

Establishing an agricultural knowledge and innovation system

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1 Executive summary

Transformation in agricultural land management is critical to achieving Scottish Government's aims of mitigating climate change, addressing the biodiversity crisis, and achieving a just transition for land and agriculture. Providing advice and collaborative learning opportunities through the Farm Advisory Service (FAS) is the key mechanism to deliver behaviour change in the agricultural sector. The Scottish Government is seeking to better integrate the FAS into an agricultural knowledge and innovation system (AKIS) for Scotland. AKIS is a system of innovation which links organisations, institutions, incentives and funding. This research comprises an evidence review and options appraisal for an agricultural knowledge and innovation system (AKIS) for Scotland.

1.1 Options appraisal

Our research considered 35 options in detail, across 6 themes. A summary table is given in the following section 1.3. The most promising options we identified are as follows:

- Developing a governance mechanism with clear remit and authority for the AKIS in Scotland. Some form of oversight, strategic planning and evaluation is required in order to bridge existing gaps and reduce duplication of service.
- The term 'AKIS' should be revisited, as it is not a recognisable term for most participants in Scotland.
- There is a need for regionalisation and specialisation of AKIS structures. This suggests a 'matrix model' where national initiatives intersect with regional hubs.
- AKIS events at regional and national levels, to encourage cross fertilisation and networking. Face-to-face and virtual visits abroad would help build international networks and increase access to specialist expertise.

- Peer-to-peer learning was recognised as critical to innovation: popular options include increasing monitor farms, on-farm demonstration and establishing farmer field schools.
- Investing in the future of the land sector can be achieved through embedding land-sector skills in the Scottish educational system, with clear pathways for young people of differing abilities to enter the sector.
- Although digital innovation hubs and new web-based platforms had inconsistent support from stakeholders, academic research has shown that benchmarking desirable practices and outcome indicators at farm level can be powerful for motivating behaviour change.
- Direct pathways from research to application on-the-ground need to be further developed for all of the main research institutions in Scotland. SEFARI Gateway (Scotland's Centre of Expertise for knowledge exchange and innovation) could be a key actor in this process.

Our research identified the following enablers, which are fundamental prerequisites to the success of many of the options:

- Provision of basic skills training and ongoing access to IT assistance could be the single most beneficial means of increasing the use of digital tools in the sector.
- Developing a strong pool of skilled workshop and networking facilitators.
- Long-term funding and a joined-up policy approach are key to addressing gaps and duplication of service provision.

It is important to note that crofters' small-scale and often remote locations create particular challenges for an effective national AKIS.

- Support for peer-to-peer learning is particularly important for crofters.
- Crofters are less likely to benefit from private sector support and therefore require additional support.

1.2 Conclusion

Creating a responsive, inclusive AKIS for Scotland requires carving new pathways between actors, and rethinking service provision. The Farm Advisory Service has had very positive reviews to date. Pursuing many of the options identified would represent a major re-organisation and re-allocation of resources. Detailed planning and consultation would be required to ensure that new approaches add value. Expansion of supports to cohorts in addition to farmers and crofters (e.g., foresters, community land owners, new landowners primarily focused on carbon offsetting or rewilding) will require reorientation of resources or increased investment. A collaborative approach across policy areas (e.g., to include Education and Skills, Rural Affairs, and Net Zero) would be required to achieve an effective, system-wide transformation.

1.3 AKIS options summary table

Option	Strengths	Weaknesses	Opportunities	Threats
Creating a unified AKIS				
1. Institutionally integrated AKIS	<p>One-stop shop for land managers.</p> <p>Reduce duplication of service and address gaps.</p>	Very expensive to achieve (logistical barriers).	<p>Could build on the current FAS.</p> <p>Direct alignment to emerging needs.</p>	<p>No stakeholder support for this option.</p> <p>Over-centralisation could make it unwieldy</p>
2. Direct Supports to a broader range of organisations	<p>Actively enrol a diverse array of organisations in advice provision.</p> <p>Broaden the reach of advisors.</p>	Potential for duplication and bureaucracy associated with allocating funding.	<p>Increased collaboration: different organisations providing specific services.</p> <p>Competition between potential service providers could increase quality.</p>	<p>Limited stakeholder support for this option.</p> <p>Potential for fragmentation.</p>
3. Formal AKIS Governance Structure: AKIS Secretariat and/or Oversight Board	<p>Mechanism for strategic direction.</p> <p>Mechanism for identifying and bridging gaps</p>	Challenging to reconcile competing interests.	<p>Empower stakeholders to direct AKIS development.</p> <p>Mechanism to identify and address gaps.</p>	<p>Could become bureaucratic and political.</p> <p>Requires a clear remit.</p>
4. Strategic Plan for AKIS	Achievement of Scottish Government's aims for the AKIS require a clear vision, scope and plan.	Increases bureaucracy.	<p>Should bring together multiple policy areas (e.g., agriculture, land use, education).</p> <p>Aligns with EU policies.</p>	Good governance is important to ensure opportunities for participation of a wider group.

Option	Strengths	Weaknesses	Opportunities	Threats
5. Establish Regular AKIS Evaluation	<p>Evaluation is a fundamental component of any progressive service.</p> <p>Establishment of suitable KPIs can ensure that changes occur.</p>	Requires a clear specification and tendering process.	Evaluation would assist in identifying gaps and establishing benchmarks.	Measurement of the impact of advice is challenging. Over reliance on KPIs can limit creativity.
Regionalisation and specialisation				
6. National Knowledge Hubs	<p>Enable specialist advisors to be identified and equipped.</p> <p>Simplify access to specialist advice.</p>	Administrative burden: coordination of FAS with non FAS organisations (e.g., QMS).	Could build on existing initiatives e.g., Scottish Pig Industry Leadership Group.	Focuses resources on existing sectors; may not lead to transformative change.
7. Crofting Think Tank	Highlight the specific needs and importance of crofters.	<p>Add further bureaucracy to crofting.</p> <p>Scotland has many small farms which are not crofts.</p>	Could act as an integrator.	May duplicate or complicate a widespread regional approach.
8. Expand KTIF (Knowledge Transfer and Innovation Fund) and Operational Groups	Enable broader range of stakeholders to participate.	Requires additional financial support and coordination.	Could build on the networks of regional NFUS staff.	Lack of trained facilitators.
9. Environmental Clusters	Support environmental actions which are suited to the region.	Reliant on trained facilitators.	Build on existing 'farming clusters' and initiatives across Europe.	Nature-based systems take years to become successful; lack of immediate results risks loss of support.

Option	Strengths	Weaknesses	Opportunities	Threats
10. Regional Green Sector Investment Groups	Mobilises private capital for environmental benefit.	May be overly influenced by private sector priorities.	Allows for regional creativity.	May not be equally feasible in all regions.
11. Regional AKIS hubs	Tailored assistance suitable to the region. Enables peer learning.	Concentration in some regions may limit access for advice for those producing commodities which are not common in their regions.	Strong support from stakeholder groups.	National actors may struggle to effectively engage in multiple regions.
Supporting peer-to-peer learning and farmer collaboration				
12. Expand Monitor Farms	Highly valued by the industry for integrating peer learning and professional advice.	Value for money: expensive to run, limited number of farmers participate. Delivery by multiple partners can be disjointed.	Development of benchmarking groups could enable farmers to track and compare progress. Integrating more environmental objectives.	Currently industry-led; could become bureaucratic to organize and fund many more.
13. Establish networks of (commercial) farms which host one-off demonstrations.	Clear benefits to local learning, exposure to different approaches.	Potential for poor quality demonstrations.	Create a culture of openness and innovation amongst farmers and crofters.	High costs – host farmers may not want to make the investment of time and resources.
14. Identify Innovative Ambassador Farmers and Crofters to actively promote innovations.	Augments knowledge available from peer farms and creates a platform for intentional influence.	Needs to be accessible to ‘normal’ farmers; could create an ‘us and them’ perception.	Potential to increase global engagement of participants and their networks.	Failure to increase pool; insufficient diversity.
15. Innovation competitions	Enables access to funding for development or implementation of novel approaches.	Deciding which applications to fund could be challenging; ‘industry disruptors’ may not get funded.	Connects research, advisors and land managers.	Could become exclusive, focus on incremental ‘safe’ innovations.

Option	Strengths	Weaknesses	Opportunities	Threats
16. Farmer (Field) Stable Schools	Positive stakeholder support. Facilitates peer learning and benchmarking.	Expensive if rolled out extensively. May not add value if participants already know each other.	Could enrol younger people; could introduce competitive elements such as stock judging.	Requires a strong coordination and support team.
17. Fund on-farm demonstration by commercial farmers	Enables more farms to demonstrate. Strong multiplier effect.	Bureaucratic to administer. Potential regional imbalances.	Link to monitor farm programme.	Risk/reward balance.
18. Include funding for on-farm demonstration in research funding	Enables more applied research. Yields practical evidence for farmers.	Achieving good quality trial data is challenging on commercial farms.	Innovations can be adapted to a wide variety of contexts. Researcher learning about local complexities.	Should not be entirely researcher led – needs a partnership approach.
19. Enable Cross Visits	Enables innovation and global engagement.	Benefits difficult to quantify. Expensive.	Build on ERASMUS-type schemes.	Politics of choosing particular individuals, sectors etc.
20. Mentoring	Increase access to specialist experiential knowledge	Burnout of potential mentors	Fully embrace the power of peer-to-peer learning.	Misinformation and liability for resultant decisions.
Promoting diversity and generational renewal				
21. Embed rural skills in the educational system	Raise profile of agriculture and enrol diverse new generation.	Requires substantial reskilling of primary and secondary school educators.	Integrate with Curriculum for Excellence.	Urban/rural disconnect and tensions. Many groups wish to influence national curricula.

Option	Strengths	Weaknesses	Opportunities	Threats
22. Young trained farmer status	Enables entry to the sector of skilled individuals.	Exclusive. Some 25% of the farming population is dyslexic.	Increased investment in education and potential for innovative new courses to be developed.	Discourages other members of the sector from learning new skills.
23. Expand Apprenticeships	Enables entry. Clear pathway to employment. Addresses worker shortage.	Bureaucratic. Current options low paid and unattractive.	Consider professional, private company training programmes.	As above.
24. Training courses specifically for women	Addresses gendered imbalances. Boosts women's confidence and role in the sector.	Seen as exclusionary.	Potential to consider quota on mixed training courses.	Reinforces the idea of women as 'other'.
25. Events tailored to typically marginalised groups	Increases access to advice and services for a wider demographic.	Seen as exclusionary. Can be seen as taking resources away from mainstream farmers.	Childcare provision at meetings and events	Could be construed as critical of family farming.
26. Create opportunities for new entrants of all ages and remove barriers to succession	Enables new skills and energy to enter the sector.	Lack of awareness of existing opportunities. Resource intensive to make system level change.	Provide a suite of services for new entrants through the AKIS.	Difficult to achieve without radical reworking of subsidy system.
Digital opportunities and upskilling				
27. Digital Innovation Hub	Accelerate uptake of digital solutions. Builds digital capacity.	High attrition rate; risk of oversaturation of options.	Enrol peer networks to facilitate learning; enable farmers to create digital tools.	Assumes all digital tools are good. Could widen the digital gap.

Option	Strengths	Weaknesses	Opportunities	Threats
28. Web platforms	Ease of access to information. Enable farmers to compare their performance to others.	Digital literacy and broadband required. Lack of buy-in leads to data omission.	Could reduce information siloes. Could bridge to face-to-face learning opportunities.	Widen the gap. Sensitive data on performance may not be easily shared.
29. Data sharing for benchmarking	Enables farmers to see what is achievable and measure own progress.	Requires access to sensitive data. Collecting standardized data and making it available requires resource	Add value to existing data collected.	Bureaucratic data collection which is not utilised. Data misuse.
30. Virtual demonstration and on-line agricultural shows	Increases access for remote users. Archive for repeated use.	Requires upskilling throughout the AKIS.	Create a culture of on-line learning. Upskill AKIS in on-line content production.	Over reliance on gimmicks and tools.
31. Facebook and Twitter Groups	Widely utilised by wide range of land managers.	Misinformation.	Easily track usage.	Over-saturation of information.
AKIS capacity building				
32. AKIS Networking Events	Enables co-learning and collaboration.	Could be seen as frivolous.	Build a community of like-minded actors.	Lack of buy-in.
33. Training for facilitation	Essential skill for enabling co-innovation and peer learning.	Cost; internal facilitators can be seen as partisan.	Create a network of facilitators to help build critical mass.	Underestimating the value of good facilitation. Facilitators who also offer fee-for- service advice may struggle to facilitate well.

