61

[50] Holland, J M, Smith, B M, Birkett, T C and Southway, S (2012) Farmland bird invertebrate food provision in arable crops. Annals of Applied Biology No 160 (1), pp66-75.

[51] Geiger, F, Bengtsson, J, Berendse, F, Weisser, W W, Emmerson, M, Morales, M B, Ceryngier, P, Liira, J, Tscharntke, T, Winqvist, C, Eggers, S, Bommarco, R, Pärt, T, Bretagnolle, V, Plantegenest, M, Clement, L W,

- Bird communities on arable land in northern France were poorer in habitat specialist species in fields with high herbicide use, particularly through the absence of herbivorous bird species, which suffer from the lack of seed food (Chiron et al 2014[52]).
- Bird species typical of lowland arable farmland in the UK showed rapid increases in populations in response to farm-scale crop management changes including low herbicide use on the fallow fields introduced into the rotation (Henderson et al 2009[53]). The study showed that a commercial crop rotation can be significantly optimised for birds.
- Herbicide drift may be significantly reducing flower, seed and berry food resources for birds, insects and other animals in hedgerows and field margins by delaying flowering times and reducing flower production and seed set in wild plant species (Boutin et al 2014[54], Schmitz et al 2013[55]).

Widespread environmental impacts of neonicotinoids and fipronil

Neonicotinoid use has been linked to losses of honey bee colonies and declines in wild pollinator species around the world (Pisa et al 2015[56], Godfray et al 2015[57]). Concern about the use of neonicotinoids and their effects has led to restrictions on use in various EU Member States, and in 2013 a temporary EU-wide ban on use of the neonicotinoids imidacloprid, clothianidin and thiamethoxam on flowering crops deemed attractive to bees was introduced. In the opinion of the European Commission the use of the three neonicotinoids posed an unacceptably high risk to bees and their approval was based on flawed data provided by the manufacturers that contained gaps in the data that missed important toxicity information. Fipronil was also temporarily banned for the same reasons.

There is now a substantial body of evidence that neonicotinoid insecticides and fipronil are having widespread, chronic impacts upon invertebrates, particularly bees, earthworms, and

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Dennis, C, Palmer, C, Oñate, J J, Guerrero, I, Hawro, V, Aavik, T, Thies, C, Flohre, A, Hänke, S, Fischer, C, Goedhart, P W and Inchausti, P (2010) Persistent negative effects of pesticides on biodiversity and biological control potential on European farmland. Basic and Applied Ecology No 11 (2), pp97-105.

[52] Chiron, F, Chargé, R, Julliard, R, Jiguet, F and Muratet, A (2014) Pesticide doses, landscape structure and their relative effects on farmland birds. Agriculture Ecosystems and Environment No 185, pp153-160.

[53] Henderson, I G, Ravenscroft, N, Smith, G and Holloway, S (2009) Effects of crop diversification and low pesticide inputs on bird populations on arable land. Agriculture Ecosystems and Environment No 129 (1-3), pp149-156.

[54] Boutin, C, Strandberg, B, Carpenter, D, Mathiassen, S and Thomas, P (2014) Herbicide impact on non-target plant reproduction: What are the toxicological and ecological implications? Environmental Pollution No 185, 295-306.

[55] Schmitz, J, Schäfer, K and Brühl, C A (2013) Agrochemicals in field margins - assessing the impacts of herbicides, insecticides, and fertilizer on the common buttercup (Ranunculus acris). Environmental Toxicology and Chemistry No 32, (5) 1124-1131.

[56] Pisa, L W, Amaral-Rogers, V, Belzunces, L P, Bonmatin, J M, Downs, C A, Goulson, D, Kreutzweiser, D P, Krupke, C, Liess, M, McField, M, Morrissey, C A, Noome, D A, Settele, J, Simon-Delso, N, Stark, J D, van der Sluijs, J P, Van Dyck, H and Wiemers, M (2015) Effects of neonicotinoids and fipronil on non-target invertebrates. Environmental Science and Pollution Research No 22 (1), pp68-102.

[57] Godfray, H C, Blacquière, T, Field, L M, Hails, R S, Potts, S G, Raine, N E, Vanbergen, A J and McLean, A R (2015) A restatement of recent advances in the natural science evidence base concerning neonicotinoid insecticides and insect pollinators. Proceedings of the Royal Society of London B: Biological Sciences No 282 (1818).

several freshwater taxa, which have been found to be highly susceptible to lethal and sublethal effects of neonicotinoids and/or fipronil at environmentally relevant concentrations (Chagnon et al 2015[58], Vijver et al 2014[59], Van Dijk et al 2014[60]). This is likely to be having major negative effects on ecosystem services such as pollination and nutrient cycling in soils and water (van der Sluijs et al 2015[61], Kreutzweiser et al 2008[62]). The accumulation of neonicotinoids in soil is much greater than has been assumed by pesticide regulators, and as they are systemic they are taken up by weeds and other vegetation growing on or near arable fields (Botías et al 2015[63]). The resulting presence of neonicotinoids in pollen and nectar has toxic effects on flower-visiting insects including bees, beetles and butterflies (Krischik et al 2015[64]). A study found that pollen collected by bumblebees from both oilseed rape and wildflowers near crops contained high levels of the neonicotinoids thiamethoxam and thiacloprid (David et al 2016[65]). There is evidence of a tritrophic effect on predaceous beetle activity through slugs feeding on treated seedlings (Douglas et al 2015[66]). Neonicotinoids are also prevalent in water and distributed in air via dust particles generated during sowing of crops with treated seed and aerosols during spraying (Krupke et al 2012[67]). The impacts on terrestrial and aquatic invertebrates are likely to be linked to declines in insectivorous farmland birds in western Europe (Hallmann et al

[58] Chagnon, M, Kreutzweiser, D P, Mitchell, E A D, Morrissey, C A, Noome, D A and van der Sluijs, J (2015) Risks of large-scale use of systemic insecticides to ecosystem functioning and services. Environmental Science and Pollution Research No 22 (1), pp119-134.

[59] Vijver, M G and van den Brink, P J (2014) Macro-invertebrate decline in surface water polluted with imidacloprid: a rebuttal and some new analyses. PLoS ONE No 9 (2), e89837-DOI: 10.1371/journal.pone.0089837.

[60] van Dijk, T C, van Staalduinen, M A and van der Sluijs, J P (2013) Macro-invertebrate decline in surface water polluted with imidacloprid. PLoS ONE No 8 (5), e62374-doi:10.1371/journal.pone.0062374.

[61] van der Sluijs, J P, Amaral-Rogers, V, Belzunces, L P, van Lexmond, M B, Bonmatin, J M, Chagnon, M, Downs, C A, Furlan, L, Gibbons, D W, Giorio, C, Girolami, V, Goulson, D, Kreutzweiser, D P, Krupke, C, Liess, M, Long, E, McField, M, Mineau, P, Mitchell, E A D, Morrissey, C A, Noome, D A, Pisa, L, Settele, J, Simon-Delso, N, Stark, J D, Tapparo, A, Van Dyck, H, van Praagh, J, Whitehorn, P R and Wiemers, M (2015) Conclusions of the Worldwide Integrated Assessment on the risks of neonicotinoids and fipronil to biodiversity and ecosystem functioning. Environmental Science and Pollution Research No 22 (1), pp148-154.

[62] Kreutzweiser, D P, Good, K P, Chartrand, D T, Scarr, T A, Holmes, S B and Thompson, D G (2008) Effects on litter-dwelling earthworms and microbial decomposition of soil-applied imidacloprid for control of wood-boring insects. Pest Management Science No 64 (2), pp112-118.

[63] Botías, C, David, A, Horwood, J, Abdul-Sada, A, Nicholls, E, Hill, E and Goulson, D (2015) Neonicotinoid residues in wildflowers, a potential route of chronic exposure for bees. Environmental Science & Technology No 49 (21), pp12731-12740.

[64] Krischik,V., Rogers,M., Gupta,G., Varschney,A. (2015) Soil-applied imidacloprid translocates to ornamental flowers and reduces survival of adult *Coleomegilla maculata*, *Harmonia axyridis*, and *Hippodamia convergens* Lady Beetles, and larval *Danaus plexippus* and *Vanessa cardui* butterflies. PLoS ONE 10(3): e0119133: doi:10.1371/journal.pone.0119133

[65] David, A, Botías, C, Abdul-Sada, A and Goulson, D (2016) Widespread contamination of wildflower and bee-collected pollen with complex mixtures of neonicotinoids and fungicides commonly applied to crops. Environment International No 88, pp169-178.

[66] Douglas, M R, Rohr, J R and Tooker, J F (2015) Neonicotinoid insecticide travels through a soil food chain, disrupting biological control of non-target pests and decreasing soya bean yield. Journal of Applied Ecology No 52 (1), pp250-260.

[67] Krupke, C H, Hunt, G J, Eitzer, B D, Andino, G and Given, K (2012) Multiple routes of pesticide exposure for honey bees living near agricultural fields. PLoS ONE No 7 (1), e29268-doi: 10.1371/journal.pone.0029268.

2014[68]) and neonicotinoids may be linked to butterfly decline in England (Gilburn et al 2015[69]).

Pesticides and amphibians

A study for EFSA in 2012 pointed out the substantial data gaps in assessing pesticide risks to amphibians, particularly on land and in arable fields (Fryday & Thompson 2012[70]). A number of studies have shown that some pesticides, including strobilurin fungicides, are more toxic to amphibians in the agricultural environment at current recommended label rates than is accounted for by current environmental risk assessments (eg Belden et al 2010[71], Brühl et al 2013[72], Hooser et al 2012[73], Wagner et al 2013[74]). The authors conclude that large-scale negative effects of terrestrial pesticide exposure on amphibian populations seem likely. The added surfactants in many glyphosate-based herbicide formulations have been shown to stress amphibians, and acute toxic, chronic and delayed effects at environmentally relevant and sublethal concentrations have been shown (Wagner et al 2013[75]). Amphibians are regularly exposed to pre-sowing and/or pre-emergence glyphosate pesticide applications to cereals in spring (Berger et al 2014[76]).

Pesticides and freshwater biodiversity

Water monitoring across Europe shows that pesticides and other organic chemicals are likely to chronically affect fish, aquatic invertebrates, and/or algae in at least 42% of river and lake monitoring sites, and to acutely affect at least one group in at least 14% of sites (Malaj et al 2013[77]). This is likely to be a significant underestimate of impacts on freshwater

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[68] Hallmann, C A, Foppen, R P B, van Turnhout, C A M, de Kroon, H and Jongejans, E (2014) Declines in insectivorous birds are associated with high neonicotinoid concentrations. Nature No 511 (7509), pp341-343.

[69] Gilburn, A S, Bunnefeld, N, Wilson, J M, Botham, M S, Brereton, T M, Fox, R and Goulson, D (2015) Are neonicotinoid insecticides driving declines of widespread butterflies? PeerJ No 3, e1402. http://www.ncbi.nlm.nih.gov/pubmed/26623186

[70] Fryday, S and Thompson, H (2012) Toxicity of pesticides to aquatic and terrestrial life stages of amphibians and occurrence, habitat use and exposure of amphibian species in agricultural environments. EFSA Supporting Publications: EN-343. Study by FERA for European Food Safety Authority, York, UK. http://www.efsa.europa.eu/en/supporting/pub/343e.htm

[71] Belden,J., McMurry,S., Smith,L., Reilley,P. (2010) Acute toxicity of fungicide formulations to amphibians at environmentally relevant concentrations. Environmental Toxicology and Chemistry 29(11): 2477-2480.

[72] Brühl, C A, Schmidt, T, Pieper, S and Alscher, A (2013) Terrestrial pesticide exposure of amphibians: An underestimated cause of global decline? Scientific Reports (Nature) No 3 (1135), doi:10.1038/srep01135.

[73] Hooser,E.A., Belden,J.B., Smith,L.M., McMurry,S.T. (2012) Acute toxicity of three strobilurin fungicide formulations and their active ingredients to tadpoles. Ecotoxicology 21: 1458-1464

[74] Wagner,N., Reichenbecher,W., Teichmann,H., Tappeser,B., Lötters,S. (2013) Questions concerning the potential impact of glyphosate-based herbicides on amphibians. Environmental Toxicology & Chemistry 32(8): 1688-1700

[75] Wagner, N, Reichenbecher, W, Teichmann, H and Lötters, S (2013) Questions concerning the potential impact of glyphosate-based herbicides on amphibians. Environmental Toxicology and Chemistry No 32 (8), pp1688-1700.

[76] Berger, G, Graef, F and Pfeffer, H (2013) Glyphosate applications on arable fields considerably coincide with migrating amphibians. Scientific Reports (Nature) No 3 (Article number: 2622), -doi:10.1038/srep02622.

[77] Malaj, E, von der Ohe, P C, Grote, M, Kühne, R, Mondy, C P, Usseglio-Polatera, P, Brack, W and Schäfer, R B (2014) Organic chemicals jeopardize the health of freshwater ecosystems on the continental scale. *Proceedings of the National Academy of Sciences of the USA* No 111 (26), pp9549-9554.

biodiversity across Europe, given the poor sampling density and the small number of chemicals monitored in Southern Europe during the period 2006 to 2010.

Field evidence shows that current EU thresholds for aquatic ecotoxicity are not protective for aquatic communities subject to multiple stressors, pesticide mixtures, and repeated exposures (Schäfer et al 2012[78]). Pesticides at concentrations that current legislation considers environmentally protective have been shown to cause statistically significant effects on both the species and family richness of stream invertebrates in Germany and France, with losses of up to 42% of the recorded taxa (Beketov et al 2013[79]). Several studies have shown how fungicides have wide ranging impacts on freshwater biodiversity and leaf litter breakdown at currently recommended application rates (McMahon et al 2012[80], Zubrod et al 2015[81], Dijksterhuis et al 2011[82]).

A wide range of pesticides accumulate in soft sediments of edge-of-field ponds, ditches and streams, where they are often more concentrated than in the water (EFSA 2015[83]), and where the combination of ongoing exposure with accumulated pesticides (including many banned substances) may be significantly more toxic than in the body of the water (Rasmussen et al 2015[84]). Current EU risk assessment models are failing to predict realistic concentrations of pesticides in surface water (Knäbel et al 2013[85]), and ignore accumulated pesticides in sediment, and therefore may be severely underestimating the risk of ecological effects on freshwater biodiversity.

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[78] Schäfer,R.B., Von Der Ohe,P.C., Rasmussen,J., Kefford,B.J., Beketov,M.A., Schulz,R., Liess,M. (2012) Thresholds for the effects of pesticides on invertebrate communities and leaf breakdown in stream ecosystems. Environmental Science & Technology 46(9): 5134-5142

[79] Beketov, M A, Kefford, B J, Schäfer, R B and Liess, M (2013) Pesticides reduce regional biodiversity of stream invertebrates. Proceedings of the National Academy of Sciences of the USA No 110 (27), pp11039-11043.

[80] McMahon, T.A., Halstead,N.T., Johnson,S., Raffel,T.R., Romansic,J.M., Crumrine,P.W., Rohr,J.R. (2012) Fungicide-induced declines of freshwater biodiversity modify ecosystem functions and services. Ecology Letters 15(7): 714-722. doi:10.1111/j.1461-0248.2012.01790.x

[81] Zubrod,J.P., Englert,D., Feckler,A., Koksharova,N., Konschak,M., Bundschuh,R., Schnetzer,N., Englert,K., Schulz,R., Bundschuh,M. (2015) Does the current fungicide risk assessment provide sufficient protection for key drivers in aquatic ecosystem functioning? Environmental Science & Technology 49, 1173-1181

[82] Dijksterhuis,J., van Doorn,T., Samson,R., Postma,J. (2011) Effects of seven fungicides on non-target aquatic fungi. Water Soil Air Pollution 222: 421-425.

[83] EFSA (2015) Scientific Opinion on the effect assessment for pesticides on sediment organisms in edge-of-field surface water. EFSA Journal 2015 13(7): 4176

[84] Rasmussen,J.J., Wilberg-Larsen,P., Baattrup-Pedersen,A., Cedergreen,N., McKnight,U.S., Kreuger,J., Jacobsen,D., Kristensen,E.A., Friberg,N. (2015) The legacy of pesticide pollution: An overlooked factor in current risk assessments of freshwater systems. Water Research In Press, doi: 10.1016/j.watres.2015.07.021

[85] Knäbel,A., Meyer,K., Rapp,J., Schulz,R. (2014) Fungicide field concentrations exceed FOCUS surface water predictions: urgent need of model improvement. Environmental Science & Technology 48(1): 455-463

2.2 Drivers of change in pesticide use in the UK

The Voluntary Initiative was designed to be a direct driver for change in the way pesticides are used, the quantity of pesticides that are used, to minimise the risks of pesticide use and to reduce the adverse environmental effects of pesticide use in the UK. However, it does not and never has stood alone in this regard and cannot be considered to be the sole driver for change in the UK. The following section reviews the key regulations, guidance and initiatives run by government, industry and others aimed at driving and encouraging change in pesticide use, as well as EU wide legislation and regulation.

2.2.1 Withdrawal of pesticide active substances in the UK

The approval and review of the active substances in pesticides is regulated at the EU level since 1993 when Directive 91/414/EEC came into force, replaced in 2011 by the more stringent Plant Protection Products Regulation (Regulation (EC) No 1107/2009[86]). The Regulation was brought in to reduce the harmful effects of pesticides on human health and the environment. Under this regulation active substances can be approved for up to 15 years[87], but they will not be approved or re-approved in the EU if they are classified as having one or more of a list of intrinsic properties above defined thresholds (known as 'cut-off criteria'), including persistence and bio-accumulation in the environment and in wildlife. This is a change from a purely risk-based approach, in which any chemical could be approved if the exposure was considered acceptable, to one which includes some hazard-based elements, where chemicals with certain intrinsic highly toxic properties are considered unacceptable independently of expected exposure. The Commission has drawn up a list of candidates for substitution that qualify for the 'cut-off criteria', currently containing 77 active substances[88]. Whenever nationally authorised pesticides with these substances need to be approved or reapproved, national authorities must carry out an assessment to establish whether more favourable alternatives to using the plant protection product exist, including non-chemical methods.

The environmental risk assessment of pesticide active substances in the EU is supposed to follow the latest guidance produced by the European Food Safety Authority (EFSA) (Box 4). Pesticide approvals must also be evaluated against EU legislation on allowable pesticide levels in water.

[86] 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. http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32009R1107

[87] Commission Regulation (EU) No 283/2013 provides a comprehensive list of the tests and studies required to support an active substance for approval and then to support an application for product authorisation at Member State level.

[88] http://ec.europa.eu/food/plant/pesticides/approval_active_substances/docs/draft_list_cfs_en.pdf

Box 4: EU guidelines for environmental risk assessment of pesticide active substances

Guidance on environmental risk assessment under the EU Plant Protection Products Regulation is available for: wild birds and mammals (EFSA 2009[89]), aquatic ecotoxicology (EFSA 2013[90]), honeybees and wild bees (EFSA 2013[91]), movement to groundwater (EFSA 2014[92]), and various other technical standards. The guidance is reviewed and approved by Member States representatives in the Plants, Animals, Food and Feed (PAFF Committee[93]). EU Member States failed to approve the bee guidance, and the Commission is now assessing the potential impact of adoption[94]. The European Food Safety Authority (EFSA) is currently revising its guidance on terrestrial ecotoxicology, and will produce new guidance on in-soil organisms, non-target arthropods, amphibians and reptiles, and non-target terrestrial plants in the next few years[95]. After approval by the PAFF Committee, the guidance becomes obligatory both for new pesticide active substances and reviews of old approvals[96]. The European Commission can also request EFSA to re-assess active substances at any time[97] in light of new scientific and technical knowledge and monitoring data and according to the current guidance.

EU-wide withdrawals and bans have been the most visible drivers of reductions in the overall environmental impact of pesticides since 2001 by removing the most persistent chemicals, for example the withdrawal of atrazine and simazine has clearly reduced pesticide concentrations in water[98]. All pesticide active substances being used in the EU in 1993 were reviewed under Directive 91/414/EEC, and over three-quarters were not re-approved by the EU. This resulted in a list of around 230 active substances with 10 year re-approvals at the EU level by 2011[99]. This has reduced the number of highly toxic, persistent and bio-accumulative pesticide active substances, largely because of the withdrawal of older chemicals. However, overall, a relatively small number of active substances have been completely withdrawn by the EU for environmental reasons and/or due to the 'cut-off criteria' (Box 5). The main reason for withdrawal up to 2011 was because the data to support their EU registration was not supplied, because the agro-chemical industry decided there was not enough economic interest to support the cost of review. Evidence of

[89] EFSA (European Food Safety Authority) (2009) Guidance Document on Risk Assessment for Birds and Mammals on request from EFSA. EFSA Journal No 7 (12), 1438-doi:10.2903/j.efsa.2009.1438.

[90] EFSA (2013) Guidance on tiered risk assessment for plant protection products for aquatic organisms in edge-of-field surface waters. EFSA Journal No 11 (7), 3290-doi:10.2903/j.efsa.2013.3290. http://www.efsa.europa.eu/en/efsajournal/pub/3290.htm

[91] EFSA (2013) EFSA Guidance Document on the risk assessment of plant protection products on bees (Apis mellifera, Bombus spp. and solitary bees). EFSA Journal No 11 (7), 3295-doi: 10.2903/j.efsa.2013.3295. http://www.efsa.europa.eu/en/efsajournal/pub/3295.htm

[92] Assessing Potential for Movement of Active Substances and their Metabolites to Ground Water in the EU; Commission Guidance Document SANCO/13144/2010, version 3, 10 October 2014 http://focus.jrc.ec.europa.eu/gw/docs/NewDocs/focusGWReportOct2014.pdf

[93] NB this was known as the Standing Committee on the Food Chain and Animal Health (SCOFCAH) until September 2014

[94] Bee Life May 2015. EFSA Guidance: New methodologies to assess the risks of pesticides on bees. European Beekeeping Coordination ASBL. http://bee-life.eu/medias/temp/guidance-en.pdf

[95] EFSA News in Brief 12 February 2015. http://www.efsa.europa.eu/en/press/news/150212b.htm

[96] However, the guidance does not produce legally binding effects and does not prejudice any measure taken by a Member State under Directive 91/414/EEC

[97] According to Article 21 of the Plant Protection Products Regulation

[98] Nödler, K, Licha, T and Voutsa, D (2013) Twenty years later – Atrazine concentrations in selected coastal waters of the Mediterranean and the Baltic Sea. Marine Pollution Bulletin No 70 (1-2), pp112-118.

[99] As new substances have been approved since 2001, a total of 471 active substances are currently approved at the EU level. This includes 4 basic substances and 3 low-risk substances. EU Pesticides Database http://ec.europa.eu/food/plant/pesticides/pesticides_database/index_en.htm

environmental impacts has more commonly resulted in EU-wide restrictions in some uses, whilst other uses remain approved.

