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Environmental Standards Scotland

Baseline Evidence Review – Population, human health and cultural heritage (Strategy and Analysis)

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Contents

Version Control

Version	Author	Purpose	Date
1.0	ESS	Baseline evidence review of public sources accessed up to August 2022.	30/09/2022
1.1	ESS	Minor edit to summary of pollution impact on human health on P29 and to replace Health Protection Scotland with Public Health Scotland on P16 and in the sources.	1/11/2022

Executive summary

This baseline evidence review provides a high level summary of key published information about the current position, recent trends and performance and progress towards relevant targets and standards in the area of population, human health and cultural heritage in Scotland.

Background

A series of rapid reviews of key evidence sources were undertaken to support the identification of environmental issues of most concern, where Environmental Standards Scotland's (ESS) proposes to focus its initial analytical work.

Eight reviews were produced, covering the environmental categories of air; biodiversity and ecosystem resilience; climate change; cross-cutting environmental governance; land and soil; population, human health and cultural heritage; resource use and waste; and water. These categories are primarily intended to help Environmental Standards Scotland organise, manage and prioritise its work and are based on those used in the Strategic Environmental Assessment and the Environmental Impact Assessment processes. Considering the evidence within each category provides a structure for assessment.

There will be overlaps amongst these categories and to minimise duplication, topics have been covered under what was considered to be the most relevant category. For example, there is some discussion of the health impacts of waste crime in the Resource Use and Waste review.

Rapid reviews were undertaken in each topic area, with a narrow scope of identifying key data sources and summarising what they tell us about how the environment is changing in Scotland. The focus was on National or Official Statistics and Annual Reports and their related data, mainly from Government and other national organisations, to obtain a high-level summary of current environmental conditions and to ensure confidence in the quality of the information.

The approach started with the data, considering whether Scotland is on track to achieve its current environmental targets and objectives. The reviews are not intended to be detailed explorations of the reasons behind any individual issues. Similarly, they are not intended to provide exhaustive lists of relevant legislation. If a

topic is not included, it is because it is covered in another review or relevant published data was not found within the scope of the review at this point. However, the topic will still form part of ongoing horizon scanning activity and could be explored in the future with relevant organisations.

Future stages of analysis will consider whether performance trends relate to any issues of compliance with or effectiveness of environmental legislation and scrutinise the detail underpinning trends identified.

ESS' monitoring and analysis work will progress through a series of stages. This will range from horizon scanning to identify high-level areas of concern, through to a deepening analysis and understanding of how things are changing, the causes of this, and how policy and regulatory decisions affect this. All of the monitoring and analysis work will be focused on identifying areas where further investigation or use of ESS' powers may be necessary. It will also support active investigations, and help to assess whether the changes that have been made in response to ESS' recommendations or use of powers are having the desired impact.

As the analytical priorities are taken forward, it is likely that some will quickly be identified as not having any compliance or effectiveness issues that merit further analysis or investigation at this stage. These can then be returned to horizon scanning in case an issue arises in the future, and a new issue can be added to the list of those subject to more detailed analysis. The list of analysis priorities is expected to be dynamic and regularly updated. The evidence reviews, however, are a snapshot in time as of August 2022 and there is no plan for these to be updated on a regular basis.

Summary of key baseline evidence review findings

Population, human health and cultural heritage is a broad area with many areas of interest for ESS.

This review identified many environmental factors that are thought to negatively impact human health in Scotland. For example, there are regular exceedances of World Health Organisation noise exposure guidelines within Scotland, exposure to which has been linked with a variety of poor health outcomes.

In addition, it is consistently found that air pollution negatively impacts human health, with more significant effects for vulnerable people such as young people, the elderly and people with pre-existing conditions. Negative effects of air pollution have also been found at levels of exposure below current guidelines. Other impacts on human health identified include increasing risks from antimicrobial resistance, climate change and flooding.

The review also highlighted that there is some indication that the level of exposure to chemical incidents that pose a risk to human health is decreasing. However, further analysis is needed to understand whether there are other factors at play.

The risk to health from radiation is thought to be small but there may be some areas where levels of radon gas exceed the level at which action is needed to reduce it.

In addition, there have been concerns from the public around the health implications of the use of sewage sludge in agriculture and pollution in freshwater environments. It is thought that the risk to human health from these issues is low. However, further research is needed to confirm this conclusion. Further research is also needed to understand the risk to health from exposure to ground gas, light pollution and microplastics.

There are concerns about food security in Scotland relating to the lack of access to adequate or appropriate food for low income households. Furthermore, climate change, biodiversity loss and geopolitical factors pose significant risk to global and UK food systems. Climate change will also increase the risk of water scarcity events.

Nonetheless, there have been positive trends in people's interaction with the environment, with an increase in people regularly visiting the outdoors between 2012 and 2019. However, there has been a slight decrease in satisfaction with green and blue spaces between 2013 and 2019. More people are also recognising that climate change is an urgent issue.

Cultural heritage and the historic built environment provides both economic and social benefits to Scottish society. However, there are disparities in how people experience Scotland's heritage and culture, for example by level of deprivation. Lack of data means the state of the historic and built environment cannot be fully quantified. Nonetheless, there are increasingly significant pressures on the historic and built environment in Scotland including climate change and criminal damage,

leading to an increase in maintenance needs. Other pressures include development, air pollution and poorly executed maintenance. Further analysis would be needed to understand the state of and pressures on cultural sites that are not currently monitored by centralised programmes.

It is important to note that in many areas a lack of data limited ESS' ability to draw firm conclusions about Scotland's environment and the impacts on population, human health and cultural heritage.

Conclusions for initial ESS analytical priorities

This baseline review identified a wide range of possible issues for further analysis. This included the impact of indoor air pollution, microplastics and antimicrobial resistance on human health, food security and the general consideration in all work that environmental issues are likely to have unequal impacts across society.

However, for the purposes of our initial analytical priorities, ESS will focus on:

- Developing a better understanding of antimicrobial resistance, controls and impacts;
- Developing a better understanding of current noise levels, controls and the impact on human health.

ESS' proposed Strategic Plan describes how issues will be prioritised for further analysis according to a range of criteria, including:

- Importance – the size and risk of the potential effect on the environment and/or public health; the urgency with which improvement is required;
- Nature and Scope – recent trends in environmental performance; whether the issue of concern appears to be systematic and/or longstanding;
- Neglect – whether there has been action taken on the issue of concern, or further action is planned in the near future; and
- Added-value – the contribution we could make, considering whether other monitoring, oversight or scrutiny bodies are planning to take, or could take, action to address the issue of concern.

These priorities takes account of that scheme. They recognise the importance of the impact of noise pollution on health, and the relative neglect of this issue due to a lack

of centralised reporting which also makes it difficult to determine trends over time. Similarly, they recognise the costly impact on environmental wellbeing of leaving antimicrobial resistance unchecked as well as the need for further analysis to better understand progress in tackling it. In keeping with the prioritisation process, the added value that ESS can bring to an area will also be considered taking account of other actors, in deciding where to focus future work.

Although ESS intends to focus on two issues in the first instance, other issues will be retained on a list for potential future analysis and horizon scanning in line with the stages of monitoring and analysis work set out in the strategic plan.

Population, Human Health and Cultural Heritage Baseline Evidence Review

1. Introduction

Population, human health and cultural heritage are broad areas with cross-cutting impacts for both people and the environment. Many of the factors impacting human health are environmental and preventing their impact on human health may have co-benefits for the environment. In addition, making improvements to the environment is also likely to benefit human health and wellbeing.

This review will cover environmental and other factors that may impact human health, people's interaction with the environment, cultural and built heritage and food and water security. It is unlikely to be comprehensive since there will be a bias towards impacts which have already / are already occurring and about which there is publicly available information. Lower risk issues that may have high impact in the future are not covered unless relevant publicly available data or information was found.

2. Review methodology

A rapid review of key evidence sources has informed this report. This has focussed on scanning across the topic area, identifying key data sources and summarising what they tell us about how the environment is changing in Scotland and whether environmental targets and objectives are on track to be achieved.

The scope of the work was deliberately narrow and was intended to provide a snapshot of the evidence rather than a fully comprehensive picture. Where ESS' initial assessment of the evidence has identified potential concerns or issues that warrant further scrutiny, more detailed monitoring and analysis will be considered.

The work focussed on published analytical reports and datasets, searching for relevant evidence by:

- using the terms 'pollution', 'air pollution', 'noise', 'chemical' in combination with 'impact' and 'human health'.
- using the terms 'landscape', 'cultural heritage', 'built heritage', 'food security, 'water security'

- using the term ‘environmental justice’ in combination with ‘access’, ‘equality’ and/or ‘impact’.
- having searched for the broad terms above, sometimes specific searches were undertaken for particular types e.g. ‘microplastics’ or ‘flooding’.
- where necessary these terms were combined with ‘Scotland’, ‘UK’, ‘EU’ or ‘International’ to search for comparisons with other countries.

These terms were derived from ESS’ environmental categories and sub-categories. Specific searches of key organisations’ websites were also undertaken, based on knowledge and understanding of those active in the area. For population, human health and cultural heritage data this focussed on Scottish Government, UK Government, Public Health Scotland, NatureScot and SEPA. There is some subjectivity in the choice of terms and organisations which may have an impact and were somewhat mitigated by consulting with key stakeholders on sources.

The focus of the reviews was on National or Official Statistics and Annual Reports and their related data, mainly from Government and other national organisations. This enabled ESS to obtain a high-level summary of current environmental conditions with a tight scope which allowed the reviews to be completed in time to inform strategic plan development. Only publicly available information was considered, Individual research reports or grey literature on specific, detailed areas of the topic were not within scope. Evidence of issues relating to compliance with or effectiveness of environmental legislation was not the focus at this stage. It is envisaged that this will form part of future analysis activity on priority analytical areas.

The approach started with the data, considering whether Scotland is on track to achieve its current environmental targets and objectives in this area. They are not intended to be detailed explorations of the reasons behind individual issues. Similarly, they are not intended to provide exhaustive lists of relevant legislation.

Baseline evidence reviews have been undertaken in each of the ESS Environmental Categories and there are naturally some topics which could fall across a number of reviews. For example, there is some discussion of the health impacts of waste crime in the Resource Use and Waste review.

If a topic is not included, it is because it is covered in another review or no relevant published data was found within scope. However, the topic is likely to still form part of future horizon scanning activity and could be explored further with relevant organisations.

Initial drafts of the evidence reviews were shared with the ESS Board and with key identified analytical stakeholders to provide proportionate checks that no key sources had been missed and no information had been misinterpreted. Going forward into more detailed analytical projects and undertaking further horizon scanning, ESS expects to engage a wide range of experts, including academics and specialist organisations.

