

CROP PRODUCTION SECTOR PLAN

DRAFT FOR CONSULTATION

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Why we are consulting

The draft sector plans are our initial ideas on where we can make the most significant impact. Getting feedback early in the process from our communities, partners and stakeholders is important and your feedback is critical to the success of our sector planning approach. If you think that we have got something wrong, missed a critical opportunity or not been as transparent as possible, please let us know your thoughts.

We aim to get these plans finalised in the first months of 2019 and then push on to implement them. Your views will also help to shape the prioritisation for the implementation, which will be completed following the consultation period.

The consultation is open until Friday 15 February 2019. Have your say, by completing the online consultation survey available from:

<https://consultation.sepa.org.uk/sector-plan/crop-production>



SEPA has a strong track record of regulating to improve the Scottish environment. We are proud of what we have achieved since we were set up just over two decades ago in 1996. We know we need to do more over the next two decades to build on this success. Much more.

The mounting scientific evidence about climate change, plastics in our oceans, the pressure on our freshwater and more shows us that humanity must rise to tackle major environmental challenges. This scientific knowledge underpins SEPA's strategy for how we will regulate - One Planet Prosperity. If everyone in the world lived as we do in Scotland, we would need three planets. There is only one.

So, we will regulate to help Scotland prosper within the means of our one planet. Successful businesses in future will be those that use low amounts of water, materials and carbon-based energy and create little waste. Prosperous societies will be comprised of these businesses. This can be Scotland.

In every sector we regulate, this means we will have two simple aims. We will ensure:

1. that every regulated business fully meets their compliance obligations;
2. as many regulated businesses as possible will go beyond the compliance standards.

This draft sector plan outlines how we will do this in regulating the crop production sector.

As the world's population grows beyond seven billion people and the global and local stresses on our environment increase, the challenge of how humanity feeds itself will be a tough one. In growing crops, as in all agricultural production, we will need to continue to look for ways to minimise environmental impact. Excellence in stewardship and the search for new forms of innovation will be the hallmarks of a vibrant crop production sector.

That is why this draft sector plan is so important. It spells out how, as Scotland's environment protection regulator, we intend to play our role to ensure full compliance with environmental laws and help the sector with the pursuit of moves beyond the legal standards that generate environmental, social and economic gains.

This draft plan is ambitious. It spells out how we will use traditional environmental protection agency (EPA) regulatory tools, such as permits and enforcement, in clearer and more powerful ways. It sets out some completely new ways, such as novel partnerships, that we will develop and use to support innovation in this sector.

As SEPA is not the main influencer in the crop production sector, we need to work extensively in partnerships, which we will further develop and use to support innovation in this sector.

We would love to hear what you think of our draft plan. Once it's finalised, we are going to push on and implement it. So, if you think we've got something wrong, missed something out or not been as transparent as possible, please let us know your thoughts. We want to get this right and then get on with it.

Terry A'Hearn

SEPA Chief Executive Officer

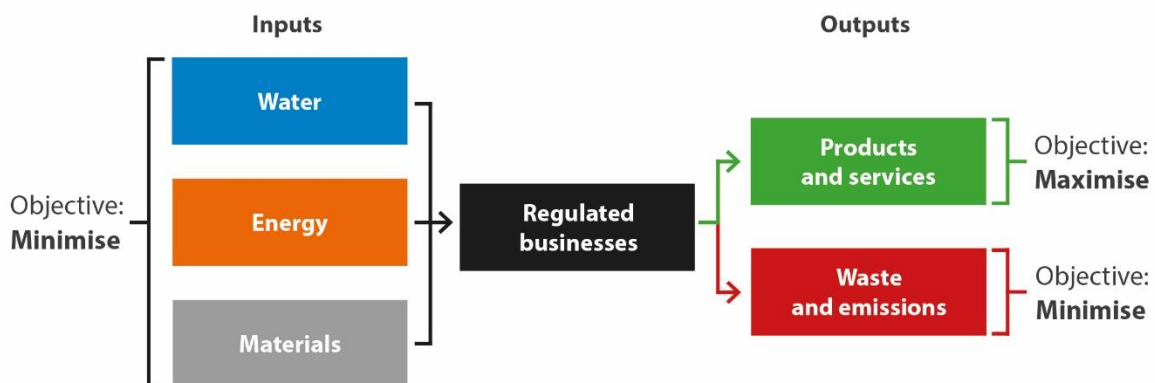
1. Introduction

For SEPA to help create a prosperous Scotland that lives within the means of our one planet, we need to radically change the way we work. In the past our approach to regulation has been grounded in the different set of rules we manage to protect the environment. This has helped us to deliver, for example, improvements in water quality. However, it will not enable us to make the transformational changes needed to tackle today's problems.

We are moving instead to ground our regulation in working across whole sectors. In this way we can systematically identify the compliance issues that need to be tackled by the sector. But mere compliance and small scale incremental change will not be enough. We want to help businesses and sectors to implement successful innovation and support them in their ambitions to do more than they are required to by regulation. We call this 'moving beyond compliance': helping already high performing businesses to do more for the environment because it makes sense for them to grow in a sustainable manner. We will also identify where the biggest opportunities are for us to help the sector to go beyond compliance. In both ways this will help regulated businesses operate successfully within the means of one planet.

All businesses that we regulate in a sector use water, energy and raw materials to produce the products and services they sell. In doing so, they also create waste and emissions. We can think of these as environmental flows that need to be managed by the business (Figure 1).

Environmental flows (Figure 1)



We want to help as many businesses as possible to manage these flows effectively and reduce their use of natural resources and creation of waste in ways that enable them to meet their legal obligations, drive further improvements and operate their business successfully. To do this, we are preparing sector plans for every sector that we regulate.

Sector plans are at the heart of everything we do, shaping the interactions with every sector and the businesses in them. Through them, operators will get the relationship that their attitude and performance earns. Those that demonstrate a commitment to good environmental performance and deliver solid outcomes will receive powerful support through guidance and advice. Those that demonstrate behaviour that leads to significant or chronic non-compliance can expect SEPA to use the most appropriate enforcement tools to bring them into compliance.

This is our plan for the crop production sector. It details how we will regulate the sector and work with it to protect and improve the environment. The plan focuses on key areas in the crop production sector such as soils, nutrients, water and energy. It applies across the whole crop production sector from cereals to high value crops such as vegetables and soft fruit. It explains how we will work directly with farmers and includes ways that we will work with them to use our shared influence to improve environmental performance throughout the industry supply chain.

Together with major stakeholders, such as National Farmers' Union of Scotland (NFUS) and Scotland's Rural College (SRUC), we have made great strides to improve the environmental footprint of the sector and we want to build on this success and help ready the industry for the future.

2. Our vision for the crop production sector

A prosperous and resilient crop production sector that successfully produces crops to feed Scotland and beyond, and recognises that protecting and improving the environment is fundamental to its success.

Five key characteristics of Scotland's crop production sector:

- Ready for the future. The sector is ready to face future challenges resulting for example from the changing climate and funding mechanisms.
- Values healthy soils as the farmer's cornerstone. Good land management practices prevent soil degradation, ensure soils remain healthy and in the field, enable long-term crop growing success, and reduce the need for water, nutrients and pesticides.
- Uses nutrients efficiently and re-circulates nutrients within the economy. Nutrients are essential for crop growth and yield but future global supplies of essential nutrients such as phosphates is limited. It is therefore important that nutrients are used efficiently and that they are circulated within the economy.
- Energy and carbon neutral. Farm businesses have a great opportunity to reduce energy usage and, in many cases, produce energy on-farm, thus striving towards becoming self-sufficient in energy. This will help reduce dependence on fossil fuel energy sources whilst also reducing costs and improving energy security.
- Effective water management. The right amount of water at the right time at the right place is essential to grow high value crops and we will work to optimise water management and work with industry towards efficient and effective water use.

Innovation is key to drive these changes and we will work with all stakeholders to accelerate the transition of knowledge into practice.