Box 5: Examples of EU withdrawals or restrictions on pesticide active substances since 2001 that have had or can be expected to have environmental benefits in the UK

EU withdrawals:

- **Atrazine** and **simazine** were withdrawn in the EU in 2004 because of persistent groundwater contamination, with use under derogations up to 2007.
- **Diazinon** EU approval was withdrawn in 2007, though it is still authorised as a biocide (eg in sheep dip in the UK). It is an EU priority substance for water quality monitoring.
- **Dichlobenil** EU approval was withdrawn in 2008, which primarily affected its use as herbicide outside agriculture (eg forests, parks). It was shown to be very persistent in groundwater (eg in Denmark), and moderately toxic to mammals, aquatic organisms, honeybees and earthworms.
- **Dichlorvos** EU approval was withdrawn in 2012. It is an EU priority substance for water quality. The UK withdrew all uses in 2002 primarily because of the human health risk.
- **Trifluralin** failed EU re-authorisation in 2007 and was withdrawn end 2009, due to its high toxicity risk to fish and it's potential for bioaccumulation in aquatic organisms, also due to the fact that it is highly persistent in soil and not readily biodegradable.
- **Carbendazim** was withdrawn in the EU in 2014 due its classification as a known mutagen and its reproductive toxicity to humans. It remains authorized in the UK for use on amenity turf until the end of the grace period in 2016. NB carbendazim is still authorized as a biocide in antifouling paint and other uses, and thiophanate-methyl, which remains authorized as a fungicide, produces carbendazim as its major metabolite[100].

EU restrictions:

- **Imidacloprid**, **clothianidin**, **thiamethoxam** (neonicotinoids) and **fipronil** containing pesticide have been temporarily restricted for use as seed treatment, soil treatment and pre-flowering applications on flowering crops (eg oilseed rape and sunflower) and on spring planted cereals in 2014-2015 because of their potential effect on bees[101]. The restrictions also include the complete withdrawal of amateur uses. The active substances continue to be used in greenhouses, on winter cereals and non-flowering crops (eg sugar beet), and as a foliar spray after flowering is over.
- **Methiocarb** slug pellets were withdrawn in the EU from September 2014 because of hazardous effects on granivorous birds, earthworm-eating birds and predatory birds. The active substance remains approved for use as a bird and slug repellent seed treatment and insecticide.

The UK has additionally banned or withdrawn a few pesticides with EU-authorized active substances for environmental reasons since 2001 (Box 6). Public pressure and/or pressure from the EU could lead to the UK withdrawing active substances in future because they are causing breaches of water quality standards and/or because they are on the 'candidates for substitution' list and fail the alternatives test due to evidence of harmful environmental impacts.

Box 6: UK bans or withdrawals of pesticides and biocides with EU-authorized active substances since 2001

Examples:

- **Diuron** pesticide approval was revoked in December 2007 because of evidence of water pollution (it was already withdrawn as a biocide in antifouling paint on boats in 2002).
- **Bifenthrin** products were withdrawn in the UK in 2009 when the EU approval was withdrawn, and no pesticides have been approved or re-approved since EU approval was reinstated. The EFSA assessment[102] refers to persistence in the environment and risk of bioaccumulation/biomagnification, risk to aquatic organisms, in particular fish and invertebrates, and risk to non-target arthropods and

[100] http://www.pan-europe.info/News/PR/141022.html

[101] Regulation 485/2013

[102] EFSA 2011 Conclusion on the peer review of the pesticide risk assessment of the active substance bifenthrin. EFSA Journal 2011 9(5):2129 http://www.efsa.europa.eu/en/search/doc/2159.pdf

bees.

- **Cypermethrin** was suspended from sale as biocide for use in sheep dipping in 2005 and then permanently banned as biocide for use in sheep dip in 2010[103]. This was the result of research that highlighted evidence for impacts on aquatic invertebrates and certain fish such as salmon, and a public campaign, as well as frequent failures to meet water quality standards.
- **Isoproturon (IPU)** failed to gain re-registration in the UK in 2007, and was banned in 2009 because of its aquatic ecotoxicity. However, since 2014 it is re-registered in two mixed pesticides Blutron and Blutron Plus (mixture with diflufenican)[104]. The pesticides are formulated with a new technology which uses a much lower concentration of active substance, so that it now has a minimum effective dose for aquatic organisms that passes the UK aquatic toxicity risk assessment[105].

2.2.2 UK government pesticide policy and guidance

UK government best practise guidance on pesticide use

The 'Green Code' (Code of Practice for the Safe Use of Pesticides on Farms and Holdings 2006[106]) is a set of guidelines for using pesticides throughout England and Wales issued by the government in 2006. There is a similar code in Scotland. It is aimed at ensuring that users of pesticides do so safely and in such a way as to comply with legal obligations. The guidance is a statutory code of practice, so whilst it is not a legal offence not to follow the advice that it gives, failure to do so can be used as evidence of a breach of legislation. The focus is on encouraging best practise and the advice ranges from asking whether you really need to use a pesticide in the first place through record keeping, storage, preventing contamination of surface and ground water, controlling exposure and health surveillance. There is no monitoring of what effect the code has.

UK national action plan on pesticides

The Directive on the Sustainable Use of Pesticides (Directive 2009/128/EC) (SUD) is an attempt by EU legislators to bring a more sustainable approach to the use of pesticides throughout all Member States. The Directive required Member States to draw up National Action Plans (NAPs) by November 2012. The plans should set objectives and targets to 'reduce risks and impacts of pesticide use on human health and the environment and to encourage the development and introduction of integrated pest management and of alternative approaches or techniques in order to reduce dependency on the use of pesticides'. Member States should specifically address pesticide user training, pesticide sales, equipment inspection, monitoring of pesticide poisoning, prohibition of aerial spraying, public awareness-raising, minimisation or prohibition of pesticide use in public areas, measures to protect the aquatic environment and drinking water, and the promotion of low pesticide-input integrated pest management.

The UK National Action Plan for the Sustainable Use of Pesticides published in 2013 falls short of meeting the goals of the directive. The UK NAP does not include quantitative goals

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103 https://www.buglife.org.uk/campaigns-and-our-work/campaigns/cypermethrin-sheep-dip-%E2%80%93-campaign-victory

104 https://secure.pesticides.gov.uk/pestreg/getfullproduct.asp?productid=28301&pageno=1&origin=prodsearch

105 http://www.fwi.co.uk/arable/new-technology-revives-ipu-herbicide.htm

106 http://www.pesticides.gov.uk/guidance/industries/pesticides/topics/using-pesticides/codes-of-practice/code-of-practice-for-using-plant-protection-products

for reducing pesticides that are of concern in terms of water pollution or potential harm to biodiversity; it does not include adequate targets or incentives for the promotion of IPM as some other Member States have included; it does not include any measures to restrict use in sensitive areas; and other options were missed out that could have contributed to a change in the approach to pesticide use in the UK. The NAP instead continues to rely on best practise guidance and voluntary measures.

England National Pollinator Strategy (NPS)

Defra with the support of a number of relevant UK organisations launched the national pollinator strategy in 2014 in order to address some of the issues affecting pollinators, including that of pesticide use. The strategy aims to provide advice to the general public on the importance of considering whether you actually need to use a pesticide and to consider other non-chemical methods for dealing with pest or weed problems, and to encourage the creation of diverse habitats for pollinators including wildflower meadows and similar habitats, but contains no concrete actions addressing pesticide use by farmers. It is a voluntary measure and partly replicates advice provided by others. The advice to the general public will have little impact on the overall level of pesticide use in the UK, as this is relatively small market, but the advice and encouragement to create habitats could reduce the use of herbicides if taken up widely by farmers and amenity sectors as well as the general public. It is too early to see results from the Strategy.

2.2.3 Pesticides and water quality control in the UK

Government action

The UK government approach to trying to reduce non-compliance with drinking water standards under the EU Water Framework Directive currently relies on voluntary measures in the drinking water Safeguard Zones. According to the WFD, all drinking water sources must be designated as Drinking Water Protected Areas (DWPAs), and Member States may choose to designate parts or all[107] of DWPAs as Safeguard Zones (SgZs) in order to implement measures to protect water quality. The Environment Agency has designated around 200 such zones in England and Wales[108]. Water companies together with the Environment Agency have only recently developed Safeguard Zone Action Plans[109,110,] so there is as yet no evidence of their effectiveness. UK legislation[111] gives the possibility of designating Water Protection Zones in which the Secretary of State has the power to ban certain substances and/or activities that threaten water quality. The Environment Agency proposed 8 candidate WPZs in 2009[112], but to date only one has been designated on a

[107] Safeguard Zones may be as large as or may extend beyond the boundary of a groundwater body, eg to protect karstic aquifers, and they may also cover whole territory of a Member State (Directive 2006/118/EC).

[108] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/297347/LIT_7660_9a3742.pdf

[109] https://ea.sharefile.com/download.aspx?id=s629c58e6d06455d8

[110] http://www.stwater.co.uk/about-us/environment/catchment-management/learning-zone/water-safeguard-zones

[111] Water Resources Act 1991 with an amendment to implement aspects of the Water Framework Directive

[112] http://www.euwfd.com/SH090227_WPZ__Part_2.pdf

stretch of the River Dee in 1999 to address industrial chemical pollution concerns (with an exemption for agriculture)[113].

Water company initiatives

The costs of removing pesticide residues from drinking water run to approximately £100 million per year for the water companies[114], costs which are reflected in the price consumers pay for their water. Water companies have adopted projects offering a combination of advice, practical solutions and incentives to farmers to reduce pesticide use, particularly metaldehyde. These are increasingly proactive relationships between the water companies and farmers, offering incentives and pilots to adopt alternatives, rather than relying only on the provision of advice on best practice pesticide use.

- Wessex Water has established catchment management partnerships in 15 'at risk' catchments since 2005[115]. Catchment advisors provide individual advice and solutions to farmers, currently in two specific pesticide management projects.
- South West Water Upstream Thinking programme provides integrated land management advice to its catchment farmers through the Westcountry Rivers Trust since 2010, including non-chemical weed management and other pesticide advice in the Drift reservoir catchment in West Penrith with the Wild Penrith project, and pesticide reduction actions in the Wimbleball and Roadford Catchments.
- Thames Water established a catchment management project to reduce water pollution from metaldehyde in 2010.[116] The project combines several approaches, including payments for farmers who change their practices to stop using metaldehyde, subsidising ferric phosphate slug pellets at £1 a kilo[117] in high risk fields, trialling physical barriers (swales) in fields to reduce runoff, and providing training for sprayer operators.
- FWAG together with Thames Water has engaged 500 farmers with sustainable pesticide management in the Upper Thames catchment (Cole, Ampney Brook, Meysey Brook, Lydiard Brook and Ray)[118]
- Anglian Water launched a similar scheme in 2015 in association with farmers in the region. The campaign is trialling measures around six reservoirs in the area[119]. A team of advisors[120] from Anglian Water are working with farmers to give advice on keeping metaldehyde out of water. The company will compensate farmers for any extra costs that they might incur in switching away from metaldehyde and they will also receive payment for taking part in the scheme.

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113 https://www.gov.uk/government/publications/consent-for-a-controlled-activity-within-the-river-dee-water-protection-zone

114 http://www.voluntaryinitiative.org.uk/importedmedia/library/952_s4.pdf

115 Wessex Water (2011) Catchment management. https://www.wessexwater.co.uk/uploadedFiles/Corporate_Site/Catchment%20management.pdf

116 http://www.thameswater.co.uk/about-us/18682.htm

117 South East Farmer 02.03.2015 Defra plans to restrict slug pellets. http://www.southeastfarmer.net/section/news/defra-plans-to-restrict-slug-pellets

118 Water with Integrated Local Delivery (WILD) project key outcomes from Phase 1

119 Alton Water in Suffolk; Ardleigh Reservoir near Colchester; Hollowell Reservoir, Ravensthorpe Reservoir and Pitsford Water in Northamptonshire and Grafham Water in Cambridgeshire.

120 http://www.anglianwater.co.uk/environment/our-commitment/our-plans/meet-the-team.aspx

2.2.4 *Private farm and food assurance schemes*

Nowadays, most retailers in the UK require farmers to be members of some kind of farm/food assurance scheme in order to be able to sell their produce to the retailer. These schemes have mainly arisen since the launch of the Voluntary Initiative. The VI steering group was influential in integrating pesticide use requirements and obligatory crop protection/IPM planning into the schemes (Glass et al 2006[121]).

Red Tractor

Assured Food Standards[122] is a private not-for-profit food assurance scheme established in 2000 that covers food production on the farm, food processing and food packaging. It provides the Red Tractor consumer label for food products. The standard requires the correct selection of pesticides appropriate for the target pest, disease or weed and fully registered for the purpose in the UK, but does not include any specific requirements to reduce pesticide use or to stop using any particular authorized pesticides. Farmers must follow the UK code of good practice pesticide use, with requirements for sprayer training and annual equipment testing, and document and follow an integrated pest management plan (since October 2014), though this does not have to be the VI/NFU plan[123]. The rules concerning pesticides must be complied with to achieve certification, and failure can lead to immediate suspension from the scheme. However, an assessment of cross-compliance breaches between 2005 and 2012 found no evidence that Red Tractor members were more likely to comply with pesticide regulations than non-members[124].

LEAF Marque

The LEAF Marque is a not-for-profit consumer label for fresh produce and livestock products set up in 2003[125]. It provides added value to existing food assurance schemes, as all LEAF scheme farmers must also be part of one or more Red Tractor Assured Food Standards Schemes or GlobalGAP (or an equivalent standard). LEAF farms must have a crop protection policy covering integrated farm management including IPM and crop rotation. The crop protection policy must include selection of resistant varieties, appropriate dose rate, resistance management strategy, and adoption of non-pesticide pest control where appropriate. The standard recommends two metres of uncropped and unsprayed margins around all field margins and hedges[126]. There is no published evidence of effectiveness in reducing pesticide impacts, though the requirements for uncropped and unsprayed field

[121] Glass et al (2006) Evaluation of the performance of the Voluntary Initiative for pesticides in the United Kingdom. Report No P3OG1001.

[122] Red Tractor Assurance website. http://www.redtractor.org.uk/

[123] Red Tractor Assurance (2014) Red Tractor Assurance for Farms – Fresh Produce Scheme Standards. http://assurance.redtractor.org.uk/resources/000/965/982/Fresh_Produce_Scheme_Standards.pdf

[124] FERA (2013) Study on farm assurance scheme membership and compliance with regulation under cross compliance. Project BR0114. FERA report to Defra, York, UK. http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=18477&FromSearch=Y&Publisher=1&SearchText=BR0114&SortString=ProjectCode&SortOrder=Asc&Paging=10

[125] LEAF in 2014. http://www.leafuk.org/resources/001/025/798/annrev14_final_15_Dec_14_web.pdf

[126] LEAF Marque Standard. http://www.leafuk.org/leaf/farmers/LEAFmarquecertification/standard.eb

margins and hedges and encouraging wildlife can be expected to increase natural pest control and decrease reliance on pesticides.

Other farm assurance schemes in the UK that include specific requirements for pesticide use are Scottish Quality Crops[127], Genesis Standards[128] (part of NSF Safety & Quality Ltd.), and GLOBALG.A.P. Some supermarkets, such as Marks & Spencer, run their own assurance schemes.

2.3 The UK Voluntary Initiative: what has it done?

Following proposals put forward by the then Labour Government for the introduction of a pesticide tax, the Crop Protection Association (CPA) led a campaign against its introduction. This led to the government asking the CPA to develop a plan that would help to protect the environment from the harmful effects of pesticides and so avoid the need for a tax.[129] Working with other farming and crop protection organisations the CPA devised a set of voluntary measures designed to minimise the environmental effects of pesticide use in the UK. These proposals were accepted by the government and in 2001 the Voluntary Initiative (VI) was born (Box 7). The VI was initially designed to last five years and was composed of 24 defined projects under three "pillars" [130]. These were: the establishment of a baseline of industry practise through a survey of current application practises throughout the UK (published in June 2002); the establishment of Crop Protection Management Plans, and the Biodiversity Strategy and Action Plan for the crop protection industry. The VI was evaluated[131] and reviewed during 2004/5 by a parliamentary sub-committee, and a decision was taken to maintain the VI on a rolling two year basis after 2006, with a particular emphasis on water quality issues.

Box 7: Governance of the Voluntary Initiative

The original members who agreed the VI are: Agricultural Engineers Association, Agricultural Industries Confederation, Country Land and Business Association, Crop Protection Association, National Farmers Union, National Farmers Union of Scotland, National Association of Agricultural Contractors, Ulster Farmers Union. They continue to be its sponsors. The VI steering group which consults on its activities and reports progress to Defra is composed of a more diverse range of organisations in addition to the sponsors. The current membership consists of: Association of Independent Crop Consultants, Assured Food Standards, BASIS (Registration) Ltd, British Crop Production Council, City and Guilds, Department of Agriculture and Rural Development Northern Ireland, Defra, Department for Business Innovation and Skills, Environment Agency, Farmers Union of Wales, Food Standards Agency, Game and Wildlife Conservation Trust, HSE Chemicals Regulation Directorate, LEAF, Natural England, Pesticides Action Network UK, Royal Society for the Protection of Birds, Scottish Environment Protection Agency, Scottish Government, Water UK and the Welsh Assembly Government.

The overarching consideration of the VI at its inception was to "minimise the environmental impacts from the use of pesticides" [132]. This has shifted towards a drive to "promoting the

[127] http://www.sqcrops.co.uk/
[128] http://www.genesisstandards.com/index.php?id=6#.VaORrPnF8R0
[129] http://www.voluntaryinitiative.org.uk/en/about-us/origins
[130] http://www.voluntaryinitiative.org.uk/media/1027/first-annual-report.pdf
[131] Glass,C.R., Boatman,N.D., Brown,C.B., Garthwaite,D., Thomas,M. (2006) Evaluation of the performance of the Voluntary Initiative for pesticides in the United Kingdom. Report Number P3OG1001.
[132] http://www.voluntaryinitiative.org.uk/en/about-us/origins

responsible use of agricultural pesticides" [133]. This is quite a shift in thinking although it is claimed by the VI that the latter approach will lead to the former goal. The VI state that the outcome of this responsible use of pesticides will:

- Reduce the risks to drinking water sources and the aquatic environment
- Protect farm wildlife and enhance conservation features
- Reassure neighbours and the wider public that pesticides are being correctly and safely applied
- Provide confidence to retailers that regulations are being followed and minimises the risk of pesticide residues on produce
- Avoid Government introducing further regulation restricting pesticide availability and minimise the requirement for farm visits and enforcement action

The VI established three key measures to ensure that best practise is adopted by farmers in the UK; the National Register of Spray Operators (NRoSO), National Sprayer Testing Scheme (NSTS) and Crop Protection Management Plans (CPMP). Farmers, advisers and pesticide operators are expected to adopt five core measures; operator training, testing of pesticide application equipment, adviser training and qualification, adoption of best practise, and planning and managing the use of pesticides. The most recent VI annual report published in July 2015[134] presents the results:

Indicator (UK)	Before the VI	2013	2014	2015
No of registered operators in National Register of Spray Operators members	0	20,960	21,169	21,672
% of sprayed area in National Sprayer Testing Scheme	Estimate 5%	89.2%	94.4%	94.8%
Area covered by Crop Protection Management Plan (now discontinued) / Integrated Pest Management Plan (IPMP) (since 2014)	0	583,271 hectares		2,664,652 hectares

The VI claims that these figures represent evidence of the continued success of the VI over the 12 years of its existence.

Integrated Pest Management Plan IPMP (previously Integrated Crop Protection Management Plan CPMP)[135]

The VI initially established a Crop Protection Management Plan in 2003. It was superceded in 2014 by the current IPM plan (IPMP), which was developed by the National Farmers Union as a voluntary self-assessment tool for farmers to demonstrate the use of IPM tools and act as a decision support system, in accordance with the Sustainable Use of Pesticides Directive. The VI aim was to encourage all users of professional pesticides to be using the

[133] http://www.voluntaryinitiative.org.uk/media/636680/vi-annual-report-2014-15compressed.pdf (Page 4)
[134] http://www.voluntaryinitiative.org.uk/media/636680/vi-annual-report-2014-15compressed.pdf
[135] http://www.nfuonline.com/ipm-plan/

plan by the end of 2014[136]. According to VI reporting, around half of the total UK crop area (including temporary grassland and fallow) is now covered by a plan (see table above). The LEAF Sustainable Farming Review and membership of Conservation Grade are considered by the VI to meet the same requirements as the IPMP.[137] The Red Tractor and Fresh Produce Assurance Schemes have required a farm level IPM plan since October 2014, but this does not have to be the VI/NFU plan.

The IPMP is not, however, a systematic tool for the uptake of the suite of IPM techniques that farmers and growers should be using in order to deliver a comprehensive IPM farm system. The questionnaire is completed by individual farmers online, and there seems at present to be no method for checking the veracity of the information on the forms, no incentives or encouragements for farmers to adopt wide IPM measures and no penalties for not doing so. VI reporting does not differentiate between farmers who have recorded use of only one of the IPM techniques available and farmers that might be using the full range of IPM methods. This offers an inflated view of the level of IPM uptake in the UK and makes it into a tick box exercise to show that the NFU and the VI, and as a consequence the UK Government, are meeting IPM requirements under the SUD.

National Register of Sprayer Operators (NRoSO)[138]

This is a central register of sprayer operators who hold the relevant City & Guilds certificate of competence (NPTC PA) and who are using continuing professional development (CPD) to ensure that they are involved in ongoing training. It was launched by the VI in 2002. Members of the scheme are required to collect points over a three year period through on farm training, attendance at registered events and courses, or other accredited events that cover legislation, application equipment, environmental safety, occupational health and safety, crop protection technology, plant protection and integrated crop management. Upon membership renewal there is a renewed requirement to attain points.

National Sprayer Testing Scheme (NSTS)

This is considered to be a main pillar of the VI since it started in 2003.[139] The NSTS tests sprayers on an annual basis to ensure that they are in good repair and suitable for spraying in a safe and effective manner. NSTS testing is a requirement for the Red Tractor assurance scheme. Sprayer testing is mandatory since 2014 under the Sustainable Use of Pesticides Directive, but annual testing goes beyond the requirements set out in the directive.

The Biodiversity Strategy and Action Plan (2002-2006)

Published in November 2002, this was designed to minimise the adverse environmental impacts of pesticides, in particular to reduce the impact of pesticides on water quality and the biodiversity of terrestrial ecosystems. The stated goal of the plan was to allow the crop

[136] NFU 13/11/2013. Frequently asked questions on Integrated Pest Management under the Sustainable Use Directive. https://www.nfuonline.com/assets/20830

[137] http://www.voluntaryinitiative.org.uk/en/vi-schemes/ipm-plans

[138] https://www.nroso.org.uk/

[139] http://www.nsts.org.uk/our-role?mr=586

protection industry to "play its full part in improving the rich and diverse wildlife associated with farmland habitats" by promoting 'best practise' in the use of its products (pesticides). The Crop Protection Association committed to forming a biodiversity network to help communication from the crop protection industry and other sources to farmers and growers. The plan was designed to support the UK Biodiversity Action Plan and focused on lowland arable farming with particular reference to the need to protect the grey partridge and the corn bunting due to the evidence for indirect impacts of the use of pesticides through the loss of insect and wildflower seeds which form a key part of the diet of both species.