3. Baseline evidence for environmental areas

Noise impact on human health

Legislation, guidance and noise management action plans

The EU Environmental Noise Directive (END)[1] was transposed into Scots law under the Environmental Noise (Scotland) Regulations 2006[2]. This legislation aims to identify noise pollution levels and ensure action is taken to tackle this where necessary.

The regulations apply to noise that humans are exposed to such as that from road, rail, air traffic and industrial sources. It does not cover noise caused by people from domestic activities, at work or from military activities. They require the Scottish Ministers to develop strategic noise maps and noise management action plans for major roads, railways and airports, and agglomerations with more than 100,000 inhabitants every five years. The affected public must be involved in the development of these plans.

Under these regulations, six noise management action plans have been developed in Scotland. Four cover the main urban regions (Glasgow, Edinburgh, Dundee and Aberdeen), one covers airports and one covers transportation generally[3]. The Scottish Government is the competent authority for implementing these plans. Further analysis will be required to determine whether these are effective.

The World Health Organisation (WHO) have published guidance on acceptable levels of noise pollution. These are shown in Table 1[4].

Table 1: WHO average noise exposure recommendations

Source	dB L_{den}[i,5]
Road traffic	53
Railway	54
Aircraft	45
Wind turbine	45
Leisure	70

Source: WHO, Environmental Noise Guidelines for the European Region[4]

Note: These are the average recommendations and the report also provides lower recommendations for night noise exposure.

Exposure to noise in Scotland

Review of data[6,7] reported under the Environmental Noise (Scotland) Regulations indicates that a large number of people are regularly exposed to noise levels breaching the WHO guidelines.

It appears that more people are exposed to noise exceeding WHO guidelines from roads than from any other source measured (railways, industry or airports). There do not appear to be consistent trends in the number of people exposed to noise pollution from different sources between the three rounds of reporting which started in 2007[ii]. However, it is important to note that mapping methodology has changed with each round[8] so this should be interpreted with caution. Further analysis of the raw data is also needed to confirm these conclusions.

It is important to note that exposure to noise pollution, in particular transport generated noise, is likely to be correlated with exposure to air pollution[9]. More information on the impact of air pollution exposure on health can be found below.

[i] L_{den} refers to noise level (measured in decibels) during the day-evening-night.

[ii] Reporting rounds occur every 5 years, round 1 in 2007, round 2 in 2012 and round 3 in 2017.

Impact of noise exposure on health

The WHO review of the burden of disease from environmental noise found 'sufficient evidence from large-scale epidemiological studies linking the population's exposure to environmental noise with adverse health effects'. Specifically, they estimated that at least 1 million healthy life years are lost every year from traffic-related noise in western European countries, including EU Member States.

Mechanisms through which disability-adjusted life-years are lost include through sleep disturbance, annoyance, ischaemic heart disease, cognitive impairment of children and tinnitus.[10] Furthermore, the EU DG Environment found that exposure to noise in Europe contributes to about 910,000 additional prevalent cases of hypertension, 43,000 hospital admissions per year, and at least 10,000 premature deaths per year related to coronary heart disease and stroke. Since this study was based on partial data on noise exposure, the overall health effects in the entire EU are likely to be even higher than currently estimated.[11]

International comparisons

The EU's Seventh Environmental Action Programme[12] highlighted that over half (65%) of residents in major urban areas within Europe are exposed to noise levels over 55dB L_{den} and 50dB L_{night}[13,iii].

The European Environment Agency also publish individual country fact sheets summarising information on noise pollution for European Environment Agency member countries. The most recent factsheets were published in 2021[14]. Further analysis is required to understand the trends in these factsheets.

Summary

There are regular exceedances of World Health Organisation noise exposure guidelines within Scotland, and elsewhere in Europe. This is important because exposure to noise pollution has been linked to health problems such as sleep disturbance, hypertension and heart disease. In Scotland, more people are exposed to noise exceeding WHO guidelines from roads than from any other source measured (railways, industry or airports).

[iii] $L_{den\ refers\ to\ noise}$ level (measured in decibels) during the day-evening-night. $L_{night\ refers\ to\ noise}$ level (measured in decibels) during the night.

However, a lack of a centralised report on progress, with only raw data and maps available and changing methodologies over time, mean further analysis is required to understand the scale of the issue and the trends over time. Noise action management plans are in place to manage noise exposure, however the impact of these on noise levels is currently unclear.

Chemical impact on human health

This section relates to exposure to hazardous chemicals being stored or used, and excludes chemical pollution/chronic exposure from air, soil, and water, as these are covered in other sub-categories and reviews.

Exposure to environmental incidents

The Control of Major Accident Hazards Regulations 2015[15] aim to reduce the risks of potential major accidents involving dangerous substances, such as toxic substances (e.g. chlorine), flammable substances (e.g. liquefied petroleum gas), substances that are environmentally hazardous, and explosives[iv,15]. The regulations apply to any establishment storing or handling quantities of chemicals or substances of a hazardous nature, including production facilities, warehouses, and some distributors. In Scotland the competent authorities are SEPA and the Health and Safety Executive or the Office for Nuclear Regulation.[16] There is a variety of other guidance and legislation pertaining to exposure to chemicals[17].

Public Health Scotland run the Scottish Environmental Incident Surveillance System (SEISS) which conducts surveillance of environmental incidents involving risk to human health at a national level in Scotland. The system is based on a comprehensive incident database for Scotland, combining information on the occurrence of chemical, microbiological and radiological incidents with details of the response, sources of information and lessons learned.[18] A report by Public Health Scotland provides a summary of the incidents reported via the SEISS that occurred in Scotland during 2020.[19] The report showed that:

[iv] A full list of dangerous substances and relevant threshold quantities can be found in Schedule 1 of the COMAH Regulations 2015, which is separated into Part 1 (generic categories) and Part 2 (named dangerous substances).

- There were 67 environmental incidents (65 chemical and 2 micro-biological agents) in 2020.
- Smoke was the most commonly reported chemical hazard (13 cases).
- Residential sites were the most common locations for incidents involving chemical hazards (21 cases).
- NHS Greater Glasgow & Clyde and associated Local Authorities recorded the highest number of incidents. However, this is the largest NHS area so the higher number may just reflect the overall larger size. More analysis would be needed to confirm.
- In 2020, information was provided on actual human exposure in 14 of the 67 (21%) reported incidents. There were a total of 14 reported casualties and 4 fatalities associated with these incidents. The fatalities occurred in separate incidents following deliberate, accidental or suspected chemical exposures. An incident at a primary school resulted in a number of children being treated for exposure to carbon monoxide.[19]
- Cyanobacteria (blue-green algae) was responsible for both micro-biological incidents recorded. While there were only 2 incidents in 2020, blue-green algae have consistently been the most commonly reported microbiological agent (waterborne contamination) between 2002 to 2020 (779 incidents compared to 35 for cryptosporidium, the next most common).
- Recreational areas have been the most common locations for incidents involving microbiological agents between 2002 and 2020.
- Examining cumulative data from 2002-2020, asbestos was the most commonly reported hazard involved in incidents (314), followed by smoke (192), ammonia (117), mercury (76), carbon monoxide (75) and gasoline or petrol (63).

The key points from the 2017, 2018, 2019 reports were the same except overall 135 incidents were recorded in 2019[20], 169 were reported in 2018[21] and 178 were recorded in 2017[22].

While this data would suggest that the number of environmental incidents is decreasing, the data producers do not report such analysis. More research would be needed to determine whether this difference is statistically significant and if other

factors such as reporting practices have changed, for example due to the pandemic since figures for 2020 are particularly low.

Nonetheless, although smoke has been the most common chemical issue in recent years, asbestos has been the most common over the longer term. Similarly, there is clear evidence that chemical issues are most commonly reported in residential areas.

REACH legislation

Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) is the main EU legislation for the regulation of chemicals in the EU and the European Economic Area (EEA). REACH requires substances that are manufactured in, imported into or used in the EEA to be registered with the European Chemicals Agency (ECHA). It then provides a regulatory framework to identify and control or restrict the use of hazardous substances.[23]

The EU-exit has created challenges for this model of regulation to be applied in the UK because it relies on the ECHA and the EU single market. REACH ceased to have effect in the UK after the transition period on 1 January 2021. This may create problems because REACH is a requirement for trade that impacts many UK manufacturing sectors. Companies that trade in and out of Northern Ireland will need to be fully conversant and compliant with both EU REACH and UK REACH. For example, companies that import chemicals to Scotland and then act as distributors for users throughout the UK (GB and NI) will need to comply with the UK REACH regulation for the import to Scotland, and ensure compliance with EU REACH for shipping that substance to NI.

The UK Government have created, and set out in regulations, a UK REACH regime[24] that applies to businesses that import, make, sell or distribute chemicals in Great Britain, with the Health and Safety Executive (HSE) taking over the functions of the ECHA. HSE is also required to obtain the advice of the Environment Agency, who in turn is required to collaborate with the other environmental regulators when formulating the advice (that is SEPA in Scotland, and Natural Resources Body for Wales).

However, under the Northern Ireland Protocol the EU REACH Regulation will continue to apply to Northern Ireland[25]. The UK Government set out its intention for

the UK REACH regime to replicate the EU system as closely as possible, maintaining the fundamental aims and purposes of REACH including high standards of health and environmental protection. However, industry and environmental stakeholders have raised concerns that the UK REACH regime will be costly for industry, lacks transparency and has the potential to quickly diverge from the EU REACH regime. For example, companies that trade with the EU and UK will have to operate to both UK REACH and EU REACH.

Chemical and manufacturing industry stakeholders have also called for an agreement with the EU that ensured frictionless trade and regulatory consistency, ideally aligning as close as possible to REACH. While the chemicals industry has welcomed the free trade agreement, and no tariffs or quotas being applied to trade in goods, concerns have been raised about the absence of a data-sharing agreement on chemicals between the UK and EU.

Currently, there is no provision for the UK to access the ECHA's REACH database which contains detailed information about the intrinsic properties of chemical substances, for the purposes of human and environmental safety. This increases the likelihood that this information will need to be re-registered on a UK-only database[23].

Further analysis will be needed in future to understand the impact of regulatory changes associated with REACH on the environment and human health.

Other chemicals legislation is applicable in Scotland but it beyond the scope of the current review.

International comparisons

The European Environment Agency's State and Outlook of the Environment Report 2020[26] stated that over the past 10-15 years there have been mixed trends for emissions of chemicals and the risks to human health and that future targets are unlikely to be met. Furthermore, the report found that there is a projected increase in chemical production and emissions of persistent and hazardous chemicals meaning that the burden on health from exposure to chemical pollution is unlikely to decrease.

The report suggests that transitioning to using chemicals that are safe by design and using less hazardous chemicals during product development would provide an opportunity to reduce chemical pollution. However, the report highlights issues with the current system that make improvements difficult.