Option	Strengths	Weaknesses	Opportunities	Threats
34. Mandatory CPD for farmers and advisors	Upskilling of farmers and advisors.	Very difficult to achieve equitably.	Create a culture of life-long learning.	Strong industry resistance.
35. Fund commercial farm trials of applied research	Increase up-take of recent scientific advances on farm.	Cost. Data collected often not scientifically rigorous.	Requires a collaborative approach.	Impact of unsuccessful trials.

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3 Glossary / Abbreviations table

Acronym	Term
AHDB	Agriculture and Horticulture Development Board
AKIS	Agricultural Knowledge and Innovation Systems
CAP	Common Agricultural Policy
CPD	Continuing Professional Development
Defra	Department for Environment, Food & Rural Affairs
FAS	Farm Advisory Service
Ha	Hectare
HND	Higher National Qualification
KTIF	Knowledge Transfer and Innovation Fund
LINSAs	Learning and Innovation Networks for sustainable agriculture
NESAAG	North East Scotland Agriculture Advisory Group
NbS	Nature-based Solutions
NFUS	National Farmers Union of Scotland
ONE	Opportunity North East
QMS	Quality Meat Scotland
RHET	Royal Highland Education Trust
RLUP	Regional Land Use Partnership
RSPB	Royal Society for the Protection of Birds
SAYFC	The Scottish Association of Young Farmers Clubs
SBCGPB	Suckler Beef Climate Group Programme Board
SCF	Scottish Crofting Federation
ScotEID	Scottish EID Livestock Traceability Research

SCF	Scottish Crofting Federation
SEPA	Scottish Environment Protection Agency
SG	Scottish Government
SQC	Scottish Quality Crops
SRUC	Scotland's Rural College
SRDP	Scottish Rural Development Programme
SLU	Swedish University of Agricultural Sciences
SUAS	Sustainable Uplands Agri-environmental Scheme
Teagasc	Agriculture and Food Development Authority (Ireland)
YTF	Young Trained Farmer

4 Introduction

Transformation in agricultural land management is critical to achieving the Scottish Government's aims of mitigating climate change, addressing the biodiversity crisis, and achieving a just transition for land and agriculture. Implementation of the new Climate Change Plan, Scottish Climate Change Adaptation Programme, Just Transition Plan for Land and Agriculture, the Vision of Agriculture and Scottish Biodiversity Strategy, as well as the new Land Reform Bill and Circular Economy Bill will require major changes to agricultural practices. Providing advice and collaborative learning opportunities through the Farm Advisory Service (FAS)¹ is the key mechanism for Scottish Government to deliver behaviour change in the agrifood sector.

The Farm Advisory Service (FAS) are lodged within a broader 'Agricultural Knowledge and Innovation System' (AKIS): "a system of innovation, with emphasis on the organisations involved, the links and interactions between them, the institutional infrastructure with its incentives and budget mechanisms" (EU SCAR 2019 p. 13).

The AKIS concept recognises that innovation occurs through collaboration between different farmers, advisors, educators, researchers and industry organisations². The traditional model of advisory service provision is for qualified expert advisors to respond to farmers' needs with specific advice or information. This 'top down' model is effective where the information is specialist and the advisor best positioned to access and transfer this information. However, it largely negates any expectation for farmers or crofters to innovate.

Over the past two decades, land managers have been increasingly recognised as important sources of innovation. The European Commission has promoted the role of 'interactive innovation' through the European Innovation Partnership, with targeted funding for Operational Groups and thematic networks, as well as numerous large-scale research projects. These projects all demonstrate the value of peer-to-peer learning, on-farm innovation, and the importance of trained facilitators to enabling these processes.

Scotland benefits from a diverse AKIS. The Farm Advisory Service is provided by Ricardo ('one-to-one' advice from experts to farmers) and SAC Consulting ('one-to-many' i.e., group activities). There are also a strong set of sectoral organisations that both lobby government

¹ Throughout this report 'Farm Advisory Services' refers to state-funded agricultural advisory services. In Scotland these are currently provided by SAC Consulting and Ricardo.

² The AKIS concept originated in the academic literature in the late 1980s as 'Agricultural Knowledge and Information Systems', but was rebranded as 'Agricultural Knowledge and Innovation Systems' by the European Commission in the early 2010s. The European Commission's Standing Committee on Agricultural Research formed an 'Agricultural Knowledge and Innovation System Collaborative Working Group' which has produced a series of foresight exercises and policy position papers which argued that innovation could progress more rapidly in the agricultural sector if a broader range of actors (farmers, advisors, stakeholder organisations etc) are recognised as sources and collaborators of innovation, rather than recipients. See <https://scar-europe.org/akis-mission-and-aims> The European Commission has also funded over a dozen major research projects in the past decade, which have investigated different aspects of the AKIS. The reports of these projects were included in the grey literature review for this report.

and offer advice to farmers. There are also a wide range of environmental charities which offer environmental advice, and an array of 'private' fee-for-service agronomic and business advisors. In addition, many input suppliers and supply chain actors provide 'free' advice as part of their product or service provision. Accountants, lawyers and bank staff also offer advice to land manager clients. Research shows that farmers, crofters and other land managers most commonly identify their peers (i.e., other farmers and crofters) as their best sources of advice. Scottish Government funds major research providers (SRUC, Hutton, Moredun, Rowett, BROSS) as well as university and college staff focused on research, which provides an evidence base for both government policy and on-the-ground/in-the-field action. There are thus a broad array of individuals and entities which could be considered part of the Scottish AKIS.

This report presents the outcomes of an evidence review and options appraisal for an agricultural knowledge and innovation system (AKIS) for Scotland.

4.1 Aims

This research had the following aims:

- 1) To identify the design and implementation characteristics of AKIS in countries comparable to Scotland
- 2) To identify and appraise options for achieving a new fully integrated AKIS service. These can be grouped:
 - A) Access to high quality advice, training and innovation support:
 - Effective tools and methods for providing advice, and how these can effectively influence a diverse and inclusive array of farmers, crofters, small holders and agricultural estates.
 - Support for collaborative actions (including farmer-to-farmer peer learning, co-development of innovations and innovation support within the AKIS)
 - Maximising farmer and land manager involvement and up-take (including 'hard to reach' farmers and under-serviced groups: women, younger and older farmers; part-time farmers; small holders)
 - Optimised drivers for change to achieve measurable results on the ground
 - Skills development, training and continued professional development (CPD) for agricultural land managers and advisors, and how this training and good practice can be recognised
 - Mechanisms for supporting digital upskilling, digital technology adoption and big data mobilisation
 - B) Increasing collaboration between key actors:
 - Traditional and non-traditional actors (e.g., financial services, input suppliers, processors)

- Between FAS service providers (currently Ricardo Energy & Environment and SAC Consulting)
 - Linkages to agricultural or wide business financial support schemes, publicly funded enterprise and skills networks (e.g., Scottish Enterprise, HIE) and associated agendas
 - Linkages to private and third sector business circles in Scotland international expertise (e.g., EU Farmbook, thematic networks)
 - Integration between advisors and scientists to load the 'back office' of diverse advice suppliers and engage researchers to help farmers and crofters keep pace with rapid development
- 3) To enrol a robust, representative sample of stakeholders from across Scotland in appraising these options. This is important for embedding an impact culture and affecting a paradigm shift in behaviour.

4.2 How can we assess if advice is effective?

It is extremely difficult to measure the impact of advice: there is rarely a one-to-one relationship between advice and action. That is, it is rare for a farmer or crofter to learn about an innovation for the first time at an event or meeting and immediately implement it. Instead, ideas typically build up gradually and land managers seek multiple sources of information before making a decision. The impetus for change may come from outwith traditional sources. For example, Tesco has recently begun requiring suppliers to be LEAF certified.

The reviews of the Farm Advisory Service demonstrate that the majority of farmers who come to the service already have a good idea of the innovation they wish to pursue. Advice is also needed throughout the innovation cycle – from conception throughout the implementation and adjustment processes.

In addition, there are periods of time in which farmers are more motivated to make changes. 'Trigger events' such as changing commodity prices, impending farm succession or disease outbreaks lead farmers to question the status quo. Farmers and crofters experiencing these triggers will be much more open to new ideas. The same event or piece of advice offered to a farmer or crofter experiencing a trigger event will have a much stronger influence than the same event or advice for a land manager who is not responding to a trigger. It could be years before that individual or household is sufficiently triggered to respond to the information. Some farmers and crofters are also more risk averse or have more 'room for manoeuvre' because of the resource base on which they have to draw.

Meetings and events also have important secondary benefits, such as building networks, creating opportunities for peer learning and reducing isolation.

Metrics for evaluating advisory services thus tend to emphasise the characteristics of the service (e.g., breadth and diversity of service provision, training of advisors), volume of activities, as well as feedback and demographic characteristics of service users.

4.3 Research process

The research was designed to address the research aims identified in the call text.

- Aim 1 (comparing AKIS internationally) was addressed by selecting and assessing the AKIS in Belgium, Ireland and Sweden
- Aim 2 (improving advice and collaboration) was addressed through academic and grey literature review, options identified while addressing Aim 1, and feedback from stakeholders
- Aim 3 (enrolling stakeholders) was achieved through six stakeholder workshops and an on-line (shared-document based) e-consultation.

An initial stakeholder analysis comprised of a review of stakeholder consultation responses to recent Scottish Government calls and a list of potential stakeholders provided by the funder. Identified stakeholder organisations were invited to an initial stakeholder consultation in January 2023, where 23 stakeholder organisations were represented (see Appendix 9.1). Representatives from three comparator country AKIS (Belgium, Republic of Ireland, Sweden) participated and gave presentations on their national AKIS. Participants in this meeting identified their vision for the future of Scottish AKIS and identified preliminary options for exploration.

The academic literature review was undertaken utilising a modified Rapid Evidence Appraisal process. Key words along seven domains (agricultural knowledge and innovation, stakeholders, methods of advisory service provision, environmental, farm economy, diversification and life on farms) were identified, yielding 82 key words in total. Key word searches using Web of Science yielded over 3500 unique journal articles; however, many of these articles addressed less developed countries. A total of 350 papers were identified as relevant to a developed world context and abstracts reviewed for relevance. Individual options were identified in 170 papers and summarised in table form (see Appendix 9.6)

The grey literature review combined a dual approach of targeted search of websites (particularly of European Commission funded projects), Scottish organisations identified in the stakeholder scoping exercise. The review included recent reviews of the Scottish FAS and monthly reports, UK FAS organisation websites, and public consultations on agriculture-related policies (e.g., Climate Change Plan, Scottish Climate Change Adaptation Programme, Just Transition Plan for Land and Agriculture, the Land Reform Bill) (see Appendix 9.7). An analysis table of options, sources and salient features was produced.

Five options appraisal workshops and an E-consultation were held in March 2023. Participants from 43 organisations participated in reviewing the strengths, weaknesses, opportunities, strengths, and enablers of the 35 options identified in the evidence review and initial stakeholder workshop (see Appendix 9.2). All invitees (including those who could not attend) were given the opportunity to respond in writing to the on-line e-consultation, which comprises the tables in Appendix 9.8.

4.3.1. Limitations

The research took place on a tight timeline. This limited the time available for in depth literature review and reflection and recruitment of industry participants. The research team emphasised the importance of face-to-face interactions, in order to build foundations for the new AKIS which will secure sectoral buy-in. The on-line events had higher participation than the face-to-face events, with a total of sixty-four participants across the regional workshops. However, the research was successful in engaging a broad range of stakeholder groups (see Appendix 9.1).