The plan included funding for research through the Sustainable Arable link programme, training for technical staff and advisors, and better stewardship and communication. The VI and CPA co-sponsored the Sustainable Arable Farming for the Environment (SAFFIE) project from 2002 to 2007, which developed evidence for specific arable crop management options, including skylark patches, beetle banks, and field margin management techniques[140]. The BASIS Biodiversity and Environment Training for Advisors (BETA) qualification was gained by 836 advisors by 2006[141], involving 2-5 days of training and an exam. A survey in 2010 found that 57% of the 4,200 agronomists in the BASIS professional register had taken the training, whilst 14% were not aware of it (and of these 81% were giving advice to farmers)[142]. However, no follow-up survey was done to assess the long-term impact of the training. Demand for the BETA qualification fell as the new training for the Campaign for the Farmed Environment took priority and trained a much larger number of agronomists[143].

Since 2006, the VI has mainly contributed to the Campaign for the Farmed Environment actions related to biodiversity. A leaflet with advice on pesticides and farmland birds was published in 2010.

Pesticide advice in the Catchment Sensitive Farming scheme in England

Since 2006 the VI together with ADAS provides pesticide management advice to agronomists and other key providers of crop protection advice to farmers in the Catchment Sensitive Farming Scheme. As of July 2015 advice was provided in seven[144] of the priority catchments targeted by the scheme. Pesticide advice focussed primarily on agronomists and other key influencers of crop protection practice through workshops, on-farm demonstrations, and other communications. Most advice was targeted to farms with cereals or mixed cropping systems.

H2OK initiative

The Crop Protection Association sponsored the H2OK initiative with the VI in 2010 to provide farmers with best practise information on how to keep pesticides out of water[145] .

[140] http://www.saffie.info/
[141] http://www.voluntaryinitiative.org.uk/media/1023/annual-report-2005-06.pdf
[142] http://www.voluntaryinitiative.org.uk/media/1019/annual-report-2009-10.pdf
[143] http://www.voluntaryinitiative.org.uk/media/1018/annual-report-2010-2011.pdf
[144] River Wensum; Yare & Waveney; Yorkshire Ouse, Nidd & Swale; River Lugg; and River Teme
[145] http://www.voluntaryinitiative.org.uk/_attachments/resources/1194_s4.pdf

The campaign was aimed at ensuring that non-compliance with the WFD is avoided and thus restrictions on problem pesticides are not brought in as a result. Whilst booklets and other information have been distributed, there is no documentation of how this has bought about changes in practice to reduce water pollution from pesticides.

Pesticide product stewardship initiatives led by crop protection industry

In an attempt to prevent their withdrawal in the UK because of the threat they pose to water quality, the crop protection industry is currently running product stewardship programmes for the active substances bentazone, carbetamide, chlorotoluron (CTU), clopyralid, mecoprop-P, metaldehyde, metazachlor and propyzamide[146]. There is concern that occurrences of these substances in water causing non-compliance with the Water Framework Directive could lead to withdrawal of market approval or increased restrictions. The campaigns consist of fact sheets that advise on best practice pesticide use to avoid water pollution from that pesticide, and are promoted by the Voluntary Initiative. There is however no information available on the impact of these initiatives.

- *Metaldehyde Stewardship Group 'Get Pelletwise'*[147]. The 'Get Pelletwise' scheme was set up in 2009 by the Metaldehyde Stewardship Group (MSG) to promote and encourage best practise use of metaldehyde slug pellets, to minimise environmental impacts and in particular to protect water. The scheme provides information to farmers via leaflets, booklets and information in the website. The scheme is also running pilot projects in two areas to eliminate metaldehyde use in areas that have been identified by the relevant water companies as being high risk.
- *Metazachlor Matters.* First launched in 2014 this is a joint initiative undertaken between BASF and Adama Agricultural Solutions, to give stewardship best practise guidance for the use of the herbicide metazachlor to avoid its use being curtailed.[148] Metazachlor is used as a pre and post emergence herbicide for oil seed rape. The pesticide companies offer best practise guidance to growers and advisors for how to use it and reduce the likelihood that it will find its way into water sources.[149,150]
- *Bentazone EU Water Stewardship Programme.* The herbicide bentazone is the most frequently detected approved pesticide in UK groundwater and it is also found in surface water bodies.[151] BASF initiated a stewardship programme in 2013 aimed at advising growers and advisers on how to use bentazone in order to keep it out of water bodies.[152]

146 http://www.voluntaryinitiative.org.uk/en/water/advice
147 http://www.getpelletwise.co.uk/
148 http://www.adama.com/uk/en/environment/metazachlor-stewardship-programme/
149 http://www.voluntaryinitiative.org.uk/media/636684/metazachlor-matters-stewardship-guidelines.pdf
150 http://www.farmingfutures.org.uk/blog/tougher-recommendations-use-metazachlor-protect-water-autumn
151 http://www.agricentre.basf.co.uk/agroportal/uk/en/about_us_3/water_stewardship/bentazone_stewardship/stewardship.html
152 http://www.agricentre.basf.co.uk/agroportal/uk/media/agricentre/sustainability_in_farming/water_stewardship_on_farms/Bentazone_VI_WPAS_250315.pdf

2.4 Has the Voluntary Initiative reduced pesticide environmental impacts?

Since the Voluntary Initiative was launched, the overall crop area being treated with herbicides, insecticides and fungicides and the number of treatments applied to most of the major crops have risen (see section 2.2.1). One exception is the recent trend of decreasing metaldehyde molluscicide use, driven by the issue of water contamination, which is an encouraging indication that attitudes are changing. It should be noted, though, that an increase in the area treated is not necessarily detrimental if it is associated with a move to more environmentally benign pesticides. For example, a study calculated that the environmental hazard of orchard fruit pesticide use declined by 12% between 2000 and 2008 (Cross 2013[153])[154], and attributed this to withdrawals of active substances from the market and adoption of less toxic alternatives. Given that in general pesticide use frequency is not decreasing, and pesticides in water remain a problem, what evidence is available to show that the VI has achieved a reduction in the environmental impacts of pesticide use?

VI objective: Protect farm wildlife and enhance conservation features

The VI defined four indicators to measure impacts on farmland biodiversity (area of cereal field margins, populations of Grey Partridge, populations of Corn Bunting, and populations of Yellowhammer) but never actually reported on these indicators, though the UK Biodiversity Action Plan set targets for cereal field margins, Grey Partridge and Corn Bunting. The Grey Partridge index of spring pair density has increased slowly since 2001[155], and the Yellowhammer population decline has levelled off[156], but both species remain threatened.

The VI evaluation in 2006 (Glass et al 2006) found that, of the three Outcome Targets on benefiting biodiversity, the target area of cereal field margins had been achieved due to agri-environment payments supported by SAFFIE research, whilst the targets for the trends in Grey Partridge and Corn Bunting populations had not been achieved in full. The VI Indicator Farms Project was set up in 2004/5 and published case study data on 10 farms in 2007, but the evaluation of the effects of the VI on UK arable and grassland farming in 2006 pointed out that the non-random selection of the indicator farms and the lack of a control group limited the relevance of the monitoring[157],[158]. The parliamentary Select Committee

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[153] Cross, P (2013) Pesticide hazard trends in orchard fruit production in Great Britain from 1992 to 2008: a time-series analysis. *Pest Management Science* No 69 (6), pp768-774.

[154] The study used pesticide usage data for the seven most common fruit crops in Great Britain and the Environmental Impact Quotient of active substances to calculate an EIQ rating for environmental impact per ha of crop.

[155] http://www.gwct.org.uk/research/species/birds/grey-partridge/long-term-trends-in-grey-partridge-abundance/

[156] http://www.bto.org/birdtrends2010/wcryelha.shtml

[157] Glass,C.R., Boatman,N.D., Brown,C.B., Garthwaite,D., Thomas,M. (2006) Evaluation of the performance of the Voluntary Initiative for pesticides in the United Kingdom. Report for Defra Number P3OG1001.

[158] An Environment Agency investigation of three of the VI's indicator farms in 2005 concluded that they had good to very good biological water quality and a low frequency of pesticide detection, and there was little value to continuing to monitor them as indicators of VI impact on water quality. Lascelles, B., Turley, E., Davies, J., Knight, L., Kelly, M., Pemberton, E., Wells, C. (2005) The effect of the Voluntary Initiative on water quality. Environment Agency, UK. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/291515/scho0705bjiv-e-e.pdf

review of the VI in 2004/5 concluded that some of the Voluntary Initiative targets were insufficiently challenging and there was little irrefutable evidence of the environmental benefits that had resulted[159]. It also stated that '*Defra is unable to provide assurances on these benefits and has little confidence in the usefulness of the research it commissioned specifically to provide tools for this assessment*'. Given the lack of evidence for impacts of the biodiversity plan it difficult to see it as a success.

VI objective: Reduce the risks to drinking water sources and the aquatic environment

Initially the VI set a national target for reducing the frequency of detection of pesticides above EU drinking water maximum concentrations by 30% by 2006 for both individual levels and for combined pesticide levels[160]. This was not a particularly ambitious target given the EU legislative requirement to ensure that water bodies in the UK are kept free from contamination. Environment Agency monitoring data showed that the target was met for isoproturon and atrazine, but contamination by four of the remaining seven compounds was reduced by less than 30%, one compound showed no change and contamination by MCPA and chlorotoluron increased[161]. The VI evaluation in 2006 (Glass et al 2006) found that, of the five Outcome Targets on protecting water, only one had been achieved in full (reduce substantiated pollution incidents relating to the use of agricultural pesticides).

The VI contribution to the Catchment Sensitive Farming scheme aimed to reduce pesticide contamination in six priority catchments, and six pesticide active substances[162] were monitored in water in five of the catchments from 2006. The results indicated reductions in pesticide use between the 2006-07 and 2009-10 crop years[163]. However, no control comparison is available from catchments not receiving advice. A survey of 169 farmers within the five catchments indicated that 51 per cent had changed their behaviour regarding pesticide use as a result of advice, but despite this increased awareness and understanding, there remains only limited acceptance from farmers that agriculture makes a significant contribution to water pollution.

In 2010 the VI launched the H2OK campaign, because it was clear that nearly ten years after the VI was introduced there were still serious issues with pesticides and water pollution that had not been addressed. For example, a 2010 report by the Agricultural Industries Confederation[164] showed that the majority of farmers were still filling their sprayers on hard surface areas not suitable for doing so and contrary to the advice of the VI. Such practice carries an inherent risk of contributing to pesticide run off into water bodies. The 2013/14 VI

[159] http://www.publications.parliament.uk/pa/cm200405/cmselect/cmenvfru/258/258.pdf

[160] http://www.voluntaryinitiative.org.uk/importedmedia/library/959_s4.pdf

[161] Glass,C.R., Boatman,N.D., Brown,C.B., Garthwaite,D., Thomas,M. (2006) Evaluation of the performance of the Voluntary Initiative for pesticides in the United Kingdom. Report for Defra Number P3OG1001.

[162] Propyzamide, Mecoprop, MCPA, Clopyralid, Carbetamide, 2-4,D. During the monitoring period usage of the three other monitored pesticides changed directly or indirectly as a result of regulatory measures, so results for these pesticides were excluded from the analysis.

[163] Environment Agency (2011) Catchment Sensitive Farming ECSFDI Phase 1 & 2 Full Evaluation Report. Environment Agency, UK. http://publications.naturalengland.org.uk/publication/5329340644458496?category=45002

[164] AIC Agronomist Survey 2009/10. Pesticide Filling and Handling Activities on Farm. Executive Summary. http://www.voluntaryinitiative.org.uk/_attachments/resources/1331_s4.pdf

annual report[165] states that there are very clear challenges and in particular highlights the potential problems of oilseed rape herbicides and metaldehyde.

In summary, the VI continues to meet its own operational targets in terms of delivering training and certification of agronomists and users and testing of sprayers, but there is to date no indicator or mechanism that can determine if these measures are actually making any quantifiable difference to reducing environmental impacts. The VI admits that measuring the impact of its work is difficult and that environmental indicators for biodiversity and water quality can be affected by numerous factors outside of the control of the VI. In practice, it is very difficult to quantify any actual environmental benefits or reductions in pesticide use that can be directly attributable to the VI. The reason for this is that there are numerous drivers of pesticide use including fluctuations in pest pressure, changes in the type of crops being grown, changes in pesticide price and availability and application methods, and agricultural subsidies. Unless better indicators and monitoring are developed it will remain impossible to link the work of the VI with any positive changes in the environmental impact of pesticides in the UK.

2.5 The need for intervention

Changing the way users of pesticides think about how they use them is one of the goals of the VI[166]. Better use, more sustainable use, following best practice guidance are all terms that regularly crop up in VI literature and advice. What is consistently lacking is the idea of actually reducing dependence on pesticides and making more use of non-chemical techniques. This is a major flaw as the VI is bound ideologically to maintaining the status quo so long as the risks of use can be kept to a level deemed acceptable.

The clear intention of the Sustainable Use Directive and other EU initiatives is to drive reductions in pesticide use, promote and research non-chemical methods, in order to avoid the potential for harm to human health and the environment. The Sustainable Use Directive states that "implementation of the principles of integrated pest management is obligatory" and that "Member States should describe in their National Action Plan how they ensure the implementation of the principles of integrated pest management, with priority given wherever possible to non-chemical methods of plant protection and pest and crop management." The Directive lays out a clear hierarchy for IPM and shows that the use of pesticides should be a last resort[167]. Other countries in the EU, such as Denmark and France, have set out plans for reducing the overall use of pesticides or have targeted individual active substances of concern for quantified reductions.

The VI has succeeded in uniting the agrochemical industry to a common aim and developing a sense of responsibility towards the use of pesticides[168]. However, within the VI there is a belief that there are no inherent problems with current pesticide use, and that any risks can be adequately managed through promoting existing best practice guidance. This thinking permeates upward to legislators who are thus falsely reassured that the current situation is

[165] http://www.voluntaryinitiative.org.uk/media/628105/annual-report-2013.pdf
[166] http://www.voluntaryinitiative.org.uk/media/628105/annual-report-2013.pdf
[167] Directive 2009/128/EC Annex III
[168] https://www.rspb.org.uk/Images/progress_pesticides_tcm9-132859.pdf

working. It is difficult to say whether there would have been more restrictions on pesticides in the absence of the VI, but it is clear that the activities of the VI have been insufficient to prevent the need for regulatory action. Given successive UK government positions opposing new pesticide regulation it is possible that this would have been the same situation despite the VI but it is probable that input from the VI helped to shape the government position. Notably, there has not been any introduction of a requirement for increased farm visits or enforcement action under the National Pesticide Action Plan. The VI can also be seen as hindering innovation in non-chemical techniques and approaches as the thinking reinforces the notion that no fundamental change is necessary.

It is clear that substantial challenges remain to reduce or eliminate the environmental impacts of pesticide use in the UK. Water pollution and biodiversity loss are major issues that have not been adequately addressed by current legislation or voluntary measures. Pesticide contamination of water throughout the UK has remained a significant problem with regard to non-compliance with regulatory water standards (see section 2.2.3). Pesticides in water also pose potential risks to aquatic biodiversity (see section 2.2.4).

3 Review of experiences with policy mechanisms in the EU

3.1 Summary and method

This section identifies policy mechanisms currently being used to reduce the environmental impacts of pesticide use in EU Member States; examines selected case studies of current policy mechanisms; and examines the evidence for their impact on pesticide use and environmental outcomes.

The review focuses on a selection of policy mechanisms and case studies of approaches in the UK and other EU Member States, which highlight opportunities and barriers relative to the UK approach. The following policy mechanisms were reviewed:

- Total or partial bans on specific pesticides at Member State level
- Area-based restrictions on pesticide use: restrictions on pesticides in drinking water protection zones, and restrictions on pesticide use in public spaces
- Other restrictions on pesticide use for water protection: label-based restrictions, voluntary initiatives, private payments for pesticide reductions (Payments for Ecosystem Services)
- Registration and promotion of biopesticides
- Advice and support for integrated pest management: farmer advice and information programmes and crop risk insurance
- Private assurance schemes to implement IPM and reduce pesticide use

The policy mechanisms are described according to:

- Whether they are voluntary or obligatory for pesticide users
- How they are funded
- How they are enforced and how compliance is monitored

The table below summarises which of the different policy mechanisms are being used in the UK and in what way, and the comparisons from other countries.

policy mechanism	UK implementation	other examples
total or partial bans	limited	Luxembourg, various
area restrictions	relies on voluntary approach, eg water company schemes	Luxembourg, Denmark, various
restrictions for water protection (other)	buffer strips; label-based no-spray zones; water company initiatives	Germany, France
restrictions in public spaces/ on nonprofessional use	prohibition of blanket spraying on hard surfaces	France, Belgium, Switzerland
biopesticides	national scheme	Netherlands, Denmark
IPM support	voluntary IPM plan	Denmark, France
crop risk insurance	none	Italy
private assurance schemes	Red Tractor, LEAF, others	Switzerland

3.2 Total or partial bans on specific pesticides at Member State level

Description of policy mechanism

- Obligatory mechanism for pesticide users and pesticide companies
- Enforcement and monitoring of compliance is carried out through control of sales
- Public expenditure for compliance monitoring and enforcement. Costs to pesticide manufacturing industry in lost sales. Costs to farmers associated with changes to production and/or purchase of alternatives.

Member States have the legal option[169] to apply total or partial bans of particular pesticides and restrict uses that are approved at the EU level, if they have sufficient evidence of harmful effects on human health or unacceptable effects on the environment, or of failure to achieve water quality objectives of the WFD. Furthermore, '*Member States shall not be prevented from applying the precautionary principle where there is scientific uncertainty as to the risks with regard to human or animal health or the environment posed by the plant protection products to be authorised in their territory*'. According to the Sustainable Use of Pesticides Directive, Member States should adopt appropriate measures to protect the aquatic environment and drinking water supplies, including giving preference to pesticides that are not classified as dangerous for the aquatic environment. In addition, Member States can withdraw pesticides containing one of the active substances on the 'candidates for substitution' list based on the 'cut-off criteria', if a suitable less toxic alternative is available. However, a ban on an EU approved pesticide could also be legally challenged as being disproportionate to reaching the objective of reducing use.

Enforcement and monitoring of compliance is carried out through control of sales, which is in general effective as the pesticide industry and pesticide sales points are obliged by law to submit annual data on pesticide production, imports and sale. However, Member States cannot legally ban the import or use of EU-approved pesticide-treated seeds[170].

Evidence from case studies

Examples of the use of national bans with reference to the precautionary principle are the national bans on certain neonicotinoids that preceded the EU-wide suspension (see Case Study 6.1), which were primarily based on concerns for honeybee populations and justified by data on honeybee losses, because the scientific research that has confirmed the impacts on bees and other wildlife in the field has mostly been published more recently[171]. These

[169] under Article 44 of the Plant Protection Products Regulation

[170] Regulation (EC) No 1107/2009 Article 49(1) states that Member States shall not prohibit placing on the market and use of seeds treated with plant protection products authorised for that use in at least one Member State, and pesticide-treated seeds are not covered by the pesticide definition.

[171] See eg van der Sluijs, J P, Amaral-Rogers, V, Belzunces, L P, van Lexmond, M B, Bonmatin, J M, Chagnon, M, Downs, C A, Furlan, L, Gibbons, D W, Giorio, C, Girolami, V, Goulson, D, Kreutzweiser, D P, Krupke, C, Liess, M, Long, E, McField, M, Mineau, P, Mitchell, E A D, Morrissey, C A, Noome, D A, Pisa, L, Settele, J, Simon-Delso, N, Stark, J D, Tapparo, A, Van Dyck, H, van Praagh, J, Whitehorn, P R and Wiemers, M (2015) Conclusions of the Worldwide Integrated Assessment on the risks of neonicotinoids and fipronil to biodiversity and ecosystem functioning. Environmental Science and Pollution Research No 22 (1), pp148-154.; Godfray, H C J, Blacquière, T, Field, L M, Hails, R S, Petrokofsky, G, Potts, S G, Raine, N E, Vanbergen, A J and McLean, A R (2014) A

national bans were superseded by the temporary EU suspension on the seed treatment on open-field flowering crops, although some Member States have granted exemptions for some crops and regions. EFSA is currently carrying out a review of the evidence for risks to bees from thiamethoxam, clothianidin and imidacloprid, which will be published in autumn 2017[172],[173],[174]. The European Commission can then propose, if justified, to modify the conditions of approval of neonicotinoids. The ban remains in place until a decision is made on the Commission proposal. EFSA published an opinion pointing to a potentially high risk to bees from neonicotinoid sprays in August 2015[175].

Luxembourg passed a decree in February 2015 banning the use of all products containing the herbicide active substance S-metalochlor, justified by the need for groundwater protection and the prevalence of the metalochlor-ESA metabolite in groundwater monitoring[176]. The water administration carried out a national groundwater survey in October 2014 at 130 sample points for 11 pesticide active substances plus their metabolites, and found metalochlor-ESA in over half the samples[177]. This triggered a high level of public concern. There is no information on the expected impacts of the ban. However, maize and sugar beet farmers may switch to dimethenamid-P[178] or foramsulfuron[179] based products in order to maintain season-long control of grass weeds. Dimethenamid-P is considered to have a high toxicity to aquatic organisms and its metabolites also have a high persistence in groundwater[180].

In Italy, the municipality of Malles Venosta in the province of South Tirol has voted in a referendum to ban pesticide use in the municipality, which is dominated by intensive apple orchards. The ban has been implemented through a local statute that mandates a 50m buffer zone for all pesticide use to neighbouring land. Due to the very small parcel structure (average 2.5 to 3 ha) this amounts to a de facto ban. The mayor is setting up a working

restatement of the natural science evidence base concerning neonicotinoid insecticides and insect pollinators. Proceedings of the Royal Society of London Series B Biological Sciences No 281 (1786), 20140558.

[172] European Food Safety Authority 22 May 2015. Call for new scientific information as regards the risk to bees from the use of the three neonicotinoid pesticide active substances clothianidin, imidacloprid and thiamethoxam applied as seed treatments and granules in the EU. http://www.efsa.europa.eu/en/data/call/150522.htm

[173] EU scientists begin review of ban on pesticides linked to bee declines. Guardian newspaper 7 January 2016. http://www.theguardian.com/environment/2016/jan/07/eu-scientists-begin-review-ban-pesticides-linked-bee-declines

[174] AgraFacts No.02-17 11/01/2017 Neonicotinoid ban costing €900m a year, study

[175] EFSA press release 26 August 2015. http://www.efsa.europa.eu/en/press/news/150826

[176] Chronicle.lu newspaper article 13/2/2015. Drinking Water Quality: Pesticides banned, 80 protection zones created. http://www.chronicle.lu/categoriesluxembourgathome/item/10288-drinking-water-quality-pesticides-banned,-80-protection-zones-created

[177] Luxembourger Wort newspaper article 5/11/2014. Un tiers des sources sont polluées au Luxembourg. http://www.wort.lu/fr/luxembourg/pesticides-dans-l-eau-potable-un-tiers-des-sources-sont-polluees-au-luxembourg-545a31ecb9b3988708083249

[178] AgroNews 20/2/2012. BASF launched herbicide to tackle growing weed challenges for maize growers (Dimethenamid-p). http://news.agropages.com/News/NewsDetail---6368.htm

[179] Bayer Crop Science (2014) news article: New maize herbicide MaisTer WG launched. http://www.bayercropscience.co.uk/news-and-opinion/articles/2014/03/new-maize-herbicide-maister-wg-launched/

[180] http://www.efsa.europa.eu/de/efsajournal/doc/53r.pdf

group with the local apple farmers to support the transition to organic farming (see Case Study 6.2).