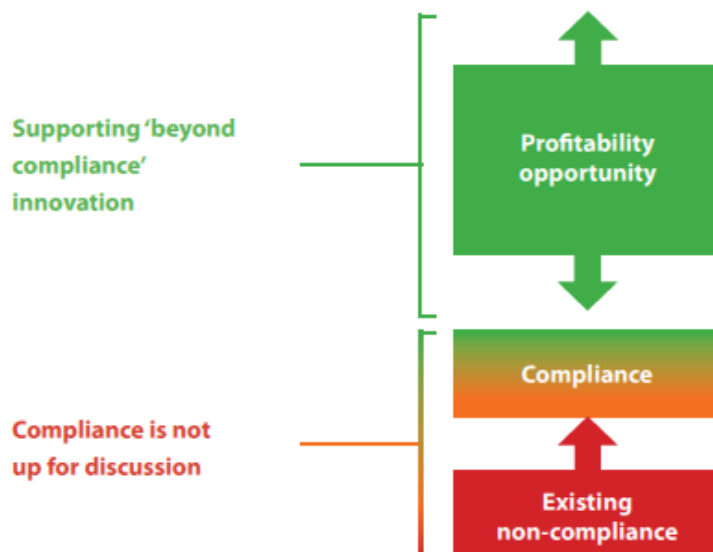
Our objectives

The objectives of the Crop Production Sector Plan are to:

- ensure that all crop farmers reach and maintain full compliance with Scotland's environmental protection laws;
- help as many farm businesses as possible in the sector to move beyond compliance.

This is illustrated by the sector roadmap (Figure 2).

Sector roadmap (Figure 2)



This sector plan sets out how SEPA will work with the crop production sector. For our vision and objectives to be achieved, our staff will work with partners and facilitate liaison between them and the sector to create opportunities that link business success with environmental success.

We want to bring together skilled, experienced and innovative people from across the sector to understand key challenges and opportunities to create innovative solutions. If we get this right, it will mean that the environment is not seen as a constraint, but a platform on which economic and social success can be built, putting the crop production sector on a pathway to becoming a 'one planet' sector.

3. The crop production sector

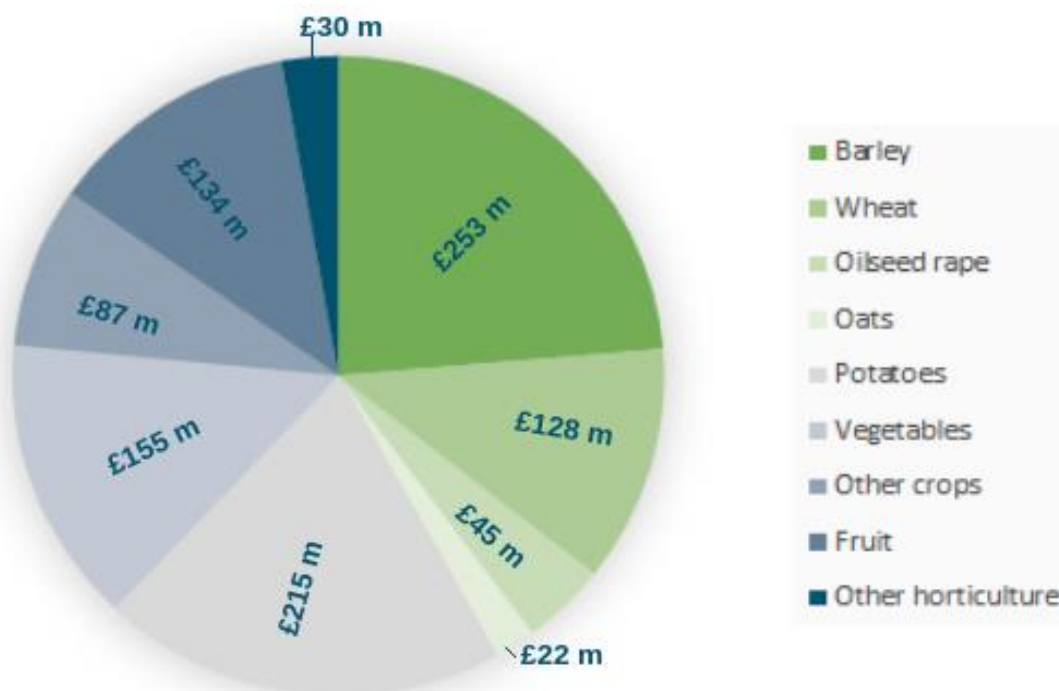
Scotland's farmers produce a wide range of arable crops that are directly consumed, act as input to the food and drink sector, feed livestock and produce energy.

Approximately 10% of agricultural land (or 7.5% of Scotland's total land area) is used for crop production, which employs up to 20,000 people. Most of this takes place on the east coast of Scotland (Figure 3) where the land and climate is more suitable to producing high quality crops.

This sector plan deals with all arable crops (including energy crops), potatoes, vegetables and soft fruits, but not with grass for grazing, which is covered in other sector plans, such as the [Dairy Production Sector Plan](#)¹.

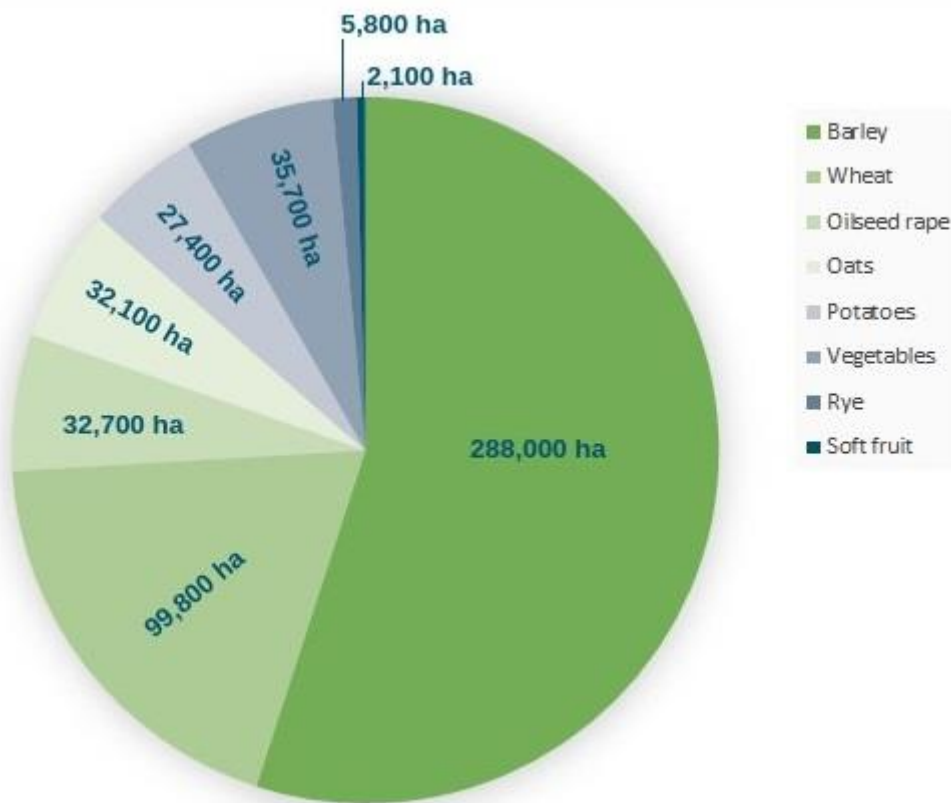
The main crop grown in Scotland is barley, with the majority being spring barley (250,500 ha planted in 2018), of which over a third is used for malting and over half is used as animal feed. Potatoes are also an important crop for Scotland, particularly seed potatoes, which make up just under half of the planted area of potatoes (12,100 ha of seed potatoes in 2018). Soft fruit production occupies an area of approximately 2,100ha predominantly in the most fertile areas, such as Tayside and Angus, but is a significant crop in terms of value.

Farm output (£ million) (Diagram 1)



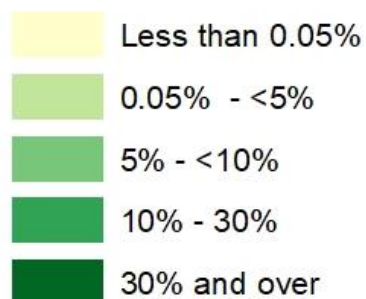
¹ Sector plans are available from sectors.sepa.org.uk

Crop area (ha) 2018 (Diagram 2)



Cereal producing areas of Scotland (Figure 3)

CEREAL AREA - PERCENTAGE OF TOTAL PARISH AREA, JUNE 2018



Some parishes have been merged with neighbouring parishes to ensure minimum risk of identifying information about individual holdings. Which parishes have been merged is not shown.

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Source: Scottish Government RESAS, October 2018

Crop production in Scotland is diverse in terms of size of farm and structure. Some farms will concentrate solely on crop production with a typical rotation including crops such as spring barley, wheat and oil seed rape. Many cereal farmers will also grow an area of potatoes or let land on a short-term basis to specialist potato growers. Mixed farming is also common in Scotland, much of this will involve, for example, keeping beef cows and growing barley for malting and animal feed.

