

Review of the environmental and socio-economic barriers and benefits to organic agriculture in Scotland

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Review team

Nicola Randall¹, Luke Briggs¹, Abigail Graceson¹, Katy James¹, Carla Barlagne², Gill Banks³ Laure Kuhfuss³

¹Centre for Evidence-Based Agriculture, Harper Adams University, Newport, Shropshire, TF10 8NB

²James Hutton Institute, Craigiebuckler, Aberdeen, AB15 8QH

³James Hutton Institute, Invergowrie, Dundee, DD2 5DA

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1. Introduction

1.1. Background

Organic agricultural production has a wide range of potential benefits for the environment, society and the economy. For example, Lobley *et al.*, 2005 & 2009a showed that organic agriculture can provide positive benefits to rural economies in England and Wales through employment. Their research indicated that organic producers are “more likely to be willing to diversify their operations and enter into innovative marketing arrangements in ways which generate more employment overall and a greater proportion of non-family labour on their farms”. A substantial amount of research, particularly from Europe, also indicates that compared to conventional farming, organic farming can have greater biodiversity benefits, although research gaps still exist. Benefits also vary amongst species and between crops. This is possibly a consequence of the small size and isolated context of many organic farms (e.g. Hole *et al.*, 2005; Fuller *et al.*, 2005; Rahmann, 2011; Smith *et al.*, 2011; Tuck *et al.*, 2014).

Organic production still accounts for only a small percentage (2.1%) of agriculture in Scotland, compared to almost 3.0 per cent in the UK as a whole. National Statistics for Organic Farming in Scotland, show an eighth consecutive fall in the area of organic land in 2016, although this increased by over 1000ha in 2017 to a total land area of 122,660 hectares (Organic Farming in Scotland, 2017 Statistics). Under the Scottish Rural Development Programme, farmers can apply for the Agri-Environment Climate Scheme (AECS) for support to convert their land to organic.

To help develop future policy and decision-making, the Government require wider environmental and socio-economic evidence, particularly in a Scottish context, of the benefits of organic agriculture compared to conventional agriculture. Wider environmental benefits of organic farming may include improvements in water quality and soil health, and a reduction in soil erosion and contributions to global warming (e.g. Anon, 2004; Shepherd *et al.*, 2003). For example, although pasture (permanent and temporary grassland and rough grazing) makes up 93% of organic land in Scotland (Organic Farming in Scotland statistics, 2017) reviews have highlighted that there is less relevant evidence for these types of habitat to biodiversity (Hole *et al.*, 2005; Smith *et al.*, 2011). Wider socio-economic benefits could include the provision of local organic produce helping to re-connect farmers and consumers and retain money in the local economy (e.g. Lobley *et al.*, 2009b).

Uptake of sustainable farming practices, and organic farming may be constrained by ability and willingness to adopt. A wide range of factors can facilitate or constrain ability to adopt practices for example: education, age, succession status, off farm work, land tenure, business strategies, stage in the family life-cycle, social networks, finances, and management capacity (e.g. Ahnstrom *et al.* 2008; Kabii and Horwitz 2006; Läßle and Kelley, 2010; Lastro-Bravo *et al.*, 2015; Wilson and Hart 2001). Willingness to adopt is where behavioural intentions of an individual are directly related to his/her attitude or beliefs and the ability to act effectively. For example, a farmer's perception of what others in a community relevant to them think is appropriate behaviour may well affect decisions on uptake (Läßle and Kelley, 2010; Lynne, 1995).

Lobley *et al.*, 2009a highlighted that the viability of smaller producers in the organic sector in England and Wales depends on mitigating the escalating cost and availability of primary organic inputs such as feed and seed, limiting the concentration of box schemes by supermarket chains and national organic suppliers, as well as facilitating adding value for producers in regions with limited demand for organic food and a shortage of processing capacity. Similar and additional limitations (e.g. knowledge of organic systems, labour requirements, lack of organic land to rent, infrastructure requirements and cost of certification for small scale production) were highlighted by the consultation process involving farmers and growers in the development of the 'Organic Ambitions' Scottish Organic Action Plan 2016-2020 (The Scottish Government, 2016). The Scottish Government supported Scotland's organic industry's 'Scottish Organic Forum' to create an organic action plan for Scotland for the period 2016-2020 that recognises these positive contributions and aims to strengthen and promote Scotland's organic food and drink supply chain (The Scottish Government 2016).

The Scottish Government needs to better understand factors which determine public attitudes towards organic produce and factors that influence demand so that it can uphold its commitment to increasing supply and demand of Scottish organic food, using public procurement to drive demand.

A consultation of Scottish consumers' attitudes towards organic produce in the development of the Scottish Organic Action Plan 2016-2020 (The Scottish Government, 2016) highlighted barriers (e.g. cost, availability) to consumption and potential solutions (e.g. better ranges, lower prices) which included increasing public awareness of the benefits of organic farming. Since this consultation, the Soil Association Scotland (2019) has suggested that the increase in the awareness of the benefits of organic farming through the Scottish Organic Action Plan has contributed to a rise in interest for organic produce by consumers. In 2018, the Soil Association's Organic Market Report (Soil Association, 2018), highlighted that sales of organic food in Scotland grew by 19.4 per cent in 2017, and accounted for 6.5 per cent of UK sales. When this report was released, the Soil Association Scotland also reported that 100 per cent of Scottish independent retailers expected organic sales to maintain or increase in 2018 (Soil Association Scotland, 2019).

Maintaining and building on public awareness initiatives to highlight the benefits of organic farming may therefore be one way to continue to increase public demand for Scottish organic produce.

Organic farming has the potential to fit with and contribute to a wider range of environmental and socio-economic goals within Scottish policy, for example:

- To deliver 2020 Challenge for Scotland's Biodiversity, 2013
- Contribute to Scotland's climate change targets by reducing greenhouse emissions from agriculture - Climate Change (Scotland) Act, 2009
- Contribute to the Scottish Government's commitment to promoting the sustainable economic growth of the food and drink industry, and ensure that food is nutritious, fresh and environmentally sustainable - Recipe for Success: Scotland's National Food and Drink Policy – becoming a Good Food Nation, 2014.

1.2. Aims and objectives

The aim of this project was to identify the socio-economic and environmental benefits and impacts of organic agriculture versus conventional farming systems in Scotland, including what factors are influencing or driving uptake of organic production and consumer demand for organic produce.

The research objectives for this project were as follows:

- a) Undertake a Rapid Evidence Assessment (REA) of the existing evidence base on environmental and socio-economic impacts of organic production systems, focusing on evidence from, or of demonstrable relevance to, Scotland.
- b) Conduct a comparative SWOT analysis on Scottish organic and conventional farming systems.
- c) ^aIdentify and assess the relative importance of factors which i) determine public attitudes and behaviours towards organic produce, and ii) influence consumer demand, ^busing the results to inform recommendations for ways to increase consumption of Scottish organic produce.
- d) ^aIdentify, and where possible, quantify, factors contributing to the year-on-year decline in the percentage of Scotland's land certified as organic and ^bmake recommendations for potential ways to reverse this decline.