Firstly, there is a large variety of chemicals used in Europe so it is impossible to carry out risk assessments for each chemical and monitor their prevalence in the environment and people's exposure to them. There are therefore knowledge gaps regarding the impact of chemical pollution on health which restrict the ability of policies to effectively target the most important issues.

Secondly, the current policies and legislation mainly address single chemicals in separate policies/laws meaning the legislative landscape is likely to be of limited efficacy. The report suggests that governance for chemicals should become more integrated and efficient. However, they do state that European chemical policies have contributed to improved air and surface water quality and reduced related harm to the environment and people's health.

Summary

There is some indication that the level of exposure to chemical incidents that pose a risk to human health in Scotland is decreasing but further analysis is needed to understand whether there are other factors at play. The most common types of exposure (asbestos and smoke) and location of exposures (residential) have persisted over time.

EU level reporting suggests that chemical impacts on human health are unlikely to decrease, and may increase over time with greater production. Further research would be needed to determine whether this applies to Scotland.

Further analysis is also required to better understand the implications of changes to chemicals legislation as a result of the EU-exit.

It is also important to note that chemical incidents relating to other aspects of the environment, such as the water environment, may indirectly affect human health. For example, chemical pollution in water may affect fish stocks and can be a risk to human food security due to bioaccumulation. Further information can be found in other reviews.

Air pollution impact on human health

Background to the legislation pertaining to air pollution, standards/objectives/targets for limiting pollution levels and progress against these can be found in the Air baseline evidence review document. This section will focus on the evidence showing the extent of the impact of air pollution on health.

Impact of air pollution on health

A wide range of studies have concluded that exposure to air pollution has a negative impact on human health[27,28,29,30]. For example, research has found that air pollution is causally linked to a range of adverse health outcomes such as those affecting the heart and lungs.

Long term exposure to particulate matter is associated with increased mortality, including from heart attacks, strokes and lung cancer. Short term exposure is associated with asthma attacks, increased hospital visits and earlier death. Exposure to air pollution has also been associated with low birth weight, chronic illnesses such as diabetes and neurological problems such as dementia[31]. There have been a small number of studies which have found a tentative link between air pollution and subjective measures of wellbeing (e.g. self-reported life satisfaction).

Air pollution impacts everyone, but the impact is more pronounced for the young, elderly and people with pre-existing medical conditions. Furthermore, air pollution is often worse in urban and inner city areas, which are more likely to have high levels of deprivation, worsening existing socioeconomic and health inequalities[27,28].

However, it is important to note that the worst air quality is not always found in the most deprived areas[29]. Further analysis would be needed to understand the relative impact of exposure to air pollution on health in different socioeconomic groups.

There is also some research which suggests that harmful effects of air pollution exposure can be seen at levels below the current WHO guidelines. For example, associations have been found between exposure to $PM_{2.5}$ and mortality at levels below the annual WHO air quality guideline level for $PM_{2.5}$ (10 $\mu g/m^3$)[32]. Therefore, while there has been reductions in air pollution concentrations in Scotland it has been suggested that there is scope for further improvements[9].

It is important to note that exposure to air pollution is likely to be correlated with exposure to noise pollution[9]. More information on the impact of noise pollution exposure on health can be found above.

Outdoor/ambient air pollution

In 2014, Public Health England estimated the annual mortality, and associated life-years lost, that could be attributed to exposure to anthropogenic $PM_{2.5}$ air pollution. For Scotland as a whole, they estimated that 2094 deaths within the population age 25 and over and the loss of 22,474 associated life-years could be attributed to anthropogenic $PM_{2.5}$ air pollution.[33]

Health Protection Scotland (HPS) provided an update to these statistics in 2018 using data from 2016. They report that between 2010 and 2016 $PM_{2.5}$ levels have decreased in Scotland by 22%, therefore HPS estimate that there were 1724 deaths attributable to exposure to $PM_{2.5}$ in 2016[34]. It is important to note that these values are estimates from complex modelling, rather than recorded deaths of individual people.

An independent review of progress towards the Cleaner Air Strategy for Scotland published in 2019[9] found that there is uncertainty from international studies around the scale of health effects from exposure to low levels of air pollutant concentrations. In addition, the literature examining the impacts of air pollution on health in Scotland specifically is small.

The existing literature does find similar results to international studies. For example, a large-scale academic study found that long-term exposures (over 3 years) to PM_{10} and NO_2 were significantly associated with respiratory hospital admissions in Edinburgh and Glasgow. There was evidence of risks in Aberdeen and Dundee but they were non-significant.[35] However, due to the small amount of literature it is not possible to provide pooled estimates of health effects in Scotland equivalent to those calculated in international studies.[36]

Occupational and indoor air pollution

People living in urban areas in the UK are thought to spend around 90% of their time indoors, which could suggest that the quality of indoor air is at least as important as that of outdoor air for health[9].

WHO have published[37] guidelines for indoor air quality including, for each substance considered:

- a general description;
- the sources and pathways of exposure;
- the indoor–outdoor relationship;
- kinetics and metabolism;
- the health effects;
- a health risk evaluation, and
- guidelines.[38]

The National Institute for Health and Care Excellence (NICE) have also produced guidelines on indoor air quality at home[39].

Occupational air quality, and exposure to other hazards, is regulated by The Control of Substances Hazardous to Health Regulations 2002 (COSHH) regulations in the UK.[40]

There are also Workplace Exposure Limits (WELs) for relevant substances[41]. However, unlike outdoor air quality, there are no regulated limits for indoor pollutants in domestic settings in the UK.[42]

In its Cleaner Air for Scotland 2 strategy consultation, the Scottish Government states that, given the wide range of factors contributing to indoor air quality, no single body or organisation can realistically have sole responsibility for addressing it. The consultation therefore suggests a need for policy integration and coherence to avoid the risks of unintended consequences.[42]

There is limited monitoring of indoor and occupational air quality and data on trends in Scotland could not be found. Furthermore, indoor air quality is influenced by multiple factors including ambient outdoor air pollution. This makes estimating the health impacts of indoor air quality alone very difficult. There is, however, some scientific research showing that there are negative impacts of indoor air quality on health[43] and particularly on children and young people's health[44], as well as other vulnerable groups such as the elderly.

International comparisons

In 2014, Public Health England estimated the annual mortality and associated life-years lost that could be attributed to exposure to anthropogenic $PM_{2.5}$ air pollution[33]. The results for the four UK countries are presented in Table 2.

Table 2: Annual mortality and associated life-years lost that could be attributed to exposure to anthropogenic $PM_{2.5}$ air pollution in 2010

Country	Number of deaths within the population aged 25 and over	Associated life-years lost
Scotland	2094	22,474
England	25,002	264,749
Wales	1320	13,549
Northern Ireland	553	6063

Source: Public Health England, Estimating Local Mortality Burdens associated with Particulate Air Pollution

A report from the Royal College of Physicians has found that each year in the UK, around 40,000 deaths are attributable to exposure to outdoor air pollution.[45]

Data from the OECD reveals the mortality and welfare costs of exposure to air pollution[46]. The UK is shown to have the 58th lowest mortality rate due to air quality (of 171 countries, with a mortality rate of 214 per 1 million population in 2019). Iceland performs best with a rate of 46 per million and North Macedonia worst with 1,321 per million.

The UK is also in the best performing half of European countries, with a lower mortality rate than countries such as Germany (324 per million) and Italy (408 per million). The OECD estimate that the welfare cost of premature deaths to the UK is 2.1% of GDP[47].

The European Environment Agency has stated that air pollution is the single largest environmental health risk in Europe, with around 400 000 premature deaths attributed to air pollution in Europe in 2018[48].

Summary

There is an established evidence base surrounding the health effects of air pollution which consistently concludes that air pollution has negative impacts on human health, with more significant effects for vulnerable people such as young people, the elderly and people with pre-existing conditions.

Exposure to air pollution has been linked to health conditions such as lung cancer, heart attacks and low birth weight. Negative effects of air pollution have also been found at levels of exposure below current guidelines.

Due to the limited evidence base it is not possible to estimate the total magnitude of health effects of air pollution in Scotland. However, data indicates that over 2,000 deaths could be at least partially attributed to exposure anthropogenic $PM_{2.5}$ air pollution in a year.

Indoor air quality is likely to impact health yet there is limited monitoring or understanding of the magnitude of impact on health.

This issue is not specific to Scotland and has been recorded across the UK and EU. Indeed, it is thought that air pollution is the largest environmental health risk in Europe. However, the UK is seen to have a lower mortality rate from air pollution than other countries worldwide.

Pollution impact on human health

This section covers the impact of exposure to pollutants on human health that have not been covered in other sections of this review. It is important to note that there are a large number of pollutants that may impact human health, for example some can be viewed on the Scottish Pollutant Release Inventory[49].

It was not possible to include details on all pollutants in the current review. Instead, a select few pollutants have been chosen due to the availability of data relating to their impact on human health, relevance to ESS' work and discussion with stakeholders that highlighted these as key issues.

Pollution from land

Information on contaminated land can be found in the Land and Soil baseline evidence review.

Vacant and derelict land

Over a quarter (27%) of the population was estimated to live within 500 metres of a derelict site in 2021[50], though there were differences across the country. North Lanarkshire had the highest percentage with 74%. In Na h-Eileanan Siar (Westerns Isles) none of the population lives within 500 metres of a derelict site.

It is thought that derelict sites can affect a community's health, environment, economy and social cohesion[51]. It is thought that the extent of vacant and derelict land is decreasing. Further analysis is needed to understand the impact of derelict land on health.

More information on the extent of contaminated, vacant and derelict land can be found in the land and soil baseline review.

Use of sewage sludge in agriculture

Sewage sludge is a by-product of the waste-water treatment process and is produced by Scottish Water (20%) and Public Finance Initiative contractors (80%). The Scottish Government estimate that each year approximately 50 million tonnes of manure/slurry is spread on land with 200,000 tonnes of other organic material (of which, around 70,000 tonnes is sewage sludge) also spread[52].

There has been concern from the public surrounding the spread of sewage sludge on land[52]. For example, in 2021 the James Hutton Institute conducted a community engagement workshop as part of their research on the application of sewage sludge to land[53]. They found that the residents' main concerns surrounded malodour but ranged across issues such as possible effects of using sewage sludge on health and potential malpractice[54]. It is important to note that the workshop was attended mostly by residents with concerns about sewage sludge, so may not be representative of the population.[54]

The wider James Hutton Institute (JHI) project[55], of which the survey was part, found that existing controls mean that the majority of 'traditional' hazards (heavy metals, pathogens) and the majority of 'emerging' hazards (primarily organic pollutants, pharmaceutical and personal care products) pose minimal risks to human health and well-being in most situations.

In addition, they did not find any evidence that prions posed human health risks due to spread via sewage sludge[55]. This is supported by research published in 2019 by WCA Environment for SEPA which found that there was a low level of risk to human health through exposure to contaminants in organic matter applied to land[56,57].