Key barriers and opportunities

Withdrawals are a relatively simple solution to the problem of water quality infringements, as a relatively small number of active substances cause most of the problems, with the added benefit in many cases of reducing the risk to aquatic biodiversity[181]. For example, an assessment in the Netherlands[182] estimated that the removal of a small number of pesticide active substances in horticultural crops would reduce the risk to aquatic biodiversity associated with typical crop spray schemes by up to 80%.

The need for comparative assessments of alternatives to the 'candidates for substitution' may result in the withdrawal of some active substances at the national level, forcing growers to look for non-chemical alternatives if new chemical active substances are not registered. In Germany, the requirement for comparative assessments may affect up to 25% of all authorised pesticides and around 50% of all uses of pesticides, with alternative chemical products currently available for around half of these uses[183]. There are currently 58 active substances approved for use in the UK that appear on the EU draft list of 77 actives considered for substitution.[184,185]

The withdrawal of an active substance provides an opportunity to promote the use of alternative methods to all farmers affected by the ban. However, this relies on a significant investment in information, advice and capacity building for affected farmers. As an example, the municipality of Malles Venosta ban will require the active cooperation of the regional apple producer cooperative, which will need to support the conversion of the Malles apple production to organic, as well as the willingness of farmers to comply with the organic standards. Total bans can have perverse effects if farmers switch to other more environmentally damaging pesticides, in the absence of measures to guide the switch to more environmentally beneficial effective alternatives.

Concerns are often raised that there are no alternatives to the banned product, and farmers will sustain crop losses. For example, a UK study anticipates that the actives most likely to be substituted using the candidates for substitution mechanism include several with high crop impact (abamectin, thiacloprid, prochloraz, iprodione, linuron, mancozeb and tebuconazole), and that their loss could lead to large yield losses in edible horticulture

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[181] Eg Räsänen,K, Mattila, T, Porvari, P, Kurppa, S, Tiilikkala, K (2015) Estimating the development of ecotoxicological pressure on water systems from pesticides in Finland 2000–2011. *Journal of Cleaner Production* 89: 65-77. http://www.sciencedirect.com/science/article/pii/S0959652614011792

[182] van Eerdt, M M, Spruijt, J, van der Wal, E, van Zeijts, H and Tiktak, A (2014) Costs and effectiveness of on-farm measures to reduce aquatic risks from pesticides in the Netherlands. Pest Management Science No 70 (12), pp1840-1849.

[183] Faust, M, Vogs, C, Rotter, S, Wöltjen, J, Höllrigl-Rosta, A, Backhaus, T and Altenburger, R (2014) Comparative assessment of plant protection products: how many cases will regulatory authorities have to answer? Environmental Sciences Europe No 26 (11), -doi 10.1186/s12302-014-0011-8.

[184] http://ec.europa.eu/food/plant/pesticides/approval_active_substances/docs/draft_list_cfs_en.pdf

[185] including the herbicides diflufenican, flufenacet, metsulfuron-methyl, the fungicides cyprodinil, isopyrazam, the insecticides and nematicides pirimicarb, ethoprophos, fosthiazate, ozamyl

crops, including yield losses of over 50% in protected salad leaves and rhubarb, and yield reductions in leeks, salad onions, asparagus, carrot, blackberry, raspberry, strawberry, and hops[186].

Withdrawals at the national level are only effective if the illegal use of withdrawn products can be prevented. In some Member States the use of illegal pesticides is quite high and undermines attempts to reduce the use of harmful pesticides[187]. In Denmark, where a pesticides tax has significantly increased the price of some pesticides, an assessment by the European Commission found that the system for control of illegal pesticides is weak: the scope and frequency of inspections, particularly of retailers and importers, is not sufficient to determine that only authorised pesticides are marketed[188]. In response, the Danish government has installed a government taskforce to monitor illegal use and implement new initiatives to tighten control and raise penalties, including inspections of spray records and tax returns, and a regulation allowing the revoking of sprayer certificates[189]. EU-wide monitoring and control of illegal and counterfeit pesticides is essential and is being expanded[190]. Policy options to control the trade in illegal pesticides include addressing the need for an EU centralised database gathering all national pesticide authorisations, currently a legislative gap[191].

3.2.1 Restrictions on pesticides in water protection zones

Description of policy mechanism

- Obligatory (statutory) or voluntary
- Enforcement through pollution limit fines/ sanctions at point sources or through local inspections
- No direct public costs but public funding required for compliance enforcement, information and awareness raising

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186 Andy Evans (2 March 2015) Crops: Pesticide withdrawal: Potential impacts in conjunction with increasing levels of insecticide resistance. SRUC. Presentation to the Edinburgh Discussion Circle, 2nd March 2015. Available at: http://www.sruc.ac.uk/downloads/file/2395/crops_pesticide_withdrawal_potential_impacts_in_conjunction_with_increasing_levels_of_insecticide_resistance

187 FCEC (2015) Ad-hoc study on the trade of illegal and counterfeit pesticides in the EU. Report for European Commission under Framework Contract for evaluation and evaluation related services - Lot 3: Food Chain. Food Chain Evaluation Consortium (FCEC), Civic Consulting - Agra CEAS Consulting - Van Dijk Managment Consultants - Arcadia International, Berlin, Germany. http://ec.europa.eu/food/plant/pesticides/docs/study_on_illegal_ppps_summary_en.pdf

188 European Commission (2014) Final report of an audit carried out in Denmark from 17 to 24 June 2014 in order to evaluate controls of pesticides. DG(SANCO) 2014-7184-MR FINAL. Food and Veterinary Office, European Commission, Brussels.

189 The Danish Government (2013) Protect water, nature and human health: Pesticides strategy 2013-2015. The Danish Government, Denmark. http://ec.europa.eu/food/plant/pesticides/sustainable_use_pesticides/docs/nap_denmark_en.pdf

190 For example see: EurActiv.com with EFE translated by Samuel Morgan 18 Dec 2015. 190 tonnes of illegal pesticides seized by Europol. http://www.euractiv.com/sections/justice-home-affairs/190-tonnes-illegal-pesticides-seized-europol-320585

191 FCEC (2015) Ad-hoc study on the trade of illegal and counterfeit pesticides in the EU. Executive summary. Fstudy for European Commission DG SANCO. Food Chain Evaluation Consortium, Berlin, Germany.

Area-based restrictions may be obligatory through national or local regulations, or voluntary through local initiatives. The Water Framework Directive requires that Member States adopt “measures to meet the requirements of Article 7, including measures to safeguard water quality in order to reduce the level of purification treatment required for the production of drinking water”. If, therefore, there are problems with the protection of drinking water sources or a need to reduce purification for drinking water supply, the WFD obliges Member States to adopt measures. However, many Member States have failed to adopt many basic measures under Article 11. Legal options will vary depending on national legislation. The Sustainable Use of Pesticides Directive also encourages Member States to take measures to minimise or prohibit the use of pesticides in Drinking Water Protection Areas and in groundwater Safeguard Zones.

Evidence from case studies

The UK government approach has relied on voluntary measures to try to reduce the frequency with which pesticide concentrations in UK surface waters exceed the water standards. These consist mainly of the Voluntary Initiative schemes to increase farmer compliance with the no-spray zone requirements, and good practice advice on when not to spray, industry-led product stewardship schemes to prevent water pollution, and water company initiatives to pay farmers in their catchments to reduce pesticide pollution.

In contrast, Luxembourg has taken the step of banning all plant protection products containing the active substance metazachlor completely in its drinking water safeguard zones (see Case Study 6.3). The Luxembourg National Action Plan on pesticides also states that tighter restrictions will be applied to certain pesticides in water protection areas, and the use of plant protection products identified as priority substances under the Water Framework Directive will be prohibited or restricted in these areas. Luxembourg is introducing a rural development measure[192] to provide compensation for applying certain compulsory farming practices in drinking water protection areas, including the bans on using specific pesticides.

Denmark has announced it will consider prohibiting pesticides found to exceed thresholds in surface or groundwater as a result of the Danish pesticide leaching assessment programme, and is reviewing current pesticide approval practices in the EU and other countries, with the aim of recommending further initiatives on preventing pesticide leaching to groundwater[193]. The Danish government is also providing DKK 30.3 million (around 4 million Euros) in 2013-2015 for enhanced efforts for protection of groundwater, primarily financed by the revenues from the new tax on pesticides[194].

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192 Under EAFRD regulation Article 31 for Water Framework Directive (FWD) payments, http://ec.europa.eu/agriculture/rural-development-2014-2020/country-files/lu/factsheet_en.pdf

193 The Danish Government (2013) Protect water, nature and human health: Pesticides strategy 2013-2015. The Danish Government, Denmark. http://ec.europa.eu/food/plant/pesticides/sustainable_use_pesticides/docs/nap_denmark_en.pdf

194 The Danish Government (2013) Protect water, nature and human health: Pesticides strategy 2013-2015. The Danish Government, Denmark. http://ec.europa.eu/food/plant/pesticides/sustainable_use_pesticides/docs/nap_denmark_en.pdf

Key barriers and opportunities in the UK

As drinking water protection zones are primarily precautionary measures, the costs are generally shared by the public, in part indirectly through water charges, rather than by individual potential polluters. As most pesticide pollution is diffuse, it is rarely possible to trace agricultural pesticide pollution to a particular individual in order to implement the polluter pays principle. Most of the costs are shared by the UK authorities and water companies, including: establishing and delineating protection zones, enforcing restrictions and limitations on activities within zones, awareness raising and information, advice and education programmes, water monitoring, and compensations to polluters for voluntary measures. Potential polluters may have to bear the loss of earnings resulting from restrictions on activities within the zone, and more general conditions such as more restrictive label requirements.

Water companies can save costs associated with water treatment to remove pesticides and costs of the closure and replacement of abstraction sources due to pesticide pollution, as well as the reputational risk associated with customer awareness that their drinking water contains pesticide residues. In the absence of government action, water companies are taking the initiative to pay farmers and other polluters in their catchments to change their practices and renounce the use of certain pesticides. Measures to reduce agricultural pesticide pollution would be assisted by better coordination between agricultural authorities, river basin management authorities and water companies. Defra plans to open a public consultation on possible measures to reduce the water quality risks posed by metaldehyde and oilseed rape herbicides in England[195].

3.3 Other restrictions on agricultural pesticide use for water and habitat protection

Description of policy mechanism

- Statutory mechanism (user responsibility)
- Public funding: training, compliance support measures (certification and checks of users and equipment); private funding: information, advice and training

Buffer zones or strips along water bodies and hedges are recommended or mandatory measures to prevent water pollution by pesticides. **Label-based restrictions** are used to restrict the use of certain pesticides for the purpose of water protection, for the protection of users, and to avoid public exposure. Farmers receiving direct payments under the Common Agricultural Policy must follow **cross-compliance** rules on leaving buffer strips along water courses, and comply with European legislation on groundwater protection. Member States may also impose national rules on pesticide use under cross-compliance.

[195] http://www.pesticides.gov.uk/Resources/CRD/Migrated-Resources/Documents/P/Agenda%20item%204%20Simon%20Crabbe%20PF%2018%20June%202014%20Water.pdf

Pesticide pollution of surface water from agricultural sources is caused by surface run-off or field drainage or by point-source pollution from sprayer filling areas and farmyards. Surface run-off can be reduced by reducing soil erosion through permanent vegetated buffer zones along field edges and/or across large fields, reducing soil compaction, and by careful attention to the timing of pesticide applications in relation to rainfall and soil moisture status. However, many UK fields are under-drained and reducing losses via field drainage is difficult, as herbicides are predominantly applied in late summer when soils may be cracked and entry into the soil water occurs very quickly. Pollution from sprayer filling areas and farmyards is more easy to address through the installation of covered pesticide handling areas with separate water drainage systems.

Permanent vegetated buffer strips can be effective in preventing pesticide pollution to surface water through surface run-off, though they will not prevent pollution through field drainage flow[196]. In fields with pipe or tile drainage, soil runoff can be stored or blocked, thereby reducing pesticide pollution, through the incorporation of a small trench and/or elevated ridge just before the watercourse, and/or a strip of vegetation that is semi-permanently or permanently wet (Dworak et al 2009[197]). A large survey in Germany indicated that riparian buffer strips must be at least 5m in width to effectively mitigate the effects and exposure of pesticides (Bunzel et al 2014[198]). A three zone design has been proposed for its multiple benefits, comprising a permanent grassy crop margin, a strip with shrubs or short rotation trees, and an undisturbed zone with tall vegetation on the bank (Christen and Dalgaard 2013[199]). Ideally, the design of buffer zones in any given area would be based on a sound diagnosis at the catchment or the hill slope scale (Carluer et al 2014[200]).

Examples from case studies

In Denmark, the Buffer Zone Law (also called Border Zone Act) came into force in September 2012 and requires 10m buffer zones along all watercourses (but not ditches with standing water) and around lakes larger than 100m^2 (with minor exceptions). The buffer zones cannot be fertilized, sprayed with pesticides or cultivated (Elbersen et al 2014[201]). The farmer cannot be compensated for the allocation of the land, but is entitled to an annual grant for establishment.

[196] http://www.getpelletwise.co.uk/news/buffer_zones_are_not_the_whole_solution/

[197] Dworak, T, Berglund, M, Grandmougin, B, Mattheiss, V and Nygaard Holen, S (2009) International review on payment schemes for wet buffer strips and other types of wet zones along privately owned land. Study for RWS-Waterdienst, Ecologic, Berlin.

[198] Bunzel, K, Liess, M and Kattwinkel, M (2014) Landscape parameters driving aquatic pesticide exposure and effects. *Environmental Pollution* No 186, pp90-97.

[199] Christen, B and Dalgaard, T (2013) Buffers for biomass production in temperate European agriculture: A review and synthesis on function, ecosystem services and implementation. *Biomass and Bionenergy* No 22, pp53-67.

[200] Carluer, N, Tournebize, J, Gouy, V, Margoum, C, Vincent, B and Gril, J J (2011) Role of buffer zones in controlling pesticides fluxes to surface waters. *Procedia Environmental Sciences* No 9, pp21-26.

[201] Elbersen, B, Beaufoy, G, Jones, G, Noij, G J, Doorn, A v, Breman, B and Hazeu, G (2014) Aspects of data on diverse relationships between agriculture and the environment. Final report for DG-ENV contract no: 07-0307/2012/633993/ETU/B1. Alterra in cooperation with EFNCP, Wageningen, The Netherlands. http://ec.europa.eu/environment/agriculture/pdf/report_data_aspectsAgriEnv.pdf

In the Noord-Brabant province of the Netherlands, a scheme funded by the regional government and the water boards pays farmers under 6-year contracts to establish and maintain 5 m buffer strips along permanent ditches. The strips are sown with annually cut grass and flower mixes and cannot be fertilized, sprayed with pesticides or cultivated (Elbersen et al 2014).

Key barriers and opportunities in the UK

Under cross-compliance rules, farmers in the UK can have their direct farm payments sanctioned for discharging significant quantities of hazardous substances to groundwater, for applying unauthorized pesticides, for not following the pesticide application requirements according to the label and/or the authorisation permit, and for not following good plant protection practice[202]. Farmers must not cultivate or apply pesticides to a 2m strip along a watercourse or ditch in Wales and Scotland[203]; 2m from the centre of the watercourse or ditch or 1m in from the top of the bank in England[204]. Cross-compliance rules also specify that farmers must not apply pesticides to a strip within 2m of the centre of a hedge (with exceptions for recently planted hedges) in England or Scotland. However, this obligatory 1-2 m uncultivated buffer strip along watercourses is not sufficient to control pesticide pollution through field drains when there is heavy rainfall and the soil is saturated.

Most pesticides in the UK are subject to a 'no-spray' buffer zone label restriction of at least 5m when applied by horizontal boom or broadcast air-assisted sprayers[205]. Larger buffer zone requirements up to 20m were introduced in November 2011 for certain pesticides and crops in an attempt to reduce surface water pollution[206] [207] [208]. Pesticide users can reduce the 5m buffer zone for some pesticides if they complete a Local Environment Risk Assessment for Pesticides (LERAP), but not for those pesticides that require the larger zones. The new LERAP requirements now differ according to which crop a pesticide is used on, which makes the system more complicated, and may have increased the potential for non-

[202] According to the Code of Practice for Using Plant Protection Products dated 2006 for England and Wales. Defra & Welsh Assembly Government, UK. http://www.pesticides.gov.uk/Resources/CRD/Migrated-Resources/Documents/C/Code_of_Practice_for_using_Plant_Protection_Products_-_Complete20Code.pdf

[203] http://www.gov.scot/Topics/farmingrural/Agriculture/grants/Schemes/Crosscompliancesection/crosscompliance2015

[204] Defra (2014) The Guide to Cross Compliance in England 2014 complete edition. Department for Environment Food & Rural Affairs Rural Payment Agency, UK.

[205] 206 of the 250 approved active substances http://www.pesticides.gov.uk/guidance/industries/pesticides/topics/using-pesticides/spray-drift/leraps

[206] https://secure.pesticides.gov.uk/LerapsCatAB/lerapsearch.asp

[207] http://www.pesticides.gov.uk/guidance/industries/pesticides/topics/pesticide-approvals/pesticides-registration/applicant-guide/updates/Introduction-of-new+larger-aquatic-buffer+zones-for-horizontal-boom-sprayers

[208] Currently (August 2013) applies to products with the active substances cymoxanil, diflufenican, quinoclamine, deltamethrin, dimethaclor, thifensulfuron-methyl and tribenuron-methyl, dimethomorph and fluazinam, foramsulfuron, pendimethalin, metribuzin, dimoxystrobin and epoxiconazole, penthiopyrad and picoxystrobin

compliance. However, it is also acting as an incentive to farmers to install and maintain wide buffer strips in order to avoid any risk of not complying with LERAP requirements[209].

Agri-environment payments under the Entry-level Stewardship Scheme in England from 2001 to 2014 paid farmers to install and manage buffer strips under various options for 2m, 4m or 6m strips along water courses, hedges or other boundaries. The ELS scheme aimed for an uptake on as many farms as possible, but the new Countryside Stewardship scheme in England will only fund buffer strips in target areas for water quality, and applicants are selected on a competitive basis[210]. A 2010 survey of 146 large arable farms by the Voluntary Initiative found that only 69% of the farms had vegetated buffer strips, whilst 63% of farmers considered the risks of pesticides reaching watercourses through erosion, run-off or drainage on their farm were not significant[211].

3.4 Restrictions on pesticide use in public spaces and in other areas outside agriculture

Description of policy mechanism

Label-based restrictions are used to restrict the use of certain pesticides in non-agricultural areas for the purpose of water protection, for the protection of users, and to avoid public exposure. Other restrictions are used to reduce the use of pesticides by non-professional untrained users, and to restrict the use of pesticides in non-agricultural environments more generally. The Sustainable Use of Pesticides Directive encourages Member States to ensure that the use of pesticides is minimised or prohibited in certain specific areas in response to public health concerns and/or biodiversity risk assessments. This has provided political leverage for national and local statutory restrictions in public areas, building on previous voluntary initiatives.

Amenity sector pesticide use is dominated by herbicides used for keeping roads, railways, buildings and other areas free of vegetation[212]. There are specific issues of concern with regard to amenity pesticide application. Due to its nature there is an increased risk that members of the public will be exposed to pesticides. There have also been concerns raised about the levels of pesticides running off from hard surfaces into water bodies as a result of amenity spraying. Amenity weed control is a very public operation which is often carried out in sensitive areas, such as in schools, on pavements, precincts and urban green spaces, often near drains, rivers and canals. It should therefore be carried out to high professional standards, by qualified, certificated operators, to protect the public and environment. Weed control in non-agricultural spaces is usually carried out by contractors for either local authorities or corporate businesses. Weed control contracts should only be awarded to those with the necessary skills and training, and training must be promoted and encouraged, to raise standards and awareness of current best practice.

[209] Mills, J, Gaskell, P, Reed, M, Short, C, Ingram, J, Boatman, N D, Jones, N E, Conyers, S T, Carey, P, Winter, M and Lobley, M (2013) Farmer attitudes and evaluation of outcomes to on-farm environmental management. Report to Defra IF01114. CCRI, University of Exeter and FERA, Gloucester.
[210] https://www.gov.uk/guidance/countryside-stewardship-manual
[211] AIC agronomist survey 2010 Field Practice and Soil Management. http://www.voluntaryinitiative.org.uk/importedmedia/library/1460_s4.pdf
[212] https://secure.fera.defra.gov.uk/pusstats/surveys/documents/amenity2012v2.pdf

The use of pesticides by amateurs in private spaces (homes, gardens etc) can only be controlled by limiting the products available on the market, either by removing certain active substances or by limiting the formulations and packaging to restrict exposure.

Evidence from case studies

France passed a Decree in 2011 to prohibit certain pesticides with health risks in schools, childcare places, playgrounds and other child play areas; and a no spray zone of 50m around hospitals & healthcare/rehabilitation centres, retirement homes and care homes (Case Study 6.4). A new law will prohibit the public or private use of pesticides in all public spaces, green areas, and forests from 1 January 2020 (some measures start in 2017).

France has also passed a new law that will ban all non-professional pesticide uses by 2022 (including some restrictions by 2017) with the exception of bio-pesticides and low-risk substances (see Case Study 6.4). The proposed sanctions may be heavy - anyone using or found with banned pesticide products could be imprisoned for up to two years with a 300,000 EUR fine. Exceptions will be allowed for necessary measures to destroy and prevent the spread of pests.

All three regions of Belgium are planning to ban pesticides in public areas, with different timeframes (Case Study 6.5). The Walloon region aims to have zero pesticide use in amenity areas by 2019 with a gradual phase in of legal restrictions from 2014. In Flanders, as of 1 January 2015, pesticide use is prohibited in places offering a public service to vulnerable groups, including schools, childcare services, hospitals, healthcare institutions, and churches[213].

A number of towns in France have voluntarily declared themselves pesticide free, notably Rennes in France has implemented a pesticide-free policy since 2000, primarily motivated by water pollution issues[214] (see Case Study 6.6). In the Flanders region of Belgium, 34 towns already voluntarily declared themselves pesticide-free by the end of 2014[215].

The UK has imposed label-based restrictions on blanket spraying of hard surfaces, which apply mainly to local authorities and non-professional pesticide users spraying pesticides on roads, paths, railways, paved squares and parking places. There is no information on compliance. In Switzerland, where similar restrictions have applied since 1986 for local authorities and 2001 for private users, the government has funded training for local authority staff. A 2010 survey of local authorities whose staff had received training in the herbicide use restrictions found that 61% had stopped using herbicides completely and

[213] Decision of the Flemish Government of 15 March 2013 laying down detailed rules on the sustainable use of pesticides for non-agricultural and horticultural activities in the Flemish Region. http://www.zonderisgezonder.be/openbare-diensten/Definities_Openbare%20dienst_commerciele%20activiteit_Zorginstellingen_kinderopvang_versie_2014_12_11.pdf

[214] http://www.pan-europe.info/Activities/Conferences/150608/presentations/presentation%20PAN%20Europe%20FV%2008%2006%202015.pdf

[215] http://www.zonderisgezonder.be/

another 20% had reduced usage, with a continuing increasing trend, but that in contrast awareness amongst garden owners was low[216] (see Case Study 6.7).