In order to address these objectives, the project was carried out in four stages:

Stage 1:

A desk review of the existing research evidence relating to the environmental and socio-economic benefits and impacts of organic agriculture in Scotland in order to identify trends and gaps in existing research knowledge. (Objective a)

Stage 2:

An analysis of strengths, weaknesses, opportunities and threats (SWOT analysis) factoring organic farming in Scotland. The findings of the REA were combined with previous organic farming consultations of farmers, growers and consumers to inform this process. (objectives b, c^a and d^a)

Stage 3:

Gather stakeholder opinion on the areas for future prioritisation for the organic sector in Scotland. The areas identified in the SWOT analysis were prioritised for importance by members of the Scottish Organic Forum, together with some of their members and contacts. A stakeholder workshop was held to identify potential actions to address these priorities. (objectives c^b and d^b)

2. Rapid Evidence Assessment of the benefits and impacts of organic agriculture in Scotland

2.1. Introduction to the Rapid Evidence Assessment (REA)

A rapid evidence assessment of academic and grey literature was carried out to address the following questions:

Primary question:

‘What is the available evidence for the environmental and socio-economic benefits and impacts of organic agriculture versus conventional farming systems in Scotland?’

The question was broken down into a population, intervention, comparator and outcome (PICO) framework to support this process (Table 1).

Table 1 Question elements of the Rapid Evidence Assessment

Population	Environment, Social-economy, Economy, Consumers, Farmers
Intervention	Organic agriculture
Comparator	Conventional agriculture/alternative non-organic agriculture
Outcome	Changes in the: environment (e.g. climate change, soil, water, soil erosion); social-economy (e.g. employment, rural development), and economy (e.g. rural economy). Public (consumer, farmer & grower) attitudes, behaviours and drivers towards organics, and solutions to increase demand and production

Secondary questions:

1. What factors determine public attitudes and behaviours towards organic produce and influence consumer demand?
2. What factors have led to a decline in organic certified land in Scotland?

2.2 Scope of the REA

All retrieved studies were assessed for relevance using inclusion/exclusion criteria developed in collaboration with funders and subject experts as follows:

Relevant subjects: Studies that investigate the evidence for the environmental (e.g. biodiversity, soil health, climate change etc) and socio-economic (e.g. rural economy) benefits and impacts of organic agriculture compared to conventional farming systems in Scotland. Subjects for the secondary questions include factors affecting public attitudes and behaviours towards organic produce and the decline in organic certified land in Scotland.

Relevant types of study: Primary research and grey literature reports..

Geographical limits (primary question): The primary question focused on temperate countries with similar farming systems to the UK: Northern European countries (e.g. Austria, Belarus, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Holland, Hungary, Ireland, Latvia, Liechtenstein, Lithuania, Luxemburg, Norway, Poland, Romania, Serbia, Slovakia, Slovenia, Sweden, Switzerland, UK, Ukraine); northern states of the USA, Canada and New Zealand.

Geographical limits (secondary question 1): The first secondary question focussed on Northern European countries as listed above.

Geographical limits (secondary question 2): The second secondary question focussed on Scotland only.

Farming types: cereal crops (wheat, oats, barley, oilseed rape, maize), potatoes, root vegetables, fresh produce, soft fruits, pasture and livestock systems

Language: Studies published in the English language

Date of Publication: No date restrictions

2.3 Method for the REA

The REA was conducted following Defra/Natural Environment Research Council (NERC) guidelines for the production of Quick Scoping Reviews and Rapid Evidence Assessments (Collins *et al*, 2015).

2.3.1. Scoping search

An initial scoping search was performed to validate the methodology. Keywords were tested for specificity and sensitivity using the online database ISI Web of Knowledge (Table 2). A wildcard (*) was used to pick up multiple word endings. For example, water* picks up water and waters. Keywords were also made more restrictive by the addition of a qualifier, or multiple qualifiers. A full list of the searches performed during initial scoping and the number of hits achieved is located in Appendices

Appendix 1.

2.3.2. Searches

Following discussion with the Scottish Government and the Review Team, the final search string used was:

- (“Organic farm*” OR “Organic agricultur*”) AND (Environment* OR Water* OR Soil* OR Biodiversity OR “Climate change” OR "rural econom*" OR Consumer* OR Farm*)

Online literature databases, the first 50 hits of search engines, and websites of relevant organisations (Table 2) were searched with keywords to identify relevant literature. Other specific/specialised databases were searched where identified or recommended by experts within the field. Database and repository searches were conducted in the English language.

The results of each search term on each database were imported into a separate EndNote X7 library file. All the database libraries were incorporated into one library, recording the number of references captured. Using the automatic function in the EndNote X7 software duplicates were removed. A record of each search was made to enable a re-run of the search if needed. The following data was recorded: date the search was conducted; database name; search term; number of hits; and notes.

Table 2. Sources used for searching within the Rapid Evidence Assessment

Online databases

Thomas Reuters Web of Science Core Collection	http://ipsience.thomsonreuters.com
CAB Abstracts	http://www.cabi.org/
Ethos	http://ethos.bl.uk/Home.do
DART-Europe E thesis	http://www.dart-europe.eu/

Search engines

Google	http://www.google.co.uk
Google scholar	http://scholar.google.com

Organisational websites

Scottish Government online databases	http://www.gov.scot/
Defra online databases	https://www.gov.uk/government/organisations/department-for-environment-food-rural-affairs
Scottish Organic Forum	https://www.sruc.ac.uk/info/120598/scottish_organic_forum
ADAS	www.adas.uk/
Soil Association	https://www.soilassociation.org
Scottish Organic Producers Association	http://www.sopa.org.uk/
Organic Growers Alliance	https://www.organicgrowersalliance.co.uk/
Caledonian Organics	http://www.caledonianorganics.co.uk/
Scottish Organic Milk Producers	http://www.scottishorganicmilk.org/
Scottish Agricultural Organisation Society	http://www.saos.coop/
SAC Consulting	https://www.sruc.ac.uk/info/20005/sac_consulting
NERC Open Research Archive	https://nora.nerc.ac.uk/
Scotland's Rural College	https://www.sruc.ac.uk/
The James Hutton Institute	http://www.hutton.ac.uk/
Organic Research Centre	http://www.organicresearchcentre.com/
National Farmers Union	https://www.nfuonline.com/
AHDB	https://horticulture.ahdb.org.uk/search/

2.3.3. Study inclusion

The collated evidence was screened for relevant articles by applying inclusion criteria developed at the inception meeting. We used Eppi Reviewer software for the screening stage. Examples of study inclusion criteria include relevant subjects, geographic area and date of publication.

A selection of articles were screened by two reviewers first at title and abstract and then at full text. Where there was uncertainty about inclusion of an article, both reviewers examined the text and a consensus agreement was made. The number of articles included and excluded at each stage was recorded. The resulting references were used to formulate a searchable systematic map database.

2.3.4. Systematic map database

A searchable systematic map database was created to describe the volume, nature and characteristics of the research/evidence relating to this REA. The map database helped identify knowledge gaps. Articles were coded and categorised using a combination of generic (full reference, location of study) and topic specific (e.g. organic, conventional, water, soil) keywords. The content of the systematic map database was discussed with topic experts and coding included: Full reference; publication date; location of study; type of evidence; population studied; intervention studied; comparator used; outcome measured; combined robustness and relevancy scores.

Where there was more than one article found for a study, each article was recorded and cross-referenced in the systematic map database. The database is searchable by topic and can be arranged according to topic areas, publication date, country of study etc. Subject experts reviewed the completed map to ensure all relevant categories were defined. Simple numerical accounts of the frequencies in each category were obtained from the map. Pivot tables were generated from the map to allow the reviewer to investigate trends in the evidence.