Number of holdings by farm type, 2018 (Figure 6a)

	No. of holdings	Area (ha)	Total standard outputs (£000)
Specialist cereals	2,344	238,714	194,506
General cropping	1,633	260,110	345,986
Specialist horticulture and permanent crops	720	22,539	247,305
Mixed holdings¹	4,362	282,019	317,864

Number of businesses (BRN) cultivating these crops (Figure 6b)

Crop ²	Business
Fruit	562
Vegetables	1,579
Potatoes	2,088
Cereals	6,934

² Note: businesses are not mutually exclusive. They may cultivate one or more of these crops. Businesses can be made up of multiple holdings. BRN = Business reference number

¹ Note: not all mixed farms will produce crops.

Source: June 2018 Agricultural Census. Statistics prepared by Scottish Government Statistics (Agriculture)

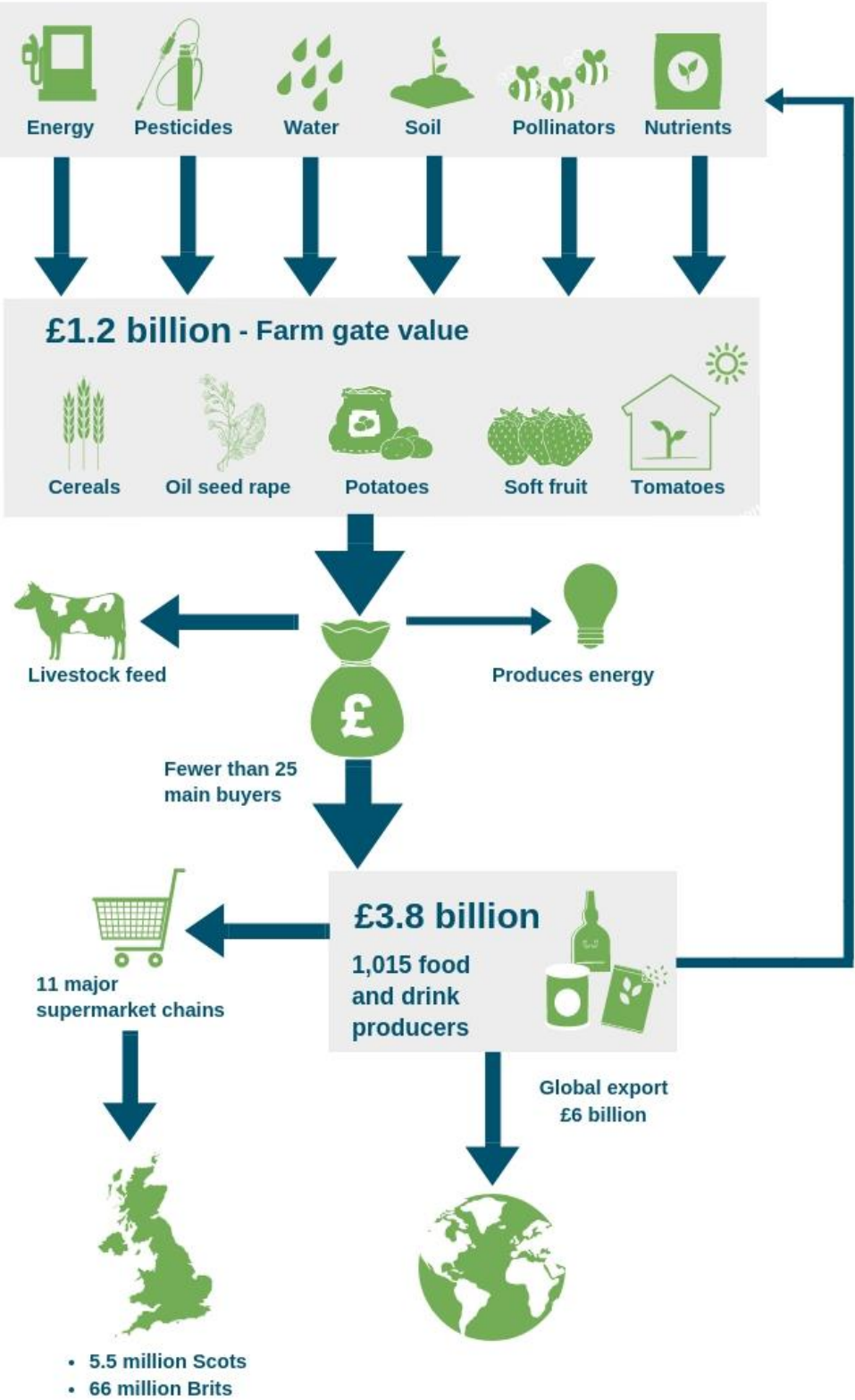
In common with all agricultural sectors in Scotland, crop production faces many future challenges, not least of which will be the new agricultural policy following Brexit, and the effects of climate change. To be ready for future challenges and to be able to take advantage of future opportunities, it is important that farm businesses are as robust and as resilient as possible.

There are many actors driving change in the crop production sector. This plan is focussed on the environmental aspects. The plan aims to promote long term successful crop production in Scotland. Successful production means producing a high quality crop profitably with due care for the environment, such that resources including nutrients and water are used efficiently, wastes, emissions and losses to the environment are minimised, and the soil is kept healthy and in the field. Agricultural support payments are one of the key influencers within the sector and we will continue to work with the Scottish Government to ensure that future policy adequately supports environmentally friendly crop production.

Figure 7 illustrates how the inputs of soil, nutrients, energy, water, pollinators and biodiversity drive successful crop production. Crops are then sold, through a relatively small number of merchants, to the food and drink industry, retail and energy producing companies or as feed for livestock.

Crop production will contribute to a Scottish drive towards using waste as a resource by recovering valuable components, such as nutrients and organic matter and reducing the need for non-renewable natural resources, such as mineral phosphate.

Crop production value diagram (Figure 7)



4. Environmental impacts and how we manage them

Environmental impacts throughout the supply chain

Modern crop production typically involves the use of nutrients, pesticides, energy and heavy machinery to cultivate the land and to grow and harvest the crop (Figure 7). The way these activities are carried out and how the inputs are managed will significantly influence the potential environmental impacts from the sector.

As Scotland's environmental regulator, part of our role is to protect the environment from the impacts of crop production.

This sector plan focuses on the potential impacts during the growing and storage of crops on farm; other sector plans (e.g. [Scotch Whisky Sector Plan²](#)) will deal with the environmental impacts of the use of the crops during processing and manufacture.

As Figure 8 shows, the crop production sector has significant potential to impact on water, soil health, aquatic ecology, biodiversity, air quality and climate change.

However, many of these impacts can be avoided and the risks adequately managed while also providing benefits to producers. It is therefore important to work with stakeholders within the sector to help minimise these impacts while successfully producing high quality crops.

² Sector plans are available from sectors.sepa.org.uk

Potential environmental impacts of crop production (Figure 8)

Cultivation

- Diffuse pollution, soil loss, habitat and biodiversity loss caused by cultivating on slopes and too close to watercourses.
- Greenhouse gas emissions emitted by farm machinery and tilled soil.
- Soil erosion via run-off and wind due to minimal vegetation cover.
- Pollution of ground water due to nitrogen leaching caused by minimal vegetation cover.
- Soil damage caused by compaction (e.g. plough pans).

Growing

- Water pollution caused by pre- and post emergence herbicides and slug pellets applied in autumn being washed to the water.
- Contamination of public and private drinking water supplies via use of pesticides.
- Reduced biodiversity (terrestrial and aquatic) due to cultivation and pesticide use.
- Contamination of groundwater through application of nitrate fertilisers.
- Water pollution in surface waters due to over application of phosphate fertilisers.
- Soil contamination due to over application of non-agricultural waste materials to land.
- Reduced aquatic ecology due to over abstraction of water for irrigation.
- Greenhouse gas emissions and air pollution from machinery use and fertiliser use (and its production).
- Air pollution caused by ammonia from fertiliser use.
- Soil damage caused by compaction from machinery traffic.

Harvest and Storage

- Soil loss and compaction due to harvesting crops, such as potato and root crops, on wet soils.
- Greenhouse gas emissions and air pollution from machinery use, drying grains and refrigeration.

Environmental regulation of the crop production sector

A brief summary of the principal environmental regulations that SEPA and partner organisations use to regulate the crop production sector is set out in Figure 9 below.