4.3.2. Options for integrating applied research

Options relating to objective 2B “Integration between advisors and scientists to load the ‘back office’ of diverse advice suppliers and engage researchers to help farmers and crofters keep pace with rapid development” were limited in number. The challenge of connecting research to practice is ubiquitous throughout Europe. Ireland, with its highly integrated AKIS centred around Teagasc (an organisation which encompasses research and advice), is perhaps the most successful (see Section 5.2). Issues include:

- limited academic incentives for engaging in applied research
- limited research funding for field trials and demonstrations
- lack of translation work to ensure academic research is relevant at farm level
- limited incentives for agricultural advisors to access new research
- limited contact between advisors and researchers

Options relating to creating a unified AKIS (options 1 to 5) and AKIS capacity building (options 31-34) address these issues. Other options include:

- developing clear academic career pathways for researchers who focus on science communication and applied research
- prioritising funding for applied research projects
- recognising researchers for the impact they have had on agricultural production and practices

Elaborating the above three options was deemed to be beyond the scope of the review process.

5 Comparator Countries

Aim 1 of the research was to identify the design and implementation characteristics of AKIS in countries comparable to Scotland, in order to identify potential opportunities and threats to the development of the Scottish AKIS.

5.1 Introduction to the comparator countries

The Republic of Ireland, Belgium and Sweden were selected by the research team for comparison to Scotland. The three countries have in common their location in northern

Europe, their relatively small amounts of arable land, and aging farming populations. A comparison of these countries agricultural sectors can be found in Table 1.

Table 1 Country comparison table

	Belgium	Republic of Ireland	Sweden	Scotland
Total Agricultural Land	1,368,120 ha (2020)	4,920,270 ha (2020)	3,005,810 ha (2020)	5,640,000 ha (2021)
Total arable land	869,280 ha (2020)	1,209,770 ha (2020)	2,538,170 ha (2020)	625,800 ha (2021)
Agricultural holdings	36,880 (2016)	135,037 (2020)	62,937 (2016)	51,356 (2017)
Beef cattle	937,147 (2021)	7,396,200 (2022)	1,466,300 (2019)	424,000 (2021)
Breeding ewes	117,320 (2022)	4,029,140 (2022)	548,900 (2019)	2,565,000 (2021)
Female holders (2016)	14%	11%	15%	8%
Holders over 65 (2016)	8.5%	22%	15%	27% ³

³ Please note that the figures were compiled from multiple sources, based in different years, and are intended for illustrative purposes only. Sources: Total Agricultural Land (2020), Total Arable Land (2020): Cropping pattern statistics, Eurostat https://ec.europa.eu/eurostat/statistics-explained/images/4/4e/StEx_Cropping_patterns_statistics_2020.xlsx

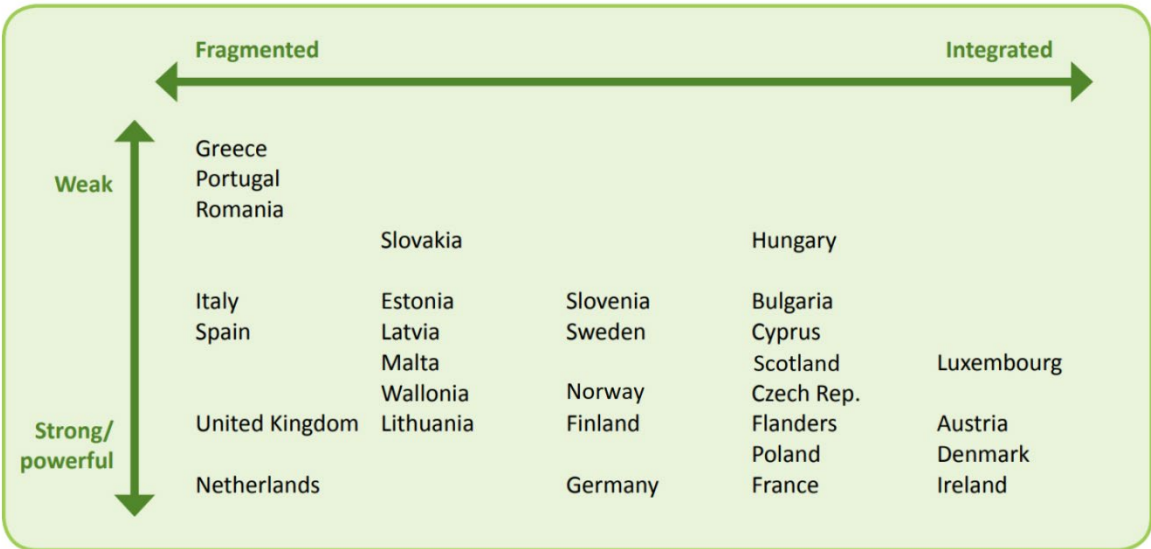
Agricultural holdings (2016), Livestock, Farms: Statistical factsheet, Belgium, European Commission [agri-statistical-factsheet-be_en_0.pdf \(europa.eu\)](#), Census of Agriculture, Central Statistical Office [Introduction and Overview of Results - CSO - Central Statistics Office](#), Statistics Sweden [Number of holdings by size group of arable land \(scb.se\)](#)

Female farm holders (2016): Females in the field [Females in the field \(europa.eu\)](#)

Farm holders over 65 (2016): Eurostat [File:Distribution of working population by age groups, 2016 \(LFS\).png - Statistics Explained \(europa.eu\)](#)

Figure 1 demonstrates the level of integration of AKIS across Europe: the extent to which AKIS actors (e.g., providers of advice, stakeholder organisations and researchers) are directly connected or co-located; and the investment and strength of the AKIS on the sector. The placement of the UK towards the left of the figure largely reflects England’s AKIS, where advice is primarily provided by private companies and is therefore more fragmented. Scotland’s AKIS is more accurately placed just above the Czech Republic. This placement reflects the central role played by SAC Consulting. Although ADAS continues to provide advisory services, service provision is shared across a much wider array of actors and has limited state funding in England. For illustrative purposes, the Scottish AKIS is presented in Appendix 9.3

Figure 1 Characterisation of AKIS across Europe



Source: Sutherland et al. (2023), adapted from Knierim et al. 2015.

Like England and Scotland in the UK, Flanders and Wallonia within Belgium have distinctive AKIS, appearing separately in Figure 1. In Flanders, major providers of agricultural advice include the national farmers union, which offers fee-for service advice on agronomic issues but draws funding from the European Commission to act as a free FAS for environmental and compliance issues.

Ireland is notable for land capability which is similar to Scotland. However, Irish farms are typically smaller and more focused on dairy production. The Irish AKIS is highly integrated, with Teagasc – the Agriculture and Food Development Authority – providing integrated research, advice, and training services to the agrifood industry and rural communities.

Results from the Scottish Agricultural Census: June 2021 (2021) [Results from the Scottish Agricultural Census: June 2021 - gov.scot \(www.gov.scot\)](http://www.gov.scot/results-from-the-scottish-agricultural-census-june-2021)

Sweden also has land capability similar to Scotland, and similar issues with large volumes of less favoured areas and dispersed agricultural population in the north. Like Ireland, its agriculture is more oriented towards dairy. Sweden is notable for identifying almost all its farmers as directly reached by fee-for-service advisors. However, Sweden has also identified a major disconnection between agricultural research – largely undertaken at the Swedish University of Agricultural Sciences (SLU) – and advisory services.

5.2 AKIS in the Republic of Ireland

5.2.1. Agriculture in the Republic of Ireland

- High percentage of small-scale ‘family’ farms based largely around dairy, beef and sheep production.
- 4.9 million hectares of agricultural land.
- Grassland forms 92% of usable agricultural area.
- Around 11% of Ireland’s farm holders are women.
- Around 22% of Ireland’s farm holders are over 65.
- Agriculture is recognised as a major driver of the Irish economy, exporting 80 to 90% of its beef and dairy products.⁴

5.2.2. AKIS in Ireland: Strong and Integrated

Much of the AKIS in Ireland is consolidated into a single organisation – Teagasc – which was formed by the state in 1988. It is part-funded by the Department of Agriculture, Food and the Marine. Teagasc currently comprises seven research centres, seven agricultural colleges and 52 local advisory offices. It also coordinates over 100 demonstration farms. In addition to Teagasc’s over 300 advisors, there are a similar number of smaller commercial advisors and industry members (e.g., input suppliers) who provide advice to farmers. Teagasc estimates that about 75% of Ireland’s farmers are connected to an agricultural advisor. However, research by Kinsella (2018), based at University College Dublin, estimated that less than half of Ireland’s farmers are reached by advisors (i.e. that Teagasc’s estimates are optimistic). Agricultural research is undertaken at TEAGASC and at multiple universities throughout the country. For a diagram of the Irish AKIS, see Appendix 9.4.

5.2.3. Comparison to Scotland

The formation of Teagasc in the late 1980s was counter to European trends towards privatisation of agricultural advice. In the UK – particularly England but also Scotland to some degree – the 1980s and 1990s saw a reduction of state support for agricultural advisory services. However, Scotland has retained an organisation which encompasses research and education: Scotland’s Rural College (SRUC) SRUC employs approximately 1300 staff – about the same number as Teagasc. SRUC operates from 6 campuses, 5 farms, 24 consulting offices, 6 research centres, seven veterinary surveillance centres and a veterinary and analytical laboratory. Scotland also has four other major research providers in addition to SRUC which undertake agricultural research: The James Hutton Institute, The

⁴ <https://www.teagasc.ie/rural-economy/rural-economy/agri-food-business/agriculture-in-ireland/>

Moredun Institute, The Rowett Institute, and the Roslin Research Institute. Agricultural research is also undertaken at Scotland's universities and colleges. Scotland is unique in its 'Centres of Expertise' approach (EPIC, CXC, CREW and SEFARI Gateway).

Teagasc has a strong reputation and Ireland is recognised at European level as having a strong AKIS. Consolidation of the AKIS around one actor has the benefit of reducing duplication and offering a one-stop shop to farmers. Not all Irish farmers are reached; Kinsella (2019) identified Ireland's 'hard to reach' farmers as reflecting two cohorts: those who are elderly with no successor and those who are relatively young and working off farm. Those cohorts, as well as female farmers, are also 'hard to reach' in Scotland (Sutherland et al. 2022)

Teagasc has experimented with a number of approaches, including offering payment to farmers for participating in continuing professional development (CPD). While this can motivate participation, it can also lead to a culture of expectation of payment for participation, and 'box-ticking' by farmers. Any large organisation will have difficulties responding in an agile manner to a rapidly evolving change in demand. Teagasc are also constrained by the funding envelope offered by the Irish government, which limits room for growth.

5.2.4. Opportunities/Options Emergent from the Irish AKIS

- Formation of a single organisation which encompasses the major AKIS actors.
- Increasing numbers of demonstration farms; a strong monitor farm programme
- 'Trained new entrant' certification.
- The Teagasc 'ConnectEd' programme acts as a 'one-stop-shop' for research, education, information and on-line tools.⁵
- 'Local county enterprise boards' – a regional actor which provides direct grant-support to farms and other businesses.
- The CAP Strategic plan proposes to implement 'Knowledge Transfer Groups' formed in accordance with local needs. The groups will be structured to address both centrally determined 'Priority KT topics' based on policy priorities and topics chosen by the groups.
- Teagasc has recently developed an apprenticeship programme, launched in 2021.

5.3 AKIS in Belgium

5.3.1. Agriculture in Belgium

- Flanders and Wallonia have distinct farm structures, averaging 26.7 ha in Flanders and 57.5 ha in Wallonia. 80% of Belgium's small farms have disappeared in the past 30 years.
- 1.4 million hectares of agricultural land.
- Around 14% of Belgium's farm holders are women.
- Around 8.5% of Belgium's farm holders are over 65.

⁵ <https://www.teagasc.ie/about/our-organisation/connected/>

- Flanders's agricultural subsidy structures emphasise investment support, where farmers can receive funding for investments which make their holdings more sustainable.