Nonetheless JHI did identify ten potentially harmful agents (nine organic and pharmaceuticals plus malodour) as posing a potential risk to human health and well-being under 'plausible worst case' situations[55]. In addition, it is thought that malodour can impact well-being and heighten sensitivity and perceptions of risks associated with land spreading. But it is thought that many of the risks can be managed. The research acknowledges that due to limitations in data and knowledge, it is not possible to fully assess the extent of some potentially hazardous agents (such as microplastics) [55].

In 2016, the Scottish Government reviewed the storage and spreading of sewage sludge on land. As a result they made a number of recommendations including around licensing, complaints and storage of sludge[52].

There is also concern around the impact of ammonia emissions from agriculture on human health. As detailed in the air baseline evidence review, agriculture is the dominant source of ammonia emissions in Scotland. It is emitted during storage and spreading of manures, slurries and fertilisers[58].

Ammonia emissions can impact human health because it reacts in the atmosphere to produce particulate matter which has been shown to negatively impact human health. This can also cause long-term harm to sensitive habitats by depositing nitrogen onto soils and into freshwaters which can impact the animals and plants that depend on them.[58] More information can be found in the air baseline evidence review.

A 2014 report conducted a quantitative risk assessment for human health for dietary exposure resulting from the presence of contaminants in waste applied to agricultural land. The results of the assessment indicated that there was no risk to health even when using worst case assumptions.[57] This suggests that the risk to human health from exposure to contaminants found in sludge applied in agriculture is limited. However, there may be risks to health from other chemicals used in agriculture.

Therefore, while quantitative evidence suggests a low risk to human health from the spread of sewage sludge in agriculture, further analysis may be required due to concerns raised by the public and the known impact of ammonia emissions on human health.

Pollution from water

There is a lack of research quantifying the impact of poor water quality on human health in Scotland. However, the water baseline evidence review shows that there are still some water bodies in Scotland which have not met good status for water quality and there may be some issues with sewage discharges and pharmaceutical pollution into water. This could impact human health if people use these water bodies, such as for swimming, and are exposed to pollution.

For example, Forth Rivers Trust and West Lothian Council, with support from the Friends of Almondell & Calderwood Country Park and River Almond Action Group, applied for bathing water status in a section of the River Almond given that many people use the river for recreational swimming[59]. This has been denied due to high levels of E.coli and intestinal enterococci in the river[60]. It also did not meet the requirement for a large number of bathers.[61]

Nonetheless, 84 of 85 bathing waters met their target objective under the River Basin Management Plan (RBMP) in 2020[62]. In addition, in 2021, only one was

classified as poor under the RBMP system with 17 classified as sufficient, 35 as good and 32 as excellent[63].

The water baseline evidence review also covers the quality of drinking water.

Pollution from waste

Information on the impact of waste on health can be found in the Resource Use and Waste baseline evidence review.

Summary

There have been concerns from the public around the health impacts of sewage sludge. Agriculture is the dominant source of ammonia emissions in Scotland and the use of sewage sludge is a small contributor to this. However, there is a lack of evidence that the practice of sewage sludge storage and spreading significantly directly impacts human health. Some risks have been identified but it is thought that these can be managed. However, the ammonia emissions released during this practice are likely to make a contribution to the known negative impacts on both human health and the environment caused by increased ammonia.

There have also been concerns from the public around the impact of pollution in freshwater and coastal environments on human health. However, only one bathing water did not meet its target objective in 2020, suggesting problems may not be widespread. There is also a lack of consistent research quantifying the impact of pollution in water on health meaning further analysis is required.

Over a quarter of the Scottish population live within 500 meters of a derelict land site, which may have health implications. Further analysis is needed to understand these.

Further information on the impact of other types of pollution such as noise, chemical and air pollution can be found elsewhere in this review.

There are also many other sources of pollution that may impact human health such as from the health and care system, that are beyond the scope of the current review.

In addition, the Chief Medical Officer stated in 2017 that there is a lack of data to fully understand the impact of pollution on human health[64]. Further analysis will therefore be needed.

Other impacts on human health or safety

Antimicrobial resistance

Antimicrobials and antimicrobial resistance (AMR) are currently not legislated against in Scotland or the EU[65].

Scotland did produce an action plan for the management of AMR between 2014 and 2018[66] and a strategic framework for 2016-2021[67]. The UK Government have also produced a plan for AMR covering 2019 to 2024[68] and a vision for 2040[69]. The UK's five year plan has three aims: reducing the burden of infection, optimising the use of antimicrobials, and developing new diagnostics, therapies, vaccines and interventions. It is clear that the impact of leaving AMR unchecked is costly in terms of environmental wellbeing as well as global and ecosystem health (the concept of 'One Health' i.e. that the health of humans, animals and the environment are interconnected).

The Scottish One Health Antimicrobial Use and Antimicrobial Resistance (SONAAR) programme, part of ARHAI Scotland (Antimicrobial Resistance and Healthcare Associated Infection) provides research on AMR to support the implementation of the UK's five year plan[70].

The most recent report by ARHAI Scotland summarising antimicrobial use and antimicrobial resistance was published in 2021 covering 2020.[71] Key findings from the report were[70,72,73]:

- Total antibiotic use in humans has decreased by 17.1% since 2016.
- Antibiotic use in primary care has decreased by 20.9% between 2016 and 2020.
- There has been a 2.3% increase in antibiotic use in acute hospitals since 2016.
- 22.3% of the Scottish population had at least one course of antibiotics in 2020.
- In 2020, there were an estimated 1,312 drug resistant bacteraemia of which 86.4% were caused by drug resistant Gram-negative bacteria
- In 2020, *Escherichia coli (E. coli)* was the most common cause of Gram-negative bacteraemia in Scotland with an incidence of 76.9 per 100,000

population, which represents an 11.8% decrease between 2019 and 2020 and a 2.8% decrease since 2016. Resistance in these ECB isolates has remained stable from 2019 to 2020.

- Urinary tract infections are common, and are most commonly caused by *E. coli*. Resistance in the *E.coli* urinary isolates has remained stable between 2019 and 2020 apart from resistance to co-amoxiclav which has decreased and fosfomycin which has increased.
- There has been a decrease from 128 Carbapenemase-producing organisms (CPOs), which can inactivate carbapenem antibiotics, in 2019 to 59 in 2020, with an incidence rate of 1.1 per 100,000 population.
- The incidence and resistance of *E. faecium* bacteraemia isolates has remained stable between 2019 and 2020, with 45.6% of isolates resistant to vancomycin.
- There has been a decrease of 4.4% in the number of consultations for companion animals resulting in prescription of antibiotics over the past 5 years.
- Further monitoring is needed to understand the rate of AMR in animals.

Therefore there has been mostly positive trends with regards to the use of antibiotics in Scotland, however there has been a slight increase in the use of antibiotics in acute hospitals. AMR within the organisms included in the official statistics has mostly remained stable over the past few years, with a few increases and decreases.

A review by the Centre of Expertise for Waters on the actions taken in Scotland to tackle AMR[74] found that there is a wide range of activities to tackle AMR from multiple institutions. Areas of particular strength included AMR in animals, understanding how AMR spreads and infection prevention and control. Areas with limited action included increasing access to other therapeutics and the development of alternative treatments. Overall, while there are some areas of positive progress, more work is needed to better understand and tackle AMR.

International comparisons

The United Nations Environment Programme (UNEP) have stated that AMR is a global threat to people, animals, plants and the wider environment and may become the leading cause of death globally by 2050[75]. In 2016, it was estimated that 700,000

people die of resistant infections each year[76]. As well as deaths and suffering caused by AMR, it also increases the costs of treatment[77]. The environment is thought to play a key role in driving AMR[75].

The UK Health Security Agency publish an annual English surveillance programme for antimicrobial utilisation and resistance report[78] including national data on antibiotic prescribing and resistance. The most recent publication found that the total consumption of antibiotics has declined from 2016 to 2020, similar to the trends in Scotland. Most antibiotics are prescribed from general practice (73%). However, they also found that there had been a 5% increase in the number of resistant pathogens in bloodstream infections, this represents a 2 percentage point increase in the proportion of resistant bloodstream infections from key pathogens from 2016 to 2020[79].

Some actions which are thought to reduce the risk of AMR are:

- increasing awareness;
- preventing the spread of infection;
- reducing unnecessary use of antimicrobials in agriculture and their dissemination in to the environment;
- improve global surveillance of AMR;
- improve diagnostics to reduce the use of antimicrobials; and
- promote the development of alternatives to antimicrobials[76].

UNEP is carrying out further work to tackle AMR[75].

In 2014 the World Health Assembly adopted a global action plan on AMR which incorporates these actions.[80] The EU has also adopted an action plan against AMR[77].

A review of the effectiveness of the World Health Assembly action plan in 2021 concluded that it is difficult to understand progress as there is a lack of agreement on the expected outcomes. The overall implementation score was 44.3%, with higher levels of implementation in high income countries. Some actions, such as the development of action plans and coordination mechanisms, have shown more progress than others, such as infection prevention and control. Therefore, further work is needed to implement the action plan and tackle AMR at a global scale.[81]

Summary

AMR poses a large risk to human health both in Scotland and globally. While there has been a decrease in antimicrobial use in Scotland in recent years, there have not been significant declines in AMR. There are action plans in place both in the UK and globally to tackle AMR, but further work is likely to be needed.

Built environment

People living in urban areas in the UK are thought to spend around 90% of their time indoors[9]. It is therefore likely that features of the built environment impact human health. A 2013 review by the Glasgow Centre for Population Health[82] summarised the main ways in which the built environment can influence health and wellbeing.

The review states that the direct impacts of the built environment on health include those from air quality, climate change, water quality, noise and traffic-related injuries and that the indirect impacts include housing and buildings (e.g. dampness, lighting, house design) and neighbourhoods (e.g. community behaviour, greenspace). Many of these factors are considered in other baseline evidence reviews.

Public Health Scotland have also recognised the impact of the built environment including housing on health and wellbeing[83]. They also recognise that the impact of the built environment on health may be different for different social groups. For example, poor housing could exacerbate existing health inequalities relating to low income[84].

More information about the influence of the built environment on public health can be found in the Landscape section below.