Environmental legislation used by SEPA and partner organisations to regulate the crop production sector (Figure 9)

Environmental legislation within SEPA's remit
<ul style="list-style-type: none">■ Water Environment (Controlled Activities) (Scotland) Regulations 2011 (CAR) – General Binding Rules, registrations, licences:<ul style="list-style-type: none">• Cultivation• Fertiliser storage and application• Oil storage• Abstraction• Pesticide storage and use• Engineering■ The Sludge (Use in Agriculture) Regulations 1989■ Environmental Protection Act 1990 and Waste Management Licensing (Scotland) Regulations 2011 - waste management licenses and waste exemptions:<ul style="list-style-type: none">• Imported wastes for use on farm• On-farm disposal of waste (e.g. burning)• Duty of care■ Nature conservation legislation
Environmental regulations and standards used by other regulators
<ul style="list-style-type: none">■ Action Programme for Nitrate Vulnerable Zones (NVZ) 2008■ Cross compliance■ Plant Protection Products (Sustainable Use) Regulations 2012■ Regulations for placing Plant Protection Products on the market■ Nature conservation legislation

SEPA regulates the pollution of the water environment principally through the Water Environment (Controlled Activities) (Scotland) Regulations 2011. These regulations contain a number of diffuse pollution General Binding Rules that control activities such as cultivation, fertiliser storage and application, and the storage and use of pesticides.

The following sections describe in more detail the key environmental impacts associated with crop production and the ways in which these are regulated.

Soils

Soils are the foundation of crop production and are a non-renewable resource. In Scotland, soils develop slowly; it can take hundreds of years to form a few centimetres of soil. However, soils can be damaged or lost very quickly. For example, soil can be lost from a field in a few minutes by erosion during a heavy rain storm.

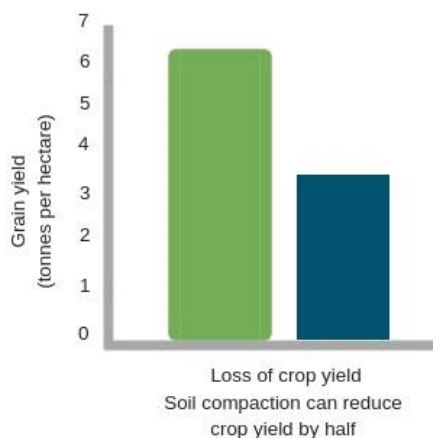
These eroded soils are not only a loss for the farm business and the long-term viability of the farm, but can also impact on any receiving waterbodies. Eroded soils are not only a pollutant in their own right, but also carry with them other pollutants such as nutrients and pesticides. Mismanaged soils can easily leave the field and cause pollution.



It is essential that soils remain healthy and in the field, as this secures long-term success for the farm business.

SEPA regulates the pollution of the water environment principally through the Water Environment (Controlled Activities (Scotland) Regulations 2011. These regulations control activities such as cultivation, fertiliser storage and application and the storage and use of pesticides.

Effect of compaction on wheat yield (Diagram 3)



Nutrients

Nutrients are essential to grow healthy crops. Scotland imports 17 million tonnes of mineral fertiliser annually. However, key studies indicate that globally we will run out of mineable phosphate in 80 to 100 years. Furthermore, the production of nitrogen fertiliser is a very energy demanding activity; to such an extent that 30 to 40% of the greenhouse gas emissions associated with the production of a loaf of bread is attributable to the production of the ammonium nitrate fertiliser that is used to grow the wheat³.

Inappropriate fertiliser application that exceeds the need of the crop and rotation, is a wasted resource. These nutrients are vulnerable to loss from the soils and can enter the water environment and cause air pollution. Excess fertiliser application therefore pollutes the environment and contributes to greenhouse gas emissions⁴.

SEPA regulates the application of fertilisers to land principally through the Water Environment (Controlled Activities) (Scotland) Regulations 2011 (CAR). The Rural Payments and Inspections Division also has an important role through their enforcement of the Nitrate Vulnerable Zone Action Programme and cross compliance. We regulate the application of non-agricultural waste materials that are spread to land for agricultural benefit (for example, sewage sludge and anaerobic digestate) through the Waste Management Licensing (Scotland) Regulations 2011 and the Sludge (Use In Agriculture) Regulations 1989 in relation to sewage sludge. Waste products that are treated so that they become materials, such as PAS 100 AD and PAS 110 compost, can be applied to land without a waste exemption. Their storage and use will still be subject to regulation under CAR.

Consultation question 4

Non-agricultural organic materials such as sewage sludge, digestates and compost contain valuable nutrients and sources of organic matter but they may also contain undesirable elements such as microplastics and medicine residues.

What additional actions could SEPA and the sector take to ensure these nutrient sources are used safely and efficiently?

³ <https://www.nature.com/articles/nplants201712>

⁴ [Climate Change Plan for Agriculture](#)

Pesticides

Growing crops to meet market requirements requires the control of diseases and pests. The use of pesticides is controlled through CAR and UK regulations, such as the product approval regulations and the Plant Protection Products (Sustainable Use) Regulations. The 'Voluntary Initiative' (VI) plays an important role in raising awareness of legal requirements and of good practice amongst growers. In addition to guidance material, the VI has established an operator training scheme and a sprayer testing system that helps to ensure pesticides are used safely.

Consultation question 5

What further action could be taken by SEPA and the sector to help support the 'Voluntary Initiative' in Scotland?

Energy and machinery

Growing crops requires the use of heavy machinery to prepare the land, manage and harvest the crop, and store the crop before passed on in the supply chain. The emissions of greenhouse gases contribute to climate change, while other air emissions have a negative impact on the air quality and plant biodiversity in Scotland.

The Scottish Government has made decarbonisation of the energy system by 2050 a core aspect of its Energy Strategy. Although we do not directly regulate the use of energy on arable farms, or electricity and heat generation on the farm, we can use our regulatory tools, experience, knowledge and partnership approach to support the sector to move beyond compliance; helping drive the use of the most suitable energy sources, increase energy efficiency and productivity. The [farming for a better climate initiative](#) has taken significant steps in this regard. The [Climate Change Plan for Agriculture](#) contains ambitious targets and policy outcomes and "sets out the path to a low carbon economy while helping to deliver sustainable economic growth and secure the wider benefits to a greener, fairer and healthier Scotland in 2032."

Management impacts

Water in the right place, in the right amount and of the right quality underpins our society and economy. We need water to drink, wash, grow food, supply power, build things and maintain the benefits we all receive from a healthy functioning natural environment. Scotland's water resources vary by orders of magnitude in time and space and uncontrolled exploitation of water can affect its availability for other uses. This may be by increasing flood risk, reducing water availability, polluting water supplies or introducing invasive species into rivers, lochs and groundwater. All of these risks may be further enhanced as our climate changes and it is important that sector plans take account of risks from and to water resources.

Growing healthy crops requires sufficient water and, for most crops in years of normal rainfall, soil moisture is sufficient. However, in particularly dry years some crops, such as potatoes, require additional water to improve yields and achieve the quality demanded by the

market. This can be added using irrigation. Through CAR licensing, we regulate the abstraction of water for irrigation purposes. This helps ensure that the needs of the farming industry are balanced with the needs of other users and the environment across a catchment.

Consultation question 6

Irrigation water can come from surface and groundwater and from lagoons or storage.

We think that water should be managed more holistically in a wider catchment. What are your views on this?

SEPA is developing a Flood Strategy that will consider themes of future change, social impact and extended engagement in defining our ambition and outcomes to deliver effective flood risk management now and in the future. Early and strong links between this sector plan and flooding will strengthen opportunities for outcome delivery.

Flood Risk Management Strategies published in 2015 identified 200,000 ha of agricultural land at risk of flooding. A proportion of this will be used for crop production so flooding can be an issue for crop producers. However, they can also be part of the solution of reducing flood risk for downstream communities by implementing natural flood risk management measures (NFM), for example, by storing flood water.

Consultation question 7

What natural flood management measures are most appropriate to the crop production environment, and how can we best work with the sector to encourage uptake?

Wider impacts

Managing large areas of Scotland will inevitably influence biodiversity and the animals and plants that use the landscape. Pollinators are essential for the successful production of some of the crops that are grown in Scotland, such as oil seed rape.

Research indicates that biodiverse soils produce better crops and require less nutrients, water and pesticides. Hedgerows and buffers provide habitats for birds, insects and other animals that naturally help keep pests under control. It is therefore essential that biodiversity is managed effectively in the farming landscape. We have a biodiversity duty under nature conservation legislation and work with Scottish Government, Scottish Natural Heritage (SNH) and stakeholders to drive towards more biodiverse farming.

Consultation question 8

How can we best support the protection and improvement of on-farm biodiversity to benefit farming businesses and support the wider catchment?

Around 80% of environmental legislation in Scotland originates from the European Union. As the UK leaves the EU, changes will, where necessary, be made to domestic legislation to ensure that the standards of environmental protection we enjoy today and the principles upon which they are based are maintained. Therefore, while some of the detail of the legislation we use to regulate may change, our work to protect Scotland's environment will not. Our commitment to tackling non-compliance with environmental laws and, where necessary, taking enforcement action will not diminish as a result of the UK leaving the EU.