Key barriers and opportunities for the UK

The driver for the moves to ban the use of pesticides for amenity uses in France and Belgium has been the Directive on the Sustainable Use of Pesticides (SUD), which has been used to extend existing regulations and introduce new legislation that will ensure that the regions of Belgium are meeting the requirements of the SUD.

In contrast, the UK is relying on a voluntary approach, and progress on implementing good practice standards has been slower than in agriculture. The Amenity Assured Standard was introduced in 2007, and revised in 2012, as a certificate of responsible pesticide use for contractors and companies[217]. It specifies good practice in pesticide risk assessment, application and storage[218]. A register of certified and trained professionals in the amenity sector (BASIS Amenity Training Register), came into force at the start of 2015[219], combining two previous registers[220] and there is not yet any information on how many pesticide users have registered or whether local authorities or private companies in the amenity sector are looking for certified contractors or not.

Defra recently published new integrated pest management guidance in amenity use for local authorities[221]. The guide assumes that good planning will cut down on the amount of pesticide used from the start, and from the industry side, the Amenity Forum is keen to encourage best practice and the adoption of an integrated approach to head off any potential outright EU ban[222]. Some local authorities in the UK are taking the initiative to test non-chemical weed control methods, but are faced with strong pressure to reduce short-term costs by selecting chemical control over mechanical control, particularly hand weeding, and the tender is often prepared and assessed by staff with no knowledge of pesticides.[223]. However, the relative costs used in the guidance will change as more non-chemical methods are marketed and become more cost-effective.

[216] BAFU (2010) Umsetzung des Verbots von Pflanzenschutzmitteln. Untersuchung zum Stand der Umsetzung des Anwendungsverbots von Unkrautvertilgungsmitteln auf und an Strassen, Wegen und Plätzen. Bundesamt für Umwelt, Bern, Switzerland. http://www.bafu.admin.ch/publikationen/publikation/01556/index.html?lang=de

[217] https://basis-reg.co.uk/Schemes/Amenity-Assured/About-Amenity-Assured

[218] https://basis-reg.co.uk/Portals/1/Resources/AMENITY%20Assured/AMAS%20new%20booklet.pdf

[219] https://basis-reg.co.uk/Schemes/Amenity/About-Amenity-Register

[220] the previous BASIS Amenity Register and the City & Guilds National Amenity Spray Operator Register (NASOR)

[221] Defra 2015. Best practice guidance notes for integrated and non-chemical amenity hard surface weed control. http://www.emr.ac.uk/wp-content/uploads/2015/03/BPWeeds2015web1.pdf

[222] http://www.hortweek.com/guide-aims-reduce-levels-pesticide-use-setting-four-step-approach/parks-and-gardens/article/1341925

[224] http://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:32009L0128

3.5 Advice and support for integrated pest management

Description of policy mechanism

- Voluntary (though IPM management plan may be obligatory under CAP cross-compliance)
- Public and/or privately funded training and advice
- Public and/or privately applied research and support for farmer innovation

Under Article 14 of EU Directive 2009/128 on the Sustainable Use of Pesticides (SUD) Member States are required to[224]:

• Take all necessary measures to promote low pesticide-input pest management, with priority being given to non-chemical methods wherever possible.

• Establish or support the establishment of the conditions needed to implement IPM, particularly ensuring that monitoring and decision making tools and advisory services on IPM are available.

• Ensure the general principles of IPM set out in Annex III of the Directive are implemented by all professional users by 1st January 2014.

• Establish appropriate incentives to encourage users to implement voluntary crop or sector specific guidelines.

The key components of IPM listed in the SUD include:

- Preventative measures:
  - crop rotation
  - use of adequate cultivation techniques & timing of operations,
  - use of resistant/tolerant cultivars and certified seed
  - hygiene measures
  - protection and enhancement of natural biological control through beneficial organisms
- Use of non-chemical methods eg mechanical weed control techniques, steam, and environmentally benign pest control products eg biopesticides and release of biological control agents
- Survey and monitor pests and use warning, forecasting and early diagnosis systems
- Decision-making on pesticide use according to damage thresholds and
- Choice of the most specific pesticides with least side effects
- Use of chemical pesticides at necessary levels only eg by reduced dosage, reduced application frequency, or partial applications
- Prevent development of resistance

The first two can be considered to be in-depth IPM, whilst the last four points comprise integrated pesticide management.

Key elements of IPM support for farmers include:

- Pest warning service for farmers

[224] http://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:32009L0128

- Websites with IPM guidance for particular crops or users and pest information
- Publicly funded targeted advisory service for farmers
- Network of best practice and pilot farms and promotion to farmers
- Applied research and support for farmer innovation
- Public IPM guidance for farmers
- Availability of pest and disease resistant varieties

Evidence from case studies

IPM advice for farmers
The Danish Farm Advisory Service offers a heavily subsidised IPM advice service to arable farmers, which has so far covered around 15% of the arable area with two-year advisory packages. The scheme has been funded with around 4.3 million Euros over five years, partly through income from the Danish pesticide tax. There is not yet much evidence of an impact on farmer behaviour and pesticide use (see Case Study 6.8). However, the Danish average fungicide input on winter wheat of 0.6 full dose rates (TFI) compares favourably with the UK winter wheat TFI of 2.3 full dose rates (Jorgensen et al 2014[225]). The evaluation surveys have mostly only measured changes in farmer attitudes shortly after the training, whereas several growing seasons are required for farmers to effectively switch to IPM based crop management.

The French Ecophyto plan is aimed at reducing pesticide use in France by 50% (see Case Study 6.9), and funds a package of actions designed to promote the use of low-pesticide IPM. It has not been possible to demonstrate a country-wide reduction in pesticide use so far, but the evaluation of the plan concluded that it has stimulated IPM on the more pioneer farms by building networks between research and practice. The plan has stimulated the establishment of a network of experts and best practice demonstration farms with each of the main cropping systems across France (Butault et al 2010[226]).

In the UK, the government advisory service provides pesticide advice through the Campaign on the Farmed Environment partnership and the Voluntary Initiative[227]. However, the larger arable farms get their IPM advice primarily from private consultants, and very few report using government advice[228]. There is anecdotal evidence that private consultants can be held liable if crop damage occurs when a farmer has followed their advice, which tends to promote precautionary pesticide treatments and is therefore a disincentive to encouraging farmers to reduce pesticide use.

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[225] Jørgensen, L N, Hovmøller, M S, Hansen, J G, Lassen, P, Clark, B, Bayles, R, Rodemann, B, Flath, K, Jahn, M, Goral, T, Czembor, J J, Cheyron, P, Maumene, C, De Pope, C, Ban, R, Nielsen, G C and Berg, G (2014) IPM strategies and their dilemmas including an introduction to www.Eurowheat.org. Journal of Integrative Agriculture No 13, (2) 265-281.

[226] Butault, J-P, Dedryver, C-A, Gary, C, Guichard, L, Jacquet, F, Meynard, J M, Nicot, P, Pitrat, M, Reau, R, Sauphanor, B, Savini, I and Volay, T (2010) Écophyto R&D. Quelles voies pour réuire l'usage des pesticides? Rapport d'Étude (9 tomes), Étude menée par l'INRA à la demande du Ministère de l'Écologie, de l'Énergie, du Développement durable et de la Mer et du Ministère de l'Alimentation, de l'Agriculture et de la Pêche, France

[227] http://www.cfeonline.org.uk/news/crop-protection-guidance/

[228] Bailey, A, Bertaglia, M, Fraser, I, Sharma, A and Douarin, E (2009) Integrated Pest Management portfolios in UK arable farming: results of a farmer survey. Pest Management Science No 65 (9), pp1030-1039.

There is an urgent need for more sustainable winter oilseed rape-wheat cultivation practices and rotations, which reduce herbicide use and build up soil quality (see Box 8). To achieve this will require more focus on diversified rotations, reduced inputs, resistant varieties appropriate to local conditions, and more knowledge and understanding of IPM.

Box 8: The sustainability of herbicide use in winter oilseed rape – wheat rotations

The key oilseed rape herbicides carbetamide, clopyralid, metazachlor and propyzamide are at the top of the list of pesticides causing failures to meet water quality targets. Avoiding leaching into watercourses requires extreme care to not apply these herbicides on dry or saturated soils on fields with sub-soil drainage, and to guard against applications less than 48 hours before heavy rain, which are likely to result in contamination.[229] A possible but relatively radical option to reduce water quality failures would be to withdraw these herbicides from the market. Carbetamide and propyzamide, together with metazachlor, are frequently used in autumn-sown oilseed rape to control black-grass in cereal-based rotations[230]. Winter oilseed rape production in the UK could be considerably affected by the withdrawal of these herbicides. One 2009 study predicted that pesticide withdrawals would trigger gross margin reductions of oilseed rape nationally of up to 43% due to reduced black-grass control, and up to 20% due to reduced rye grass control (Twining and Clarke 2009[231]).

Some experts, however, consider that the widespread UK wheat-oilseed rape rotation, with herbicide use to control weeds, is unsustainable, due to the combination of black-grass weed pressure and loss of soil organic matter[232]. Black-grass now has multiple-herbicide resistance on almost all farms[233]. Furthermore, the UK Agriculture & Horticulture Development Board quotes evidence that oilseed rape yields are failing to increase because the cropping frequency is increasing soil disease[234]. According to government guidance, farmers will need to switch to weed control strategies in oilseed rape that use non-chemical control methods, notably ploughing instead of minimum tillage, in combination with alternative pre-or early post-emergence herbicides, or they will need to switch to more diverse arable crop rotations incorporating fallows or grass or legume leys or cover crops and more spring-sown crops[235]. A two-year fallow or ley is needed to get rid of high black-grass infestation levels[236]. Autumn ploughing provides good control of black-grass but could bring other weed seeds to the surface, can increase herbicide leaching through the soil, and can lead to soil erosion problems. There is therefore an urgent need for farmers to be helped to successfully implement more sustainable wheat-oilseed rape rotations that both use less herbicide and provide better soil quality.

Key barriers and opportunities for the UK

Farmers tend to implement IPM as individual tools or measures rather than as a whole farm system. IPM advice should therefore follow a tiered approach that provides incentives for farmers to progress from optimising pesticide use on individual crops or fields to reducing pesticide dependence by introducing non-chemical management measures across the whole farm. IPM training should be on-going rather than episodic, progressing from a basic understanding towards higher and more permanent sessions, keeping all the involved

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229 http://www.voluntaryinitiative.org.uk/importedmedia/library/1147_s4.pdf

230 http://cereals.ahdb.org.uk/media/177741/ts116_autumn_grass_weed_control_in_cereals_and_oilseed_rape.pdf

231 Twining, S. & Clarke, J. (2009) Future of UK winter oilseed rape production. ADAS report prepared for Crop Protection Association and Agricultural Industries Confederation. http://www.voluntaryinitiative.org.uk/importedmedia/library/1152_s4.pdf

232 http://www.agrovista.co.uk/news/news.aspx?pname=Latest-News-Blackgrass-Masterclass&newsid=1066

233 http://cereals.ahdb.org.uk/media/433525/is30-black-grass-solutions-to-the-problem.pdf

234 http://cereals.ahdb.org.uk/media/305093/g55-oilseed-rape-guide-jan-2014-update.pdf

235 http://www.pesticides.gov.uk/Resources/CRD/Migrated-Resources/Documents/W/WRAG_Black_grass_leaflet_Everything_you_really_wanted_to_know_May_2013.pdf

236 http://cereals.ahdb.org.uk/blackgrass

operators up to date with the technical progress. Information provision is a key component, including an easy to access web platform, integrated with a proper local support service for farmers less used to information technologies. The flow of information should be bidirectional, to verify the correct implementation of IPM and the actual result of the recommendations.

Achieving substantial reductions in pesticide use on farms requires the introduction of systematic changes to the farming system which go beyond crop management decisions on individual fields or particular crops. For example, a study on pesticide use on wheat fields in Germany found that the two main influences on pesticide use were the farm characteristics which determine overall cropping intensity, and the routine of pest treatment decisions on the farm, whilst 10% of the pesticide use differences between individual fields reflected field-scale IPM crop management decisions (Burger et al 2012[237]).

Increasing the use of pest and disease resistant varieties could have a large impact. For example, in orchard crops (pears and apples) in the Netherlands[238], where frequent applications of highly toxic pesticides with sideward spraying techniques result in the highest aquatic risk per crop, the use of 90% drift-reducing technologies is already mandatory and no alternative chemicals are available, but the use of apple scab resistant varieties would potentially decrease the aquatic risk by 43%.

3.6 Registration and promotion of biopesticides

Description of policy mechanism

Biopesticides[239] include micro-organisms or other living organisms, pheromones or other semiochemicals, products based on plant extracts, and novel low-risk products. They are generally highly specific and usually have a lower environmental impact than conventional chemical pesticides (Chandler et al 2011[240]). They offer alternatives that can significantly reduce non-organic farmers' dependence on chemical pesticides, as well as being important components of organic farming systems (see Box 9). However, it is important to note that biochemicals, which are sometimes also considered to be biopesticides, are not necessarily

[237] Burger,J., de Mol,F., Gerowitt,B. (2012) Influence of cropping system factors on pesticide use intensity – a multivariate analysis of on-farm data in North East Germany. European Journal of Agronomy 40, 54-63

[238] van Eerdt, M M, Spruijt, J, van der Wal, E, van Zeijts, H and Tiktak, A (2014) Costs and effectiveness of on-farm measures to reduce aquatic risks from pesticides in the Netherlands. Pest Management Science No 70 (12), pp1840-1849.

[239] Biopesticides include products based on pheromones or other semiochemicals (for mass trapping or trap cropping), products containing a microorganism (e.g. bacterium, fungus, protozoa, virus, viroid) or other living organism (nematodes, predatory insects), products based on plant extracts, and other novel alternative products. These almost always fall within the definition of plant protection product in the EU pesticide legislation. Unless combined with an insecticide, products intended solely to monitor insect populations do not require an approval.

[240] Chandler, D, Bailey, A S, Tatchell, M, Davidson, G, Greaves, J and Grant, W P (2011) The development, regulation and use of biopesticides for integrated pest management. *Philosophical Transactions of the Royal Society B: Biological Sciences* No 366 (1573), pp1987-1998.

less toxic to non-target organisms or less prone to resistance development than synthetic chemicals[241].

Box 9: Some benefits and disadvantages of biopesticides compared to chemical pesticides

Benefits – biopesticides' high selectivity and short residual activity means they have a high amenability to combined use with biological control; their short residual activity means reduced product residues and so more flexible use up to harvest; complex chemistries and potentially multi-facetted modes of action may provide lower potential for developing pest resistance. The effect of a biopesticide is often a combination of different modes of action.

Disadvantages – biopesticides have lower and slower overall kill rates, and they are more sensitive to environmental degradation so require specific thresholds for temperature, moisture and UV-exposure post-application). They often require direct pest contact to work, which necessitates high spray volumes and more informed application procedures. They have a limited shelf life and specific storage requirements.

Biopesticides are typically developed by SMEs, often start-ups, and biopesticides generally cater to a small specialised market with low economic value compared to chemical pesticides. Developers therefore rely on finding funding to see them through the development and registration of a product, and are reliant on a short and efficient registration process. Biopesticides differ considerably from conventional chemical pesticides, and evaluations need to be adapted to the specific needs of the particular active substance and product. However, although the EU framework declares a clear commitment to provide guidance for biopesticide registration and an opportunity to streamline biopesticide registration and increase availability to growers, progress is slow. The approval of new biopesticide active substances in the EU is also limited by the lack of capacity at Member State level, as the EU approval process for new active substances relies on a rapporteur Member State to carry out the initial assessment on behalf of the EU. The UK and other Member States have therefore put in place projects or programmes to promote the registration of biopesticides.

Evidence from case studies

The **UK biopesticide scheme** piloted from 2003, and implemented from 2006, provides a biopesticide champion within the HSE pesticide approval team, free advice to applicants, and lower registration fees for biopesticides. The scheme is most relevant for the horticulture sector, and eight of the ten new biopesticide active substances approved since the start of the project are for use on protected crops[242]. The scheme has co-funded[243] trials of new biopesticides that have identified some effective products for protected crops[244].

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[241] For example the bacterial compound spinosad impairs worker flight behaviour in the bee *Melipona quadrifasciata*, and azadirachtin (Neem tree extract) causes sublethal effects that impair foraging efficiency and increase mortality of bumblebee *Bombus terrestris* workers. Examples of resistance development include spinosad resistance in thrips and abamectin resistance in spider mites. References: Tomé et al (2015) Spinosad in the native stingless bee *Melipona quadrifasciata*: Regrettable non-target toxicity of a bioinsecticide. Chemosphere 124: 103-109.; Barbosa, W.F., De Meyer, L., Guedes,R.N.C., Smagghe,G. (2015) Lethal and sublethal effects of azadirachtin on the bumblebee *Bombus terrestris* (Hymenoptera Apidae). Ecotoxicology doi: 10.1007/s10646-014-1365-9 http://www.ncbi.nlm.nih.gov/pubmed/25300506

[242] Tim O'Neill 22 Jan 2014. Biopesticides: an introduction. ADAS presentation at BPOA Conference. Tim O'Neill is SCEPTRE coordinator.

[243] HortLINK scheme

[244] George, D.R. et al (2014) Identification of novel pesticides for use against greenhouse invertebrate pests in UK tomatoes and peppers. Insects 6: 464-477; doi:10.3390/insects6020464

The **Netherlands** programme to increase approval of biopesticides started in 2003 and registered 14 products by 2007[245]. Overall, 26 biopesticide active substances are registered in the Netherlands, including 17 micro-organisms, in 45 products[246]. Of these, 4 micro-organisms are regularly used on protected edible crops and 7 on ornamentals. The differences to the UK situation are partly explained by the greater economic size of the horticulture sector, but also by the successful establishment of 'bottom-up' networks promoting biopesticides[247].

Denmark has adopted a number of measures to increase biopesticide registration and use, including an accessible registration process, targeted advice on how to prepare the dossier and data requirements, and grants for up to 80% of application costs[248]. Denmark has also now differentiated its taxing system by environmental load to increase the likelihood of users choosing biopesticides before conventional pesticides. Uptake of biopesticides is reasonably high in glasshouse crops but currently low in field crops.

The process in **France** has been established more recently than in the UK and the Netherlands, with seven new microorganism active substances in evaluation since 2011[249].

Key barriers and opportunities for the UK

A review of the UK biopesticides scheme in 2010-11[250] found that uptake of biopesticides was low, but concluded that the true success of the scheme has not yet been realised due to the time needed to review applications and to build up trust with new 'customers' who are not familiar with the regulatory process[251]. The review found that *'In terms of value of horticulture & biopesticide numbers the UK is performing favourably compared to other countries'*. In contrast, the horticulture industry says progress has been painfully slow[252]. Barriers of data requirements for approval, especially efficacy data, are still considered to be a problem, and the industry consider that there is a need for greater levels of biopesticide specific expertise applied to the evaluation of applications, and more UK led input at EU level. At the EU level, the biopesticide industry is campaigning to decrease regulatory hurdles, citing inappropriate dossier requirements, long and non-transparent submission

[245] Sparkes,J. (2013) Biopesticides project. ADAS report for Chemicals Regulation Directorate. Ref PS2810.
[246] http://www.hdc.org.uk/sites/default/files/Aleid%20Dik.pdf
[247] Sparkes,J. (2013) Biopesticides project. ADAS report for Chemicals Regulation Directorate. Ref PS2810.
[248] Sparkes,J. (2013) Biopesticides project. ADAS report for Chemicals Regulation Directorate. Ref PS2810. http://sciencesearch.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=18053
[249] http://www.scc-gmbh.de/images/scc/Newsletter/SCC_Newsletter_Vol-15_No-2_May_2015.pdf
[250] ADAS (2012) Biopesticides policy final report – PS2810. http://sciencesearch.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=18053
[251] Chandler, D, Bailey, A S, Tatchell, M, Davidson, G, Greaves, J and Grant, W P (2011) The development, regulation and use of biopesticides for integrated pest management. Philosophical Transactions of the Royal Society B: Biological Sciences No 366 (1573), pp1987-1998.
[252] Claire Shaddick 12 August 2011 Crop Protection: Biopesticides - a natural selection. Horticulture Week. http://www.hortweek.com/crop-protection-biopesticides-natural-selection/article/1084167

procedures, and high costs of registration for SMEs[253]. The industry expects that a large proportion of biopesticides will be registered as low risk substances which should benefit from lower data requirements and longer approval periods.

The review suggests that market constraints are more of a barrier than the slow pace of approval of biopesticides, including the higher costs of biopesticides to growers due to their higher input costs and greater specificity. There is an unmet need for specific technical guidance. There are also still barriers to collaboration and participation in the policy process, and the UK still lacks effective biopesticide support networks[254].

There are still only a few products available to UK field vegetable growers, in particular very few bioherbicides and nematicides. Biopesticides are generally not replacing chemical pesticides, but are used in combination with reduced doses of the chemical pesticide. However, farmers lack information and knowledge on how microbial biopesticides interact together or in combination with chemical pesticides.[255]

As an example of the challenges facing biopesticide use on outdoor crops, there are currently no non-chemical methods used to control aphids such as *Myzus persicae* on outdoor crops in the UK[256]. Control of aphids has relied on pyrethroid, organophosphate and carbamate sprays, and increasingly on neonicotinoid seed treatments.

3.7 Use of crop risk insurance for Integrated Pest Management

Description

Some Member States have used public funding to help set up and support the use of crop risk insurance schemes for farmers using integrated pest management.

Evidence from case studies

In Italy, a regional farmer mutual crop insurance fund is offering crop insurance against pest damage in maize (see Case Study 6.10). Farmers must comply with good agricultural practice and integrated pest management and follow the recommendations of the local arable crop protection bulletins. The use of imidacloprid and thiamethoxam-based maize seed treatments has been banned in Italy since 2008. A long-term pest monitoring study showed that the incidence of wireworm damage (the main seedling pests targeted by the seed treatment) is very variable between areas and on average lower than 5%. The crop insurance is therefore more cost-effective than using treated seed in most cases, and covers the costs of crop damage in the few cases where wireworm damage is significant, and also covers significant damage by fungal disease of the seed and seedling. The crop insurance

[253] IBMA International Biocontrol Manufacturers Association position paper: Constraints to providing bio-pesticides for the farmer. http://www.ibma-global.org/upload/attach-image/ibmapositionpaperonappropriateregulationsversion1.pdf
[254] Greaves, J. et al. (2010). Underperforming policy networks: The biopesticides network in the United Kingdom. British Politics, Vol. 5, pp. 14-40 is available online at: http://dx.doi.org/ 10.1057/bp.2009.15
[255] http://www.hortweek.com/crop-protection-biopesticides-natural-selection/article/1084167
[256] http://adlib.everysite.co.uk/adlib/defra/content.aspx?id=000IL3890W.182V9NZT30EQ9N

also covers significant damage from corn rootworm, but as crop rotation and restricted fertiliser management are requirements of the insurance, the risks of this pest are kept low.