2.4. Results of the REA

A total of 10,217 articles were collated after removing duplicates. Initial screening of titles and abstracts was used to remove articles that were clearly not in scope. Common reasons for exclusion included studies with non-relevant geographical locations (nearly 500 studies were from India, China, Africa, and South America) or crop types (Rice, olive, coffee and grape for example), studies which focused on management methods (type of pest management, weed control, or fertilizer methods), and studies which focused purely on crop yields.

This initial exclusion reduced the number of relevant articles to 774, which were categorised into three groups: consumer/ farmer attitudes and behaviour, economics and environment. The articles within these groups were subject to a more detailed screening of the abstracts and a total of 323 studies were included in the final database. Table 3 shows the breakdown of these studies. Environmental studies were by far the most favoured theme (194 of 323 studies), with a particular focus upon habitat diversity and species richness (n=137). There were relatively low numbers of study outcomes directly related to humans. i.e. human health (n=17),

labour (n=14), attitude (n=28) and behaviour (n=26). The number of studies with outcomes related to climate change (n=22) was also relatively low. A full database containing all the included studies is available as an additional excel file (Additional File 1).

Since 2014, the number of studies relevant to the inclusion criteria, has been lower than the relevant number of studies in 2005 (Figure 1).

Of the 323 studies included, 266 studies categorised 'conventional' farming as a comparative system to organic farming. This categorisation by authors was over twenty times more common than any other comparator (Figure 2).

Table 3. Total number of studies found within each of three categories in the Rapid Evidence Assessment

Theme	Number of studies
Environment	194
Economic	117
Consumer/ Farmer attitudes and behaviour	44

N.B studies covering more than one theme were categorised in multiple groups

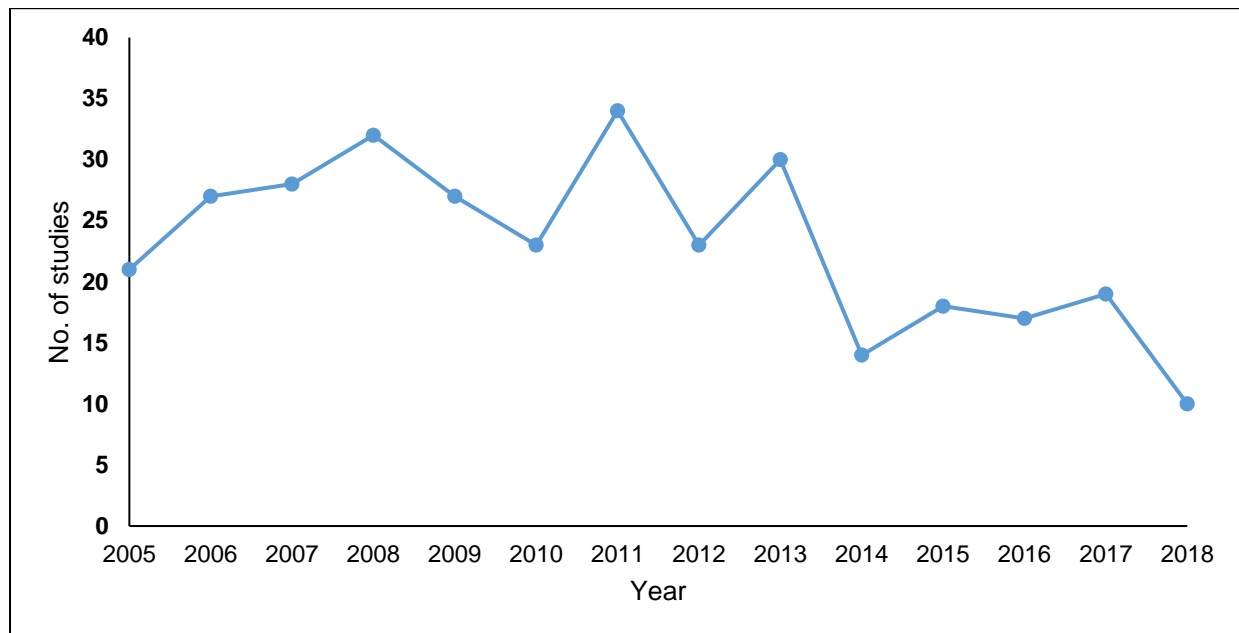


Figure 1. The number of studies per year (2005-2018*) in the systematic map database. **N.B.** Studies were recorded until July 2018.

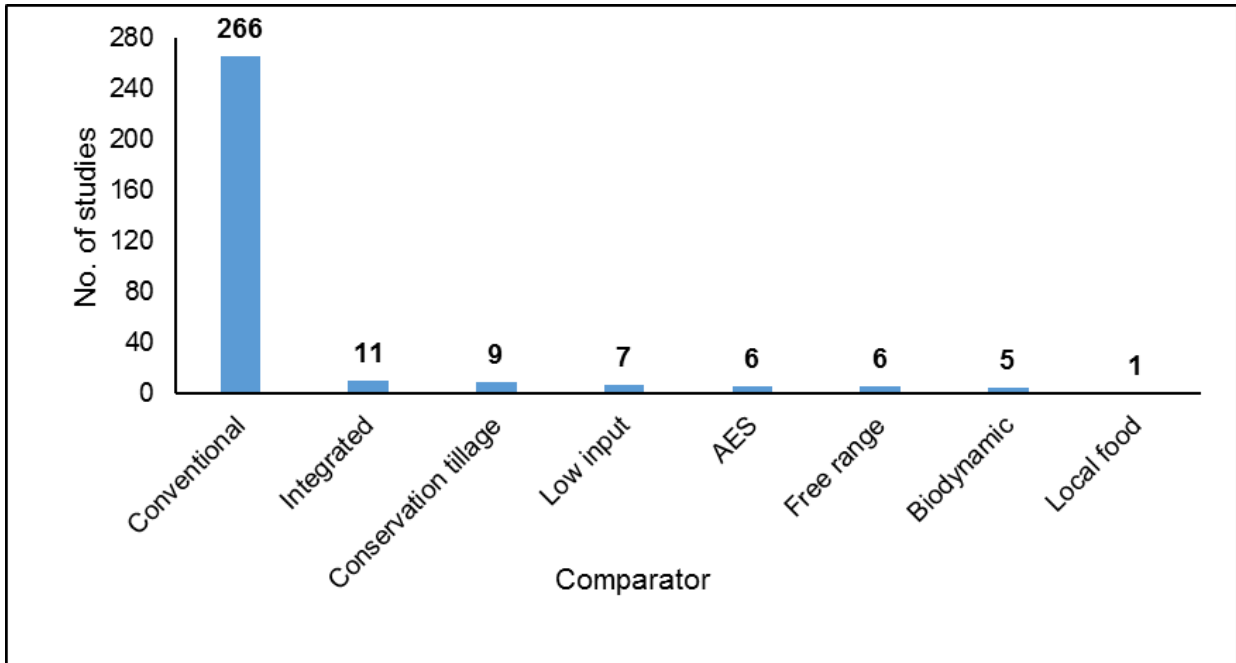


Figure 2. The number of studies for each comparator system to organic farming.