5.3.2. AKIS in Belgium – Flanders and Wallonia

Belgium has two AKIS structures: Flanders and Wallonia. For diagrams of the Belgian AKIS, see Appendix 9.4. In Flanders, experimental stations provide a link between applied research, farmers and farmers' unions. However, the link between research and advice is considered to be weak by industry experts. In Wallonia, pilot centres, a production college and range of organisations provide resources and support, but this is fragmented. In both Wallonia and Flanders, advice is offered primarily at a regional scale.

5.3.3. Comparison to Scotland

The two Belgian AKIS offer important comparisons to the Scottish AKIS. As is the case in Scotland, both enrol a wide array of actors in the AKIS. The strong role of farmers' organisations in providing advice to their members is a major difference between Belgium and Scotland. An important similarity is that the Flemish government directly supports 12 research stations, and the Wallonia government 11 'pilot centres', which perform practical experiments and host demonstration events. In Scotland, major research providers (e.g., SRUC, The James Hutton Institute) operate 'research farms' where research is undertaken and demonstrations organised. Like Scotland, both Belgian nations recognise that stronger links could be made between research and farming practice.

5.3.4. Opportunities/options emergent from the AKIS in Belgium

- Wallonia included investment in digital technologies in its CAP AKIS strategic plan
- Apiculture (beekeeping) is specifically identified as a topic in the AKIS
- Wallonia is funding an Operational Group which specifically addresses how to link research with practice
- Flanders supports farmers in digitalising their farm management, e.g., through training and advice, demonstration projects and investment support
- Flanders directly supports training centres where farmers receive support to follow a specific training on a chosen subject. Farmers can also visit projects where they learn how results of research can be applied in practice
- Advice in Flanders is largely fee-for-service, provided through advisors employed by major farmer membership associations

5.4 AKIS in Sweden

5.4.1. Agriculture in Sweden

- High percentage of medium scale 'family' farms based largely around cereal production with some dairy and beef production.
- 69% of land is covered in forest; almost half of this forest is privately owned.
- Grassland forms 22% of usable agricultural area.

- Around 15% of Sweden's farm holders are women.
- Around 15% of Sweden's farm holders are over 65.

5.4.2. AKIS in Sweden

Sweden has three types of advisors: commercial, supply chain and publicly funded. Commercial advisors - advisors who work for private companies where provision of agricultural advice is their primary business - are believed to reach almost all Swedish farms. There are three main national providers and 60 to 70 smaller ones. Supply chain actors are companies which provide advice along with a service they provide. For example, the farmer cooperative Lantmännen is a major provider of advice; the cooperative offers advice on the use of the inputs it supplies to farmers. Publicly funded advice solely addresses environmental measures and cross compliance. One university conducts most of the agricultural research in Sweden – SLU (Swedish University of Agricultural Sciences).

Although many farmers are also foresters, forestry is not considered within analyses of AKIS in Sweden.

5.4.3. Comparison to Scotland

Sweden is more reliant on fee for service (i.e., private advice) than Scotland. Like Sweden, the Scottish Agricultural Organisation Society (SAOS) provides advice to its members, as does Ringlink, a large machinery sharing cooperative. As is common amongst highly privatised advisory services, there is a disconnection in Sweden between agricultural advice and academic research. The Swedish Government is attempting to bridge this gap with research funding calls which seek proposals to develop a well-integrated approach to improve joint knowledge creation with advisors and farmers. The country expert from the initial workshop stated that there is still considerable work to be done on making this connection. He also pointed to the importance of facilitators to enable local initiatives.

5.4.4. Opportunities/options emergent from the Swedish AKIS

- The Swedish CAP AKIS strategic plan includes an emphasis on bringing high-speed broadband to sparsely populated areas. This is recognised as benefiting AKIS actors with digital solutions, while also enhancing the attractiveness of rural and sparsely populated areas.
- The Swedish Rural Network organises one large meeting per year for actors and organisations involved in the AKIS.
- The Federation of Swedish Farmers (LRF) has (in the past) funded a regional coach to support farmers as entrepreneurs.
- The Swedish University of Agriculture offers a number of on-line knowledge platforms (e.g., Future Forest, Future Food, SLU Future One Health).
- Public private partnerships: Alnarp is a partnership between SLU, the business and the society with a focus on agriculture and the green sector. It is financed by membership fees for participating firms and organisations and by SLU. The Royal Swedish Academy of Agriculture and Forestry is a network organisation and think

tank working with issues relating to the green sector, and is economically independent of the authorities, business and interest groups (Yngwe, 2014).

- Sweden has 14 green clusters. The clusters aim to strengthen the green sector through cooperation between organisations, business activities and education. The clusters work differently in each area.
- Public private green sector initiatives: there are several examples of initiatives which bring together regional groups, including commercial companies to invest in the green sector. For example, AgroÖst is owned by organisations and companies in the counties Östergötland, Sörmland and Örebro encourages municipalities, regional associations and county administrative boards to invest in the green sector. Agroväst, in the west of Sweden, Agroväst works closely with the agricultural sector to stimulate, initiate and refine activities and projects that benefit the green sector.

5.4.5. National AKIS comparison summary

The comparison of AKIS between Belgium, the Republic of Ireland, Sweden and Scotland demonstrated a number of options for further consideration:

- Option 1: Institutionally integrated AKIS (Ireland - Teagasc).
- Option 9: Environmental Clusters (Sweden – Green clusters).
- Option 10: Regional Green Sector Investment Groups (Sweden – Alnarp).
- Option 11: Regional AKIS hubs (Ireland).
- Option 12: Expand monitor farms (Ireland – local county enterprise boards and Knowledge Transfer Groups).
- Option 21: Embed rural skills in the educational system (Ireland – Teagasc apprenticeship programme).
- Option 22: Young trained farmer status (Ireland).
- Option 28: Web Platforms (Ireland - The Teagasc 'ConnectEd' programme; Sweden 'Future Forest', 'Future Food').
- Option 32: AKIS Networking Events (Sweden – Swedish Rural Network organises an annual AKIS event).

The comparison of the four countries also identified important, underpinning enablers for an effective AKIS:

- Highspeed broadband and digital upskilling (Sweden, Belgium).
- Skilled event and network facilitation (Sweden).

The analysis also demonstrated that the disconnection between research and land management practices are similar across the countries studied, with no simple solutions. Wallonia (Belgium) is funding an Operational Group which specifically addresses how to link research with practice. The formation of such a group is also a recommendation in this report.

6 Options

The literature searches, in combination with the initial stakeholder workshop in Edinburgh, yielded a set of 35 options which were reviewed at the stakeholder workshops across Scotland and on-line. These options were organised under six themes:

- Creating a unified AKIS;
- Regionalisation and specialisation;
- Supporting peer-to-peer learning and farmer collaboration;
- Promoting diversity and generational renewal;
- Digital opportunities and upskilling;
- AKIS capacity building.

Within these themes, participants were encouraged to identify new options and variations, as well as identifying strengths, weaknesses, opportunities, threats, and enabling features of the options presented. A detailed summary of the options assessed can be found in Appendix 9.5.

The following sections detail these themes and the options within them. The sections are structured as follows: details of the desired outcome are outlined; the specific challenges addressed are detailed; specific options are presented and appraised against the results of the evidence review and the stakeholder feedback. The numbering of the 35 options is continuous throughout the document.

6.1 Creating a unified AKIS

The options within this theme address research question 2B: increasing collaboration between key actors. The options specifically concern the formalisation of AKIS governance, i.e., to develop a coordinated innovation ecosystem in Scotland which enables innovation across the land-based business sector. The aim of these objectives is that all relevant actors are connected and acting together to provide an efficient and effective AKIS in Scotland. These options are not mutually exclusive.

6.1.1. Specific options for 'Creating a unified AKIS'

OPTION 1 Institutionally integrated AKIS: Formal integration of the publicly funded organisations involved in AKIS, e.g., FAS and private advisory services, colleges and universities, major research providers. This could take on a number of forms, ranging from full integration of these institutions through to a 'Hub and Spoke' model, where a central organisation coordinates spokes to the major AKIS actors. The spokes would offer more specialist advice grounded in applied research NGOs, charities, and research institutions. There is also the opportunity to more strongly integrate education, training, and advice to create a culture of life-long learning. Teagasc in Ireland is an example of this type of approach.

OPTION 2 Direct supports to a broader range of organisations: Subsidised advice available through membership organisations (e.g., NFUS), charities etc. At present ‘free’ advice is provided through the Farm Advisory Services and input supply companies (who include advice as an element of their sales). This is an alternative to Option 1: instead of integrating the AKIS institutionally, financial resources would be redistributed directly to more organisations. This option would formally recognise and support the role of organisations like SAOS, Scottish Agronomy and SLE who provide advice to their members.

OPTION 3 Formal AKIS Governance Structure: AKIS Secretariat and/or Oversight Board: A governing body, charged with defining roles of participants, bringing together public and private partners to provide a wide (and expanding) range of delivery partners, creating a governance structure, ensuring good knowledge flow between actors, overseeing delivery to minimise fragmentation, identifying gaps in provision, assessing future demand/requirements, developing skills base of advisors (and possibly their accreditation). There is currently a FAS stakeholder group which meets quarterly. This group could form a foundation for the secretariat; it would require a new governance and influence structure.

OPTION 4 Strategic plan for AKIS: AKIS descriptions were required in all EU member state CAP strategic plans for 2023-2027. A similar process could be conducted in Scotland, as part of the Agriculture Bill. AKIS descriptions in the strategic plans are required to include: the organisational set up of the AKIS; a description of how advisors, researchers and CAP networks will work together; and how advice and innovation support services are provided.

OPTION 5 Establish regular AKIS evaluation: Undertake a formal evaluation (e.g., every three years). This process could evaluate key performance indicators: fit to strategic objectives; fit to user needs (current and anticipated future needs of the identified beneficiaries, with the potential to align with local needs rather than one-size-fits-all approach); ability to deliver, including staff skills and knowledge – impact on current delivery team, training requirements; ability to address inequalities; financial assessment; fit with other services/support (seeking to create additional value through joined-up approach).

6.1.2. Options appraisal for ‘Creating a unified AKIS’ options

The bullet points below represent the analysis of the research team, based on the evidence review and stakeholder consultation.

- Formally integrating the institutions involved in the AKIS (Option 1) would be very expensive to do well. Redistributing the FAS funding to a broader group of stakeholders (Option 2) would be complex and risk fragmentation. Neither Option 1 nor Option 2 are recommended
- There is strong justification and stakeholder approval for developing a governance mechanism for the AKIS in Scotland (Options 3 to 5). Some form of oversight,

strategic planning, and evaluation for the AKIS are required in order to bridge existing gaps and reduce duplication of service.

- This mechanism requires a clear remit and authority. An Operational Group could be formed to develop a preferred structure.
- Clear aims and objectives for the AKIS could be identified and KPIs formed.
- The term ‘AKIS’ should be revisited, as it is not a recognisable term for most participants in Scotland. It also emphasises agriculture to the exclusion of other rural industries and businesses. Options include ‘Land Use Knowledge and Innovation System’ or ‘Rural Knowledge and Innovation System’. However, AKIS is the term used in Europe (e.g., SCAR AKIS working group, CAP AKIS strategic plans).

SWOT table for ‘Creating a unified AKIS’

	Strengths	Weaknesses	Opportunities	Threats
OPTION 1 Institutionally integrated AKIS	One-stop shop for land managers. Reduce duplication of service and address gaps.	Very expensive to achieve (logistical barriers).	Could build on the current FAS. Direct alignment to emerging needs.	No stakeholder support for this option. Over-centralisation could make it unwieldy.
OPTION 2 Direct supports to a broader range of organisations	Actively enroll a diverse array of organisations in advice provision. Broaden the reach of advisors.	Potential for duplication and bureaucracy associated with allocating funding.	Could increase collaboration, with different organisations providing specific services. Competition between potential service providers could increase quality.	Limited stakeholder support for this option. Potential for fragmentation.