Key barriers and opportunities in the UK

In the UK, no schemes offer insurance against pest damage, and crop insurance is limited to hail damage. It is unlikely that crop insurance schemes to support IPM implementation will be developed in the UK soon, but it is worth considering if some extra support eg through research and innovation projects, LEADER groups, or agricultural cooperatives, could kick-start some pilot schemes.

3.8 Private assurance schemes to implement IPM / reduce pesticide use

Description of policy mechanism

Farm and food assurance schemes are private or independent not for profit initiatives that provide reassurance for retailers and consumers that food supplies meet certain quality standards that go beyond the level of basic compliance and therefore contain fewer pesticide residues. Farmers comply with specific requirements and are audited regularly in return for increased premiums on their produce. This policy option does not cover the organic sector, although it is recognised that the sector is an important contributor to pesticide use reduction in agriculture.

Evidence from case studies

The two main farm and food assurance schemes in the UK (outside the organic sector) are the Red Tractor Assured Food Standards scheme and the LEAF Marque certification scheme. Both schemes include requirements with regard to pesticide use. The Red Tractor scheme has the potential to be a driver of farmer compliance with good practice on pesticide use, as the scheme covers around 75% of UK fresh produce and 80% of combinable crops in the UK, as well as the majority of livestock production[257] and around 60,000 farm inspections are carried out under the scheme annually[258] - ie around a fifth of all farms in the UK. This is a much larger number of farm inspections each year than under government monitoring of pesticide use practices. However, an assessment of cross-compliance breaches between 2005 and 2012 found no evidence that Red Tractor members were more likely to comply with pesticide regulations than non-members[259]. The LEAF Marque, currently used on 186,989 ha farmland in the UK, including 22% of horticultural crops[260], goes further by encouraging farmers to manage field margins and hedges for wildlife which can be expected

[257] Pesticides Forum (2014) Pesticides in the UK: The 2014 report on the impacts and sustainable use of pesticides. http://www.amenityforum.co.uk/downloads/Briefing%20Notes/PesticidesForumReport2014.pdf

[258] Clarke, David (2014) Red Tractor Scheme presentation. http://www.pesticides.gov.uk/Resources/CRD/PRiF/Documents/Other/2014/David%20Clarke%20Red%20tractor.pdf

[259] FERA (2013) Study on farm assurance scheme membership and compliance with regulation under cross compliance. Project BR0114. FERA report to Defra, York, UK. http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=18477&FromSearch=Y&Publisher=1&SearchText=BR0114&SortString=ProjectCode&SortOrder=Asc&Paging=10

[260] LEAF in 2014. http://www.leafuk.org/resources/001/025/798/annrev14_final_15_Dec_14_web.pdf

to increase natural pest control. This can decrease the need for pesticides if the farmer is monitoring pests and using thresholds to determine the need for pesticide applications. However neither scheme aims to reduce pesticide use or to shift use to less harmful products. Neither scheme has assessed to what extent it has influenced pesticide use.

In Switzerland, the IP Suisse label (see Case Study 6.11) has gone further by prohibiting the use of some active substances completely on certain crops, and prohibiting the use of pre-emergence herbicides and fungicides on wheat, almost all herbicide use on potatoes, and fungicides and insecticides on oilseed rape. It covers around a quarter of Swiss bread wheat production, though the share of other crops is smaller. There is no evidence of impact on pesticide use, however, and as Swiss agricultural subsidies also include specifications on pesticide use including limits on the use of pre-emergence pesticides it would be difficult to pinpoint the influence of the IP Suisse conditions.

Key barriers and opportunities in the UK

The lack of evidence that the Red Tractor Scheme and LEAF are reducing pesticide use or pesticide impacts is a key gap, because the former is essentially the only compliance mechanism for good practice pesticide use in the UK, and the latter is the only provider of best practice low-pesticide use demonstration farms in the UK, other than industry-led schemes and the organic sector.

4 SWOT analysis of policy mechanisms

4.1 SWOT of pesticide policy options

Table 4.1 provides a short analysis of strengths, weaknesses, opportunities and threats of policy mechanisms that could reduce the environmental impacts of pesticide use. The SWOT takes into account the following criteria analysed in the case studies (see annex):

- Environmental effectiveness (ie reducing pesticide impacts)
- Other benefits – environmental or health
- Perverse effects on pesticide use
- Feasibility of implementation – eg time lags, monitoring, ensuring compliance
- Costs to farmers/users – eg cost impacts on production
- Other costs – administration, monitoring, compliance control, advice etc

Lack of evidence of impact on pesticide use
The case studies revealed that the evidence base for the effectiveness of policy mechanisms to reduce the environmental impacts of pesticides is generally low or absent. National level pesticide monitoring statistics are generally not precise enough to detect the influence of particular programmes.

Combining policy mechanisms
The case studies highlight the importance of combining policy mechanisms. To implement more extensive measures to reduce pesticide use, legislation in combination with enforcement is usually needed. It is also important to implement a broad array of policy instruments to match different farmer motivations. Some farmers are more economically motivated while other farmers are more focused on optimising yield and pay less attention to expenditures and crop prices, and are therefore less responsive to economic policy instruments (Pedersen et al[261]).

[261] Pedersen,A.B., Nielsen,H.O., Christensen,T., Hasler,B. (2012) Optimising the effect of policy instruments: a study of farmers' decision rationales and how they match the incentives in Danish pesticide policy. Journal of Environmental Planning and Management 55(8): 1094-1110.

Table 4.1 SWOT analysis of policy mechanisms

	Strengths	**Weaknesses**	**Threats**	**Opportunities**
Total or partial bans	Targeted ban of a problematic pesticide can be very effective in reducing impact on water quality and/or environmental risk. Relatively simple to implement.	Requires control of illegal pesticide sales and use. Not possible to ban use of imported seed treatments. Affects particular crops/ users so can be perceived as unfair. Can result in economic losses in the absence of measures to guide the switch to more environmentally beneficial effective alternatives. Can result in reduction of crop area if farmers perceive risks of alternatives as too high & abandon crop.	Users usually switch to chemical alternative in the absence of incentives to use non-chemical methods – this may increase the use of other problematic pesticides.	Can promote users to implement non-chemical alternatives if supported by sufficient advice and other incentives, and so reduce dependence on pesticides. 'Candidates for substitution' alternatives test requirement is opportunity to restrict problematic pesticides and promote alternatives.
Area-based restrictions to protect drinking water	Drinking water safeguard zones can be used to target incentives and enable regulatory actions eg banning particular pesticides within zones. Water companies have an economic incentive to invest in catchment management to save costs of removing pesticides from drinking water as well as to avoid infringements and reputational risks.	Limits to traceability of point pollution to individuals. Limits to statutory powers to prosecute and fine. Farmers underestimate the contribution of field drainage to diffuse herbicide pollution of water. Requires designation of drinking water protection zones, which requires geological research.	Pollution spikes can be caused by low frequency of non-compliance/bad practice so incentive schemes need to enrol nearly all farmers in a catchment to effectively reduce pollution. Coordination failures between water companies, river basin management committees, and agricultural organisations can undermine initiatives.	Schemes can simultaneously address nitrate and pesticide pollution issues.
Other agricultural restrictions for water protection	Sufficiently wide permanent vegetated buffer strips can effectively reduce pesticide impacts on water and field-edge habitats such as hedges. Increased no-spray buffer zone requirements (up to 20m) for particular pesticides are still quite new so effectiveness as yet	Compulsory (cross-compliance) buffer strips are generally too narrow to prevent pesticide pollution. Compliance monitoring is low.	Lack of agri-environment support (2015-2020) for buffer strips outside target areas may result in destruction of some installed strips.	Permanent vegetated buffer strips and field margins can enhance natural biological control.

	unproven, but requirements are expected to reduce impacts.			
Area-based restrictions in public spaces	Can generally rely on a high level of public support, sometimes via bottom-up mechanisms (referenda, local initiatives etc). Effective reduction of public exposure and pesticide use volumes because of herbicide cuts.	Local initiatives without national support may have to rely on local statutes or regulations and resources, which may be difficult to enforce/mobilise.	Cuts in local authority budgets favour low-cost chemical-based pest and weed control and low standards. Lack of understanding of pesticide issues at local authority level means standards are not raised.	Creates economic opportunities for non-chemical pest and weed control. Enables the creation of more wildlife-friendly public spaces.
Advice and support for IPM	In-depth IPM results in long-term reduction in pesticide use and pesticide dependency.	Many farmers rely on private advice rather than public. Requires public funding for a package of measures.		Pest resistance development is a key driver for IPM implementation. Practical experiences in cropping systems that reduce pesticide reliance in other EU MS could be assessed for feasibility in UK.
Approval and promotion of bio-pesticides	Bio-pesticide registration capacity has been built and more products are being registered. Biopesticides are generally expected to have lower environmental impacts than conventional pesticides.	Products are mainly aimed at protected crops sector, few products for field crops.	Uptake of bio-pesticides on field crops is still very low. EU level authorisation of low-risk substances still very slow.	Bio-pesticides are key elements of IPM and organic production and facilitate pesticide use reduction.
Crop risk insurance for IPM	Facilitates IPM and eliminates need for precautionary pesticide applications by covering risks of crop damage from pest outbreaks. Encourages good practice by making it a pre-condition.	No basis of public crop risk insurance schemes in the UK.	Risk of scheme setting requirements that farmers carry out some preventative pesticide use to qualify for insurance e.g. seed treatments.	Uses area-wide pest monitoring data to predict pest frequencies and encourages use of pest monitoring and information services.
Pesticide reduction through private assurance schemes	Potentially effective compliance mechanisms for good pesticide practice. LEAF Marque offers demonstration farms for farmer learning.	Current UK schemes (other than organic) do not encourage pesticide use reduction or prohibit particular pesticides.	Lack of government oversight could lead to 'greenwash' schemes that advertise more sustainable pest management but do not have sufficient standards or enforcement mechanisms to back this up.	LEAF Marque encourages measures to promote natural biological control, which should reduce dependence on pesticides.

5 Policies to reduce the environmental impacts of pesticides in the UK

5.1 Policy mechanisms to reduce pesticide impacts on the environment and wildlife

This section offers some potential policy mechanisms to reduce the environmental impacts of pesticide use in the UK.

In principle there are a number of approaches to reducing pesticide impacts on the environment and wildlife. These include initiatives to:

- Restrict or completely ban the use and availability of particular pesticides and thereby displace some pesticides completely
- Reduce pesticide use in particular sensitive areas
- Create pesticide-free areas
- Reduce the amount of pesticide applied
- Improve the precision and best practice application of pesticides
- Promote the use of systems that use no or few pesticides e.g. organics

It is very unlikely that any single policy option will be adequate to deliver sustainable agriculture and effectively tackle the overall impact of pesticides on the environment. More realistically, a suite of mutually supporting approaches needs to be developed, logically built to support overall objectives, such as a target to cut pesticide use by certain quantities over time. A package could make use of a number of different policy tools, such as regulation setting a baseline for pesticide authorisations and pesticide use that provides adequate environmental protection according to current research findings; research, training and information to support farmers in making changes; measures that counter the drivers of continued levels of reliance on pesticides; positive incentives for continuous improvement in practices and uptake of IPM taking full advantage of synergies with other objectives (such as water protection or pollinator conservation).

The UK lacks an overarching policy goal that drives the different policy mechanisms that influence pesticide use and that all involved in the use of pesticides can work towards. At the governance levels where policy is set, there is no sense of an urgent need to change, and the focus in both government agencies and the farming sector is on individual risk reduction measures, rather than addressing the need to reduce use levels overall. At present there is a lack of monitoring data on the environmental impacts of pesticides, and changes in pesticide use in agriculture are primarily being driven by the need to meet water quality targets. There is a focus on ensuring that farmers have access to as many pesticides as possible to deal with the pest problems they face and to maintain pesticide-based pest resistance management strategies. However, effectively reducing the current levels of reliance on pesticides, as well as environmental impacts associated with specific active substances and use conditions, will require a joined up approach to tackle pesticide use across all sectors. An alternative, more effective, approach would be to identify problem areas and initiate research into how the problems can be dealt with using non-chemical methods. The threat of losing active substances should be seen as an opportunity for innovation rather than simply a threat to productivity. It is however also necessary to recognise that a large part of UK arable production is economically dependent on pesticide use to maintain current cropping systems.

The following text presents a number of policy options to achieve these goals.

Establish an overall pesticide use reduction target

A pesticide reduction target needs to be aimed at reducing overall dependence on pesticide use and reducing risks to the environment, water and human health. An overall target would send a clear message to all sectors involved with pesticides that there is a need for change. The UK government decided not to set an overall target within the National Action Plan, arguing that a quantitative reduction target is not meaningful in relation to the health and environmental impacts of pesticides. The way in which reductions are measured and reported is indeed crucial, as both area treated and kilograms of active substance applied do not relate directly to environmental impact. However, Denmark and France have set quantitative pesticide use reduction targets in their plans, and one of the key consequences has been that both Denmark and France have invested considerable effort into finding better ways in which to measure and track pesticide use and impacts. The UK could learn from the experience.

One option would be to set targets for those actives identified on the Pesticide Action Network list of Highly Hazardous Pesticides and/or the pesticides on the 'candidate for substitution' list, and make commitments to reduce use to a specific level and/or to phase out within a set time frame.[262] The EU legal obligation to apply a comparative risk assessment to all pesticide active substances classified as Candidates for Substitution (CfS) provides an opportunity to replace some actives, currently a list of 77, that meet the criteria set out in the Plant Protection Products Regulation for CfS. These CfS are currently authorised active substances that raise concerns about certain of their properties, for example endocrine disrupting properties. The assessment may result in their replacement with substances that are of less concern. However, the UK government currently has no proactive position on how it will deal with the actives currently in use in the UK that might be lost as a result of substitution.

To be meaningful, any target should be supported by a collection of complimentary policies that respond to the needs of farmers and assist them in reducing the use of pesticides: comprehensive IPM programme for training farmers, supporting them to adopt non-chemical techniques, advising them on emerging issues and responding to their specific research requirements. Practical support to drive the adoption of IPM techniques rather than simply distributing information on best practice would need to be a key element.

Improve the environmental impact assessment of pesticides before approval

National pesticide regulatory agencies are coming under increased pressure to speed up pesticide review and approval, and at the same time contribute to the increasing workload

[262] PAN International HHP List version June 2015. Via: http://www.pan-germany.org/gbr/project_work/highly_hazardous_pesticides.html

of active substances reviews at the EU level[263]. However, we still largely do not understand the full impact of unintended side effects of pesticides on wildlife at the level of populations, communities, and ecosystems (Köhler & Triebskorn 2013[264]), and there is likely to remain some uncertainty associated with potential risks for the foreseeable future, not least because of the complexities involved. A key opportunity is now available to promote and develop the use of the alternatives assessment associated with applications for pesticide approvals and re-approvals on the 'candidates for substitution' list.

Use a combination of bans on individual pesticides and area-based incentives and restrictions to reduce environmental impacts on freshwater

Users perceive bans on individual pesticides as unfair because they feel that bans do not recognise the role of correct practice in pesticide application, which is regarded as guaranteeing a low risk to the environment[265]. However, good practice applications can only reduce water pollution and subsequent environmental impacts down to a certain threshold, as there will always be the risk of unforeseen events, such as herbicide applications before heavy rain, which will cause a certain level of pollution. An action plan on measures to protect English Natura 2000 sites from threats, including impacts from diffuse water pollution[266], concluded that '*there is a need to better understand the contribution that non-compliance with basic (regulatory) measures makes to diffuse water pollution pressure and the extent to which dealing with non-compliance can help bridge the pollution gap. It is likely that improved compliance will require an enhanced enforcement presence prioritized at the catchments of Natura 2000 sites*.'

In the UK, cross-compliance requirements are delivering only minimal protection of water courses from pesticide pollution[267] (Bunzel et al 2014[268]) and greater use of other measures may be required to secure water quality. Buffer strips and no-spray buffer zones cannot influence pesticide losses through field drainage and leaching through soil (with the exception of wet buffer zones), and the only feasible ways to prevent this pathway of pesticide pollution other than wet buffer zones are by substituting alternative pesticides and approaches to crop management, reducing application rates, shifting application dates, and scrupulously avoiding applications when heavy rain is expected. Voluntary agri-environment measures play a role here but take up is variable and there are uncertainties

[263] Eg the Swedish Chemical Agency has recently been criticised by the Swedish Office of the Chancellor of Justice. KEMI Swedish Chemicals Agency Memo 17 June 2015. Action plan for reviewing applications for authorisation. https://www.kemi.se/Documents/Bekampningsmedel/Docs_eng/Handlingsplan_handlaggningstider_engelsk_20150617.pdf?epslanguage=en

[264] Köhler, H-R and Triebskorn, R (2013) Wildlife ecotoxicology of pesticides: can we track effects to population level and beyond? Science No 341 (6147), pp759-765.

[265] DEFRA (2010) Consultation on the implementation of EU pesticides legislation; summary and government responses. DEFRA, UK. http://www.pesticides.gov.uk/guidance/industries/pesticides/topics/pesticide-approvals/eu/eu-thematic-strategy/consultation-on-the-implementation-of-eu-pesticides-legislation

[266] Natural England et al (2015) Diffuse water pollution theme plan. Improvement Programme for England's Natura 2000 Sites – Planning for the Future'.

[267] Buffer strips do not hinder significant pesticide run-off through field drainage. http://www.getpelletwise.co.uk/news/buffer_zones_are_not_the_whole_solution/

[268] German survey indicated riparian buffer strips need to be at least 5m in width to effectively mitigate pesticide exposure. Bunzel, K, Liess, M and Kattwinkel, M (2014) Landscape parameters driving aquatic pesticide exposure and effects. Environmental Pollution No 186, 90-97.

about the future. For example, it is uncertain what will happen to wider buffer strips installed by farmers under the previous agri-environment programmes, which no longer qualify for funding because they lie outside the target zones and fail to obtain the competitive funding. Stricter no-spray (LERAP) buffer requirements have been applied to the pesticides causing most problems for water pollution, but it is not clear to what extent farmers are complying, although they do provide an indirect incentive to install and maintain buffer strips to avoid the risk of non-compliance.

Create pesticide-free areas in agriculture and in public spaces
Pesticide-free areas created under different mechanisms could include areas of grassland, grassy field margins, unmanaged strips within fields, set-aside and fallow. The UK agricultural area that is completely free from pesticides has decreased due to the removal of set-aside in 2008 and the increased dominance of winter wheat, as well as the decline in the area of organic farming in the UK (see section 2.2.1).

Despite proposals from the European Commission as part of the 2013 CAP reform, the opportunity was lost in the EU to stop the use of pesticides on Ecological Focus Areas in the implementation of greening in the new Common Agricultural Policy. Eventually this proposal was amended to be more permissive. This was considered necessary because the list of crops formally eligible for EFAs grew to include grain producing row crops, such as soya, peas and beans, which are currently difficult to grow without pesticides but which have an economic value for farmers. These are in contrast to green cover and forage crops such as alfalfa, clover and vetches, which do not require pesticides but have low economic value. All Member States have now allowed at least some nitrogen-fixing crops on EFAs including their management with pesticides, but the Netherlands have banned the use of pesticides on catch crops and Germany on catch crops and green cover. However, revisions of the regulations on greening may occur in future, following the current review; this may enable a requirement to ban pesticide use in EFAs to be introduced.

There is strong public support for pesticide-free public spaces – urban areas, road margins, sports facilities, nature reserves. Pesticide-free urban areas could be important havens for wildlife. However, local authorities require guidance and capacity to move their public spaces management away from the relatively cheap and easy option of large-scale pesticide use. There is also a need to promote effective non-chemical methods to control invasive non-native species.

Measures to reduce dependency on pesticides and create incentives for IPM in agriculture
The goal should be the long term sustainability of agriculture that allows farmers to make profits, deal effectively with pest, weed and disease issues whilst adjusting to the fact that, due to a number of factors (eg pest resistance, public acceptability, environmental and health risks), the chemical toolkit available to farmers is shrinking and will continue to do so. A policy that simply focuses on extending the life of chemical pesticides or direct substitution of one chemical for another is not sufficient and fails to address the longer term issues. A recent review of IPM cropping systems has found that there are opportunities for

pesticide reduction in many parts of Europe without significant losses in crop yields (Lamichhane et al 2016[269]).

Pest and disease resistance to pesticides is already driving change in farming systems. For example, increasing disease resistance to azole fungicides is driving changes in wheat crop rotations in Ireland, because of the higher cost of increased fungicide applications and the fear of crop failure[270]. In the UK, there is an urgent need for more sustainable winter oilseed rape-wheat cultivation practices and rotations, which reduce herbicide use and build up soil quality. To achieve this will require more focus on diversified rotations, reduced inputs, resistant varieties appropriate to local conditions, and more knowledge and understanding of IPM.

Farmers need to be supported to adapt, and adaptation needs to progress to more sophisticated development and utilisation of IPM along a continuum of learning, innovation, testing and establishment of changed cropping practices. It is difficult to compare the amount of funding that EU Member States are currently providing for IPM training for farmers as the funding is allocated via a range of different routes (the Common Agricultural Policy funded advisory service, nationally or regionally funded advisory services, other advisory services and applied research institutes). However, it is clear that IPM training has a higher visibility and degree of government support in Denmark and France than in the UK. France and Germany have both targeted their pesticide national action plans to invest significantly in innovative extension efforts that will provide a large role to on-farm experimentation, demonstration and data collection (Barzman & Dachbrodt-Saaydeh 2011[271]).

The UK's pesticide policy currently takes a short term approach by failing to adequately address the water pollution and environmental damage caused by pesticides, and by failing to support farmers to make the transition away from those current cropping systems that are so reliant on pesticide use. The aim of keeping as many active substances as possible available for farmers is not realistic in the EU context, where the existing policy framework means that active substances that are evidently causing environmental problems are increasingly likely to be phased out. Farmers are already finding their toolbox of pesticides decreasing for a number of reasons, including pest and disease resistance. This review recommends that the Government needs a more long term and proactive approach, facilitating the necessary resources and constructive stakeholder collaboration to support farmers on the transition to effective and sustainable pest management and broader crop and soil health strategies. It should set concrete targets, timetables and actions that not only reduce the environmental burden of pesticide use but promote reduced reliance on pesticides, phasing out priority Highly Hazardous Pesticides, as identified by PAN UK, and putting non-chemical methods, based on ecological principles, at the forefront.

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[269] Lamichhane, J R, Dachbrodt-Saaydeh, S, Kudsk, P and Messéan, A (2016) Towards a reduced reliance on conventional pesticides in European agriculture. Plant Disease No 100, (1) 10-24.

[270] http://www.niab.com/blog/post/110

[271] Barzman, M and Dachbrodt-Saaydeh, S (2011) Comparative analysis of pesticide action plans in five European countries. Pest Management Science No 67, (12) 1481-1485.

6 Annex: Case studies of policy mechanisms to reduce pesticide use

6.1 Various EU countries: suspensions of neonicotinoid pesticides and fipronil

Policy mechanism relevant to case study

Total or partial ban on specific pesticides at Member State level and at regional EU level.

Case study location and context

A temporary suspension on the use of imidacloprid, thiamethoxam and clothiniadin was introduced by the EU for all Member States from December 2013. Fipronil was also suspended. This applies to seed treatments on all flowering crops attractive to bees and other pollinator species. This has superseded national neonicotinoid bans in Member States.