Habitat/species richness was the most frequent outcome (137 studies), reflecting the greater environmental focus across the studies (Figure 3). Inputs, economics, disease levels and chemical and biological variation were also common outcomes of the studies.

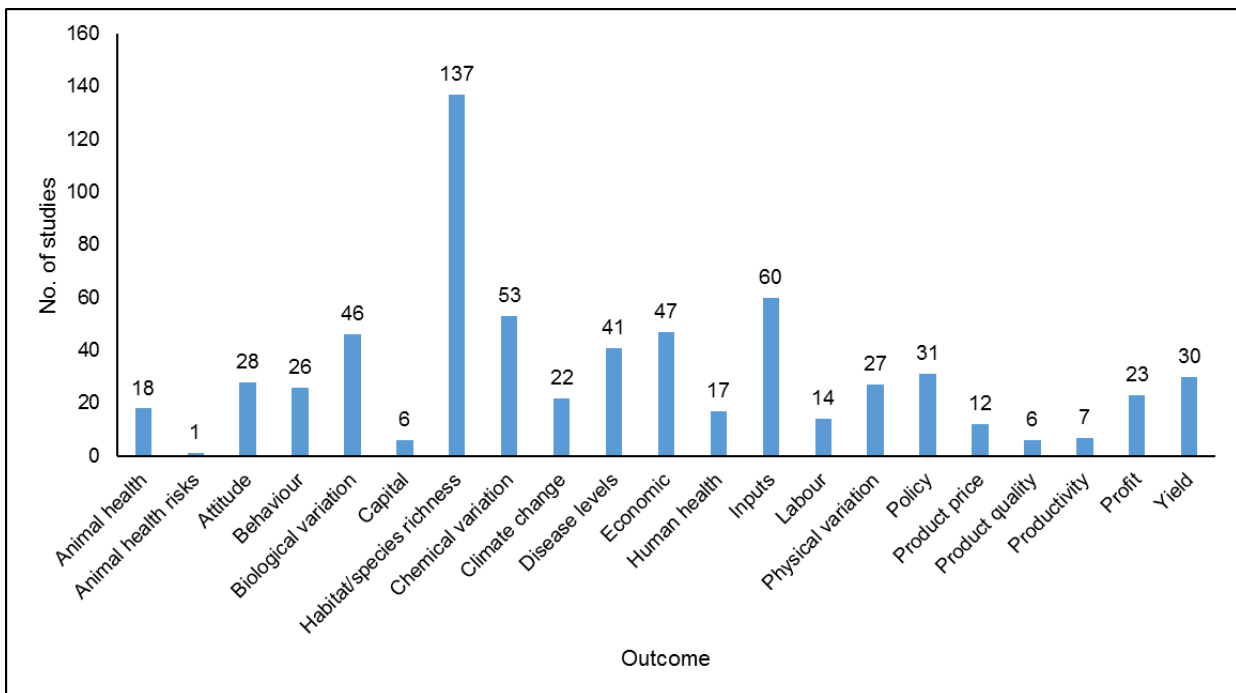


Figure 3. The number of studies related to the outcome categorisations. **N.B.** Outcome was reported on frequency of appearance within the study papers and therefore an outcome with a greater number of studies does not necessarily reflect greater importance.

2.4.1. Consumer/farmer attitudes and behaviour

A total of 44 studies passed the inclusion criteria under the main theme of consumer/farmer attitudes and behaviour, sharing themes with environment and economic categories.

Author objectives and study designs were highly variable, but some of the author conclusions included the following*:

- Organic certification logos are perceived positively by the public, whom are willing to pay a premium for Soil Association and Organic Farmers and Growers certified produce.
- UK consumers are motivated to buy organic through health and environmental concerns.
- Organic is associated with local trade.
- Consumers are frequently unable to distinguish between details of certification schemes.
- Organic farmers are more likely to perceive their farm as part of the natural environment, however both conventional and organic farmers are recognised as having a positive attitude towards on-farm biodiversity and animal health.
- Inspection cost is a key factor in uptake of organic certification on small farms.
- Young organic farmers are most likely to diversify on-farm activities.
- Farmers converting to organic are more likely motivated by financial reasons rather than ideological and lifestyle choices.
- Some “essentially organic” low-input farms have developed a positive attitude towards environmentally-conscious farming, however lack understanding to successfully implement complete organic management strategies.

2.4.2. Economics

A total of 117 studies passed the inclusion criteria under the main theme of economics. Studies initially included under the theme of disease and pests were later integrated under this category. Shared themes included environment and consumer/farmer attitudes and behaviour.

Some of the study authors reported*:

- Mixed conclusions on the profitability of organic vs conventional management.
- Conventional management yields were significantly higher than organic.
- Accounting for increased machinery and input costs generally provides organic farmers with a greater net return.
- The organic premium was an important factor in profitability, organic farms not always satisfactorily compensated.
- Larger organic farms more often have greater financial success and stability than smaller organic farms.
- Organic farms require greater labour, which could support additional local jobs and positively impact the economy of rural communities.
- Organic management provides added value to the land through improved environmental performance and ecosystem services.

- Direct payments important to the financial viability of organic farms.
- Organic farms are variable in their success i.e. breeding cattle yields consistently greater economic results than field crops.
- Mixed evidence of farm management type determining disease incidence.
- Mastitis was consistently higher in conventional dairy systems.

2.4.3. Environment

A total of 117 studies passed the inclusion criteria under the main theme of environment. Shared themes included economics and consumer/farmer attitudes and behaviour.

Some of the conclusions from authors included the following points*:

- Organic management most frequently supported greater biodiversity relative to conventional management i.e. pollinators, natural enemies, farmland birds, arable weeds, and soil bacterial and fungal populations.
- Non-marketable ecosystem services were supported and increased under organic management i.e. flood management and reduced soil erosion, eutrophication and acidification potential.
- Organic management possessed the greatest potential for environmental benefits in homogenous landscapes, an effect generally diminished with increasing landscape complexity.
- Recommendations that Agri-Environment Schemes should be more adaptive and integrate more regional-scale schemes.
- Soil health characteristics are largely benefited by organic management i.e. enhanced carbon sequestration, aggregate stability, infiltration, earthworm diversity and activity. Compaction and run-off were negatively affected.
- No-till practices were frequently observed to support comparable, and in some cases superior, enhancements to soil health characteristics.
- Organic management's effect for soil organic carbon content was mixed.
- Parameters of climate change i.e. global warming potential, greenhouse gas emissions and energy intensity, had conflicting outcomes in studies comparing organic and conventional management.
- Long-term organic farming has the potential to deplete soil phosphorous.
- Heavy metal contamination was greater under conventional management.
- On-farm non-cultivated habitats are equally important on organic and conventional farms for harbouring improved on-farm biodiversity.
- Caution required in direct comparisons between organic and conventional management due to broad variability in commitment to environmental practices within each management category.

* NOTE: No quality appraisal of any studies took place as part of this rapid evidence assessment. This means that we do not necessarily support any of the findings reported by individual authors.

3. SWOT analysis

An analysis of strengths, weaknesses, opportunities and threats (SWOT analysis) for organic farming in Scotland was carried out.

3.1. Methods

The SWOT analysis was compiled using *commonly discussed topics* from the REA together with some *key findings from the Scottish Organic Action Plan Consultation (The Scottish Government, 2016)*, in which *farmers, growers and consumers* were consulted. (*Detailed findings from the 2015 consultation can be found at: https://www.sruc.ac.uk/downloads/120636/scottish_organic_action_plan Key issues*)

3.2. Results

The findings of the SWOT analysis are presented in Table 4. The SWOT analysis was used to inform the stakeholder consultation that followed (see Section 4).