	Strengths	Weaknesses	Opportunities	Threats
OPTION 3 Formal AKIS Governance Structure: AKIS Secretariat and/or Oversight Board	Mechanism for strategic direction. Mechanism for identifying and bridging gaps.	Challenging to reconcile competing interests.	Empower stakeholders to direct AKIS development. Mechanism to identify and address gaps.	Could become bureaucratic and political. Requires a clear remit.
OPTION 4 Strategic plan for AKIS	Achievement of Scottish Government's aims for the AKIS require a clear vision, scope, and plan.	Increases bureaucracy.	Should bring together multiple policy areas (e.g., agriculture, land use, education). Aligns with EU policies.	Good governance is important to ensure opportunities for participation of a wider group.
OPTION 5 Establish regular AKIS evaluation	Evaluation is a fundamental component of any progressive service. Establishment of suitable KPIs can ensure that changes occur.	Requires a clear specification and tendering process.	Evaluation would assist in identifying gaps and establishing benchmarks.	Measurement of the impact of advice is challenging. Over reliance on KPIs can limit creativity.

6.2 Regionalisation and specialisation

The options within this theme seek to ensure a more targeted AKIS which meets regional and specialist needs. The options within this theme address research question 2A: maximising farmer and land manager uptake.

Scotland's diverse regions have different knowledge needs and ability to access advice. Specialisation is linked to regionalisation, as some commodity types are concentrated within a few regions (e.g., dairy in southern Scotland, arable farming in the east). To meet the challenges of Net Zero, as well as the climate and biodiversity crises, there is also a need for regional and specialist environmental advice. There is also an opportunity to consider expanding the AKIS to include all land managers and their diversification activities.

6.2.1. Specific options for 'Regionalisation and specialisation'

OPTION 6 National knowledge hubs: Bring together participants in a particular supply chain (e.g., dairy, poultry) with government and other relevant participants, to identify challenges and share best practice. Researchers and a budget for applied research could be included in these hubs. For example, in Sweden, "National Knowledge Hubs" address a) animal husbandry, b) ecological sustainability, c) business development and entrepreneurship, d) rural development, and e) local food system. In Wales, the Farming Connect programme has four Development Centres (Dairy, Red Meat, Organic and Land Management).

OPTION 7 Crofting think-tank: Form a multi-stakeholder group to develop bespoke advice and innovation support for crofts and small-scale farms. Group would have budget authority for experimentation and service provision, to enable bespoke crofting services to be developed.

OPTION 8 Expand KTIF (Knowledge Transfer and Innovation Fund) and Operational Groups to all land managers: To effectively reframe the AKIS as involving a broader range of participants (e.g., including forestry, diversified farm businesses and community landowners), it needs to explicitly include these actors. KTIF provides funding to organisations to deliver vocational training, coaching, workshops, courses, and farm visits. Operational Groups bring together multiple actors such as farmers, researchers, advisers, businesses, environmental groups, consumer interest groups or other NGOs to advance innovation through collaborative development of new initiatives or technologies. These resources could be expanded outside of farming to include foresters, community landowners, etcetera.

OPTION 9 Environmental clusters: Initiatives which bring farmers together to address an environmental challenge, supported by a professional facilitator. This group may or may not include other relevant actors. These can include Operational Groups. By working together, helped by an advisor or 'facilitator', farmers and land managers can work more cohesively together in their locality. This enables them to collectively deliver greater

benefits for soil, water, and wildlife at a landscape scale. Agri-environmental schemes may support the application of the work.

OPTION 10 Regional green sector investment groups: Regional organisation or limited company which brings together commercial, public, and charitable investors to sponsor innovation development and applied research for environmental benefit.

OPTION 11 Regional AKIS hubs: Regional hubs where services are co-located, and events to bring together local AKIS actors emerged as strongly important in the stakeholder consultations.

6.2.2. Options appraisal for 'Regionalisation and specialisation'

There was widespread agreement amongst stakeholders on the need for regionalisation and specialisation of AKIS structures. Both national and regional structures were favoured, suggesting a 'matrix model' where national initiatives intersect with regional hubs. National level initiatives on Scotland's primary commodities (e.g., beef and sheep) could intersect with regional hubs which emphasised the commodities produced primarily in particular regions (arable crops, dairy, potatoes etc).

There is also recognition of a need for internationalisation of the AKIS, enabling advisors and land managers to engage with specialists in other countries. This is important for capacity building. Researchers typically already have international networks but would benefit from more active engagement with advisors. Environmental clusters at local and regional level are also beneficial to establish, implement and embed environmental actions.

The specific structure for implementing this set of options requires in depth consideration. There are numerous potential structures; the boundaries of particular sectors and regions may not be easily defined. Crofting is an important subset of Scotland's land managers, already receiving special treatment. Expansion of supports to broader groups will require additional investment of resource. Access to trained facilitators is a key enabler.

SWOT table for 'Regionalisation and specialisation'

	Strengths	Weaknesses	Opportunities	Threats
OPTION 6 National knowledge hubs	Enable specialist advisors to be identified and equipped. Simplify access to specialist advice.	Administrative burden: coordination of FAS with non-FAS organisations (e.g., QMS).	Could build on existing initiatives e.g., Scottish Pig Industry Leadership Group.	Focuses resources on existing sectors; may not lead to transformative change.
OPTION 7 Crofting thinktank	Highlight the specific needs and importance of crofters.	Add further bureaucracy to crofting. Scotland has many small farms which are not crofts.	Could act as an integrator.	May duplicate or complicate a widespread regional approach.
OPTION 8 Expand KTIF (Knowledge Transfer and Innovation Fund) and Operational Groups to all land managers	Enable broader range of stakeholders to participate (e.g., foresters, community land owners).	Requires additional financial support and coordination.	Could build on the networks of regional NFUS staff.	Lack of trained facilitators.
OPTION 9 Environmental clusters	Support environmental actions which are suited to the region.	Reliant on trained facilitators.	Build on existing 'farming clusters' and initiatives across Europe.	Nature-based systems take years to become successful; lack of immediate results risks loss of support.

	Strengths	Weaknesses	Opportunities	Threats
OPTION 10 Regional green sector investment groups	Mobilises private capital for environmental benefit.	May be overly influenced by private sector priorities.	Allows for regional creativity.	May not be equally feasible in all regions.
OPTION 11 Regional AKIS hubs	Tailored assistance suitable to the region. Enables peer learning.	Concentration in some regions may limit access for advice for those producing commodities which are not common in their regions.	Strong support from stakeholder groups.	National actors may struggle to effectively engage in multiple regions.

6.3 Support peer-to-peer learning and farmer collaboration

The options in this section are concerned with increasing on-farm innovation through peer-to-peer learning. The options within this theme address research question 2A: Support for collaborative actions (including farmer-to-farmer peer learning, co-development of innovations and innovation support within the AKIS)

Uptake of innovations and development of new innovation needs to increase in order to address global challenges. Farmers and crofters are often other farmers' and crofters' best source of advice. Farmer-led demonstrations increase innovation uptake. Pioneering farmers take risks to innovate. Enabling farmers to skilfully demonstrate to and advise their peers is an important enabler for innovation.

6.3.1. Specific options for 'Support peer-to-peer learning and farmer collaboration'

OPTION 12 Expand monitor farms: Monitor farms bring together farming peers and advisors with industry representatives, commercial companies, and occasionally researchers, to share farm performance information and observe innovations as they are implemented. Monitor farms host four to six meetings on their farm in a year. Monitor farms are delivered by QMS with support from AHDB, sponsored by Scottish Government, with some input from FAS. Additionally, monitor farms could be increased in number and diversity of topic (e.g., including agri-environment, farm diversification, fruit production); monitor crofts could be established, focusing on townships and common grazings; applied research could be undertaken on monitor farms.

OPTION 13 Establish networks of (commercial) demonstration farms: A coordinated network of demonstration activities on farms within a geographic region; enables farmers to learn from each other and establish best practice across a region.

OPTION 14 Ambassador farmers: Successful, well-respected innovators could be identified and funded to lead events (e.g., on-farm demonstrations, discussion groups). Opportunities to travel to see innovations in other regions, the UK and Europe could be linked to ambassadorship once home. Diversity champions could be appointed to challenge perceptions of farmers, crofters, growers, and foresters.

OPTION 15 Innovation competitions: Individuals or groups working together with their advisors, researchers, entrepreneurs. Prize could be seed money to develop or implement the innovation. Defra's Future Farming and Countryside programme sponsors multiple types of competition (e.g., team development, practical application of theoretical innovation, new product development, work on longer-term innovations).

OPTION 16 Farmer (field) stable schools: A group of farmers within a region are brought together around a similar topic and undertake visits at each other's farms to compare experiences and learn from each other. The concept was developed in Africa and adapted to European conditions.

OPTION 17 Fund on-farm demonstration by commercial farmers: on-farm demonstration events could be included in the options for which farmers can access in under the new Rural

Development Programme from 2025. Funding could cover costs of catering, advertising, training in event design and facilitation etc. This is also an option within the European Rural Development programme.

OPTION 18 Include funding for on-farm demonstration in research funding: Applied researchers could access funding (e.g., through SEFARI gateway) to undertake demonstrations of their innovations on commercial farms.

OPTION 19 Enable cross visits: Exchange visits for land managers, advisors and relevant others to different regions and countries. Typically lasting three to four days and involving four to eight individuals. Such a programme involves a series of farm visits and group discussions. Participants are responsible for promoting what they have learned when they return.

OPTION 20 Mentoring: The FAS mentoring programme for new farmers and crofters is well received and could be expanded to a broader cohort. Mentoring could be made available for anyone pursuing a new approach.

6.3.2. Options appraisal for ‘Support peer-to-peer learning and farmer collaboration’

This section presents the analysis of the research team, based on the evidence review and stakeholder consultation.

Peer-to-peer learning is recognised academically and by stakeholders as highly important to innovation processes.

- Increasing monitor farms, on-farm demonstration and establishing farmer field schools were particularly well received in the consultation, have strong academic support, and are in-line with EU approaches.
- Identifying ambassador farmers, establishing innovation competitions and supporting cross visits have potential, but could be divisive (depending on how ‘innovation’ is defined and critiqued by evaluation panels).
- Mentoring programmes could be expanded to include broader cohorts (i.e., not limited to young people or new entrants).

Supporting peer learning requires substantial resources and high levels and availability of professional facilitation. The costs and benefits of funding the different options would need to be considered, and existing funding models revisited. All the options require good facilitation – there is clear evidence that facilitation is essential to quality interactions, building networks outside the group, and maintaining longevity. However, many traditional advisors may not have the skills to perform this role effectively.

SWOT table for 'Support peer-to-peer learning and farmer collaboration'

	Strengths	Weaknesses	Opportunities	Threats
OPTION 12 Expand monitor farms	Highly valued by the industry for integrating peer learning and professional advice.	Value for money: expensive to run, limited number of farmers participate. Delivery by multiple partners can be disjointed.	Development of benchmarking groups could enable farmers to track and compare progress. Integrating more environmental objectives.	Currently industry-led; could become bureaucratic to organize and fund many more.
OPTION 13 Establish networks of (commercial) demonstration farms	Clear benefits to local learning, exposure to different approaches.	Potential for poor quality demonstrations.	Create a culture of openness and innovation amongst farmers and crofters.	High costs – host farmers may not want to make the investment of time, resource.
OPTION 14 Ambassador farmers	Augments knowledge available from peer farms and creates a platform for intentional influence.	Needs to be accessible to 'normal' farmers; could create an 'us and them' perception.	Potential to increase global engagement of participants and their networks.	Failure to increase pool; insufficient diversity.
OPTION 15 Innovation competitions	Enables access to funding for development or implementation of novel approaches.	Deciding which applications to fund could be challenging; 'industry disruptors' may not get funded.	Connects research, advisors and land managers.	Could become exclusive, focus on incremental 'safe' innovations.