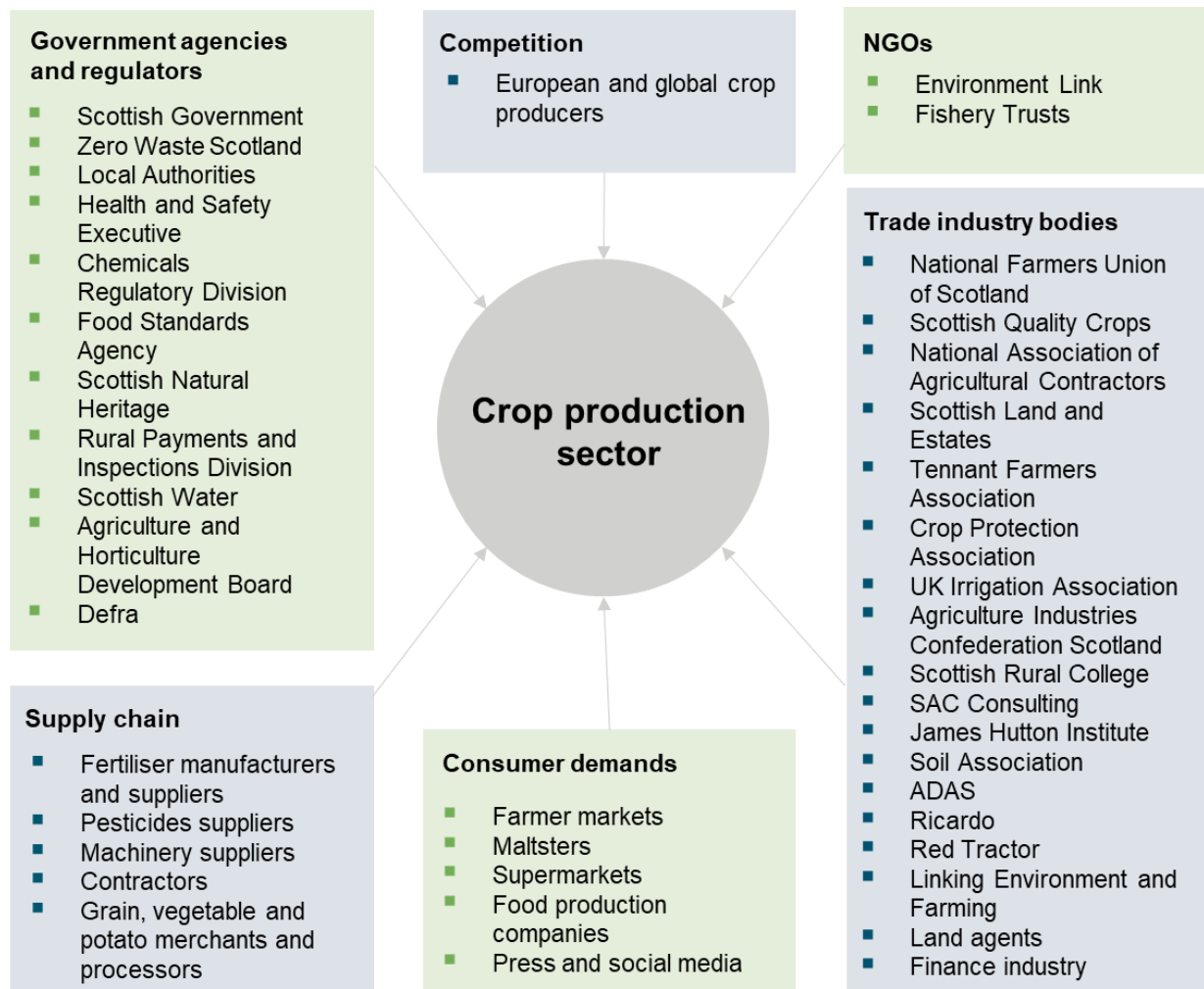
Wider influences on environmental performance of the crop production sector

Full compliance with environmental regulations will not, by itself deliver the transformational change required to secure our One Planet Prosperity objectives. The Crop Production Sector Plan needs to unlock the potential for businesses to gain strengths in resource efficiency and environmental innovation that will help them to succeed in their markets.

We need to combine the actions that we can take to influence the behaviour of a business through our regulatory role with all the other influences. Doing this will be the most effective way to secure full compliance and to help as many businesses as possible to move beyond compliance.

Working with the sector, we will place this more sophisticated way of operating at the heart of our work. Figure 10 summarises the main organisations that influence, and are influenced by, operators in the crop production sector. It also identifies those that we are likely to work with in both the short and longer term. As we implement the plan we will consider the opportunities these relationships provide and how we would like them to develop.

Crop production key influences (Figure 10)



Consultation question 9

Are there any other organisations that SEPA could work with to help implement our Crop Production Sector Plan?

5. Tackling non-compliance and taking opportunities to go beyond

Compliance in the sector

Compliance with environmental law is non-negotiable and regulated businesses in the sector need to comply.

Water

We regulate both the discharge of pollutants into the water environment and the abstraction of water from the water environment. These are covered separately below:

Control of water pollution from crop production

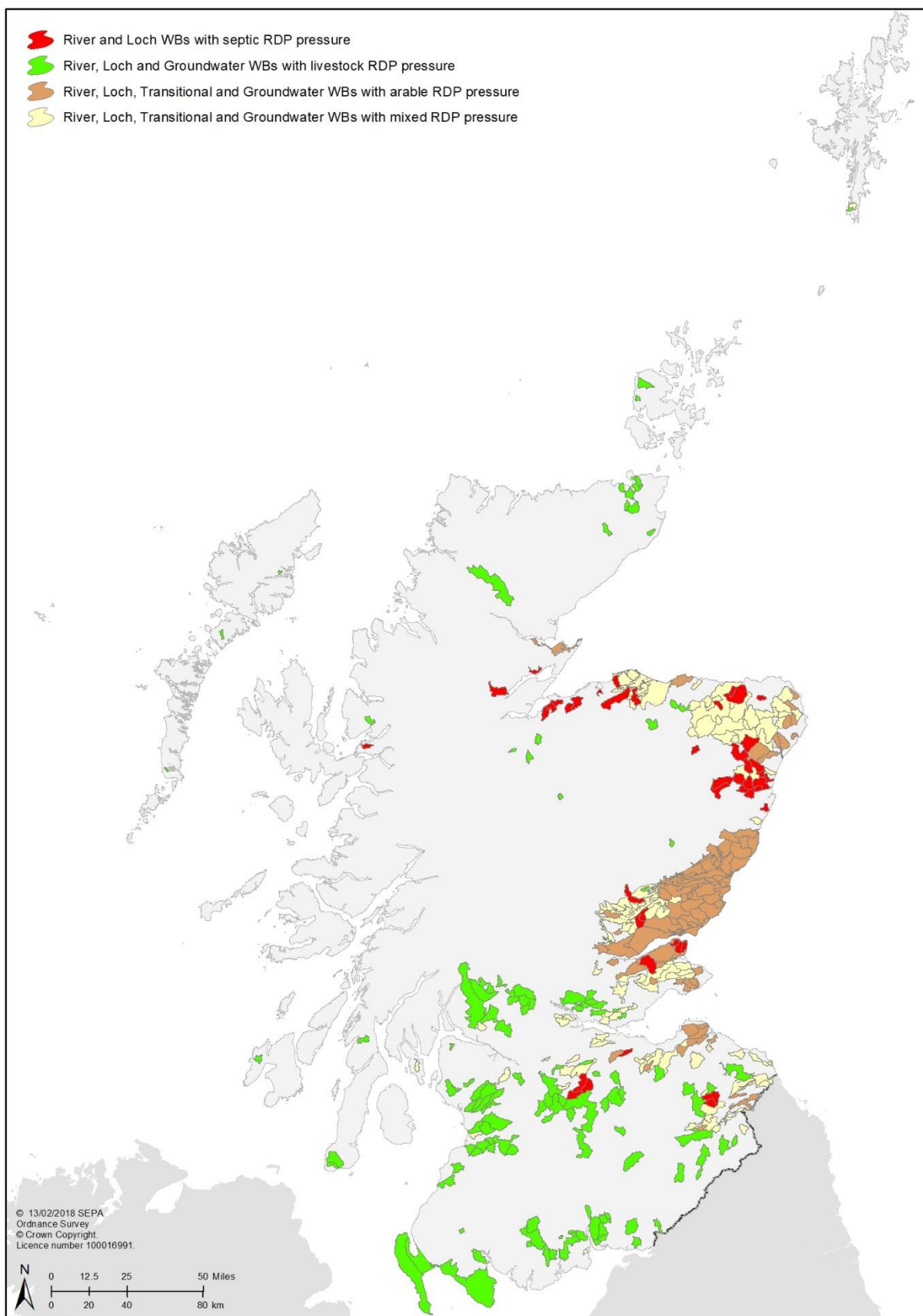
In Scotland, diffuse water pollution from agriculture is one of our main environmental challenges and is the single biggest water pollution pressure in Scotland. The current approach to tackling this problem is to identify priority catchments as outlined in the [River Basin Management Plans](#) (RBMPs). These are catchments failing to achieve good status under the Water Framework Directive, or that include drinking water protected areas, bathing waters and Natura 2000 sites.