Table 4. SWOT analysis for organic farming in Scotland.

	Strengths	Weaknesses	Opportunities	Threats
Production and market trends	<ul style="list-style-type: none"> -Increased demand for organic produce. -Rise in number of Scottish certified organic processors. 	<ul style="list-style-type: none"> - Decreasing area of Scottish land which is organic and in conversion (since 2011). -Decreasing certified organic livestock and producers (since 2011). -Yield gap between organic and conventional. -Land tenure a barrier to organic production. 	<ul style="list-style-type: none"> -Increased demand from consumers, retailers, wholesalers or the food service sector could drive organic production up. -Young farmers most likely to diversify activities and produce organically. -More diverse varieties and livestock genetics would benefit organic production. 	
Profitability	<ul style="list-style-type: none"> -Higher margins in organic production. -Larger organic farms have greater financial success. 	<ul style="list-style-type: none"> -Organic premium doesn't always satisfactorily compensate farmers. -Increased risk and uncertainty. -Smaller organic farms have lower financial stability. 	<ul style="list-style-type: none"> -Competitive ability of organic would improve with a carbon or pesticide tax (researchers found that overall energy use was lower in organic systems) 	
Subsidies	<ul style="list-style-type: none"> -Added value to the land through improved biodiversity and ecosystem services. 	<ul style="list-style-type: none"> -Current AES measures do not account for organic farming improving environmental performance in simple landscapes and less so in more complex landscapes. -Direct payments important to the financial viability of organic farms. 	<ul style="list-style-type: none"> -Accounting for environmental and health externalities to reflect all aspects of produce. -Greater value from AES could be gained through regionally targeted schemes. 	<ul style="list-style-type: none"> -Continued investment in inefficient AES.

Supply chains		-Lack of consistent, cost-effective and reliable inputs for pest, weeds and disease control. -Inconsistent availability of organic produce in shops and markets	-Increased public procurement contracts opportunities could increase organic uptake by farms. -Improved organic infrastructure could increase organic production.	
Local economy	-Organic farms demand greater labour.	-Availability of labour and affordable rural housing for workers.		
Training/ education		-"Essentially organic" farms have positive attitude towards organic but lack technical understanding.	-Improved access to training and advice could increase uptake in currently non-organic farms.	
Certification	-Consumer trust in certification bodies and labels.	-Weak consumer awareness of difference between certification labels. -Administrative and financial barriers to receiving organic certification on farms operating "organically" particularly small farms.		-An 'expectation gap' between organic certification and what consumers expect organic food to deliver.
Consumer behaviour	-Consumers willing to pay a premium. Desire to support British farmers with fair prices. -Consumers motivated by health, environmental concerns, animal welfare, social benefits and taste.	-Excessive price a barrier to consumption. -Lack of awareness of complete benefits of organic farming. -Expectation that organic produce is locally grown.	-A large occasional consumer base to be exploited.	-consumers may pick locally grown produce over organic produce
Biodiversity	-Organic farmers more often perceive their farm as part of the natural environment. -Biodiversity increased relative to conventional. -Benefits greatest in simple landscapes.			
Ecosystem services (ES)	-Non-marketable ES supported and increased e.g. flood control, pollination, natural enemies. -Generally improved soil health characteristics (comparative to no-till management).	-Evidence of long-term depletion of soil phosphorus content.	-Target management of soil organic carbon to offset climate change potential.	

4. Stakeholder consultation - Table of Priorities

To help identify areas for future prioritisation for the organic sector in Scotland, benefits and barriers, identified in the SWOT analysis, were prioritised in order of importance by members of the Scottish Organic Forum together with some of their members and contacts.

4.1 Methods for gathering stakeholder opinion on priority areas for action

Key benefits and barriers to Scottish farming, as identified in the SWOT analysis, were summarised into two lists. The two lists highlighted key environmental and socio-economic benefits and barriers to organic farming in Scotland. Each list was circulated to members of the Scottish Organic Forum. Members were invited to rate the benefits and barriers for organic farming on importance (High, Medium or Low), difficulty of addressing (Hard, Moderate or Easy) and identify which major groups could be best targeted to address them (Farmer, Consumer or Other). A mean from the ratings of importance from the 19 respondents was calculated to assess the groups' collective opinion. The items on each list were ranked in order of importance according to the respondents (Tables 5 and 6), and the order of importance was correlated cross-tabulated against the ease of actions to address the barrier or highlight the benefit (Figures 4 and 5).

4.2. Results of the stakeholder consultation

4.2.1. Benefits

Table 5 shows the potential benefits of organic farming in Scotland in order of importance according to the stakeholder group. The group thought that the benefit rated most important to organic farming in Scotland by respondents was (A) Increased demand for organic produce (Table 5). Figure 4 compares the most importance of each benefit with the ease of addressing. Generally the benefits considered most important were also thought to be the ones which could most easily be targeted in with future action. The benefit rated most difficult to address in any future prioritisation was (S) Improved diversity of varieties and livestock genetics to benefit organic producers.

The benefits highlighted as potential targets for future policy due to their high importance in relation to perceived ease of addressing were: (A) Increased demand for organic produce, (B) Organic farming supports greater biodiversity than conventional farming, (D) Organic farming generally supports improvement of soil health characteristics, and (E) Organic subsidies add value to the land by supporting greater biodiversity and ecosystem service provision.

Respondents most commonly highlighted farmers as the major target group for addressing the benefits stated within the table of priorities (Table 5).

Table 5. List of environmental and socio-economic benefits to organic farming in Scotland in order of mean importance – A (most important) - T (least important) – and the main group(s) to target to address each one, according to respondents.

	Benefit	Target group
A	Increased demand for organic produce	Consumer
B	Organic farming supports greater biodiversity than conventional farming	Farmer
C	Organic consumers are motivated to purchase by taste and health, environmental, animal welfare and social concerns	Consumer
D	Organic farming generally supports improvement of soil health characteristics	Farmer
E	Organic subsidies add value to the land by supporting greater biodiversity and ecosystem service provision	Farmer/ Other
F	Management of soil organic carbon to offset climate change potential on organic farms	Farmer
G	Potential for realisation of more committed organic consumers through the existing large occasional organic consumer base	Consumer
H	Potential for increased competitive ability of organic farms with introduction of carbon and/or pesticide taxes	Farmer/ Other
I	Organic farmers more often perceive their land as part of the natural environment	Farmer
J	Greater non-marketable ecosystem services provided by organic farming than conventional farming	Farmer
K	Consumers willing to pay a premium for organically labelled produce	Consumer
L	Rise in number of Scottish certified organic processors	Farmer
M	Improved organic infrastructure could increase conversion appeal	Farmer
N	Opportunities for higher margins comparative to conventional farming	Farmer
O	Organic farms require greater labour which could generate more local jobs	Farmer
P	Greater access to training and advice on organic management could increase uptake	Other
Q	Improved financial stability with increasing size of organic farm	Farmer
R	Improved efficiency of organic subsidies by designating proportionally greater subsidies in regions with low habitat and landscape complexity. This recognises the improved environmental benefit of organic management in such regions	Other
S	Improved diversity of varieties and livestock genetics would benefit organic producers	Farmer/ Other
T	Young organic farmers are more likely to diversify on-farm activities	Farmer