	Strengths	Weaknesses	Opportunities	Threats
OPTION 16 Farmer (field) stable schools	Positive stakeholder support. Facilitates peer learning and benchmarking.	Expensive if rolled out extensively. May not add value if participants already know each other.	Could enroll younger people; could introduce competitive elements like stock judging.	Requires a strong coordination and support team.
OPTION 17 Fund on-farm demonstration by commercial farmers	Enables more farms to demonstrate. Strong multiplier effect.	Bureaucratic to administer. Potential regional imbalances.	Link to monitor farm programme.	Risk/reward balance.
OPTION 18 Include funding for on-farm demonstration in research funding	Enables more applied research. Yields practical evidence for farmers.	Achieving good quality trial data is challenging on commercial farms.	Innovations can be adapted to a wide variety of contexts. Researcher learning about local complexities.	Should not be entirely researcher led – needs a partnership approach.
OPTION 19 Cross visits	Enables innovation and global engagement.	Benefits difficult to quantify. Expensive.	Build on ERASMUS-type schemes.	Politics of choosing particular individuals, sectors etc.
OPTION 20 Mentoring	Increase access to specialist experiential knowledge.	Burnout of potential mentors.	Fully embrace the power of peer-to-peer learning.	Misinformation and liability for resultant decisions.

6.4 Promote diversity and generational renewal in the agricultural sector

The options within this theme address research question 2A: Maximising farmer and land manager involvement and up-take (including ‘hard to reach’ farmers and under serviced groups: women, younger and older farmers; part-time farmers; small holders). These options aim for young people with strong skills and enthusiasm for land-based industry and rural life who are equipped and enabled to pursue careers. It is envisioned that all individuals involved in land management decision-making have access to training and learning opportunities.

Generational renewal is critical to the vitality and innovativeness of land-based economies. Research has shown that younger farmers are more innovative; farmers with successors are more likely to invest in their farm businesses (Potter and Lobley 1996; Calus et al. 2008; Burton and Fischer 2014). Women represent an important resource to the land-based sector but may feel marginalized by events and training opportunities that are primarily attended by men.

6.4.1. Specific options for ‘Promote diversity and generational renewal in the agricultural sector’

OPTION 20 Embed rural skills in the educational system: The agri-food sector is an important source of ‘good green jobs’ for Scotland. To ensure a highly capable and qualified new generation of farmers and agrifood sector workers, the opportunities of these professions need to be promoted and supported at secondary level:

- Create National 5 and Higher qualifications in organic/agroecological food, farming and forestry;
- Promote agri-food jobs to secondary school students (e.g., agrifood career days, work experience placements);
- Establish bridging programmes between secondary schools, colleges and universities;
- Training of teachers and the various types of industry Ambassador, in career possibilities.

OPTION 21 Young trained farmer status: An educational qualification demonstrating competence in farm management and practices. It can be linked to subsidy access. In Ireland, Teagasc offers this certification.

OPTION 22 Expand apprenticeships: Building on existing initiatives such as the Ringlink internship programme, including how best it can be funded sustainably (e.g., potential for wider industry funding), the possibility of a new qualification, and how it can be rolled out nationally. Modern Apprenticeships can be developed to equip young people for occupations in environmental management.

OPTION 23 Training courses specifically for women: Establishment of women-only training courses normalises participation in sectoral training which would otherwise be dominated by men. This option continues the training in ‘Be your Best Self’, ‘Knowing your Business’ and ‘Leadership Development’ for women, which was implemented by Scottish Government on the recommendation of the Women in Agriculture Task Force.

OPTION 24 Events tailored to typically marginalised groups: Events for specific groups, particularly those new to the FAS (foresters, community landowners, etcetera). Other groups who may be marginalised can be addressed through targeted and family-friendly events where childcare is provided. Offering childcare both enables more egalitarian attendance and communicates that women are welcome. Specifically inviting particular cohorts and designing events which meet their needs builds confidence and addresses skills shortages and information needs.

OPTION 25 Create opportunities for new entrants of all ages and remove barriers to succession: This was a theme raised at every workshop. There was considerable support for the (re)introduction of a range of new entrant supports. Existing FONE activities should be developed further, with events for both retiring farmers and successors.

6.4.1. Options appraisal for ‘Promote diversity and generational renewal in the agricultural sector’

Enrolling young and diverse populations in the land sector is critical to addressing the climate emergency, biodiversity crisis and enabling a Just Transition.

- There is widespread agreement amongst stakeholders for the need for land-sector skills to be more strongly embedded in the Scottish educational system, with clear pathways for young people of differing abilities to enter the sector.
- The women in agriculture training approaches remain somewhat controversial – well received by participants in the training, but there are others in the sector (e.g., recent graduates, new entrants) who would also appreciate access to those resources.
- Any emphasis on under-represented groups is likely to gain the criticism that it increases divisions and is exclusionary. Nevertheless, research shows that if the issues are not addressed, they will be slow to resolve themselves (McGuire et al. 2022).

The issues are highly sensitive with potential for mixed messaging around the role of the land sector in climate change mitigation and adaptation, and alternative food consumption choices.

SWOT table for 'Promote diversity and generational renewal in the agricultural sector'

	Strengths	Weaknesses	Opportunities	Threats
OPTION 20 Embed rural skills in the educational system:	Raise profile of agriculture and enroll diverse new generation	Requires substantial reskilling of primary and secondary school educators	Integrate with Curriculum for Excellence	Urban/rural disconnect and tensions. Many groups wish to influence national curricula
OPTION 21 "Young trained farmer" status	Enables entry to the sector of skilled individuals	Exclusive. Some 25% of the farming population is dyslexic.	Increased investment in education and potential for innovative new courses to be developed.	Discourages other members of the sector from learning new skills
OPTION 22 Expand apprenticeships	Enables entry. Clear pathway to employment. Addresses worker shortage.	Bureaucratic. Current options low paid and unattractive.	Consider professional, private company training programmes.	As above.
OPTION 23 Training courses specifically for women	Addresses gendered imbalances. Boosts women's confidence and role in the sector.	Seen as exclusionary.	Potential to consider quota on mixed training courses.	Reinforces the idea of women as 'other'.

	Strengths	Weaknesses	Opportunities	Threats
OPTION 24 Events tailored to typically marginalised groups	Increases access to advice and services for a wider demographic.	Seen as exclusionary. Can be seen as taking resources away from other farmers.	Childcare provision at meetings and events	Could be construed as a critique of family farming.
OPTION 25 Create opportunities for new entrants of all ages and remove barriers to succession	Enables new skills and energy to enter the sector.	Lack of awareness of existing opportunities. Resource intensive to make system level change.	Provide a suite of services for new entrants through the AKIS.	Difficult to achieve without radical reworking of subsidy system.

6.5 Digital opportunities and upskilling

The options within this theme address research question 2A: Mechanisms for supporting digital upskilling, digital technology adoption and big data mobilisation. These options are aimed at land-based businesspeople who are able to easily share information and advice on-line and through social media.

There is a wealth of on-line information available, but it can be difficult to sort through. Digital literacy is an enabler for accessing and sharing information and building networks. The restrictions of the Covid 19 pandemic led to digital upskilling amongst farming and land-sector actors but some have been left behind.

6.5.1. Specific options for ‘Digital opportunities and upskilling’

OPTION 26 Digital innovation hub: support organisations that aim to make businesses more competitive by accelerating the development and uptake of digital innovations. They provide these services close to the end-users (“at working distance”) and thereby cater to the needs of agricultural producers and food processors in a specific region.

OPTION 27 Web platforms: Easy-to-search / utilise portals and web applications. There is a wide variety of data generated through applied research, and through the agrifood chain. Bringing this data together in a way that is easily accessible to advisors and farmers could help to bridge the research/advice gap.

OPTION 28 Data sharing platforms for benchmarking: enable land managers to compare on-farm details to anonymised information from other farms, enabling land managers to see how their efforts measure up, and set achievable targets.

OPTION 29 Virtual demonstration and on-line agricultural shows: On-farm demonstration can be made 'virtual' through live video and virtual tours. Covid 19- related restrictions led to innovative production of events for land managers which have continued to varying degrees.

OPTION 30 Facebook and Twitter Groups: Facebook is widely accessed for information. Access to skilled and competent advice within these groups could improve the quality of information available. Formation of Facebook groups to address specific topics could also improve access to quality information. Options appraisal for 'Digital opportunities and upskilling'

AKIS actors rapidly upskilled during the Covid 19 pandemic. This presents both an opportunity to mobilise these new skills and a widening access gap. There is a plethora of online-resources; any effort to bring these together into a new platform must be undertaken with the buy-in of industry members. It is also important to avoid the assumption that all digital innovations are positive. The substantial investment required to mainstream most of these options must include an achievable plan for up-take and practical use. For example, stakeholder feedback suggests that 'SkillSeeder' omits many mainstream service providers in some regions, reducing its credibility.

There was inconsistent support from stakeholders for most of the options identified. However, academic research has begun to show that benchmarking can be particularly powerful for motivating behaviour change, but it needs to be underpinned by an easy-to-use system. There is growing research evidence of the power of virtual demonstration when done well (Klerkx 2021).

Facebook and Twitter are already well-established mechanisms for information exchange, utilised by the FAS.

The need for basic skills training and ongoing access to IT assistance was identified at multiple stakeholder meetings as an important enabler. Access to training needs to be linked to ongoing support e.g., IT helpdesk and practical application. Technical support is currently fulfilled to some degree on an ad hoc basis (e.g., SRPID office staff).

SWOT table for 'Digital opportunities and upskilling'

	Strengths	Weaknesses	Opportunities	Threats
OPTION 26 Digital innovation hub	Accelerate uptake of digital solutions. Builds digital capacity.	High attrition rate; risk of oversaturation of options.	Enroll peer networks to facilitate learning; enable farmers to create digital tools.	Assumes all digital tools are good. Widen the gap.
OPTION 27 Web platforms	Ease of access to information. Enable farmers to compare their performance to others.	Digital literacy and broadband required. Lack of buy-in leads to data omission	Could reduce information siloes. Could bridge to face-to-face learning opportunities.	Widen the gap. Sensitive data on performance may not be easily shared.
OPTION 28 Data sharing for benchmarking	Enables farmers to see what is achievable and measure own progress.	Requires access to sensitive data. Collecting standardized data and making it available requires resource.	Add value to existing data collected.	Bureaucratic data collection which is not utilised. Data misuse.
OPTION 29 Virtual demonstration and on-line agricultural shows	Increases access for remote users. Archive for repeated use.	Requires upskilling throughout the AKIS.	Create a culture of online learning. Upskill AKIS in on-line content production.	Over reliance on gimmicks and tools.
OPTION 30 Facebook and Twitter groups	Widely utilised by wide range of land managers.	Misinformation.	Easily track usage.	Over saturation of information.

6.6 AKIS capacity building

The options within this theme address research question 2A: Skills development, training and continued professional development (CPD) for agricultural land managers and advisors, and how this training and good practice can be recognised. These options aim to increase the skills and networks of AKIS actors, enabling them to work collaboratively and across the boundaries of their professions or disciplines.

Broadening the AKIS to include a wider array of topics and participants will require active integration across traditional divides. It is increasingly recognized that supporting ‘interactive innovation’ – innovations developed collaboratively – requires a very different skill set from traditional advice provision. Input suppliers, processors, supermarkets and the financial services are active ‘advisors’ in relation to farmers need to be able to access peer and specialist advice across an array of topics; newcomers need signposting and assistance to successfully integrate into the sector. Research structures need to bridge the gap between research and practice.

6.6.1. Specific options for ‘AKIS skill building’

OPTION 31 AKIS networking events: Events which bring together farmers, foresters, advisors, researchers, input suppliers and enterprise specialists to make innovative knowledge and processes for supporting innovation more widely accessible. Industry actors can work with advisors to identify where further support is needed for implementing innovations. Interactions between advisors acts as a form of continuing professional development (CPD).

OPTION 32 Training for facilitation: Provision of continuing professional development (CPD) for new and existing advisors in how to facilitate discussions and innovation collaboration. This training would also be useful to others within the sector, such as farmers, agronomists, and supply chain members who are looking to develop collaborative actions or business strategies.