Priority catchments are identified within the river basin management plan cycle, and there is an integrated approach to improve compliance with environmental regulation involving monitoring, awareness raising, economic incentives and one-to-one farm visits. This approach was developed and agreed with the Diffuse Pollution Management Advisory Group, which includes key stakeholders and partners from within the sector.

Figure 11 identifies the catchments where waterbodies are failing environmental standards due to rural diffuse pollution and indicates the principal sources of the diffuse pollution. It is however, important to remember that there are usually a number of contributing factors that cause rural catchments to fail. These can also include non-agricultural sources such as soil loss from forestry, phosphates from waste water treatment works or septic tanks etc.

We regulate diffuse water pollution principally through CAR regulations and use General Binding Rules (GBR) that all farmers must comply with. We assess compliance with GBRs during one-to-one farm visits that are targeted through the Diffuse Pollution Strategy, which was developed in partnership with stakeholders via DPMAG.

Catchments where waterbodies are failing environmental standards due to rural diffuse pollution (RDP) (Figure 11)

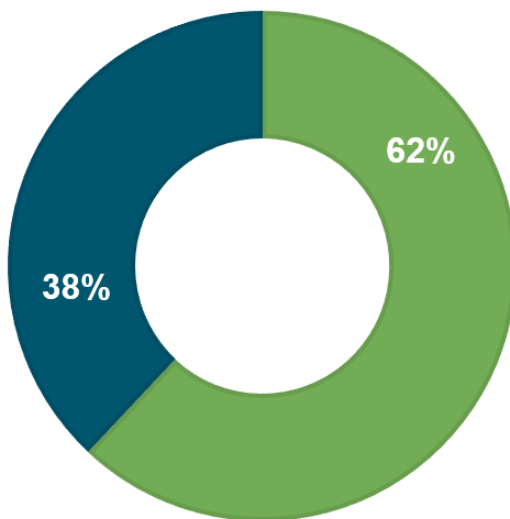


Since we started one-to-one farm visits in 2011, compliance with GBR 20, which focusses on diffuse pollution risks from cultivation and is particularly relevant to arable and mixed farms, has improved significantly in arable catchments such as the South Esk and the Tay. In these catchments, compliance with GBR 20 increased from 62% to 94% following visits to arable and mixed farms (Figure 12).

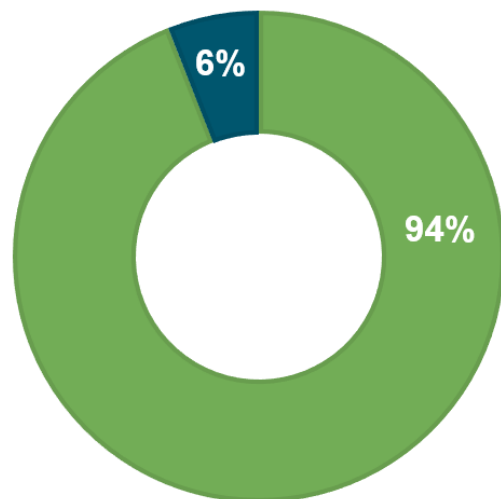
We are also seeing much higher initial compliance rates with GBR 20 in arable catchments that we are now starting to work in under Scotland's diffuse pollution strategy.

Compliance with GBR 20 in the South Esk and Tay catchments at first farm visit and then on revisit to farms where non-compliance was found at initial visit (Figure 12)

Compliance at initial visit:



Compliance at revisit:



Compliance



Non-compliance

This demonstrates the positive action that land managers within the crop production sector have taken over recent years and the progress they have made in order to improve compliance in relation to GBR 20. While this has been a very positive response, and one the sector should be credited for, crop production remains a significant source of agricultural diffuse pollution as illustrated by the map in Figure 11.

In order to achieve objectives stated within Scotland's RBMPs and reach good ecological status in waterbodies, we need to better understand where and what further action is required.

To improve our ability to meet Scotland's RBMP objectives, SEPA's aspirations are to work with partners to better understand:

- which catchments require extra effort to meet RBMP objectives;
- what diffuse pollution pathways are significant contributors to agricultural diffuse pollution;
- what practical measures can be developed and implemented to mitigate these pollution pathways.

Consultation question 10

Compliance with GBR 20, which controls cultivation close to waterbodies, has increased significantly.

We want to celebrate this success with our partners, and review if our current approach can be further improved to increase compliance with regulation and improve the status of the waterbodies. What actions do you think would be most effective at improving compliance?

Materials

Nutrients and application of materials to land

The application of fertilisers to land is regulated through CAR and the Nitrate Vulnerable Zone Action Programme within nitrate vulnerable zones (NVZs). We know that in some instances nutrients are applied during times or in quantities that cannot be used effectively by the crop. This can result in wastage of resource and potential loss to surface and groundwater, and increase greenhouse gas emissions and contribute to air pollution.

Non-agricultural wastes that are applied to land as fertiliser can result in pollution and land contamination when the wrong materials and components are applied in the wrong place at the wrong time.

Consultation question 11

What measures do you think could be taken to help ensure nutrients are used efficiently from all nutrient sources?

Pesticides

Due to the potential impacts pesticides can have on biodiversity and water quality, it is important that they are stored, handled and used safely in line with legislation and good practice.

The legislation that control pesticide use requires that professional pesticide users adopt an integrated approach to controlling crop pests and weeds, known as integrated pesticide management (IPM). This involves efficient and successful crop production while minimising negative impacts on the environment. This is achieved by reducing reliance on pesticides through use of mechanical, cultural and biological methods where appropriate. Such techniques can help reduce risks to biodiversity and water quality.

The mixing and handling of pesticides and wash down activities can be responsible for a significant proportion of pesticide losses to the environment. Ensuring these handling areas are located and managed in line with regulations can greatly reduce these risks. Taking steps beyond the legal minimum, such as using a biobed or biofilter to treat washing from handling areas, can further reduce risks of pesticide pollution.

To adequately protect the environment, it is important that the environmental impacts and risks posed by pesticides are well understood.

Consultation question 12

What further action could be taken within the sector to increase the use of integrated pesticide management (IPM) techniques that will minimise the environmental risk from pesticides?

Consultation question 13

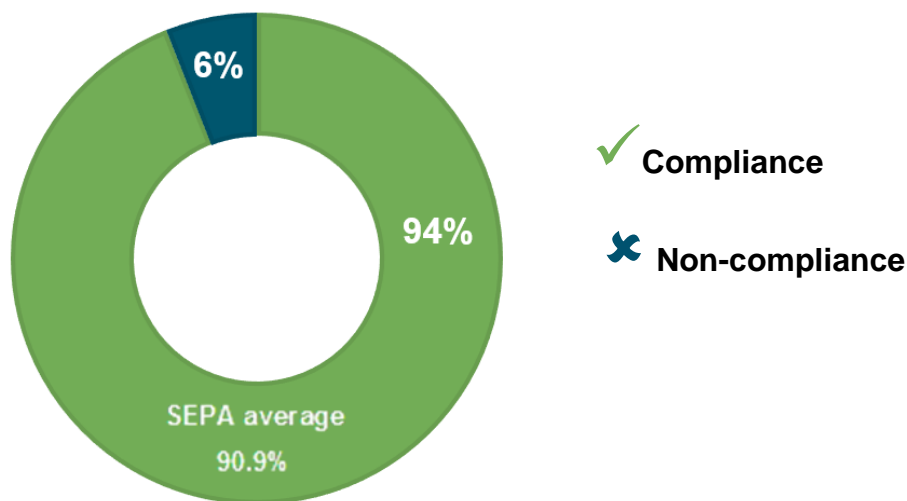
What further knowledge is required to understand the risk of pesticides to the environment and biodiversity?

Water quantity

The abstraction of water for irrigating crops is regulated by SEPA through CAR and currently over 600 businesses have licences to abstract water for irrigation.