Climate change

The Scottish Parliament's Information Centre published briefing on the impact of climate change on health in Scotland in 2012 and stated that climate change is likely to have a significant impact on people's lives. For example, by amplifying many causes of poor health. The report suggests the most significant impacts will be changing patterns of temperature-related mortality, increased incidence of respiratory, water-borne and food-borne diseases and the effects of more frequent flooding. In addition, they identified that falling crop yields, driven largely by water scarcity, will reduce the Scottish food security, potentially causing price increases

that would affect the diet of the poorest people. They also stated that they expected increased conflict due to scarcity of water and other resources and increased volatility of international markets. SPICe found that it is likely that the effects of climate change will be most severe for those already facing disadvantage. [85] Their report also suggests that it is probable that direct impacts of climate change on health in Scotland can be almost entirely countered by public health policies, which could align with policies to reduce greenhouse gas emissions. Such alignment would be powerful for improving health. However, whether or not this happens depends on policy decisions.[85]

Climate change may also affect people's mental health. According to the Scottish Household Survey, in 2019, 68% of respondents thought that climate change was an immediate and urgent problem[86]. If action is not taken to tackle the climate emergency, this could lead to high levels of climate anxiety, particularly among young people who may feel it is their responsibility to tackle the issue, without having any power to do so.[87]

More detail on the impact of climate change on people can be found in the climate change baseline evidence review.

Flooding

Information on the risks of flooding can be found in the water baseline evidence review.

Ground Gas

Ground gas generated within the ground and/or within landfills, commonly from the breakdown of vegetative matter[88]. Ground gases include carbon dioxide, methane, carbon monoxide and hydrogen sulphide. These are managed[89] under planning for new developments through risk assessments and design of protection measures. The Coal Authority maintains a record[90] (specifics are pay walled) of incidents of ground gas discharge.

In 2014 there was a ground gas incident in Gorebridge which resulted in residents experiencing ill health and 64 homes being demolished[91]. Scottish Government research following this included a review of incidents in Scotland that presented options to prevent the issue from happening again[92]. RSK was to do further work for

SG to update best practice for mine gas[93] but we haven't found evidence of this occurring.

Further research is needed to understand the risks associated with ground gas due to the lack of publicly available data on the state of ground gas in Scotland.

Light pollution

There is evidence to suggest that light pollution can have a negative impact on people's health. For example, it may disrupt circadian rhythms and sleep cycles[94].

The UK Government has produced guidance on how to consider light pollution within the planning system[95]. In addition, under the Environmental Protection Act 1990 as amended, Local Authorities must look into complaints about artificial light from premises if the light could be classed as a 'statutory nuisance'[96]. Amendments were made to the 1990 Act by the Public health Scotland Act in 2008, which includes provisions around light as a nuisance[97].

Scottish Government also published procedural guidance on statutory nuisance provisions, including light pollution, following changes brought in by the 2008 Public Health Scotland Act.

It is thought that exposure to light pollution is a widespread problem. An academic paper published in 2016 found that over 80% of the world and more than 99% of the U.S. and European populations live under light-polluted skies[98]. There is a lack of official data from government sources on the impact of light pollution on health and the extent of this impact. Further research would therefore be required to fully understand the extent of the impact of light pollution on health.

Microplastics

Microplastics are small pieces of plastic 0.05mm to 5mm long[99]. They can originate from a variety of sources including microbeads from cosmetics, industrial scrubbers for abrasive cleaning and plastic pellets used to produce other plastic products.

Microplastics can also originate from the breakdown of larger plastics. For example, washing of synthetic textiles can release microplastic fibres and the wear of tyres on roads can release rubber particles[99]. There are a variety of ways in which microplastics can impact the natural environment[100]. They can also impact humans through entering the food chain and water sources[99].

There has been some limited, early-stage research into the impact of microplastics on human health[99]. For example, studies have found that microplastics can enter the human body through consumption of food containing microplastics (particularly shellfish) and through breathing in airborne microplastics[101]. However, there is a lack of research quantifying the impact on human health[101].

Radiological

Radiation can be from many sources including[102]:

- radon gas
- mobile phones
- base stations
- electricity pylons
- electricity sub-stations
- radioactive particles, sources and emissions

Many sources are found naturally in the environment and radiation is present in all aspects of the environment including air, water soil and foods. Radiation is always present in the environment at a low level, known as the background radiation level, although this varies across the country. Radiation levels become a concern when they rise substantially above average background levels[103].

The legislation relevant to controlling exposure to radiation is summarised on the Health and Safety Executive website[104]. Controls are placed on the keeping, use and disposal of radioactive material by the relevant regulators which include the Office for Nuclear Regulation (ONR), SEPA, Food Standards Scotland and the Health and Safety Executive.

In 2010, the average annual dose of radiation to someone living in Scotland was 2,300 microsieverts; this has fallen from 2,400 microsieverts in 2003. The majority (81%) of the annual dose comes from natural sources. Total exposure to radiation has been mostly stable over time.[103]

In the UK, exposure to man-made radioactivity in the environment mainly comes from permitted or authorised releases from UK nuclear sites and from other users of radioactivity, such as hospitals, research or industrial facilities. Releases from hospital and research sites are significantly lower than for nuclear sites.

The Radioactivity in Food and the Environment (RIFE) report summarising all monitoring of radioactivity in food and the environment is published each year by environmental regulators and food standards agencies.[105] The most recent report was published in November 2021. Key points include[106]:

- Exposure from all sources of man-made radioactivity to members of the public was well below legal limits, demonstrating that radioactivity in food and the environment is safe
- Overall, between 2019 and 2020 there have been no major changes in radioactivity in samples measured around UK nuclear sites, other locations remote from these sites, or in food.
- Naturally occurring sources, particularly radon gas, accounted for around 84% of the exposure from all sources of radioactivity.
- Man-made radioactivity in the environment, from the nuclear industry and from past testing of nuclear weapons, accounted for less than 0.2% of the exposure to the UK population.
- In Scotland, people eating food collected from areas along the Dumfries and Galloway coastline were the most exposed from releases of radioactivity. The exposure in 2020 was approximately 3% of the legal limit, and as in previous years, this was mostly due to the effects of past discharges from the Sellafield site.

The biggest source of exposure to ionising radiation is from radon. Radon is a naturally produced gas, which is released by the radioactive decay of uranium ore in rocks. Radon itself decays into a radioactive dust that can be inhaled, leading to an increased risk of lung cancer, particularly amongst smokers[103].

Legislation relevant to radon includes The Building (Scotland) Regulations 2004[107] and The Ionising Radiations Regulations 2017[108].

In 2008, the Scottish Government funded a project to map radon levels in homes throughout Scotland[109]. In terms of the location of issues, the report found that for the majority of the Scottish population, who live in the central belt, radon levels in homes are generally low and not a cause for concern.

In Aberdeenshire and Highland regions, the maps do identify some areas where radon concentrations at or above the Action Level (where action should be taken to reduce levels) are likely to be found in 1% or more of homes.

Other areas with greater levels of radon include the mainland of the Orkney Islands, an areas around the centre of the Great Glen in Highland and parts of the Scottish Borders.[109] An interactive map of areas with radon exposure in the UK has also been produced[110].

Summary

There a wide variety of other impacts on human health including increasing risks from antimicrobial resistance, climate change and flooding. Further research is needed to understand the risk to health from exposure to ground gas, light pollution and microplastics. The risk to health from radiation is thought to be small however there may be some areas where levels of radon gas exceed the level at which action is needed to reduce it.

There are likely to be other impacts[111] on human health outwith the scope of this initial review that ESS may wish to analyse further in the future.

People's interaction with the environment

Accessing the environment

The Scottish Household Survey[86] provides extensive information on people's interaction with the environment over the past 15 years. The data on indicators of visits to the outdoors and access to green and blue space are also used as national performance indicators[112].

While the survey was conducted in 2020, the methodology was changed to a telephone survey due to the COVID-19 pandemic meaning the results are not directly comparable with previous years[113]. This report will therefore discuss the data from the 2019 survey instead to facilitate analysis of trends.

Two thirds (66%) of adults lived within a 5 minute walk of their nearest green or blue space in 2019. This has remained relatively stable at between 65% and 69% since 2013[86].

In 2019, 56% of adults were estimated to have visited the outdoors at least once a week. This has increased from 42% in 2012[86]. Nearly three quarters (73%) of adults were satisfied or fairly satisfied with their nearest green or blue space in 2019. This has decreased slightly from 76% in 2013[86]. Those who live closer to green and blue spaces are more likely to visit them more frequently than those who live further away.

These indicators can be broken down by, and show differences by, age, gender, urban/rural classification, self-perception of health, disability, ethnicity and religion.[114,115] For example, generally, those with lower socioeconomic status are less likely to visit the outdoors one or more times per week[86]. Further analysis would be required to determine whether any differences or trends are significant.

Perceptions of the environment

In 2019, according to the Scottish Household Survey, 68% of people thought that climate change was an immediate and urgent problem. This has increased from 46% in 2013[86].

International comparisons

Natural England have conducted an annual Monitor of Engagement with the Natural Environment (MENE) survey since 2009[116]. Similar to the results from the Scottish Household Survey, the 2018/19 survey found that there has been an increase in the proportion of people visiting the outdoors at least once a week (from 54% in 2009 to 65% in 2019). They also found variation in this proportion for different population groups and spatial locations. In addition, they found that 90% were concerned about damage to the natural environment[117].

Summary

There are positive trends in people's interaction with the environment, with an increase in people regularly visiting the outdoors between 2012 and 2019. However, there has been a slight decrease in satisfaction with green and blue spaces between 2013 and 2019. More people are recognising that climate change is an urgent issue. Similar trends have also been observed in England.

Landscape

Landscape is defined as ‘an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors’ by Historic Environment Scotland and Nature Scot.[118]

Policy and protection

Historic Environment Scotland and Nature Scot’s position statement on People, Place and Landscape outlines their vision and approach to managing landscape change. Their vision is that ‘All Scotland’s landscapes are vibrant and resilient. They realise their potential to inspire and benefit everyone. They are positively managed as a vital asset in tackling climate change. They continue to provide a strong sense of place and identity, connecting the past with the present and people with nature, and fostering wellbeing and prosperity.’ [118]

Most landscape policy and guidance is designed for planners and developers[119]. It is also important to note that other policies will affect landscapes, such as those policies on land use and management[119]. For example, agriculture and forestry have been identified as key influences on landscape.[120] More information on land use can be found in the Land and Soil baseline evidence review.

Landscapes may also include the historic built environment, more information on this can be found below.