OPTION 33 Mandatory CPD for farmers and advisors: Participating in Continuing Professional Development (CPD) activities becomes a requirement for accessing subsidies or offering professional advice.

OPTION 34 Fund commercial farm trials of applied research: Farmers trialling new innovations risk considerable out of pocket expense and loss of income. Subsidising commercial farmers to trial and demonstrate these new innovations is a gap in the current system. At present, the Operational Groups fund the facilitation and costs of organising meetings, but not the cost of the intervention pursued.

6.6.2. Options appraisal for ‘AKIS skill building’

AKIS actors already meet on an ad hoc basis at industry events (Option 31). However, there is good justification and stakeholder enthusiasm for AKIS events at regional and national levels, to encourage cross fertilisation and networking.

Facilitation (Option 32) is a key skill for encouraging collaboration, peer-to-peer learning and regional initiatives.

There was strong stakeholder resistance to mandatory CPD (Option 33). While participants recognised the value of ongoing education, they were very concerned about equality of access (available time, geographic proximity or digital capability, quality and variety of courses). While increased access to CPD would be beneficial to most, making it mandatory could further add unintended burdens to farmers and crofters who are located in remote locations or have poor digital connectivity.

Funding sufficient farm trials to demonstrate innovations across the breadth of Scotland's regions would be helpful but very expensive (Option 34).

SWOT table for 'AKIS skill building'

	Strengths	Weaknesses	Opportunities	Threats
OPTION 31 AKIS networking events	Enables co-learning and collaboration.	Could be seen as frivolous.	Build a community of likeminded actors.	Lack of buy in.
OPTION 32 Training for facilitation	Essential skill for enabling co-innovation and peer learning.	Cost. Internal facilitators can be seen as partisan.	Create a network of facilitators to help build critical mass.	Underestimating the value of good facilitation. Facilitators who also offer fee for service advice may struggle to facilitate well.
OPTION 33 Mandatory CPD for farmers and advisors	Upskilling of farmers and advisors.	Very difficult to achieve equitably.	Create a culture of life-long learning.	Strong industry resistance.
OPTION 34 Fund commercial farm trials of applied research	Increase up-take of recent scientific advances on farm.	Cost. Data collected often not scientifically rigorous.	Requires a collaborative approach.	Impact of unsuccessful trials.

6.7 Further observations

Study participants demonstrated that there was also a **lack of awareness of the current breadth of services offered by the FAS** (e.g., that it is possible to access advice from international advisors, and from Scottish advisors not directly employed by the FAS). The services and eligibility criteria would benefit from being widely advertised.

The **scope of the options** appraisal was queried by a number of participants. Aquaculture, beekeeping, and insect production were identified as important topics which were not discussed.

7 Recommendations

The options appraisal identified a number of well-justified actions which could be undertaken, as well as several ‘enabling’ actions: fundamental prerequisites to the success of many of the options.

A. Creating a unified AKIS

- There is strong justification and stakeholder approval for developing a governance mechanism for the AKIS in Scotland (Options 3 to 5). Some form of oversight, strategic planning and evaluation for the AKIS are required in order to bridge existing gaps and reduce duplication of service.
 - This mechanism requires a clear remit and authority. An Operational Group could be formed to develop a preferred structure.
 - Clear aims and objectives for the AKIS should be identified and KPIs formed.
- There was general concern about the term ‘AKIS’, and the suggestion that it should be revisited, as it is not a recognisable term for most participants in Scotland. It also emphasises agriculture to the exclusion of other rural industries and businesses. Options include ‘Land Use Knowledge and Innovation System’ or ‘Rural Knowledge and Innovation System’. However, AKIS is a well-recognised term utilised in Europe (e.g., SCAR AKIS Strategic Working Group, CAP AKIS strategic plans).
- Formally integrating the institutions involved in the AKIS would be very expensive to do well. (Option 1). Redistributing the FAS funding to a broader group of stakeholders would be complex and risk fragmentation (Option 2). Neither option is recommended.

B. Regionalisation and specialisation

- There was widespread agreement on the need for regionalisation and specialisation of AKIS structures. Both national (Option 6) and regional (Option 11) structures were favoured, suggesting a ‘matrix model’ where national initiatives intersect with regional hubs.
 - Environmental clusters (Option 9) at local and regional level are also beneficial to establish, implement and embed environmental actions. These also represent opportunities to integrate private funding from regional actors (Option 10).
 - Regional Land Use Partnerships are important regional actors to include.
- There is also a need for internationalisation of the AKIS, enabling advisors and land managers to engage with specialists in other countries. Researchers typically already have international networks but would benefit from more active engagement with advisors.

The specific structure for implementing this set of options requires in depth consideration. There are numerous potential structures; the boundaries of particular sectors and regions may not be easily defined. Expansion of supports to broader groups will require additional investment of resource. Access to trained facilitators is a key enabler.

C. Peer-to-peer learning

Peer-to-peer learning is recognised academically and by stakeholders as highly important to innovation processes.

- Increasing monitor farms (Option 12), on-farm demonstration (Option 13) and establishing farmer field schools (Option 16) were particularly well received in the consultation and are in-line with EU approaches.
- Identifying ambassador farmers (Option 14), establishing innovation competitions (Option 15) and supporting cross visits have potential (Option 19), but could be divisive (depending on how ‘innovation’ is defined and critiqued by the reviewers of applications for these positions).

Supporting peer-to-peer learning requires substantial resources and high levels and availability of professional facilitation. The costs and benefits of funding the different options would need to be considered, and existing funding models revisited.

D. Promote diversity and generational renewal

Enrolling young and diverse populations in the land sector is critical to addressing the climate emergency, biodiversity crisis and enabling a Just Transition.

- There is widespread agreement amongst stakeholders for the need for land-sector skills to be more strongly embedded in the Scottish educational system (Option 21), with clear pathways for young people of differing abilities to enter the sector.
- The Women in Agriculture training approaches (Option 24) remain somewhat controversial: well received by participants in the training, but there are many others in the sector who would also appreciate access to similar training and resources.
- Any emphasis on under-represented groups is likely to gain the criticism that it increases divisions and is exclusionary (Option 25). Nevertheless, research shows that if the issues are not addressed, they will be slow to resolve themselves.

These issues are highly sensitive with potential for mixed messaging around the role of the land sector in climate change mitigation and adaptation, alternative food consumption choices etc.

E. Digital opportunities and upskilling

AKIS actors rapidly upskilled during the Covid 19 pandemic. This presents both an opportunity to mobilise these new skills and a widening access gap. There is a plethora of on-line resources: any effort to bring these together into a new data platform or resource must be undertaken with the buy-in of industry members. For example, stakeholder feedback suggests that 'SkillSeeder' omits many mainstream service providers in some regions, reducing its credibility.

It is also important to avoid the assumption that all digital innovations are positive. The substantial investment required to mainstream most of these options must include an achievable plan for up-take and practical use.

There was inconsistent support from stakeholders for most of the digitisation options identified. However, academic research shows that benchmarking of specific practices and outcomes can be powerful for motivating behaviour change. Any benchmarking process needs to be underpinned by an easy-to-use system. There is growing research evidence of the power of virtual demonstration (e.g. on-line events with live demonstrations) when done well.

F. AKIS capacity building

There is good justification and stakeholder enthusiasm for AKIS events at regional and national levels (Option 32), to encourage cross fertilisation and networking.

There was strong stakeholder resistance to the implementation of mandatory CPD (e.g., through links to subsidy access) (Option 34). While participants recognised the value of ongoing education, they were very concerned about equality of access (available time, geographic proximity or digital capability, quality, and variety of courses).

Although establishing a clearer pathway between research and on-farm application was identified as important, no strong options emerged. A task force or Operational Group could be formed, potentially through SEFARI Gateway, to address this need. Issues include the disconnection between applied research and academic career progression, and the difficulty collecting scientific data through trials on commercial farms.

- Funding sufficient farm trials is a recognised gap in the pathway from research to application; however, to demonstrate a range of innovations across the breadth of Scotland's regions would be very expensive.

Enablers

The need for basic skills training and ongoing access to IT assistance was identified at multiple stakeholder meetings as an important enabler. Access to training needs to be linked to ongoing support e.g., IT helpdesk and practical application. Technical support is currently fulfilled to some degree on an ad hoc basis (e.g., SRPID office staff).

Most of the options require good facilitation (Option 33) – there is clear evidence that facilitation is essential to quality interactions, building networks outside the group, and maintaining longevity. Many traditional advisors may not have the skills to perform this role effectively. Therefore, recruitment and training of facilitators, and ensuring that every AKIS member has at least one member of staff capable of fulfilling facilitation functions, is critical for AKIS to develop along the lines described.

Clear opportunities for continuing professional development and career progression in the facilitator role are also required.

8 Conclusions

Creating a responsive, inclusive AKIS for Scotland requires carving new pathways between actors, and rethinking service provision. Although the Farm Advisory Service (FAS) has had very positive reviews, pursuing many of the options identified would represent a major re-organisation and allocation of resources. Detailed planning and consultation would be required to ensure that new approaches add value. Expansion of supports to cohorts in addition to farmers and crofters will require reorientation or increased investment. A collaborative approach across policy areas (e.g., to include Education and Skills, Rural Affairs, and Net Zero) would be required to achieve an effective, system-wide transformation.

9 Appendices

9.1 Stakeholder organisations represented at the national workshop

1. Crop Health and Protection Scotland (CHAP)
2. Innovation Support Center for Agricultural & Rural Development, Belgium (INNOVATIESTEUNPUNT)
3. James Hutton Institute
4. Moredun
5. National Farmers Unions Scotland (NFUS) New Entrant Forum
6. Nature Friendly Farming Network (NFFN)
7. NatureScot
8. Nourish Scotland
9. Pastures for Life
10. Quality Meat Scotland (QMS)
11. Ricardo
12. Royal Society for the Protection of Birds (RSPB)
13. SAC Consulting (SAC)
14. Scotland's Rural College (SRUC)
15. Scottish Crofting Federation (SCF)
16. Scottish Enterprise
17. Scottish Environmental Protection Agency (SEPA)
18. Scottish Tenant Farmers Association (STFA)
19. Swedish University of Agricultural Sciences
20. Teagasc Advisory Service, Ireland