Previous bans:

- Italy temporarily suspended the use of three neonicotinoid products as seed treatments on maize in 2008; the suspensions have been renewed each year.
- France suspended the use of Gaucho (imidacloprid) seed treatment on sunflower in 1999, extending it to seed treatment on maize in 2004. France suspended the use of products with thiamethoxam in 2012. France banned all agricultural uses of the systemic insecticide fipronil in 2004.
- Germany suspended use of some seed treatments containing clothianidin, imidacloprid, and thiamethoxam in May 2008. This temporary suspension was then reversed in June 2008.
- Slovenia banned the use of thiamethoxam and clothianidin for seed coating in maize and beetroot in 2011. There had already been a ban imposed in 2008 on the use of clothianidin following a spate of heavy bee losses but this was subsequently reversed prior to the 2011 ban.

Description of policy mechanism(s) or other methods used in case study

In all cases the policy mechanism used has been legislative with the National Authority imposing restrictions on specific uses or in the case of the EU suspension an introduction of restrictions for all Member States. The triggering of national and regional bans has come as a result of evidence of direct harm, as in the case of massive numbers of bee deaths in Germany, Italy, France and Slovenia, or as a result of problems identified with the risk assessment for these actives which have been identified as a result of independent scientific study highlighting shortcomings.

The adoption of the precautionary principle has been a key driver in both national and the wider EU ban. This has been controversial and argued against by a number of Member States as being far too restrictive. However, invoking the precautionary principle has been backed up by a wide range of scientific studies that have shown there are simply too many gaps in the knowledge of how neonicotinoids interact with non-target species and how they work in the wider environment to allow them to continue to be used without further studies.

There have been legal challenges mounted both for and against banning the use of neonicotinoids at national and regional level. Following the 2008 suspension in Italy the pesticide manufacturers mounted a legal challenge against the ban. This was heard in court and rejected following a robust defence of the ban by the Italian beekeepers association and the Italian State who had instigated the ban.

The EU temporary ban has been challenged by the pesticide industry and the court case is currently ongoing, although this will not affect the implementation of the two year suspension.

Evidence of environmental effectiveness

France and Italy have both seen reversals in the loss of honey bees since their bans were implemented. Although not confirmed it appears to be the same situation in Slovenia. It has been

difficult to ascertain what effect any ban will have on wild pollinator species due to the lack of information on population levels for many species. EFSA is currently carrying out a review of the risks of imidacloprid, thiamethoxam and clothiandin to bees. The effectiveness of the ban has been limited by the fact that seven Member States allowed neonicotinoid use on maize and/or oilseed rape in emergency derogations (Denmark, Germany, Romania, Bulgaria, Finland, Estonia, UK).
Evidence of other benefits
Whilst not a direct benefit as such the bans and questions raised as a result of the bans has led to a greater focus on the effects of neonicotinoids on a much wider range of species than had previously been looked at. So there is the potential for other species to benefit indirectly from the ban. The ban can also be seen as a trigger for innovation in techniques as farmers have to find new methods for dealing with pest issues following the ban.
Evidence of perverse effects on pesticide use
There is not much evidence of how farmers have handled the EU ban but so far there has been no reported increase in use of older chemistries. It is possible that there has been an increase in use of pyrethroids in some areas, however as these are applied as foliar sprays the overall pesticide load should decrease, compared with seed treatments that are applied to the whole crop every year and persist through most of the growing season. The crop protection industry has reacted to the ban by developing new seed treatment products based on the neonicotinoid active substances that were not included in the moratorium. Following the suspension of imidacloprid products on maize in France, Bayer CropScience developed a thiacloprid-based seed treatment (Sonido) for maize. There is evidence from beehive monitoring in Austria (Global2000 2015) that farmers have increased use of thiacloprid in recent years.
Compliance monitoring & enforcement – effectiveness, costs
The restrictions are at point of sale and so treated seeds are not available for farmers to purchase throughout EU Member States, effectively ensuring compliance. However, there is no specific mechanism in place to monitor or enforce the ban. Concern over the effectiveness of the EU ban has been raised as a result of the ability for Member States to grant emergency use derogations in certain circumstances. A number of these have been granted in various countries. There has been no enforcement mechanism set out for dealing with compliance.
Costs to farmers
No systematic surveys of costs to farmers or impacts on yields from the bans have been reported. Yield reports for oilseed rape crops in the UK for 2014/5 indicated that yields reached predicted levels but the area cultivated decreased by 3.3% on the previous year before the ban (Defra & NS 2015). Across the EU as a whole the oilseed rape area has fallen slightly in 2015/6, which was attributed by the European farmer's organisation Copa-Cogeca to farmers deciding not to plant the crop (AgraFacts 2016).
Other costs (administrative etc)
No information.
Information sources
http://www.bijensterfte.nl/en/node/462 PAN UK Bee factsheet 4. http://bees.pan-uk.org/assets/downloads/Bee_factsheet4.pdf GLOBAL 2000 11 June 2015. Effizienz des Neonic-verbots bestätigt. Aber: Pestizidcocktails mit 'Ersatz-Neonicotinoid' Thiacloprid bringen neue Gefahr. https://www.global2000.at/en/node/3879 Bayer Crop Science UK March 2014. http://www.bayercropscience.co.uk/news-and-opinion/articles/2014/03/wireworm-control-in-uk-maize-possible-again/ EU scientists begin review of ban on pesticides linked to bee declines. Guardian newspaper 7 January 2016. http://www.theguardian.com/environment/2016/jan/07/eu-scientists-begin-review-ban-pesticides-linked-bee-declines 19/2/2016 AgraFacts No 13-16 Defra & National Statistics 20 October 2015. Farming Statistics Provisional 2015 cereal and oilseed

rape production estimates United Kingdom. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/469400/structure-june-ukcerealoilseed-statsnotice-20oct15.pdf

6.2 Italy: municipal ban on pesticide use
Policy mechanism relevant to case study
Obligatory area-based restriction on pesticide use
Case study location and context
The Italian municipality of Malles Venosta/Mels in the province of South Tirol has around 5000 inhabitants and intensive apple production, mainly under the South Tirol apple protected geographic origin label. The apple production involves intensive use of pesticides.
Description of policy mechanism(s) or other methods used in case study
The municipal authority has passed a municipal regulation to prohibit pesticide use. The regulation bans the most toxic pesticides and requires a 50 m buffer zone to neighbouring land for the use of other chemical-synthetic pesticides. The buffer zone rule will have a significant impact as the average parcel size of apple orchards in Mels is less than 3 ha. The mayor is setting up a working group with the apple farmers with the aim of supporting the transition to organic farming. The regulation also obliges the municipality to provide organic catering. The new regulation is based on a municipal referendum which was held in August 2014, at which 3,348 of the 4,837 eligible voters participated and 75% supported a ban on hazardous pesticides. A similar municipal regulation, in place in the Italian municipality of Malosco since 2010, has been approved by the Italian Council of State.
Evidence of environmental effectiveness
No information as the ban has only just been implemented. Many apple farmers already farm according to integrated production guidelines (AGRIOS), however these guidelines fall considerably short of organic criteria, and there is no information on the level of compliance. The IP guidelines require farmers to implement a few measures from a selection of options, such as use of scab / powdery mildew resistant varieties, non-chemical vegetation management, use of pheromones, or low drift spraying. Pests and diseases must be monitored at least three times a year. A list of authorised pesticides is allowed, including up to 5 applications of dithiocarbamates (metam, thiram, ziram).
Evidence of other benefits
The mayor is promoting the vision of an organic production community in Malles, with economic, health and social benefits for apple farmers, the local population, and for tourism.
Evidence of perverse effects on pesticide use
None expected as all pesticides are subject to the buffer zone restriction.
Compliance monitoring & enforcement – effectiveness, costs
Compliance monitoring will include residue analysis.
Costs to farmers
No information available, but some apple farmers have protested against the referendum and the ban because they fear that it will have significant economic consequences for them.
Other costs (administrative etc)
No information yet. Due to the very small parcel structure (average 2.5 to 3 ha) it is very difficult for an individual farmer to convert to organic because of the influence of pesticide drift from neighbours, and the cooperative processing and marketing structure also has a strong influence. There are currently only 70 organic producers in the Val Venosta cooperatives association, which unites 2,000 fruit farmers and seven cooperatives.
Information sources

30.3.2016 "Jetzt gehts los: So will Mals sein Pestizid-Verbot umsetzen". http://www.stol.it/Artikel/Chronik-im-Ueberblick/Lokal/Jetzt-geht-s-los-So-will-Mals-sein-Pestizid-Verbot-umsetzen Personal communications from LIPU and Pesticide Action Network Italy 09.09.2014 "Mals stimmt gegen Pestizide" http://tirol.orf.at/news/stories/2667596/ 1.8.2014 "Pestizidfreies Trentino" https://www.salto.bz/article/01082014/pestizidfreies-trentino 17.7.2015 „Glaube, dass das Pestizid-Verbot noch heuer greift" http://www.stol.it/Artikel/Politik-im-Ueberblick/Lokal/Malser-Gemeinderat-stimmt-fuer-das-Pestizidverbot Beschlüsse der Gemeinde Mals. Genehmigung von Abänderungen an der Gemeindesatzung (Gemeinderat). http://data.gvcc.net/GOfficeWeb/?gemeinde=046 Parliamentary questions 26 September 2014. E-007167-14. Question for written answer to the Commission Rule 130. http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+WQ+E-2014-007167+0+DOC+XML+V0//EN 1.12.2014 E-007167/2014. Answer given by Mr Andriukaitis on behalf of the Commission. http://www.europarl.europa.eu/sides/getAllAnswers.do?reference=E-2014-007167&language=EN AGRIOS Arbeitsgruppe für den Integrierten Obstanbau in Südtirol http://www.agrios.it/geschichte.html Guidelines http://www.agrios.it/doc/agrios_richtlinien_2015.pdf Val Venosta cooperative http://www.vip.coop/en/contents-organic-production/4-52.html

6.3 Luxembourg: Decree banning the use of metazachlor within water protection zones
Policy mechanism relevant to case study
Obligatory area-based restriction on specific pesticides
Case study location and context
Luxembourg drinking water safeguard zones: Luxembourg currently only has four designated water safeguard zones but a total of 80 zones are planned, 17 of which are already in the legislative pipeline[272]. The levels of the metazachlor-ESA metabolite in Luxembourg water bodies used for drinking water regularly exceed the 0.1 µg/l limit defined in the EU Groundwater Directive, and a contamination incident in September 2014 raised public concern.
Description of policy mechanism(s) or other methods used in case study
A national decree bans the use of metazachlor within water safeguard zones from February 2015. In addition, outside the water safeguard zones, the label-based restrictions on metazachlor have been tightened. Metazachlor can only be used as herbicide applied at 0.75kg/ha and it can only be applied once every four years on the same surface. This applies retrospectively so this year metazachlor cannot be applied on areas treated with the pesticide since 2012. Luxembourg must develop an action plan to reduce the contamination of drinking water and groundwater and surface water with metazachlor, and this will be prepared by 22 December 2015 by representatives of the Ministry of Agriculture, Viticulture and Consumer Protection and the Department of Sustainable Development.
Evidence of environmental effectiveness
There is no evidence as the restriction has only just come into effect. The persistence of metazachlor metabolites in water came as a surprise to the Luxembourg authorities, as the currently accepted

[272] Three Grand Ducal regulations are already in force: Capture Doudbësch (Flaxweiler) Capture François (Simmer / Tënten) and Capture Kriipsweieren (Junglinster, Niederanven, Steinsel). Two Grand Ducal regulations are currently the subject of public procedure: Brickler-Flammang, Fischbour (Hobscheid), and 12 Grand Ducal regulations are in preparation: Bech, Fischbach, Mersch (City Ettelbruck) Waldbillig, Redange, Luxembourg, Berdorf, Contern, Weiler-la-Tour, Schuttrange, Betzdorf, Flaxweiler.

breakdown time is 20 days. On 9 October 2014 Luxembourg obtained a 3 year exemption from the EU Commission for a maximum limit of 3 µg/l metazachlor-ESA metabolite in drinking water bodies, after which the levels of metazachlor metabolites must meet the EU standard.
Evidence of other benefits
There is no evidence as the restriction has only just come into effect.
Evidence of perverse effects on pesticide use
Metazachlor is used primarily for pre-emergence weed control in autumn-sown oilseed rape. Alternatives include carbetamide, propyzamide, iodosulfuron + mesosulfuron, flufenacet, prosulfocarb and tri-allate. A number of these are also problematic in water.
Compliance monitoring & enforcement
Implementation awaits the designation of drinking water protection zones. Although Luxembourg's drinking water is almost completely sourced from groundwater, a lack of geological information has hindered the declaration of groundwater protection zones.
Costs to farmers
The past and new Luxembourg RDP includes agri-environmental programmes focusing on integrated management and a reduction in the use of plant protection products, including compensation for applying compulsory extensive farming practices in water protection zones limiting organic fertilisation, and banning the use of specific pesticides in the wine-growing sector. The new Luxembourg RDP also contains a measure under Article 31 to compensate farmers for the costs of implementing compulsory restrictions on farming practices in drinking water zones.
Other costs (administrative etc)
No information.
Information sources
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 (Annex I) Chronicle news article 13 February 2015 http://www.chronicle.lu/categoriesluxembourgathome/item/10288-drinking-water-quality-pesticides-banned,-80-protection-zones-created Tageblatt news article 10 October 2014. http://www.tageblatt.lu/nachrichten/luxemburg/story/20431710 Désignation de zones de protection des eaux souterraines destinées à la consummation humaine. Broschure d'informations de l'Administration de la Gestion de l'Eau. http://www.eau.public.lu/publications/brochures/ba_ZP_eau_potable/ZP_eau_potable_fr.pdf Administration de la Géstion de l'Eau. October 2014. Information on herbicide pollution in drinking water and groundwater. http://www.eau.public.lu/actualites/2014/10/Informationen-und-Erklaerungen-zur-Herbizidbelastung-in-Grund--und-Trinkwasser/index.html HGCA Summer 2012. Autumn grass weed control in cereals and oilseed rape. http://cereals.ahdb.org.uk/media/177741/ts116_autumn_grass_weed_control_in_cereals_and_oilseed_rape.pdf

6.4 France: Prohibition on pesticide use in public spaces & non-professional use

Policy mechanism relevant to case study
Obligatory area-based restriction on non-agricultural pesticide use in public places
Case study location and context
France: currently public spaces, especially spaces and buildings with vulnerable people. From 2017/2022, all green areas, forests and public spaces, and non-professional users and uses of pesticides.
Description of policy mechanism(s) or other methods used in case study

The Decree of 27 June 2011 builds on European Directive on the sustainable use of pesticides. It prohibits the use of some pesticides (all pesticides are banned except those that do not have an eco-toxicological classification number or classified R50-R59) in places with vulnerable people. More specifically, to protect children, pesticide use is prohibited in schools, childcare places, playgrounds and other child play areas. For other vulnerable groups of people a no spray zone at less than 50m is imposed on specific places such as hospitals & healthcare/rehabilitation centres, retirement homes and care homes. It also prohibits the use of pesticides with high health risk (corresponding to the EU 'cut-off criteria') in specific places open to the general public: parks, gardens, green spaces, sports facilities, and leisure centres. Exceptions are allowed if the place is closed to the public for at least 12 hours after the pesticide application. From 1 January 2020 (with some measures starting 2017) a new law prohibits the use of pesticides in all publicly accessible spaces, green areas, and forests. It does not apply to the use of pesticides on railways, airport runways or motorways, or agricultural areas. A second part of the law also prohibits the sale, supply, use and possession of pesticide products for non-professional use from 1 January 2022, with the exception of approved biopesticides and low risk substances (according to the EU definition). Anyone using or found with banned pesticide products could be imprisoned for up to two years with a 300,000 EUR fine. The prohibition does not apply to the necessary control of plant pests which are a public nuisance.
Evidence of environmental effectiveness
Pesticide use in France in non-agricultural zones accounts for around 10% of total pesticide use by weight (Actu Environnement 2014, FREDON paca 2012), which provides an idea of the maximum potential for pesticide use reduction under both pieces of legislation. In October 2014 a new expert group and monitoring programme was charged with monitoring negative impacts of pesticides on humans, domestic animals, cultivated plants, biodiversity, wildlife, water, soil, and air quality, and residues in food, but no monitoring information is available yet.
Evidence of other benefits
It is likely that the 2020 ban will have benefits for wildlife due to increased tolerance for weeds in gardens, verges, roadsides etc.
Evidence of perverse effects on pesticide use
If illegal sales of pesticides to non-professional users can be prohibited, there should be no perverse effects.
Compliance monitoring & enforcement
The compliance monitoring and enforcement measures of the 2011 decree are the responsibility of local/regional departments of the Ministry of Agriculture (DRAAF) and Ministry of Environment and sustainable development (DREAL). As the wider prohibition has not yet come into force there is no information available. The government has just announced an intention of making it obligatory to provide pesticide advice to non-professional users before over the counter sales of glyphosate, which it sees as a preliminary restriction in the framework of the new law. However, the announcement has created some public opposition in France.
Costs to users
There is no general information available on current costs of weed control in public places. The general public is not likely to be faced with significant costs as many alternatives are available for non-professional pesticide use, including options that are much cheaper than current pesticides for amateur use.
Other costs (administrative etc)
The implementation of the non-professional ban will require investments in awareness raising of the reasons for the ban and of alternative pest control methods for amateur users, which will partly be covered by retailers who currently sell pesticides to amateurs (garden centres, hobby centres etc). Retailers are unlikely to suffer costs overall as they can replace lost revenue with increased sales of non-chemical pest control technologies.
Information sources

LOI n°2014-110 du 6 février 2014 visant à mieux encadrer l'utilisation des produits phytosanitaires sur le territoire national (1). (Loi Labbé). http://www.legifrance.gouv.fr/affichTexte.do;jsessionid=3EC09516A7B3BE9BDFBB9751689A6F06.tpdjo08v_2?cidTexte=JORFTEXT000028571536 Arrêté du 27 juin 2011 relatif à l'interdiction d'utilisation de certains produits mentionnés à l'article L. 253-1 du code rural et de la pêche maritime dans des lieux fréquentés par le grand public ou des groupes de personnes vulnérables. http://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000024404204 Mandate for expert working group and monitoring programme 'Phytopharmacovigilance' https://www.anses.fr/fr/content/appel-%C3%A0-candidatures-d%E2%80%99experts-scientifiques-pour-la-cr%C3%A9ation-d%E2%80%99un-groupe-de-travail Temps Reel News 15 June 2016. Segolene Royal. http://tempsreel.nouvelobs.com/planete/20150615.OBS0783/segolene-royal-bannit-presque-le-roundup-la-politique-des-petits-pas.html European Directive No 2009/128/EC http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009L0128&from=EN DRAAF Franche Comté – explanatory note http://draaf.franche-comte.agriculture.gouv.fr/IMG/pdf/Note_arrete_lieux_publics_du_27_juin_2011_cle42212d.pdfhttp://draaf.franche- Actu Environnement 10/02/2014. La loi Labbé sur l'utilisation des produits phytosanitaires est publiée. http://www.actu-environnement.com/ae/news/loi-labbe-phytosanitaires-pesticides-espaces-publics-20713.php4 FREDON paca 11/12/2012. Gestion durable des espaces vertes. http://www.pole-lagunes.org/ftp/zero-pesticide/11-12-2012/1-%20Intervention_contexte_reglementaire_Fredon.pdf

6.5 Belgium: Prohibitions on pesticide use in public spaces

Policy mechanism relevant to case study
Obligatory area-based restriction on non-agricultural pesticide use in public places
Case study location and context
All 3 regions of Belgium are planning to ban pesticides in public areas, with different timeframes.
Description of policy mechanism(s) or other methods used in case study
The driver for the move to ban the use of pesticides for amenity uses has been the Directive on the Sustainable Use of Pesticides (SUD), which has been used to extend existing regulations and introduce new legislation that will ensure that the regions of Belgium are meeting the requirements of the SUD. *The Walloon Region*: there have been legal restrictions on the use of pesticides in public areas since 1984 with the exception of certain areas such as cemeteries, railway lines and paved or gravel covered areas. In 2013 an order of the Walloon government set out the framework for the Walloon pesticides reduction programme, which transposed the requirements of the SUD into local law. The aim is to have zero pesticide use in amenity areas by 2019 with a gradual phase in of legal restrictions from 2014. *Flanders*: As of 1 January 2015 pesticide use is prohibited in places offering a public service to vulnerable groups, including schools, childcare services, hospitals, healthcare institutions, churches. There has been a process of introducing legislative measures in the Flemish region since 2001 in order to reduce the use of pesticides. In 2008 a decree issued by the Flemish government set out the date of 2015 as that by which municipal areas must be pesticide free. There has been support and advice made available via NGOs on alternative strategies to the use of pesticides.
Evidence of environmental effectiveness

Many towns have already either gone pesticide free or made significant reductions in the use of pesticides in the Flanders region. Information on this and comparisons of pesticide usage between 2013 and 2014 are given and declines can be seen in many areas. Water protection is a key objective of the Flanders region and whilst improvements to water quality have not yet been reported it can be assumed that with many areas already reducing the use of pesticides and with the rest reaching zero usage there will be significant improvements to water quality.
Evidence of other benefits
The goal of the legislation in the various regions of Belgium is not just protection of the environment from pesticides but protection of human health. This is also a key theme of the SUD. The focus in Belgium is on reducing and stopping use particularly in areas where those members of the public deemed most vulnerable to the effects of pesticide exposure frequent. However, there is as yet no data available to show increased human health benefits.
Evidence of perverse effects on pesticide use
None predicted as substitution of actives is not part of the approach; elimination and changes to non-chemical methods will not result in perverse effects on pesticide use.
Compliance monitoring & enforcement
Compliance will be monitored by local and regional authorities. Penalties for non-compliance can be enforced.
Costs to users
No information found.
Other costs (administrative etc)
No information found.
Information sources
SPW-DGARNE-DEE et al (2014) Guide de recommandations à destination des gestionnaires d'espaces publics pour le respect de la legislation sur la reduction des pesticides durant la période de transition 2014-2019. http://www.gestiondifferenciee.be/files/Legislation/Guide-de-recommandations-PWRP_2015.pdf Decision of the Flemish Government of 15 March 2013 laying down detailed rules on the sustainable use of pesticides for non-agricultural and horticultural activities in the Flemish Region. http://www.zonderisgezonder.be/openbare-diensten/Definities_Openbare%20dienst_commerciele%20activiteit_Zorginstellingen_kinderopvang_versie_2014_12_11.pdf Arrêté du Gouvernement wallon du 11/07/2013 relatif à une application des pesticides compatible avec le développement durable et modifiant le Livre II du Code de l'Environnement, contenant le Code de l'Eau et l'arrêté de l'Exécutif régional wallon du 5 novembre 1987 relatif à l'établissement d'un rapport sur l'état de l'environnement wallon (M.B. 05.09.2013) http://environnement.wallonie.be/legis/general/dev016.htm Administration générale de l'Enseignement et de la Recherche scientifique Circulaire n°5223 du 30/03/2015 ENVIRONNEMENT: Utilisation des pesticides en Wallonie http://www.gallilex.cfwb.be/document/pdf/40493_000.pdf Bruxelles Environnement (2013). Le programme régional de réduction des pesticides. http://www.environnement.brussels/thematiques/espaces-verts-et-biodiversite/action-de-la-region/le-programme-regional-de-reduction-des