State and extent of Scotland’s landscapes

Between 1994 and 1999 Nature Scot commissioned Landscape Character Assessments to identify, map and describe the landscape character of all of Scotland.[121] These analyse the three main physical landscape components (landform, land cover and settlement) and how these combine to form the overall landscape.[122] This work can be used for natural heritage and planning policy making.[123]

In 2018, Nature Scot reviewed and updated the earlier work. [123] Information on the landscape character assessments made, and any changes, can be viewed online.[124]

Nature Scot runs a Landscape Monitoring Programme to capture relevant landscape changes. The programme has four groups of indicators: landscape qualities, public perception, land cover and built development.[125]

For landscape qualities, Nature Scot report the area of national landscape designations. In 2016, 25.2% (1,988,000ha) of land was covered by one or more form of landscape designation. This has increased from approximately 17% in 1996 and 24.0% (1,891,387ha) in 2006. Since 2006, the increase is largely attributed to the increase in the Cairngorms National Park in 2010 and the creation of the Inventory of Historic Battlefields. Specifically, 17.5% (1,381,100ha) of land and sea (13% of land) was designated as National Scenic Area; 8.1% (639,100ha) of land was designated as National Parks; 1.0% (76,500ha) of land was of Inventory of Gardens & Designed Landscapes status; 0.3% (27,000ha) of land was of Battlefields Inventory status and 0.2% (18,300ha) of land was of land was scheduled as Scheduled Monuments.[126]

Nature Scot also report the extent of local landscape designations. In 2017, there were 502 local landscape areas covering 27% (2,109,707.5ha) of the land area of Scotland. A further 101,124.5ha of local landscape areas extending below MHWS to include intertidal and sea areas had also been designated.[127]

The final indicator of landscape qualities is the Perceived Naturalness of land cover in the Central Scotland Green Network Area (CSGN). Perceived naturalness refers to ‘a high degree of perceived naturalness in the setting, especially in its vegetation cover and wildlife, and in the natural processes affecting the land and with little evidence of contemporary human use of the land’ and is calculated based on the landcover itself[126].

In 2016, NatureScot reported that 5% of land in the CSGN was of the most natural category. These areas are mostly found in the least urban areas. The category with the largest share of land (39%) was category two, low perception of naturalness. The areas classified within the least natural category (8% of land in CSGN) are mostly in large urban areas such as Edinburgh and Glasgow.[126]

More information on other types of protected areas can be found in the ‘Land and Soil’ and ‘Biodiversity and Ecosystem Resilience’ baseline evidence reviews.

Separately to their landscape reporting, NatureScot also report a map of wild land (where there is minimal human influence[128]), areas in Scotland. Wild land is identified as nationally important in Scottish Planning Policy but are not a statutory designation. In 2014, 42 wild land areas were identified totalling 1,537,327 ha.[129]

In NatureScot's report on public perception of Scotland's landscape. They found that the majority of adults value Scotland's wild land (where there is minimal human influence[128]), perceive that landscapes make an important contribution to the economy and that landscapes are well looked after. However, they report that the public would like to see more effort focussed on improving urban landscapes and opinion is divided on the impact of development on rural landscapes. The results were assessed as stable between 2013 and 2016.[126]

NatureScot also report public perception of local landscapes. In summary, 65% of survey respondents rated their local landscape positively with 13% rating it negatively. Negative perceptions of local landscape were most common among people living in the 15% most deprived areas in Scotland. Greenery, trees and peace and quiet were features that people particularly liked about their local landscapes[126]. However, for both of these indicators, the results are taken from surveys with 1,000 respondents, which may be too small to draw population-wide conclusions.

In terms of land cover, Nature Scot report data collected in the EUNIS Land Cover Scotland generalised land cover map which shows the types of habitats found in Scotland.

Their analysis shows that the main class of land cover in Scotland is heathland, scrub and tundra (25%), followed by grasslands and lands dominated by forbs, mosses or lichens (23.6%) and then woodland (17.8%) and mires, bogs and fens (12%). They also report that Scotland has a low percentage of woodland cover compared to other countries in Europe, although they recognise that there has been increases in woodland cover over recent years.[126]

NatureScot also report the extent of urban greenspace under land cover indicators. Their assessment in 2017 found that the total extent of all urban greenspace in Scotland was 159,274ha (54% of urban land area). Greenspace as a percentage of urban area amongst mainland local authorities ranges from 42% in Aberdeenshire and East Ayrshire, to 67% in Argyll and Bute. The total area of 'publicly accessible' greenspace (i.e. excluding private gardens and grounds, such as schools and businesses) was 119,299ha or 27ha per 1000 people, equivalent to a tennis court size of greenspace per person.

Urban greenspace can be classified by type. In 2017, 28% of greenspace was classified as private gardens and grounds, 37% as all amenity greenspace types, 19% as natural greenspace (made up of open semi-natural (8%), woodland (5%), beach or foreshore (4%) and inland water (2%)), 4% as public parks, 9% as sports areas and 3% as play spaces, allotments and community growing spaces, cemeteries and religious grounds.[127]

More information on Scotland's land use, including the Vacant and Derelict Land indicator reported by Nature Scot under this theme, can be found in the Land and Soil review.

Under the final indicator theme of built development, Nature Scot report the extent and visual influence of the built environment. The extent of built development was last updated in 2009 when it was reported that there was a slight increase between 2008 and 2009. However the extent overall in Scotland is relatively low and is more extensive in lowland areas.[126]

NatureScot have also developed the 'visual influence of built development on people' indicator which models the extent of Scotland from which built development can, theoretically, be seen. Last published in 2014, the indicator found that the area of Scotland from which one or more types of built development can be seen increased to 73% in 2013 from 11.6% in 2008. The largest change in visual influence comes from wind turbines which increased from 41.7% in 2012 to 45.9% in 2013 and this is more than double the 2008 baseline of 19.9%.[130]

Information relevant to Land Cover and Built Development are discussed in the Land and Soil review.

Summary

Around a quarter of Scotland's land is covered by a national landscape designation and a further quarter is covered by local landscape designations. However, only 5% of land in the Central Scotland Green Network Area is assessed as being in the most natural state. Nonetheless, Scotland's landscapes are important to and are rated positively by the public.

Cultural and built heritage

Policy and protection

The Scottish Government published 'Our Place in Time: the Historic Environment Strategy for Scotland' in 2014 which provides a high-level framework and 10-year vision for Scotland's historic environment.

The strategy defines Scotland's historic environment as 'the physical evidence for human activity that connects people with place, linked with the associations we can see, feel and understand'. Their 10-year vision is that 'Scotland's historic environment is understood and valued, cared for and protected, enjoyed and enhanced. It is at the heart of a flourishing and sustainable Scotland and will be passed on with pride to benefit future generations'.

The strategy aims to realise this vision through developing understanding, protection and valuation of the historic environment[131].

The Scottish Government have also published a Culture Strategy for Scotland in 2020[132] with a vision that:

- Scotland is a place where culture is valued, protected and nurtured.
- Culture is woven through everyday life, shapes and is shaped by society, and its transformative potential is experienced by everyone.
- Scotland's rich cultural heritage and creativity of today is inspired by people and place, enlivens every community and is celebrated around the world.

The three ambitions of the strategy are to strengthen culture, transform through culture and empower through culture.

A variety of other legislation and policy also cover the cultural and built heritage including landscape[133,134,135,136,137,138,139]. For example, the Historic Environment Policy for Scotland which is intended to support decision-making with the historic environment[140].

State of the cultural and built environment

Historic Environment Scotland (HES) publish an annual report on the state of properties in their care. The 2020-2021 report states that there is an increasing maintenance burden of their properties, particularly due to the legacy of historic

repairs using incompatible materials and increasing pressures from climate change accelerating natural deterioration.

Increases in crime at heritage sites (primarily criminal damage, vandalism and fire) are also reported with 53% more crimes recorded in 2020-21 than the previous year. Holyrood Park was the subject of 37% of all incidents reported.

Due to the COVID-19 pandemic it was not possible to carry out the full range of monitoring activities in the 2020-21 period.[141] It is also important to note that while useful, this report only covers properties in the care of Historic Environment Scotland, not the whole historic environment.

HES also monitor the condition of scheduled monuments. These are monuments which have been recognised as being of national importance[142]. There are around 8,200 scheduled monuments, the majority of which are monitored each year[143]. They are the property of their owners but monitored by Historic Environment Scotland.

The 2017 report[143] found that the percentage of monuments visited in the last 5 years in satisfactory condition was around 88%, closely comparable with the figure of 87% for 2007-2012. The percentage of monuments that were at high or immediate risk of further deterioration was around 8%, compared to 12% in 2012. Around 25% of monuments have showed an improvement in condition over time, however 21% showed a decline.

Important cultural heritage sites are also found in coastal and marine areas. The percentage of coastal scheduled monuments in satisfactory condition was 88% over the period 2012-2017[144]. There is a higher level of unsatisfactory condition near the coast, with causes of this thought to be ‘masonry decay’ and ‘tree/scrub regeneration’.[144]

The Scottish Government’s National Performance Framework includes an indicator showing the state of historic sites which measures the percentage of pre-1919 dwellings (sites) classified as having disrepair to critical elements. In 2019, this was 71% in 2019 and at a similar level to 2018 (73%). The proportion gradually increased from 73% in 2007 to a peak of 80% in 2012 then decreasing by 12 percentage points to 68% in 2015, and remaining at a similar level since then.

The indicator is assessed as maintaining.[112] However, it is important to note that this indicator only includes pre-1919 dwellings, rather than other historic environment

features such as castles or monuments so is unlikely to be sufficient in fully understanding the state of the historic environment.

Pressures on the cultural and built environment

As climate change has been identified as an increasing pressure on the historic environment, HES conducted a climate change risk assessment to understand, monitor and manage environmental risk to the historic environment[145]. This found that of the 352 sites assessed, 89% of sites are exposed to at least one hazard in a way that is considered unacceptable i.e. damaging to the site or monument fabric.

When the current mitigations and controls currently in place are accounted for, the percentage at risk is reduced to 53%. Risks to sites are expected to increase with climate change due to rising sea levels, increased frequency and intensity of rainfall, increasing temperatures and changes in vegetation patterns.

It is also important to note that this report only covers sites under the care of HES and so climate change impacts on other aspects of the historic environment have not been assessed.

Dynamic Coast provide an assessment of risk for coastal cultural heritage sites. It found that 210 sites will be at risk of erosion by 2050, with the risk increasing due to climate change[146]. Erosion and associated flooding can damage assets, reduce ground stability and increase mould growth, damaging cultural heritage sites[146].

Other pressures on the historic environment include:[147]

- Development pressures such as inappropriate development and demolition
- Poorly executed maintenance e.g. due to lack of suitably skilled people
- Land use, such as extensive ploughing
- Pollution may damage materials such as sandstone
- Increased visitor numbers may wear down footpaths or cause damage to nearby sites

It is important to note that the cultural and built environment is much broader than the sites and properties discussed in this review. Indeed, many of the undesignated and unmonitored sites may be at risk and due to their unmonitored status they may not be afforded protection. Further analysis will therefore be needed to understand the true state of the cultural and built environment and the pressures on it.