The potential environmental impact of these abstractions is assessed when a new licence is applied for and during license reviews. The use of irrigation water is reported to SEPA on an annual basis and this shows that in 2017, 94% of operators complied with their authorisations (Figure 13). The main reason for non-compliance was failure to submit annual data returns.

Compliance rate with abstraction licences for irrigation, 2017 (Figure 13)



The water scarcity encountered during the summer of 2018 highlighted the need for more sustainable sources and use of water, and the need to build in resilience in the sector should these conditions occur again. Our evidence shows that these situations are likely to occur twice as frequently by 2050.

Consultation question 14

What are the best opportunities to work with the sector to understand the scale of this business risk and to explore effective management solutions?

We are responsible for strategic flood risk management in Scotland. Our evidence shows that the use and management of the land and the state of the soil directly influences the speed of the transfer between precipitation and surface and ground waters. Appropriate land management can make a positive contribution to flood risk management. Our evidence shows that in a small number of cases, land managers directly change the size of watercourses through dredging, which requires a permit from SEPA. We will take appropriate action where this permission is not sought before the works are carried out.

Energy and climate change

The emission of greenhouse gases by the farming sector is significant for Scotland. We do not regulate the wider greenhouse gas emissions from the crop production sector directly, but there are clear opportunities to reduce the direct and supply-chain emissions, which are detailed under the actions in this and other specific sector plans.

We can help the sector to recognise the opportunities available to utilise low carbon, environmentally sensitive energy sources, not only in their own processes but also in those of their associated supply chain. We will work with partners and the sector businesses to identify where opportunities might exist to minimise environmental impacts associated with energy use. We can use partnership opportunities to help business access advice and guidance and will use our regulatory levers to drive behaviours that support low carbon energy use.

SEPA's aspirations are to:

- understand the key energy requirements within the sector, for example crop drying, and support the sector in identifying and implementing energy efficiency opportunities and sourcing alternative low carbon energy sources, such as anaerobic digestion.

We will help responsible compliant businesses to operate by making it significantly harder and more expensive for those who persistently fail to comply with environmental regulation to operate. We will achieve this by increasing scrutiny, prescription, fees and the use of enforcement and monetary penalties for those who fail to comply.

Where are the opportunities to go further?

We believe that those societies and economies that are low resource use, low energy use, low water use and low waste will be the most successful in the 21st century. Businesses that are the most innovative will best rise to the challenges of our time, such as over use of resources and climate change, and create sustainable economic growth.

To do this, every business must reach full compliance with environmental laws. But mere compliance and small scale incremental change will not be enough. At SEPA we want to help businesses and sectors to implement successful innovation and support them in their ambitions to do more than they are required to by regulation.

We call this 'moving beyond compliance': helping already high performing businesses to do more for the environment because it makes sense for them to grow in a sustainable manner.

The practice and policy of crop farming is largely outside SEPA's direct remit. The Crop Production Sector Plan will only be successful if we work with others and use our influence effectively outside regulation, but based on sound science and a thorough understanding of the issues, opportunities and pathways.

SEPA's aspirations are to:

- Influence the supply chain for crop producers. The value chain (Figure 7) clearly show key influencers in the onward supply chain, such as food and drinks producers and retail. We want to work with our key stakeholders to understand how we can have the most influence to deliver our vision. For example, helping those farmers who go beyond the legal minimum to receive adequate rewards from the market.

Consultation question 15

Which aspects of supply chain influencing do you think SEPA should focus on?

How can we best work with partners to encourage the market to further reward those producers who go beyond compliance and provide additional benefits to the environment?

- Accelerate innovation and encourage the practical uptake of innovation in a wide group of farmers. Technical innovation is key, but even more important is streamlining and facilitating the uptake of the innovative processes and practices by the farming community. We want to work with key stakeholders to accelerate technical innovation and work with all parties to ensure that the outputs are used on the ground.

Consultation question 16

How can SEPA be most helpful in promoting innovation and facilitating the implementation of new techniques?

Ready for the future

The future holds many challenges, including the agricultural funding review and climate change. To be ready for future challenges and to be able to take advantage of future opportunities, it is important that the crop production sector is as robust and as resilient as possible.

SEPA's aspirations are to:

- work with the sector to identify future challenges and identify environment resilient solutions;
- encourage the uptake of innovative techniques for more biodiverse and resilient farming systems and explore SEPA's role in this;
- ensure our regulatory approach is open to new innovative systems that are of benefit to the sector and the environment;
- work with the Scottish Government to ensure future agricultural support is outcome focussed and helps deliver Scotland's environmental objectives and flood risk management;
- explore opportunities to encourage cooperation between groups of farmers for landscape scale action (flooding, abstraction, diffuse pollution and biodiversity).

Case study: vertical farming

Scottish agri-tech company, Intelligent Growth Solutions (IGS), opened the world's most technically advanced vertical farm, where high value horticultural crops are grown under controlled conditions on a minimal environmental and spatial footprint. Water and nutrients are recirculated on site and highly efficient lighting and heating minimise the carbon footprint.

<https://www.intelligentgrowthsolutions.com/scottish-agritech-business-intelligent-growth-solutions-unveils-first-vertical-indoor-facility-to-revolutionise-global-horticulture-market/>

Soils

Healthy soils are the cornerstone on which crop production critically depends. Without soil there is no production (besides artificial media in controlled conditions as in polytunnels and greenhouses). Healthy soils yield more and better crops using fewer resources such as nutrients, water, energy and pesticides. Healthy soils also store more water and reduce the need for irrigation and the risk of flooding.

Soils protect water quality by filtering liquids before they reach rivers, lochs and groundwater. They also influence climate change by storing carbon and exchanging greenhouse gases with the atmosphere.

However, soils are a non-renewable resource. They can be damaged by a range of processes, such as erosion or compaction, which are often caused by poor land management practices.

We will help to work with the sector so that healthy soils are increasingly recognised as the foundation of long-term successful crop production.

SEPA's aspirations are to:

- work with partners to improve our understanding of the cause, location and extent of soil loss from arable fields and how this affects crop production, the environment and flood risk;
- explore with partners, and identify, the most effective actors and actions that position soils as the essential non-renewable resource that supports all crop production;
- celebrate with partners the success of the improvement in CAR GBR 20 compliance and identify how we can best work together with partners towards full compliance across the sector.

Case study: soil management

Balbirnie Home Farms are 'reaping' the rewards of good soil management on their mixed arable and beef unit in Fife.

By gradually increasing the organic matter content of their soils and taking steps to reduce soil compaction through reduced traffic and using non-inversion tillage, they are producing high quality crops and experiencing less soil erosion and soil loss via field drains.

Consultation question 17

How do you think SEPA can be most effective in working with the crop production sector to help keep soils healthy and in the field?

Nutrients

Nutrients are essential for healthy productive crop growth. Nitrate applications need to be targeted to the needs of the crop at its various growth stages. Excess is a waste of money and will increase the risk of polluting surface and groundwater, and the release of greenhouse gas emissions or air pollutants. Phosphates are also prone to loss particularly where the P status of the soils is higher or where soil erosion has occurred. Sufficient supplies of nutrients, such as nitrate and phosphate, are potentially available in Scotland from a number of sources (such as organic waste material) and there are clear opportunities to re-circulate these nutrients within the economy.

Crop production can contribute to the Scottish drive towards using waste as a resource by recovering valuable components, such as nutrients and organic matter, from materials traditionally thought of as waste, and reducing the need for non-renewable natural resources, such as mineral phosphate.

SEPA's aspirations are to:

- work with partners to explore how to reduce fertiliser-use to only that which is essential for the crop and therefore reduce cost and loss to the environment;
 - explore a range of opportunities to encourage all crop farmers to implement nutrient management plans to ensure the use of the right material, in the right amount, in the right place, at the right time;
 - promote best land management practices, including the use of precision farming technology, to improve the application of nutrients and organic matter to soil and to reduce environmental impacts to water, air and climate.

- work with partners to develop an action plan for circular use of nutrients in Scotland, which aims to minimise mineral fertiliser use and maximises the use of all re-circulated nutrient sources within the economy;
 - develop a Scotland wide picture of the demand of nutrients for crop production and the potential for supply of nutrients from organic material re-circulated within the economy;
 - explore the practical possibilities to re-circulate nutrients from a wide range of sources into fertiliser and soil improver.

Case study: precision farming

An increasing number of arable farmers are starting to use precision farming methods to better manage their land to help maximise yields while using inputs as efficiently as possible.