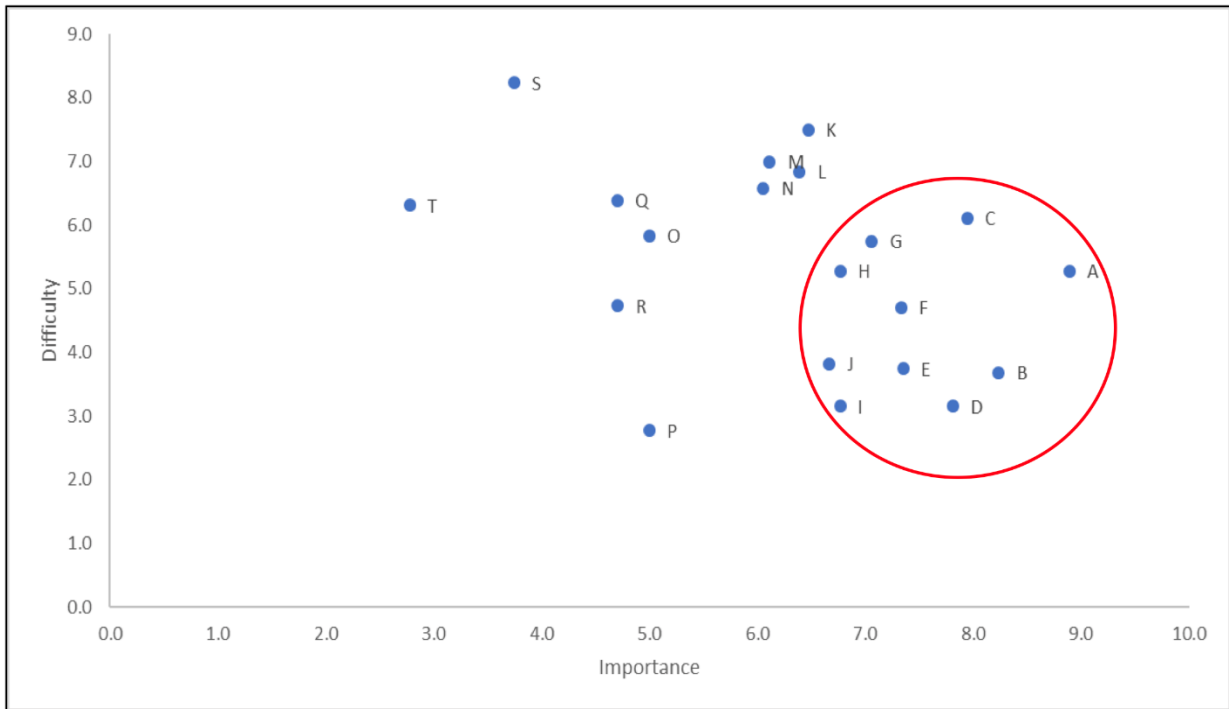


Figure 4. The correlation between mean importance of environmental and socio-economic benefits to organic farming in Scotland and the difficulty of addressing them (see Table 6 for key). Letters within the red circle represent priorities that could be considered targets for future policy due to their high importance and perceived ease of implementation. **N.B.** Metric calculation: For importance, a rating of High (H) scored 10, Medium (M) 5 and Low (L) 0. For difficulty, a rating of Hard (H) scored 10, Moderate (M) 5 and Easy (E) 0. The scores were totalled for each benefit/barrier and divided by the total number of responses, resulting in a mean score between 0 (lowest importance/easiest to address) and 10 (highest importance/hardest to address).

4.2.2. Barriers

The barrier rated by respondents as the most important to organic farming in Scotland was (A) Poor awareness of the complete benefits of organic farming (Table 6). The barriers rated equally as the most difficult to address were: (C) Reduced certified organic livestock and crop and (G) Reduced organic and in-conversion Scottish land area and producers (Figure 5)

The barriers highlighted as potential targets for future policy, due to both high importance and perceived ease of addressing were: (A) Poor awareness of the complete benefits of organic farming, (B) Direct payments important to financial viability of organic farms, (E) Inconsistent availability of organic produce in markets and supermarkets, and (F) Consumer knowledge of organic certification is low and is often not distinguished from alternative environmental certification i.e. LEAF.

Respondents most commonly highlighted farmers as the major target group for addressing the proposed barriers (Table 6). However, consumers were thought by the stakeholder group to be the priority target for addressing their most important barrier to organic farming (poor awareness of the complete benefits of organic farming).

Table 6. List of environmental and socio-economic barriers to organic farming in Scotland in order of mean importance – A (most important) - T (least important) – and the main group(s) to target to address each one, according to respondents.

	Barrier	Target group
A	Poor awareness of the complete benefits of organic farming	Consumer
B	Direct payments important to financial viability of organic farms	Farmer/ Consumer
C	Reduced certified organic livestock and crop producers (since 2011)	Farmer
D	Organic premium doesn't consistently compensate farmers	Farmer
E	Inconsistent availability of organic produce in markets and supermarkets	Consumer
F	Consumer knowledge of organic certification is low and is often not distinguished from alternative environmental certification i.e. LEAF	Consumer
G	Reduced organic and in-conversion Scottish land area (since 2011)	Farmer
H	Excessive organic pricing limits purchases	Consumer
I	Low availability of labour and affordable rural housing to accommodate workers	Farmer
J	AES measures do not account for variable environmental performance of organic management in landscapes of different complexity	Other
K	Limited financial stability for smaller organic farms	Farmer
L	Some farms keen to gain organic certification are restricted by a lack of technical understanding of organic management	Farmer
M	Financial and administrative barriers to organic certification - particularly on small farms	Farmer/ Other
N	Trust in production standards and inspection schemes related to the mandatory EU organic certification label is low	Consumer/ Other
O	Yield gap between non-organic and organic production	Farmer
P	Expectations gap between what consumers expect of organic production and the reality of organic certification	Consumer
Q	Evidence of long-term soil phosphorus depletion on organic farms compared to non-organic	Farmer
R	Organic farms experience increased financial risk and uncertainty	Farmer
S	Inconsistent supply and lack of availability of reliable and cost-effective organic inputs for pests, weed and diseases control	Farmer
T	Land tenure limits organic production	Farmer