Benefits from the cultural and built environment

Scotland's historic environment is regularly audited by Historic Environment Scotland[148]. Some key findings from their most recent report, published in 2018 are:[149]

- The historic environment generated £4.2bn for Scotland's economy in 2017 (increased from £3.4bn in 2014).
- The historic environment supports 66,000 full time-equivalent jobs (direct and induced) in 2017 (increased from 55,000 in 2014).
- More than 118,000 learners benefitted from Historic Environment Scotland free educational visits in 2017-18.
- 35% of adults had visited a historic site (increased from 28% in 2012).
- Those who visited a historic site were over 50% more likely to report a high life satisfaction.
- Membership of the two largest historic environment organisations has increased steadily over the last ten years.
- Scotland is ranked 12th out of 50 nations for its reputation of being rich in cultural heritage

Evidence used to support the Historic Environment Strategy for Scotland highlights the historic environment has significant social, cultural and economic benefits. Specifically, they cite that[131]:

- 93% of adults agree that "when trying to improve local places it is worth saving their historic features" and 71% agree that they are "interested in the history of the place where I live"
- The Moffat Centre for Travel and Tourism estimates that 14 million tourists visited historic environment attractions in 2012, representing one in three of recorded visits to all Scottish attractions.
- The historic environment is estimated to contribute in excess of £2.3 billion (2.6%) to Scotland's national gross value added (GVA) and to account for 2.5% of Scotland's total employment, supporting 60,000 FTE employees which includes seasonal employment.

Public opinion of and interaction with the historic environment

The Scottish Household Survey gives some insight into the people's opinions of the state of cultural heritage in Scotland. [86]

- 85% either strongly or tended to agree that 'It is important to me that Scotland's heritage is well looked after'. However, only 69% strongly or tended to agree that 'the heritage of my local area is well looked after'.
- Every year between 2012 and 2019 90% or more people said that they had engaged with culture in the past 12 months.
- 45% agreed that 'There are lots of opportunities to get involved in culture and the arts if I want to in my local area'.
- 46% either strongly or tended to agree that 'Culture and the arts make a positive difference to my life'. The most common reason for this was that it makes them feel happy (77%), followed by that it improves their mental health and wellbeing (44%), 28% said it makes a positive difference because they are learning new skills/knowledge.
- 74% of respondents said that they had attended a cultural event or visited a place of culture (excluding the cinema) in the past 12 months in 2019. Excluding the cinema (which 58% had attended), the most common place to visit was a live music event followed by a historic place or museum. People with higher education qualifications, younger people, those without reduced daily capacity from disability, those with higher incomes and those in the least deprived areas were more likely to have attended a cultural event/visited a place of culture. For those who reported not attending a place of culture, 70% had no aspirations to do so. However, 14% had aspirations to go to the cinema and 9% to go to a live music event. The top three factors reported that limited or prevented attendance at cultural activities were lack of time (19%), cost of tickets (15%) and that they were too far away (9%) or that they had not got round to it (9%).
- 52% reported that they had participated in a cultural activity in the past 12 months in 2019 (75% including reading). This value has increased from 48% in 2012 (78% including reading in 2012). The most common cultural activity was reading (62% reported participating), followed by viewing performances

online (23%), crafts (16%) and dance (12%). People more likely to participate in any cultural activities were women, those with higher education qualifications, those in areas of low deprivation, those with higher levels of household income and those without a capacity-limiting disability. For those who did not report participating in a cultural activity, 84% had no aspirations to do more. The most common factor reported to limit participation in cultural activity was lack of time (19%).

International comparisons

Historic England publish data on key indicators related to the historic environment. Their 2021 report[150] presented the following key findings:

- The number of sites on Historic England's Heritage at Risk Register continued to decline in 2021, dropping to 4,983 from the 2020 total of 5,097.
- Before the COVID-19 pandemic, during 2019/20 there were 325,200 free educational visits to English Heritage sites.
- There was a decline in visitor numbers to Historic England sites (including free educational visits) during 2020 due to restrictions imposed during the COVID-19 pandemic.
- In 2019/20, 72.7% of adults reported having visited a heritage site in the last 12 months, similar to the rate of 72.4% surveyed in 2018/19. The most common reason given for visiting heritage sites was to spend time with friends and family (46.1%), closely followed by having a general interest in heritage or history (43.6%). However, those in lower socioeconomic groups, ethnic minorities and those with a limiting disability or illness were less likely to visit heritage sites.

Historic England also report that in 2019, before the COVID-19 pandemic, the heritage sector provided over 206,000 jobs directly and supported a further 357,000 jobs indirectly through related sectors such as construction and tourism[151]. It also estimated that the heritage sector contributes £36.6 billion gross value added to the English economy (equivalent to 0.9% GVA)[151].

Policy-making around cultural heritage is generally the responsibility of individual countries within the EU so further analysis would be needed to understand cultural and built heritage in individual European countries.

Cultural heritage within the EU is important to people and the economy with over 300,000 people employed directly in the cultural heritage sector and 7.8 million employed in jobs indirectly linked to heritage (e.g. hospitality, interpretation and security)[152]. Furthermore, as part of the European Year of Cultural Heritage in 2018, a 'Eurobarometer' survey was conducted and found that 84% of Europeans felt that cultural heritage was important to them personally and 74% felt that public authorities should allocate more resources to cultural heritage. Over two fifths (82%) took pride in cultural heritage with 71% agreeing that it can improve quality of life[153].

Summary

Cultural heritage and the historic built environment provides both economic and social benefits to Scottish society, and this is also seen in England and the EU. For example, it makes an important contribution to the economy, provides educational benefits and likely improves life satisfaction for visitors. However, there are disparities in how people experience Scotland's heritage and culture, for examples by level of deprivation.

There are increasing significant pressures on the historic and built environment in Scotland including climate change and criminal damage, leading to an increase in maintenance needs. Other pressures include development pressures, air pollution and poorly executed maintenance.

There is a lack of complete data on the state of the historic built environment but, over 85% of nationally important monuments are thought to be in satisfactory condition. The majority of pre-1919 dwellings are not classified as having disrepair to critical elements.

Further analysis would be needed to understand the state of and pressures on cultural sites that are not currently monitored by centralised programmes.

Therefore, while cultural and built heritage provides benefits to Scotland, evidence suggests it is likely that further investment would be needed to safeguard them.

Environmental justice – unequal impact of environment

Access to environmental justice and the Aarhus convention are discussed in the Governance baseline evidence review.

Legislation

The Equality Act 2010 specifies the following as protected characteristics: disability, gender reassignment, marriage and civil partnership, pregnancy and maternity, race, religion or belief, sex and sexual orientation. Alongside protection for those with protected characteristics, the act requires public bodies to have regard to reducing inequalities when making strategic decisions[154].

The Fairer Scotland Duty, Part 1 of the Equality Act 2010, came into force in April 2018. It places a legal responsibility on particular public bodies in Scotland to actively consider how they can reduce inequalities caused by socio-economic disadvantage when making strategic decisions.[155] The implementation of this is still in the interim stage.

Trends and data

There are a variety of sources showing that environmental issues disproportionately affect those with particular protected characteristics and those facing socioeconomic disadvantage. Some of these are discussed in the relevant sections throughout this report and in other baseline evidence reviews. Others are discussed below.

For example, the 2019 Scottish Household Survey showed that while the responses to questions on walking distance to the nearest green or blue space were relatively even across Scottish Index of Multiple Deprivation groups, those in more deprived areas were less likely to actually use the green/blue spaces often and were less likely to be satisfied with their nearest green/blue space than those in less deprived areas. [86]

In addition, a report from the UK Chief Medical Officer in 2017 found that those with ethnic minority status in the UK have been found to be exposed to higher concentrations of the air pollutants NO2 and PM_{10}[64]. The report does note that it is unclear whether this is a causal relationship or due to the socioeconomic status of ethnic minority groups, and the implications for the health of ethnic minority groups are unclear.

The report also found that the majority of people living in areas which exceed NOX and PM10 air pollution standards live in the poorest areas of the UK. In addition, lifestyle related factors which increase susceptibility to the negative effects of air pollution may also be more prevalent in low socioeconomic status (SES) areas, which may exacerbate any health effects[64].

Furthermore, the Environmental Rights Centre for Scotland (ERCS) produced a report titled 'How the human right to a healthy environment advances the rights of disabled people'[156]. The report is intended to contribute to the development of a new Human Rights Bill and suggests that the incorporation of the right to a healthy environment would advance the rights of disabled people.

ERCS cite multiple lines of evidence to support this position. For example, they state that many ground floor level properties and care homes are most suited to those with mobility impairments yet are vulnerable to flooding and that biodiversity loss and climate change are likely to increase the risk from pandemics which will disproportionately impact those with ill health.

International comparisons

The European Environment Agency's 2019 report 'Healthy environment, healthy lives: how the environment influences health and well-being in Europe' found that those who are already most vulnerable face the hardest impact of environmental stressors. For example, the report states that those facing social deprivation experience a higher burden from both air and noise pollution. In addition, those with low socioeconomic status, children, the elderly and those with health conditions are more negatively affected by exposure to environmental hazards. These groups are also less likely to have the resources to adapt to environmental impacts.[157] This suggests that the impact of environmental issues is not equally spread throughout European society, there are systematic inequalities which reflect existing socioeconomic disadvantage.

Summary

It is likely that most environmental issues affecting people will disproportionally affect people from disadvantaged socioeconomic groups and those with protected characteristics such as, older and younger people and disabled people. This is seen

in Scotland and internationally. This is a cross-cutting issue which should be considered across work.

Further information can be found in the cross-cutting environmental governance baseline evidence review.

Food and water security

Information on water security can be found in the water baseline evidence review. Briefly, further analysis is required to understand the extent of water scarcity in Scotland. However, climate change, including increased droughts and floods, will increase the risk of water scarcity in Scotland, which will likely have negative impacts on health.

State of food security

The Agriculture Act 2020[158] requires the UK to produce analysis of statistical data relating to food security in the United Kingdom every three years. The first report was published in 2021[159].

While this report is useful, it is important to note that reports produced independently of government discussed below, highlight significant issues with food security at a household level, which are not highlighted in the UK Government report.

Key conclusions from the UK Government report under four themes relevant to food security were:

1. Global food availability
    a. Global food supply and availability has improved since 2010
    b. The COVID-19 pandemic caused some disruption to trans-boundary supply chains but global trade is expected to recover.
    c. Factors threatening the stability and long-term sustainability of global food production include: climate change, biodiversity loss caused by agricultural land expansion, and overexploitation of natural capital resources, including fish stocks and water resources.
    d. Current data on undernourishment as well as obesity levels across the world may indicate that global food production is not equitably meeting populations' nutritional requirements, including the UK's.
2. UK food supply sources

a. The UK has diverse and longstanding trade links that meet consumer demand for a range of products at all times of the year.
b. Trade is dominated by countries in the EU and it is too early to say what effect leaving the EU might have on that trade.
c. Domestic production is stable, with variations in yield and consumer demand balanced by imports and exports. Both agricultural production and manufacturing have become increasingly efficient and are geared towards meeting consumer demand, although food waste is still high.
d. The biggest medium to long term risk to the UK's domestic production comes from climate change and other environmental pressures such as soil degradation, water quality and biodiversity. Wheat yields dropped by 40% in 2020 due to heavy rainfall and droughts at bad times in the growing season. Although they have bounced back in 2021, this is an indicator of the effect that increasingly unreliable weather patterns may have on future production.