Techniques such as assisted steering, soil and yield mapping, variable rate application of fertilisers, lime, and pesticides can help growers to better understand the specific needs and potential of parts of their fields. This helps to reduce the costs of inputs and reduce losses of nutrients etc. to the environment.

Consultation question 18

How can SEPA be most effective in working with partners to ensure the use of the right nutrient material, in the right amount, in the right place, at the right time?

Consultation question 19

What are the best opportunities for SEPA and our partners to facilitate the recirculation of nutrients in Scotland?

Water quantity

A reliable water supply for irrigation is critical to grow high value crops such as potatoes and field vegetables, especially in dryer years. There are great emerging opportunities to increase the effectiveness of irrigation by delivering the water straight to the roots. This, coupled with integrated surface, ground and stored water management on a catchment basis, could deliver security of supply under all climate scenarios. Inappropriate irrigation risks drying up of supplies, impacting on other water users and flooding and erosion of soil and nutrients that pollute watercourses.

Case study: water use modelling

Modelling irrigation water use and availability from surface, ground and stored water by SEPA for an Angus river, showed that a doubling of storage could resolve the supply deficit under water-scarce situations. This would create security of supply for crop-farmers under all climate scenarios within that catchment.

Practical water management actions such as improving soil condition and increasing irrigation efficiency would further reduce the extra storage capacity required.

SEPA's aspirations are to:

- work with partners to support farmers in a step change that minimises water use and maximises efficiency of water used in irrigation thereby reducing costs;
- work with partners to explore practical solutions for irrigation water management at a catchment scale that ensures security of supply and protects the environment and other water users.

Consultation question 20

How can SEPA be most effective in working with partners to increase the efficiency of water use for irrigation?

Consultation question 21

What are the best opportunities for SEPA and our partners to drive towards catchment based proactive water management that increases the certainty of supply of irrigation water and that operates within the environmental limits?

Energy and climate change

Energy is an essential resource that enables social and economic development. However, while energy is fundamental to the economy, electricity and heat production, transmission, storage, and use can have significant environmental impacts.

How we use and manage our energy resources is central to our ability to live within the resources of our planet. Energy is one of the most important aspects of the transition to a sustainable low carbon economy and there are often cost savings and other benefits for businesses associated with improving their energy efficiency and making use of alternative sources of energy.

Crop farming requires large and powerful machinery to work the land and to store crops. Fossil fuel is the dominant energy source. Energy crops are increasingly being grown and there are increasing opportunities to harvest renewable energy, for example, from sun and wind. Energy costs will likely keep rising and by meeting on-farm demand from on-farm production, farm businesses can be resilient to energy price increase and fluctuations while also reducing carbon emission from the sector. Switching the source of the nitrate fertiliser from mineral to re-circulated sources can significantly reduce the greenhouse gas footprint of the sector. This also contributes to improving local air quality and reducing transboundary air pollution.

Case study: re-circulated energy powered greenhouses

Greenhouses use to supply Scotland with tomatoes. But the largely Clyde-valley based industry collapsed due too high costs. New opportunities now arise where materials from distilling (excess heat, nutrients and carbon dioxide) or geothermal heat can be re-circulated to drive the greenhouse, therefore making this profitable once again.

SEPA's aspirations are to:

Energy:

- explore, with partners, the most effective actors and actions that reduce energy use on the farm and therefore cut cost
- explore, with partners, the options to increase the amount of energy that is generated on-farm so that farms are less dependent on imported energy.

Climate change mitigation and adaptation:

- explore, with partners, the likely consequences climate change will have on crop production and how to adapt to these while minimising environmental damage;
- explore, with partners, how the crop production sector and its land management can help Scotland to reduce greenhouse gas emissions;
- explore, with partners, the opportunities and practicalities that land management within the crop sector has to reduce flood risk and other climate change related pressures.

Consultation question 22

How can SEPA be most effective in working with partners to increase energy use efficiency in the crop production sector?

Consultation question 23

How can SEPA and partners most effectively help the crop production sector adapt to climate change?

What actions are we going to take?

The following table summarises the actions that we have described above to fix compliance in the sector and, working in partnership, help businesses take opportunities to go beyond compliance. These are described according to the key outcomes that we would like this sector plan to achieve. The actions and aspirations set out are our initial thoughts on what needs to be done to achieve the aims of this sector plan. We are at an early stage in sector plan development, and the actions that we prioritise will be informed by the findings of this consultation and further internal discussions between now and March 2019.

Many actions contribute to multiple outcomes, we have positioned them to the most relevant outcome.

Outcome		Actions and aspirations
Better Environment	Healthy soils that stay in the field and thus less pollution risk	<ul style="list-style-type: none">■ Work with partners to understand the cause, location and extent of soil loss from arable fields and how this affects crop production, the environment and flood risk.■ Explore with partners to identify the most effective actors and actions that position soils as the essential non-renewable resource that supports all crop production.■ Celebrate together with partners the success of the improvement in CAR GBR 20 compliance and identify how we can best work together with partners towards full compliance across the sector.■ Better understand:<ul style="list-style-type: none">• which catchments require extra effort to meet RBMP objectives;• what diffuse pollution pathways are significant contributors to agricultural diffuse pollution;• what practical measures can be developed and implemented to mitigate these pollution pathways.

Outcome		Actions and aspirations
Better Environment	Nutrients successfully re-circulated within the economy, reducing risks to the environment and increased farm resilience	<ul style="list-style-type: none"> ■ Work with partners to explore how to reduce fertiliser-use to only that which is essential for the crop therefore reducing cost and loss to the environment: <ul style="list-style-type: none"> • explore a range of opportunities to encourage all crop farmers to implement nutrient management plans to ensure the use of the right material, in the right amount, in the right place, at the right time. • promote best land management practices, including the use of precision farming technology, to improve the application of nutrients and organic matter to soil and to reduce environmental impacts to water and climate. ■ Work with partners to develop an action plan for circular use of nutrients in Scotland, that aims to minimise mineral fertiliser use and maximises the use of all re-circulated nutrient sources within the economy. <ul style="list-style-type: none"> • develop a Scotland wide picture of the demand of nutrients for crop production and the potential for supply of nutrients from organic material re-circulated within the economy; • explore the practical possibilities the re-circulate nutrients from a wide range of sources into fertiliser and soil improver.
	Effective use of water and nutrients cuts costs and safeguards the environment	<ul style="list-style-type: none"> ■ Work with partners to explore how to best support farmers in a step change that minimises water use and maximises efficiency of water used in irrigation, therefore reducing cost. ■ Work with partners to explore practical solutions for irrigation water management at a catchment scale that ensures security of supply and protects the environment and other water users.
Stronger business	Successfully implementing innovation to the benefit of the sector and the environment	<ul style="list-style-type: none"> ■ Encourage the uptake of innovative techniques for more biodiverse and resilient farming systems and explore SEPA's role in this ■ Ensure our regulatory approach is open to new innovative systems that are of benefit to the sector and the environment.

Outcome		Actions and aspirations
Stronger business	Reduced energy use and increased on-farm energy production reduces cost and increases resilience	<ul style="list-style-type: none"> ■ Understand the key energy requirements within the sector, for example crop drying, and support the sector in identifying and implementing energy efficiency opportunities and sourcing alternative low carbon energy sources such as anaerobic digestion. ■ Explore with partners the most effective actors and actions that reduce energy use on the farm and therefore cut cost. ■ Explore with partners the options to increase the amount of energy that is generated on-farm so that farms are less dependent on imported energy.
Protected communities	Natural flood management reduces the risk of flooding	<p>Climate Change mitigation and adaptation:</p> <ul style="list-style-type: none"> ■ Explore with partners the likely consequences climate change will have on crop production and how to adapt to these while minimising environmental damage. ■ Explore with partners how the crop production sector and its land management can help Scotland to reduce greenhouse gas emissions. ■ Explore with partners the opportunities and practicalities that land management within the crop sector has to reduce flood risk and other climate change related pressures.
	Prosperous and resilient farms supporting local communities and offering opportunities to young farmers	<ul style="list-style-type: none"> ■ Work with the sector to identify future challenges and identify environment resilient solutions: <ul style="list-style-type: none"> • work with the Scottish Government to ensure future agricultural support is outcome focussed and helps deliver Scotland's environmental objectives and flood risk management; • explore opportunities to encourage cooperation between groups of farmers for landscape scale action (flooding, abstraction, diffuse pollution and biodiversity).

Consultation question 24

Which of the actions and aspirations proposed in this plan do you consider to be of the highest priority?

6. Outcomes

If we achieve the vision we have set out in this plan, we anticipate that we will help to deliver positive outcomes that protect and improve the environment in ways that also protect communities and enable businesses to operate effectively and successfully in their markets.



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