6.6 France: Rennes pesticide-free town declaration

Policy mechanism relevant to case study
Voluntary area-based restriction on non-agricultural pesticide use in public places

Case study location and context
Town of Rennes (Brittany), France.
Description of policy mechanism(s) or other methods used in case study
Started in 1996 as a result of concerns over pesticide contamination of water bodies. The main issue was that around two thirds of the pesticides being used in the town were being used on non-permeable surfaces leading to run off into water bodies. To achieve the goal of using no pesticides a number of measures have been adopted which include educating the public to accept an increased level of 'weediness', various mechanical techniques including flame weeding and use of various forms of mulching and covering to control weeds. Each year a forum is held where those involved, town officials and technical staff, can meet to discuss progress, problems and new techniques. Whilst this is a scheme that is undertaken by the municipal authorities providing information for the public and getting their support has been a key factor in its success. Rennes has a zero pesticide policy and there are now 37 villages in the surrounding area moving towards zero pesticide use.
Evidence of environmental effectiveness
In the first three years of the scheme the weight of pesticides applied was reduced by 44%.
Evidence of other benefits
By accepting a greater level of 'weediness' and encouraging the use of a variety of plant species either as ground cover increased habitats and forage for a variety of species such as pollinators has been created.
Evidence of perverse effects on pesticide use
None as there is no substitution to other pesticides but a complete cessation of use with mechanical and other non-chemical techniques being used to replace the use of pesticides.
Compliance monitoring & enforcement
Compliance and monitoring is carried out by the municipal authorities.
Costs to users
There have been no reported increases in costs due to switching away from pesticides to a non-chemical regime.
Other costs (administrative etc)
No information found.
Information sources
Francois Veillerette, PAN Europe. 8 June 2015. Presentation: Pesticide free towns in Europe. http://www.pan-europe.info/Activities/Conferences/150608/presentations/presentation%20PAN%20Europe%20FV%2008%2006%202015.pdf

6.7 Switzerland: prohibition of application of herbicides on sealed surfaces

Policy mechanism relevant to case study
Label based restriction on applications of pesticides
Case study location and context
Switzerland. Prohibition on application of herbicides on hard surfaces (roads, pavements, paths, terraces, roofs etc).
Description of policy mechanism(s) or other methods used in case study
Swiss legislation prohibits the application of herbicides to sealed surfaces since 1986 for local authorities and since 2001 for private users, including roads, pavements, paths, parking places, roofs, etc.
Evidence of environmental effectiveness
A survey in 2010 found that of 218 local authorities whose staff had participated in a pesticide

reduction course, 61% had stopped using herbicides completely and another 20% had reduced usage, and the number of local authorities stopping chemical herbicide use is increasing each year (BAFU 2010). Chemical herbicides were least likely to have been given up in cemetery management and around half of local authorities are still using them to manage cemeteries. In contrast, 53% of a small sample of garden owners had never heard of the prohibition.
Evidence of other benefits
No evidence is available
Evidence of perverse effects on pesticide use
Unlikely to be any as the restriction applies to all pesticides.
Compliance monitoring & enforcement – effectiveness, costs
Swiss local authorities are mostly following the general prohibition on herbicide use on sealed surfaces. However awareness amongst house and garden owners is very low.
Costs to local authorities
N/A
Other costs (administrative etc)
N/A
Information sources
BAFU (2010) Umsetzung des Verbots von Pflanzenschutzmitteln. Untersuchung zum Stand der Umsetzung des Anwendungsverbots von Unkrautvertilgungsmitteln auf und an Strassen, Wegen und Plätzen. Bundesamt für Umwelt, Bern, Switzerland. http://www.bafu.admin.ch/publikationen/publikation/01556/index.html?lang=de

6.8 Danish Farm Advisory Service: dedicated IPM and pesticide reduction advice
Policy mechanism relevant to case study
Advice and support for integrated pest management and pesticide use reduction
Case study location and context
Denmark. Arable farmers in the whole country (Denmark's agricultural land is over 90% arable and temporary grassland, and arable farming covers over half the total land area).
Description of policy mechanism(s) or other methods used
Farmers can receive heavily subsidised advice on IPM focused on farmers' specific crop protection challenges, which is expected to reduce dependence on chemical crop protection. Farmers sign a two-year agreement to receive a total of 6 to 12 hours advice (6 hours for farms <100 ha, + 1 hour per 50 ha to max. 12 hours) (SEGES 23/02/2015). If there are special challenges on a farm, the agreement may be extended by one year. The project funded 1400 'IPM advisory packages' in 2010-2015. In total the advice was supplied to about 15% of arable land. The advice is supplied by local agricultural advisers who must participate in annual IPM courses run by the Knowledge Centre for Agriculture. IPM information is provided on a website.
Evidence of environmental effectiveness
No direct evidence of impacts on pesticide use.
Evidence of other benefits
No evidence available.
Evidence of perverse effects on pesticide use
No evidence available.
Compliance monitoring & enforcement – effectiveness, costs
Farmers self-assessed their awareness of IPM principles using a questionnaire with a points system for different IPM tactics. A sample of 208 farmers who used the questionnaire between 2012 and 2013 showed an average increase in awareness from 56.7% to 64.3% between the start of their advice agreement and the end (SEGES 23/02/2015a, Jensen 2014). In contrast, a group of 200

farmers interviewed at the end of their IPM advice in 2013 showed no measurable increase in awareness compared to a group of non-participating farmers (SEGES 23/02/2015b).

Costs to farmers

The agreement covers on average 66% of the costs of advice, up to a maximum of 80%, and farmers pay 1500 – 3500 DKK depending on the size of farm (around 200 – 470 Euros) (Centrovice).

Other costs (administrative etc)

The Danish Government invested 6.4 million DKK each year in the IPM Advisory scheme for the five years (2010-2015), a total of 32 million DKK (around 4.29 million Euros) (Danish Horticulture 3/8/2010), financed from the Danish pesticide tax.

Information sources

IPM in Denmark. ENDURE case study. http://www.endure-network.eu/de/about_endure/all_the_news/country_profile_ipm_in_denmark

Jensen, J.E. Knowledge Centre for Agriculture. Presentation Integrated pest management in our neighboring countries – Outlooks from southern Sweden via Denmark and the EU. http://www.jordbruksverket.se/download/18.724b0a8b148f52338a33ed5/1413987176589/Integrated+pest+management+in+our+neighboring+countries.pdf

Centrovice company IPM advice prices. http://centrovice.dk/landbrug/radgivning/prisliste/

Jensen, J.E. (2014) Er landmændene IPM-klar? Conference article. Plantekongres – production, plan og milje January 2014. Tema: Innovativ production. https://www.landbrugsinfo.dk/Planteavl/Plantekongres/Sider/pl_plk_2014_prog_sessioner.aspx

SEGES 23/02/2015a. News article: IPM points as benchmarks for IPM. Danish Knowledge Centre for Agriculture (SEGES). https://www.landbrugsinfo.dk/Planteavl/Plantevaern/IPM/Sider/IPM-point-som-maal-for-integreret-plantebeskyttelse_pl_15_2082.aspx

SEGES 23/02/2015b. News article: Measuring success of IPM advice. Danish Knowledge Centre for Agriculture (SEGES). https://www.landbrugsinfo.dk/PLANTEAVL/PLANTEVAERN/IPM/Sider/Effektmaaling-af-IPM-raadgivning_pl_15_2083.aspx

Danish Horticulture 03.08.2010, news article: Financial aid for advisory services on integrated pest management (IPM). http://www.danskgartneri.dk/Nyheder/Nyhedsarkiv/2010/August/Stoette_til_raadgivning_om_integreret_plantebeskyttelse_IPM.aspx

Ministry regulation on subsidies for IPM 21 April 2010 https://www.retsinformation.dk/Forms/R0710.aspx?id=131581

6.9 French Ecophyto pesticide reduction plan

Policy mechanism relevant to case study

National pesticide reduction target and action plan

Case study location and context

France, pesticide use in agriculture, public green spaces and gardens. The Plan Ecophyto 2018 published in 2008 set a national target of 50% reduction in pesticide use by 2018 and series of actions to reduce pesticide use.

Description of policy mechanism(s) or other methods used

Ecophyto 2018 included the following actions:

- EcophytoPIC (www.ecophytopic.fr) – website to raise awareness among farmers and other professionals in the agricultural sector about integrated protection of crops (Protection Intégrée des Cultures) to encourage reduction of pesticide use.
- IPM guides for polyculture, viticulture, vegetables and fruit

- Plant health bulletins – available for free from the Internet
- CertiPhyto – a mandatory individual certificate to ensure that all pesticide users have the basic knowledge to apply pesticides safely and reduce their use
- Network of demonstration farms DEPHY
- Ease registration of biopesticides including basic substances

The new proposal contains the following:

- It maintains the pesticide use reduction target of 50% in the next 10 years (by 2025), with a mid-term objective of 25% by 2020. Ecophyto II will aim to eliminate pesticide use wherever possible in gardens, green spaces and infrastructures;
- Increased surveillance of the impacts of pesticides on public health and the environment with a view to reducing their risks;
- The promotion of agro-ecological practices
- An increased flexibility given to the regional implementation of the Plan and the promotion of participatory approaches to feed into this debate of public relevance;
- Increased research, development and innovation activities

Evidence of environmental effectiveness

The Ecophyto plan has developed several pesticide indicators: number of doses (NODU), treatment frequency index (IFT), toxic equivalence. NODU is a figure based on annual sales data supplied by pesticide distributors to the French National Office for Water & Aquatic Spaces (ONEMA). By correlating the dosage units and, in the case of an agricultural NODU calculation, the usable agricultural area, it is possible to estimate an average number of treatments per hectare. There are different NODU segments, reflecting the land use for which the products concerned were sold. IFT is the number of standardised applications per ha.

The first Ecophyto 2018 did not reach the objectives set, as a 5% increase in pesticide use was observed on average between the periods 2009-2011 and 2011-2013 (Plan Ecophyto II). However, the use of carcinogenic substances decreased. More generally, results of the latest available evaluation (Potier report, 2014) insist on the importance of assessing the evolution of risks and impacts associated with pesticides, of which a decreased pesticide use (in quantity) is a key component - but it cannot be the only indicator to be examined.

The Potier report (2014) shows a persisting and concerning level of water pollution as well as evidence of air and soil contamination (although very heterogeneous monitoring of air and soil quality is noted). It is also acknowledged that the impact of pesticides on biodiversity is not adequately monitored but could be improved thanks to research undertaken in the area of eco-toxicology.

Evidence of other benefits

Other key benefits pursued by the Ecophyto programme include: preserving public health through a reduced exposure to pesticides, and decreasing farms' dependence vis-à-vis pesticides, thereby improving their economic performance. The plan has stimulated the establishment of a network of experts and best practice demonstration farms with each of the main cropping systems across France (Butault et al 2010).

Evidence of perverse effects on pesticide use

The Ecophyto plan relies on voluntary changes in behaviour of farmers and others implicated in the use of pesticides by raising awareness, requiring certificate before pesticide use, etc. It is not expected that the plan would have strong perverse effects on pesticide use.

Compliance monitoring & enforcement – effectiveness, costs

Monitoring of Ecophyto is ensured by a national level steering committee which is chaired by the Minister of Agriculture and Forestry (Comité National d'Orientation et de Suivi du plan Ecophyto). Monitoring of pesticide use is ensured by the French water agency (ONEMA) which needs this information to collect a fee on pesticide sales. This tax is in turn used to fund some of the actions foreseen by Ecophyto. In this context, €194 million were allocated to Ecophyto actions for the period 2009-2014 (Potier report).

Costs to farmers

Farmers should in principle benefit from the implementation of Ecophyto actions thanks to a decreased dependence on pesticides.

Other costs (administrative etc)

No information available.

Information sources

Ministère de l'Agriculture et de la Pêche (2008) Plan écophyto2018. http://agriculture.gouv.fr/telecharger-le-plan-ecophyto

NODU (NOmbre de Doses Unités) http://agriculture.gouv.fr/note-methodologique-le-nodu

IFT (Indice de Fréquence de Traitement) –

Facteur d'équivalence toxique http://www.sante.gouv.fr/question-no-28-qu-est-ce-qu-un-facteur-d-equivalence-toxique.html

Guides de co-conception http://agriculture.gouv.fr/Guides,18096

Bulletins de Santé du Végétal (BSV) http://www.chambres-agriculture.fr/fileadmin/user_upload/thematiques/Ecophyto2018/brochure_bsv.pdf

Poitier Report (2014) Pesticides et agro-écologie. Les champs du possible. Rapport du Dominique Potier, Député de Meurthe-et-Moselle, au Premier Ministre Manuel Valls. November 2014. http://agriculture.gouv.fr/ministere/pesticides-et-agro-ecologie-les-champs-du-possible

Projet de plan Ecophyto II – 5 juin 2025. Public consultation closed on 29 June. http://agriculture.gouv.fr/Consultation-publique-ecophyto-2

Crosskey, P (2015) France: New law to promote agroecology, in Watts, M, Williamson, S (eds), Replacing Chemicals with Biology: Phasing out highly hazardous pesticides with agroecology, pp154-162. Pesticide Action Network International, Penang, Malaysia.
http://www.panap.net/sites/default/files/Phasing-Out-HHPs-with-Agroecology.pdf

Butault, J-P, Dedryver, C-A, Gary, C, Guichard, L, Jacquet, F, Meynard, J M, Nicot, P, Pitrat, M, Reau, R, Sauphanor, B, Savini, I and Volay, T (2010) Écophyto R&D. Quelles voies pour réuire l'usage des pesticides? Rapport d'Étude (9 tomes), Étude menée par l'INRA à la demande du Ministère de l'Écologie, de l'Énergie, du Développement durable et de la Mer et du Ministère de l'Alimentation, de l'Agriculture et de la Pêche, France.

6.10 Italy: Crop risk insurance for IPM of maize

Policy mechanism relevant to case study

Use of crop risk insurance for Integrated Pest Management

Case study location and context

Italy, in the Po floodplain region (Pianura Padana). Farmers (mainly maize) of the Crop protection consortium Veneto and Friuli Venezia Giulia. Collaboration between the mutual fund for crop risk insurance of Venice (Condifesa Veneto), with around 1800 members, and an agricultural research centre (Centro Agricoltura Ambiente Giorgio Nicoli).

Description of policy mechanism(s) or other methods used in case study

The insurance covers the risks of not using insecticide treated seed. A study in north-east Italy between 1986 and 2014 calculated the percentage of maize fields damaged by wireworms and the risk factors of wireworm damage, and showed that the incidence of wireworm damage is very variable between areas, and is mostly lower than 5% (Furlan & Kreutzweiser 2015). The insurance is therefore more cost-effective than using treated seed. Maize farmers can sign the contract for the mutual fund insurance "Fondo Risemina Mais" annually until 7 days after sowing their crop. Farmers must comply with good agricultural practice and integrated pest management, follow the recommendations of the arable crop protection bulletins from the Veneto Agriculture institute, and report any claims within the specified time periods. The crop insurance will cover pest damage to maize (as well as damage due to adverse weather conditions). The mutual fund covers significant plant density loss due to pest losses up to the 8th leaf stage (roughly the first four weeks of the growing season); ie pest losses mainly caused by wireworms (Elateridae), black cutworms (*Agrotis ipsilon*) and fungal diseases of the seed and seedling. The fund also compensates for significant *Diabrotica* corn rootworm damage if reported before the fruit set stage (and not for fields cultivated with maize for more than four continuous years), and significant damage from silk feeding if reported by the beginning of the milky stage of the ear and only if fertilisation levels are low.

Evidence of environmental effectiveness

The fund was set up in 2014, so there is no evidence of impact on pesticide use so far.

Evidence of other benefits

Farmers are encouraged to assess wireworm populations with bait traps where risk factors are present, and to introduce control strategies only when and where economic thresholds for maize are exceeded.

Evidence of perverse effects on pesticide use

None. The use of imidacloprid and thiamethoxam-based maize seed treatments to prevent wireworm damage has been banned in Italy since 2008.

Compliance monitoring & enforcement – effectiveness, costs

The scheme is being supported by research activities to monitor the pest population, investigate the relationship between the adult insect count and crop damage, and so be able to improve crop damage estimates on the basis of adult insect pheromone trapping.

Costs to farmers

An individual farmer subscription to the fund cost 15 Euros in 2015, covering losses from adverse weather and pests. The fund in 2015 covers loss of income up to 500 Euros/ha from pest damage including up to 250 Euros/ha to cover cost of reseeding and up to 250 Euros/ha to cover any production losses due to delayed crop development or switch to another crop. Compensation limits are 1000 Euros for farms up to 10 ha, 5000 Euros for 11 to 20 ha, and costs on a graded scale up to 50,000 Euros for areas over 20 ha.

Other costs (administrative etc)

The fund is a farmer-managed non-profit insurance tool. Crop insurance mutual funds in Italy qualify for rural development funding.

Information sources

Condifesa Veneto – Consorzio per la Difesa delle Colture Agriarie delle Avversitá. http://www.condifesave.it/chi-siamo.html

Ferrari,R., Tassini,C., Furlan,L., Fracasso,F., Sartori,E., Codato,F., Oddino,B. (2015) La gestione degli elateridi con i fondi mutualistici. Terra e Vita n. 14-2015 4 aprile. http://www.novagricoltura.com/wp-content/uploads/sites/10/2015/04/La-gestione-degli-elateridi-Pagine-da-TV14-2015-2.pdf

Furlan,L. Contiero,B. Sartori,E. Fracasso,F. Sartori A., Frigimelica,G. Vale,M. Chiarini,F. Vasileiadis, V.P. Sattin,M. Codato,F. Oddino,B. (2015) Mutual funds are a key tool for IPM implementation: a case study of soil insecticides in maize shows the way. Poster Presentation.

Furlan & Kreutzweiser (2015) Alternatives to neonicotinoid insecticides for pest control: case studies in agriculture and forestry. Environmental Science & Pollution Research 22: 135-147

6.11 Switzerland: IP Suisse label

Policy mechanism relevant to case study

Private assurance schemes to implement IPM / reduce pesticide use

Case study location and context

IP-Suisse is an independent association and product label for agricultural products produced in Switzerland, with a current membership of around 20,000 farmers (around 40% of Swiss farmers). Current annual production with the IP-Suisse label includes around 120,000 tonnes of bread wheat (around a quarter of total Swiss production), around 3,000 tonnes of oilseed rape (around 5% of total Swiss production), small areas of other cereals and a local maize variety, potatoes, and around 3,500 tonnes of apples for cider. It also includes milk, beef, pig meat, lamb, poultry, rabbits, and eggs.
Description of policy mechanism(s) or other methods used in case study
The IP-Suisse bread wheat standard prohibits the use of growth regulators, chemical-synthetic plant defence response stimulants, pre-emergence herbicides, fungicides, and insecticides, including the use of insecticide-treated seed (with an exception when potatoes are the follow-on crop). Post-emergence herbicide applications must follow IPM rules, and four active substances are prohibited (dicamba, 2,4-D, MCPB and MCPA). The potato standard prohibits the use of copper-based fungicides, carbendazim or iprodione products, insecticides harmful to bees (including neonicotinoids and pyrethroids), ephosin, and either no herbicides at all or only on the young crop. The oilseed rape standard prohibits the use of growth regulators, fungicides, insecticides and chemical-synthetic plant defence response stimulants. The cider apple standard mandates the use of pesticides recommended by the Swiss integrated production working group, and prohibits the use of herbicides (except in new plantings), imidacloprid, thiamethoxam, chlorpyrifos and cypermethrin. The label standards include other conditions with regard to animal welfare, biodiversity, fertilisation, etc.
Evidence of environmental effectiveness
No evidence specific to IP-Suisse production. Pesticide use trends in Switzerland are only available per tonne of active substance, and there are no statistics on trends in environmental impact. As Swiss agricultural subsidies also include specifications on pesticide use (including limits on the use of pre-emergence pesticides, using pest warning services and prognosis models when taking farming decisions, and testing spraying equipment at least every four years) it is not possible to pinpoint the influence of the IP Suisse conditions.
Evidence of other benefits
No evidence specific to IP-Suisse production, but the label provides benefits for farmland biodiversity (through requirements to provide flowering strips and other on-farm habitats) and for animal welfare.
Evidence of perverse effects on pesticide use
No evidence specific to IP-Suisse production.
Compliance monitoring & enforcement – effectiveness, costs
The annual control costs are paid by the farmers directly to the accredited Swiss agricultural inspectors, who carry out the controls on behalf of IP-Suisse, as well as any necessary fines. A typical inspection of 1 hour length may cost a farmer 100 to 200 Swiss Francs (around 95 to 190 Euros)[273].
Costs to farmers
Farmers pay an annual membership of 50 Swiss Francs, plus an annual fee per unit of product produced, and they also pay the inspection costs. Farmers are guaranteed the purchase and a premium on the approved varieties, provided the quality standards are met and IP-Suisse is able to market the entire product. The premium is generally around 10% of the market price for the product.
Other costs (administrative etc)
In 2013/14, IP-Suisse had a total administrative cost of around 5,530,300 Swiss Francs (around 5.27 million Euros), including staff, advertising, taxes, buildings and other running costs. In 2013/14, the operation of the IP-Suisse label cost a total of 62’296’792 Swiss Francs (around 59 million Euros), balanced against an income from the label of 64’206’380 Swiss Francs.

[273] http://www.agrocontroll.ch/6290/76212.html

Information sources
IP-Suisse Richtlininen für Getreide. https://www.ipsuisse.ch/CMS/ModanFileHandler.axd?DateiGUID=e3cae28e-d236-4e9d-b8ef-e514d9d84dac IP-Suisse Richtlinien für Raps. https://www.ipsuisse.ch/CMS/ModanFileHandler.axd?DateiGUID=8108488c-6856-4ab8-8a41-fcd70859554d IP-Suisse Richtlinien für Kartoffeln. https://www.ipsuisse.ch/CMS/ModanFileHandler.axd?DateiGUID=3569d4ea-4606-4844-b323-c9c01fe87fc9 IP-Suisse Richtlinien für Mostobst. https://www.ipsuisse.ch/CMS/ModanFileHandler.axd?DateiGUID=b8d8b94f-96c2-468d-9ce9-531575e0a1df IP-Suisse Jahresbericht 2013-2014. http://www.ipsuisse.ch/CMS/ModanFileHandler.axd?DateiGUID=d8c05a2c-7c4c-4f0f-9ac6-f8c6df89b8b8 BAFU (22.10.2010) Herbizidverbot auf Wegen und Plätzen ist bei Gartenbesitzern weitgehend unbekannt. Bundesamt für Umwelt, Switzerland. http://www.bafu.admin.ch/dokumentation/medieninformation/00962/index.html?lang=de&msg-id=35799 BAFU Indikatoren: Verkäufe von Pflanzenschutzmitteln. http://www.bfs.admin.ch/bfs/portal/de/index/themen/07/03/blank/ind24.indicator.240502.2405.html