3. Food supply chain resilience

a. The UK is resilient to potential shocks in the food supply chain. Supply systems, which are owned and operated by the private sector, are adaptable and flexible in responding to problems. Government monitors risks and works with industry to respond to emerging issues and maintain supply chains.
b. Notable risks to the supply chain stem from its dependence upon other critical sectors including energy, transportation, borders, labour, key inputs (chemicals, additives and ingredients), and data communications. In addition, the threat of cyber-attack to UK businesses, including those in the agri-food sector, is significant and growing.
c. Both EU and non-EU food imports, via all modes of transport, are well spread across a number of ports of entry, with no port having a dominant share. There is, however, a reliance upon the Short Strait for some food products, including fruit and vegetables, meats, and dairy. Only simultaneous disruption to several ports would be serious enough to have a material effect on UK food supply.

    d. Securing sufficient labour at appropriate skill levels presents a challenge to food supply chain resilience.
    e. Other pressures in recent years such as COVID-19 have impacted the food supply chain, however they have also highlighted the resilience within the system.
4. Food security at household level
    a. Data on household food security indicates that 92% of households regarded themselves as being food secure in the financial year 2019 to 2020.
    b. Access to food shops in England is for the most part adequate, with at least 84% of the population in every region able to reach a shop by public transport or walking within 15 minutes.
5. Food safety and consumer confidence
    a. The majority of consumers in the UK trust the food they buy and eat to be safe and accurately labelled.
    b. However, when prompted consumers have expressed concern around animal welfare, environmental issues, nutrition, and food production methods.
    c. Food business compliance with food safety regulation has remained high with slight increases in all four countries of the UK in the past six years, although there is some year-to-year variation.
    d. Laboratory confirmed reports of pathogens causing foodborne gastrointestinal disease in the UK and the proportional trends in foodborne disease outbreak surveillance data generally remained relatively stable over the period 2015 – 2019.
    e. Although food safety incident reports have increased since 2010, this is attributable to better detection and higher levels of reporting rather than an increase in risk.

Concerns about the right to food and extreme poverty and human rights in the UK were identified by United Nations Special Rapporteurs. The concerns were sent to the UK Government in August 2020. The concerns included[160]:

- The deepening level of food insecurity among low-income households, particularly families with children, and the lack of comprehensive measures to ensure their access to adequate food.
- A recent survey conducted by the Food Standards Agency indicates that almost 1 in 5 persons had cut down meal sizes or skipped meals during the months of April and May, due to not having enough money. It has been reported that levels of food insecurity are almost 250 percent higher than they were prior to the lockdown, with approximately 4.9 million adults and 1.7 million children currently food insecure.
- Even before the COVID-19 crisis, food insecurity was on a rising trend and one of serious concerns facing low-income households. In 2016, the UN Committee on Economic, Social and Cultural Rights expressed concerns about the lack of adequate measures adopted by the UK Government to address the increasing levels of food insecurity and malnutrition, as well as to reduce the reliance on food banks. In 2017, between 8 and 10 percent of households in the United Kingdom were food insecure, rising from 28% to 46% of low-income adults between 2004 and 2016.

The Scottish Government has responded to the concerns raised.[160] Their response stated that, to tackle food insecurity, they will; prevent food insecurity through increased incomes, improve food insecurity responses so they are more dignified and coordinate action on food policy.

Pressures on food security

There may be concerns surrounding food security due to environmental constraints on the current food system[161]:

- Climate change is likely to reduce the ability of the current food systems to meet demand. For example, through increased frequency of extreme weather events which could damage crops. Furthermore, climate change is predicted to increase the risk of water scarcity, while increasing the demand for water for agriculture in dry areas which could threaten food security, impacting the environment and human health[162,163].

- Biodiversity loss, such as decline in pollinating insect species numbers, is also impacting food systems.
- It is also important to recognise that the current global food chains are responsible for a significant portion of greenhouse gas emissions, and impact biodiversity, water supplies and produce waste (plastic packaging and food waste). It is likely that these will need to change if we are to meet our climate change, and other environmental, targets.
- Soil erosion and nutrient depletion, among other issues, may impact agriculture productivity.

Geopolitical factors may also impact food security. For example, the war in Ukraine poses a significant risk to global food security[164]. A taskforce has been set up by the Scottish Government to monitor the impact of the conflict on Scottish food security.[165] It is also thought that Brexit could impact food security[166,167] .

It is important to note that there are other pressures on food security such as levels of contamination in seafood or livestock. For example, the Food Standards Agency estimated that in the UK in 2018 there were 2.4 million cases of foodborne disease. This led to an estimated 222,000 GP presentations and 16,400 hospital admissions[168].

Food Standards Scotland have developed a strategy for reducing foodborne illness in Scotland[169]. These pressures are outside the scope of the current baseline evidence review.

Tackling pressures on food security

The UK Government have produced a new food strategy aiming to tackle these risks[170]. However, there has been criticism of the strategy[171,172,173].

In Scotland, the Scottish Parliament recently passed The Good Food Nation Bill[174], which requires Government, local authorities and health boards to create good food nation plans. The plans will set out clear outcomes, indicators and policies across a range of areas relating to food including the role of the food system and supply chain in the provision of food and the role of a sustainable food system and supply chain in contributing to mitigation of climate change, halting and reversing of loss of biodiversity and improvement in animal welfare.

Furthermore, the Community Empowerment (Scotland) Act 2015 placed a duty on local authorities to prepare food growing strategies for their areas and identify land that could be used for community growing, and describe how the authority intends to increase provision for community growing, in particular in areas which experience socio-economic disadvantage which may help to tackle food security[175].

International comparisons

The United Nations State of Food Security and Nutrition in the World (SOFI) report estimates the extent of hunger, food insecurity and malnutrition worldwide[176]. The most recent report was published in 2021 and found that the decline in world hunger that began in 2005 halted in 2014 and the number of people experiencing undernourishment slowly increased until 2020 when there was a large increase in the number of people experiencing undernourishment.

The report estimates that between 720 and 811 million people faced hunger in 2020, an increase of around 118 million than in 2019. There are higher percentages of those facing hunger in Africa, Asia and Latin America than other areas. The drivers behind the increases in food insecurity are conflict, climate variability and extremes and economic slowdowns and downturns. These are exacerbated by poverty (including being unable to afford a healthy diet) and high levels of inequality.

The report also concludes that the world's goal to end world hunger and malnutrition in all forms by 2030 is off track, due to a number of challenges including the COVID-19 pandemic[176]. The war in Ukraine also poses a significant risk to global food security[164].

Summary

There are concerns about food security in Scotland relating to the lack of access to adequate or appropriate food for low income households. Furthermore, climate change and biodiversity loss pose significant risk to global and UK food systems. Geopolitical factors may also impact food security.

Food security is a significant and increasing issue worldwide, with other areas such as Africa and Asia facing larger problems than Europe.

Water security is discussed in the water baseline evidence review. Briefly, climate change will increase the risk of water scarcity events, with impacts on human health.

4. Summary of next steps

This baseline review identified a wide range of possible issues for further analysis. This included the impact of indoor air pollution, microplastics and antimicrobial resistance on human health, food security and the general consideration in all work that environmental issues are likely to have unequal impacts across society.

However, for the purposes of our initial analytical priorities, ESS will focus on:

- Developing a better understanding of antimicrobial resistance, controls and impacts;
- Developing a better understanding of current noise levels, controls and the impact on human health.

ESS' proposed Strategic Plan describes how issues will be prioritised for further analysis according to a range of criteria, including:

- Importance – the size and risk of the potential effect on the environment and/or public health; the urgency with which improvement is required;
- Nature and Scope – recent trends in environmental performance; whether the issue of concern appears to be systematic and/or longstanding;
- Neglect – whether there has been action taken on the issue of concern, or further action is planned in the near future; and
- Added-value – the contribution we could make, considering whether other monitoring, oversight or scrutiny bodies are planning to take, or could take, action to address the issue of concern.

These priorities takes account of that scheme. They recognise the importance of the impact of noise pollution on health, and the relative neglect of this issue due to a lack of centralised reporting which also makes it difficult to determine trends over time. Similarly, they recognise the costly impact on environmental wellbeing of leaving antimicrobial resistance unchecked as well as the need for further analysis to better understand progress in tackling it. In keeping with the prioritisation process, the added value that ESS can bring to an area will also be considered taking account of other actors, in deciding where to focus future work.

Although ESS intends to focus on two issues in the first instance, other issues will be retained on a list for potential future analysis and horizon scanning in line with the stages of monitoring and analysis work set out in the strategic plan.

5. Summary of key sources

The end notes to this review provide details of the references and sources used throughout the document. This section is intended to provide a shorter note of those reports (in future iterations) and data sources which have been identified as likely to be important for an ongoing understanding of land and soil in Scotland.

Noise impact on human health

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Chemical impact on human health

Public Health Scotland, Scottish Environmental Incident Surveillance System (SEISS): 2020 annual report: https://publichealthscotland.scot/publications/scottish-environmental-incident-surveillance-system-seiss/scottish-environmental-incident-surveillance-system-seiss-2020/

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European Environment Agency, The European Environment – state and outlook 2020: https://www.eea.europa.eu/publications/soer-2020

Air pollution impact on human health

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Public Health England, Estimating Local Mortality Burdens associated with Particulate Air Pollution: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/332854/PHE_CRCE_010.pdf

Pollution impact on human health

Scottish Government, Scottish Vacant And Derelict Land Survey 2021: https://www.gov.scot/publications/scottish-vacant-derelict-land-survey-2021/

Scottish Government, Spreading of sewage sludge to land - impacts on human health and the environment: community concerns: https://www.gov.scot/publications/community-concerns-regarding-impacts-human-health-environment-arising-spreading-sewage-sludge-land/

Other impacts on human health or safety

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UK Health Security Agency, English surveillance programme for antimicrobial utilisation and resistance (ESPAUR) report: https://www.gov.uk/government/publications/english-surveillance-programme-antimicrobial-utilisation-and-resistance-espaur-report

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Glasgow Centre for Population Health, The built environment and health: an evidence review, https://www.gcph.co.uk/assets/0000/4174/BP_11_-_Built_environment_and_health_-_updated.pdf.

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Scottish Environment Protection Agency (SEPA), Radioactivity in Food and the Environment (RIFE) reports: https://www.sepa.org.uk/environment/radioactive-substances/environmental-monitoring-and-assessment/reports/

Health Protection Agency, Radon in Dwellings in Scotland: 2008 Review and Atlas: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/340104/HPA-RPD-051_for_website_with_security.pdf.

People's interaction with the environment

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