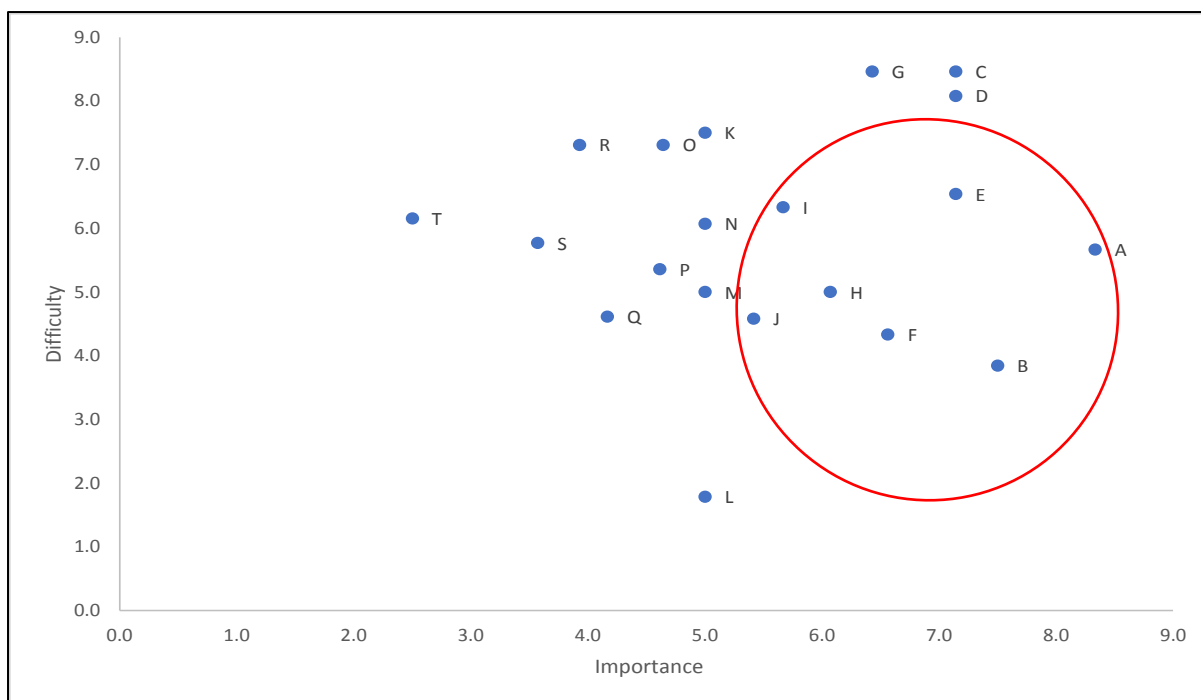


Figure 5. The correlation between mean importance of environmental and socio-economic barriers to organic farming in Scotland and the difficulty of addressing them (see Table 7 for key). Letters within the red circle represent priorities that could be considered targets for future policy due to their high importance and perceived ease of implementation. N.B. Metric calculation: For importance, a rating of High (H) scored 10, Medium (M) 5 and Low (L) 0. For difficulty, a rating of Hard (H) scored 10, Moderate (M) 5 and Easy (E) 0. The scores were totalled for each benefit/barrier and divided by the total number of responses, resulting in a mean score between 0 (lowest importance/easiest to address) and 10 (highest importance/hardest to address).

5. Scottish Organic Forum Workshop

A workshop was held to enable members of the Scottish Organic Forum to discuss more detailed ideas for future actions to address some of the priorities identified throughout the REA, SWOT analysis and prioritisation by stakeholders.

5.1. Methods

On the 8th January 2019, seven members of the Scottish Organic Forum convened at a workshop hosted by the Scottish Government and led by representatives of Harper Adams University and the James Hutton Institute. The members of the Scottish Organic Forum present included, working organic farmers, Soil Association Scotland, SRUC and the Scottish Organic Producers Association. Attendees were presented with the outcomes from the Rapid Evidence Assessment and The Scottish Organic Action Plan Consultation (2016). They were asked to discuss the outcomes, contribute with additional recommendations that were outside of the REA's scope and identify how the Scottish Government could address the priorities in consideration of importance and feasibility.

During the workshop attendees were invited to add to the benefits and barriers outlined in the tables of priorities (Table 6 & 7) with key priorities of their own. The

combined outcomes were used to form a STEEP (social, technical, environmental, economic and political) framework (Appendix 2), evaluating the different external impacts to organic farming in Scotland from both a production and consumption perspective.

5.2 Results

The group highlighted a poor perception of organic farmers in the wider agri socio-economic sphere and the need for greater support through public policy and funding as additional issues fundamental to organic farming in Scotland.

Following this, the group proposed a total of 15 significant actions that could be taken to address points within the STEEP framework (Appendix 3). To ensure manageable outcomes from the workshop for the Scottish Government, attendees were asked together to prioritise key actions, accounting for their importance, feasibility, timescale of implementation, and ability to address multiple priorities simultaneously. These key actions, their current status and who could address them were identified as:

Cooperation in utilising and promoting Scottish organic produce.

Cooperatives offer farms reduced price sensitivity due to economies of scale and present the opportunity to pool resources for wider promotion of Scottish organic produce and also improve the supply chain (see the Quality Meat Scotland campaign, supported by the Scottish Government with £200,000 funding). This could be addressed by encouraging a model of collaboration across the board, supported by the Scottish Government through greater funding and policy implementation (the implementation of the Danish Government's organic model https://en.mfv.dk/fileadmin/user_upload/FVM.dk/Dokumenter/Landbrug/Indsatser/Oekologi/7348_FVM_OEkologiplanDanmark_A5_PIXI_English_Web.pdf

has been linked with a 24 percentage point median increase in organic food use in public kitchens for example (Sørensen et al.,2016)).

Investment in increasing public understanding of organics.

Facilitate a greater awareness of the full benefits of organic farming to consumers i.e. positive contributions to the environment and public health. Develop a strategy to aid the normalisation of organic produce to reduce divisiveness and the stigma of exclusivity both internally and externally. This could be addressed by the Scottish Government enabling greater transparency in promotional materials. Promoting educational schemes at schools would enable young people to understand the origin of their food, the different ways it is produced and what the social and environmental consequences of this production are, from an early age.

Link to public procurement.

The normalisation of organic food could be supported further with a greater emphasis on procurement of organic produce in the public sector i.e. canteens and hospitals. Public procurement is a means of achieving social and environmental policy outcomes and a case can be made to decision makers about the power of food to benefit Scotland's rural economy and environment.

Investigate, facilitate and broker supply/demand of organic produce in Scotland.

Ensure a detailed understanding of the organic market prior to initiatives being established to support increased Scottish organic production so as to prevent under/oversupply within the supply chain. This could be addressed by completing assessments of different supply chains i.e. how many animals are in a supply chain. Caledonian Organics, as the only Scottish organic red meat cooperative, provide assessments of the number of animals within the supply chain. Caledonian Organics have stated they could provide more complete information with additional resources i.e. funding from the Scottish Government. Expansion to supply chain assessments of other commodities could also be supported.

Discussions within the workshop were productive, with organic industry experts engaging with outcomes of the REA in the context of their own and their organisation's experiences of the challenges and opportunities faced in organic farming in Scotland. The key outcomes of the workshop were recommendations characterised as both important and feasible. It should, however, be considered that despite the outcomes being a product of representatives from dairy farms, mixed farms, Soil Association Scotland, SRUC and the Scottish Organic Producers Association, there were only seven members present.

6. Conclusions

The Rapid Evidence Assessment of the environmental and socio-economic barriers and benefits of organic agriculture in Scotland identified a variety of key themes and knowledge gaps in the literature relating to this topic:

Within the parameters of the inclusion criteria, environmental studies were by far the most favoured theme (194 of 323 studies), particularly studies based around diversity of habitats and species. There were comparatively few studies (n=22) that considered the influence of external drivers for change, such as climate change. Socio economic studies were far less common than environmental studies, although those that were available considered a broad variety of topics such as economic, health, labour and price issues.

The most common comparator described within studies was conventional (n=266), although the meaning of 'conventional' and the wide variations that this may encompass was not often discussed in the literature.

There has been a general decline in the number of studies per year since 2013, suggesting that there has been a reduction in funding for organic research studies across the included countries in recent years.

There were only 21 research studies found that considered consumer attitude or behaviour, but the Scottish Organic Action Plan consultation (https://www.sruc.ac.uk/downloads/120636/scottish_organic_action_plan Key issues) incorporated consultations of consumers, which highlighted price and availability as key barriers to organic consumption.

The SWOT analysis and prioritisation of actions highlighted by the Scottish Organic Forum members suggested that most priority actions should be aimed at farmers, and these ideas were refined further in the stakeholder workshop.

Some implications of this work are highlighted below:

6.1. Implications for policy

To help address a decline in the number of relevant studies since 2013, and to facilitate a more detailed insight into the complexities of organic farming in Scotland, the Scottish Government could provide greater funding opportunities for organic farming research, particularly in socio-economic studies.

Farmers were generally thought by members of the Scottish Organic Forum to be easier targets to address actions towards than consumers, although a lack of awareness by consumers of the benefits of organic farming could be an area of future focus. Biodiversity and other environmental factors associated with organic farming have been highly studied and may offer an area for promotion to farmers and consumers.

The Scottish Organic Forum is a valuable resource when collating information and knowledge of current and existing programmes that may help address priorities for action.

6.2. Implications for research

The systematic map database provides a summary of the existing evidence, however further primary research is necessary to provide more detailed insights into the complexities of the drivers of and barriers to organic farming in Scotland.

There is scope for further research into the the socio-economic aspects of Scottish Organic Farming, particularly relating to studies considering the health and employment implications of organic agriculture.

It would also be useful to carry out more studies into the potential implications of future regional and global change scenarios on organic decision-making.

In order to develop a more comprehensive understanding of organic farming in relation to other non-organic systems, it would be useful for future primary research to place a greater focus on the variants of organic and of non-organic, and consider more comparisons with named practices to benefit the environment i.e. integrated management, low-input and conservation tillage.

6.3. Implications for future synthesis

More focused future evidence syntheses on some of the subtopics included in this work would provide greater detail and opportunities for critical appraisal, which was not viable within the scope of this review.

It would also be useful to periodically add to the systematic map database as new relevant research is carried out. This would contribute to an evolving and up-to-date reference of literature relevant to environmental and socio-economic impacts to organic farming in Scotland.

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Appendices

Appendix 1. Basic search terms used to refine final search strategy

#	Search term(s)	Hits
1	Environment* AND Organic	127,358
2	Environment* AND Organic AND Agricultur*	10,507
3	Environment* AND Organic farming	5,253
4	"organic farming"	4,585
4a	"Organic farm*"	5,606
5	"Organic farming" AND Environment*	1,371
6	"Organic agricultur*"	2,216
7	"Organic agricultur*" AND Environment*	754

Table 9. Population search terms (adding terms sequentially)

8	Environment* OR Water*	4,564,227
9	Environment* OR Water* OR Soil*	4,934,913
10	Environment* OR Water* OR Soil* OR Biodiversity	4,988,350
11	Environment* OR Water* OR Soil* OR Biodiversity OR "Climate change"	5,061,944
12	Environment* OR Water* OR Soil* OR Biodiversity OR "Climate change" OR "rural econom*"	5,063,837
13	Environment* OR Water* OR Soil* OR Biodiversity OR "Climate change" OR "rural econom*" OR Consumer*	5,238,610
14	Environment* OR Water* OR Soil* OR Biodiversity OR "Climate change" OR "rural econom*" OR Consumer* OR Farm*	5,279,354

Table 10. Qualifying search terms

15	UK AND ("Consumer Behavio*" OR "Farm* behavio*" OR "Consumer attitude*" OR "Farm* Attitude*")	336
16	"Consumer Behavio*" OR "Farm* behavio*" OR "Consumer attitude*" OR "Farm* Attitude*"	13,523

Table 11. Combined search terms

17	#4 and #14	3,318
18	#6 and #14	1,629
19	#4 OR #6	6233
20	(#4 OR #6) AND #15	0
21	(#4 OR #6) AND #16	65
22	(#4a OR #6) AND #14	6750

Appendix 2. STEEP framework of barriers to organic farming in Scotland using outcomes of the REA and The Scottish Organic Action Plan Consultation (2016).

(*) denotes distinct additions by the group of Scottish Organic Forum attendees to additional barriers they perceived

	Social	Technical	Environmental	Economic	Political
Production	<p>C- Reduced certified organic livestock and crop producers (since 2011)</p> <p>G- Reduced organic and in-conversion Scottish land area (since 2011)</p> <p>I- Low availability of labour and affordable rural housing to accommodate workers</p> <p>*Poor perception of organic farmers in the wider agri socio-economic sphere</p>	<p>L- Some farms keen to gain organic certification are restricted by a lack of technical understanding of organic management</p> <p>O- Yield gap between non-organic and organic production</p>	<p>Q- Evidence of long-term soil phosphorus depletion on organic farms compared to non-organic</p>	<p>B- Direct payments important to financial viability of organic farms</p> <p>D- Organic premium doesn't consistently compensate farmers</p> <p>K- Limited financial stability for smaller organic farms</p>	<p>J - AES measures not accounting for variable environmental performance of organic management in landscapes of different complexity</p> <p>M - Financial and administrative barriers to organic certification</p> <p>S - Inconsistent supply and lack of availability of reliable and cost-effective organic inputs for pests, weed and diseases control</p> <p>*Greater support needed through public policy and funding</p>
Consumption	<p>A- Poor awareness of the complete benefits of organic farming</p> <p>N- Low trust in production standards and inspections</p> <p>P- Expectations gap of what consumers expect of organic and reality</p>				

Appendix 3.

Table 12. Actions discussed by Scottish Organic Forum members to address the environmental and socio-economic benefits and barriers to organic farming in Scotland.

Action	Methods to address it	Facilitator (Current/Proposed)
Promoting organic through lower pricing		Retailers
Cooperation – utilise and promote Scottish Organic produce i.e. campaign support reflecting Quality Meat Scotland	Via policy & funding	Scottish Government
Invest in promotion for consumers (canteens, schools), promote public sector procurement		
Greater transparency i.e. Swedish Government campaign on pesticides in urine		
Application of Scottish organic labelling	Feasibility analysis fund	Soil Association (ongoing)
Create an emotional value to organic produce for consumers i.e. Food Citizens, and limit divisiveness and exclusivity	Promotion to buy consumers into the organic story	
Developing the local organic supply chain	Project ongoing assessing mobile abattoirs in Rural Innovation Support Service (RISS) group (Innovative Farmers, 2019a)	Soil Association (ongoing)
Investigate, facilitate, broker supply and demand of Scottish organic produce		Caledonian Organics (ongoing)
Provision of ongoing support for implementation of AES/ Investigate specific organic approach under a new AES equivalent post-Brexit	Policy needs to agree a provision of support	
More adaptive governance of AES	Determine whether AES is appropriate for future organics payments or a stand-alone fund?	
A focus on markets rather than farmers		
Relaxation of immigration policy for farm workers	Encourage short-term farm work i.e. WWOOF	
Incorporate agroecology into education		
Education and normalising people's perceptions of organic production		
Internal education schemes as part of certification for farmers already practicing organically	Ongoing Soil Association Scotland services include: RISS (Innovative Farmers, 2019), Farming programmes (The Soil Association, 2019) and troubleshooting by certification officers.	Soil Association (ongoing)



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