9.2 Stakeholder organisations represented at the regional workshops

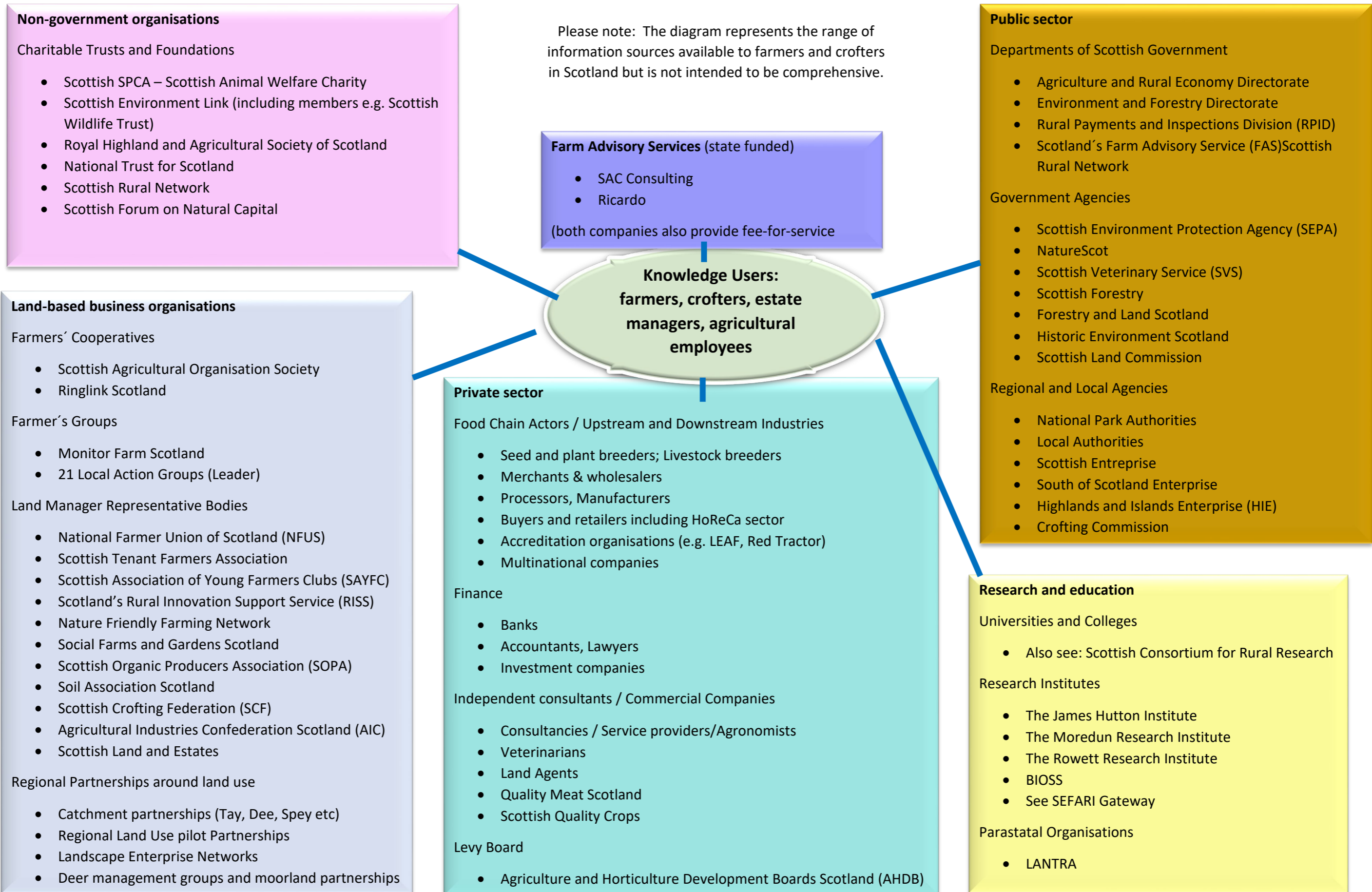
1. Aberdeen City Council
2. Aberdeenshire Council North East Scotland Agriculture Advisory Group (NESAAG)
3. Allathan Associates
4. Association for the Protection of Rural Scotland (APRS)
5. British Veterinary Association (BVA)
6. Brodies LLP Solicitors
7. Community Development Lens (CoDeL)
8. Cream o' Galloway
9. Crofting Federation member
10. Crop Health and Protection (CHAP)
11. Freelance consultant specialising in agroecological food and farming systems
12. Galloway and Southern Ayrshire Biosphere Partnership Board
13. Global Academy of Agriculture and Food Systems, University of Edinburgh
14. Highlands and Islands Enterprise (HIE)
15. Hutchisons Crop Production Specialists (HLH)
16. Institute of Chartered Foresters (ICF)
17. James Hutton Institute
18. Lantra
19. National Association of Agricultural Contractors (NAAC)
20. National Office of Animal Health (NOAH)
21. NatureScot
22. Nature Friendly Farming Network (NFFN)
23. National Farmers Union Scotland (NFUS)
24. National Sheep Association Scotland (NSA)
25. Quality Meat Scotland (QMS)
26. Reforesting Scotland
27. Regenerative Farming Network South West Scotland
28. Royal Society for the Protection of Birds (RSPB)
29. Rurali Limited

30. Soil Health Group (Dumfries and Galloway Sustainable Food Partnership)
31. SAC Consulting (SAC)
32. Scotland Food and Drink
33. Scotland's Rural College (SRUC)
34. Scottish Agricultural Arbiters and Valuers Association (SAAVA)
35. Scottish Agricultural Organisation Society Limited (SAOS)
36. Scottish Agronomy Limited
37. Scottish Crofting Federation
38. Scottish Environment Protection Agency (SEPA)
39. Scottish Enterprise
40. Scottish Forestry
41. Scottish Government Rural Communities and SRN Unit
42. Scottish Government Rural Payments and Services (SGRPID)
43. Scottish Land and Estates (SLE)
44. Scottish Rural Action (SRA)
45. Soil Association Scotland
46. South of Scotland Enterprise (SOSE)

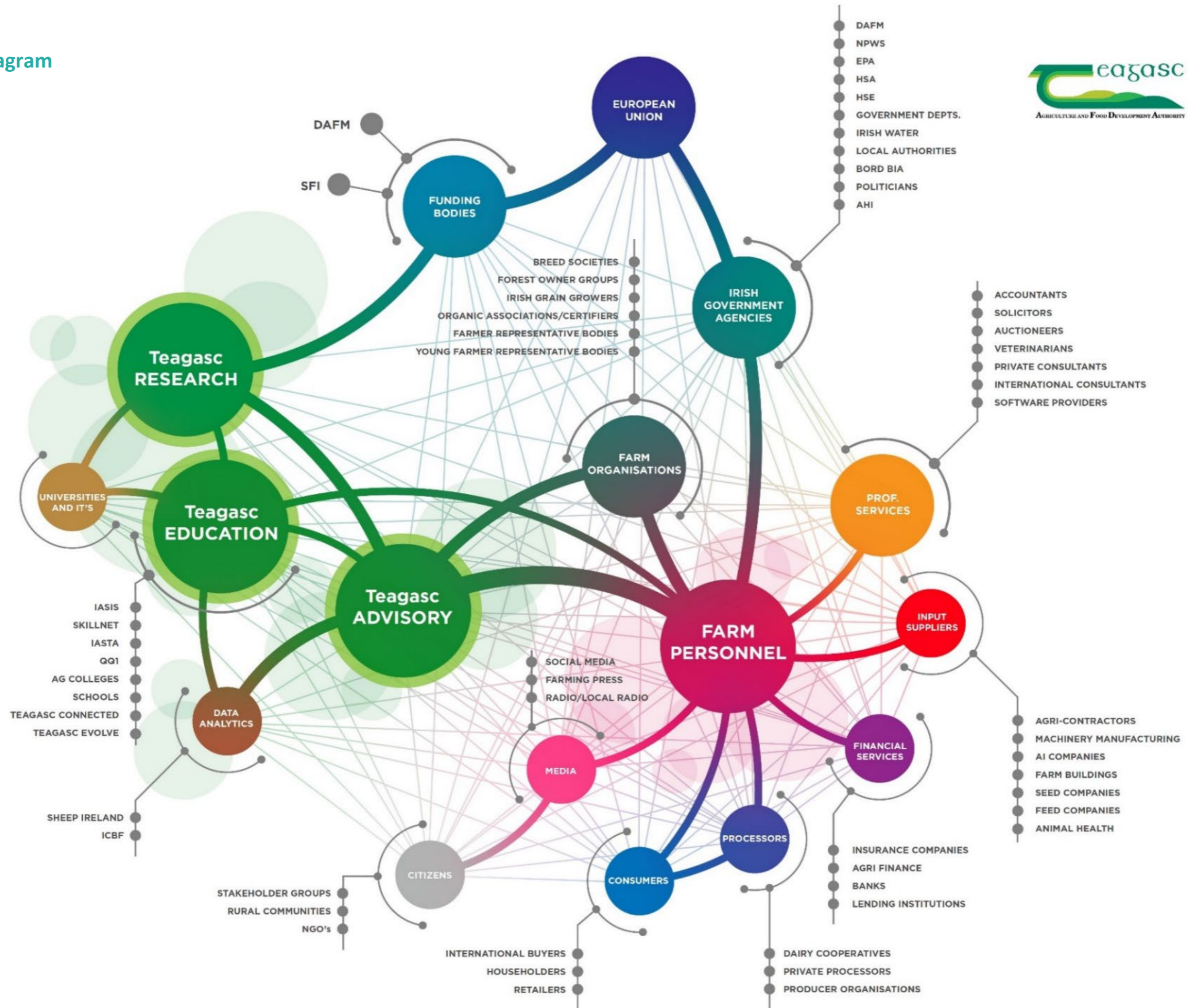
9.3 Scottish AKIS Diagram

Scotland's AKIS

Please note: The diagram represents the range of information sources available to farmers and crofters in Scotland but is not intended to be comprehensive.

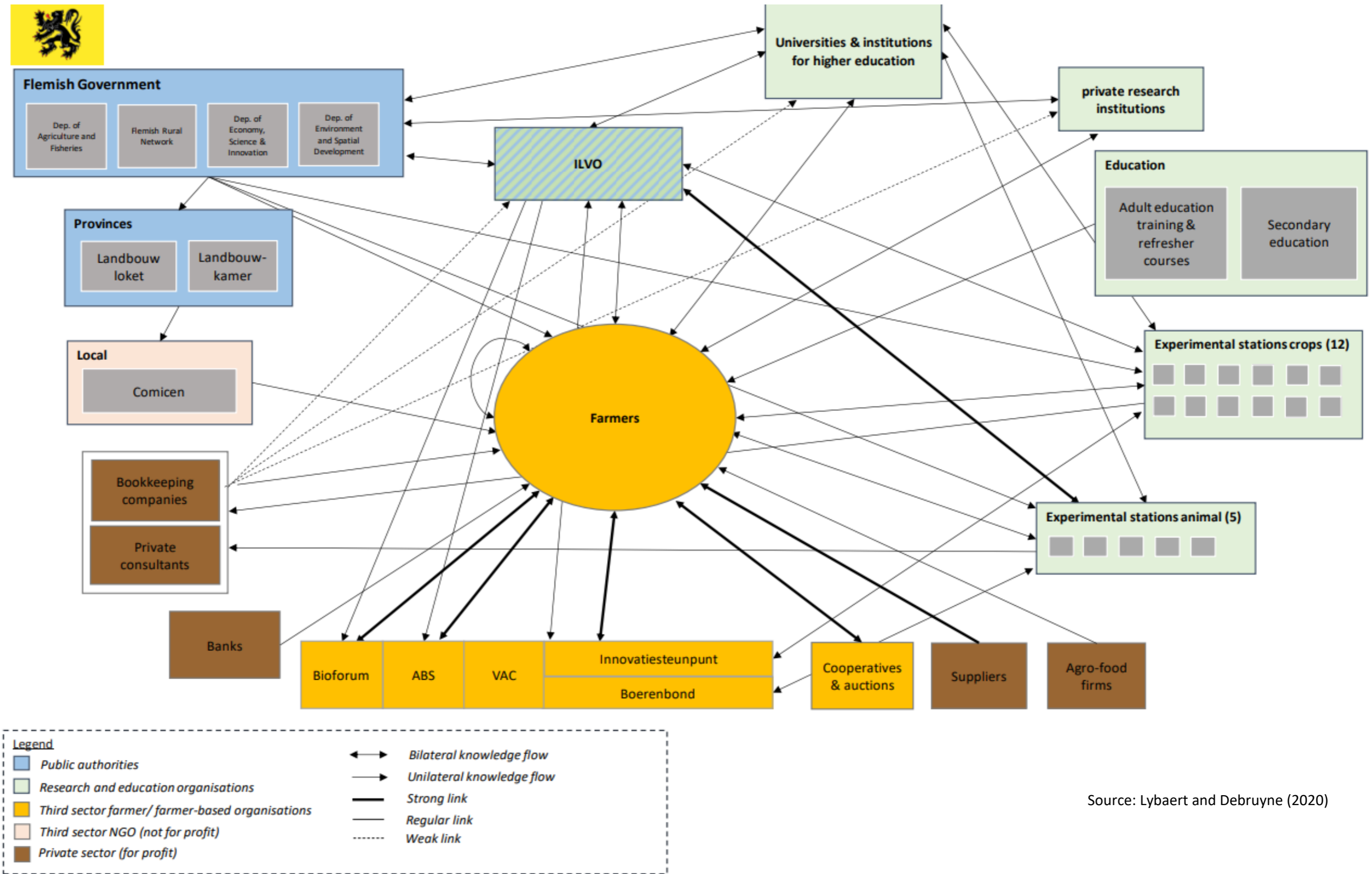


9.4 Irish AKIS diagram



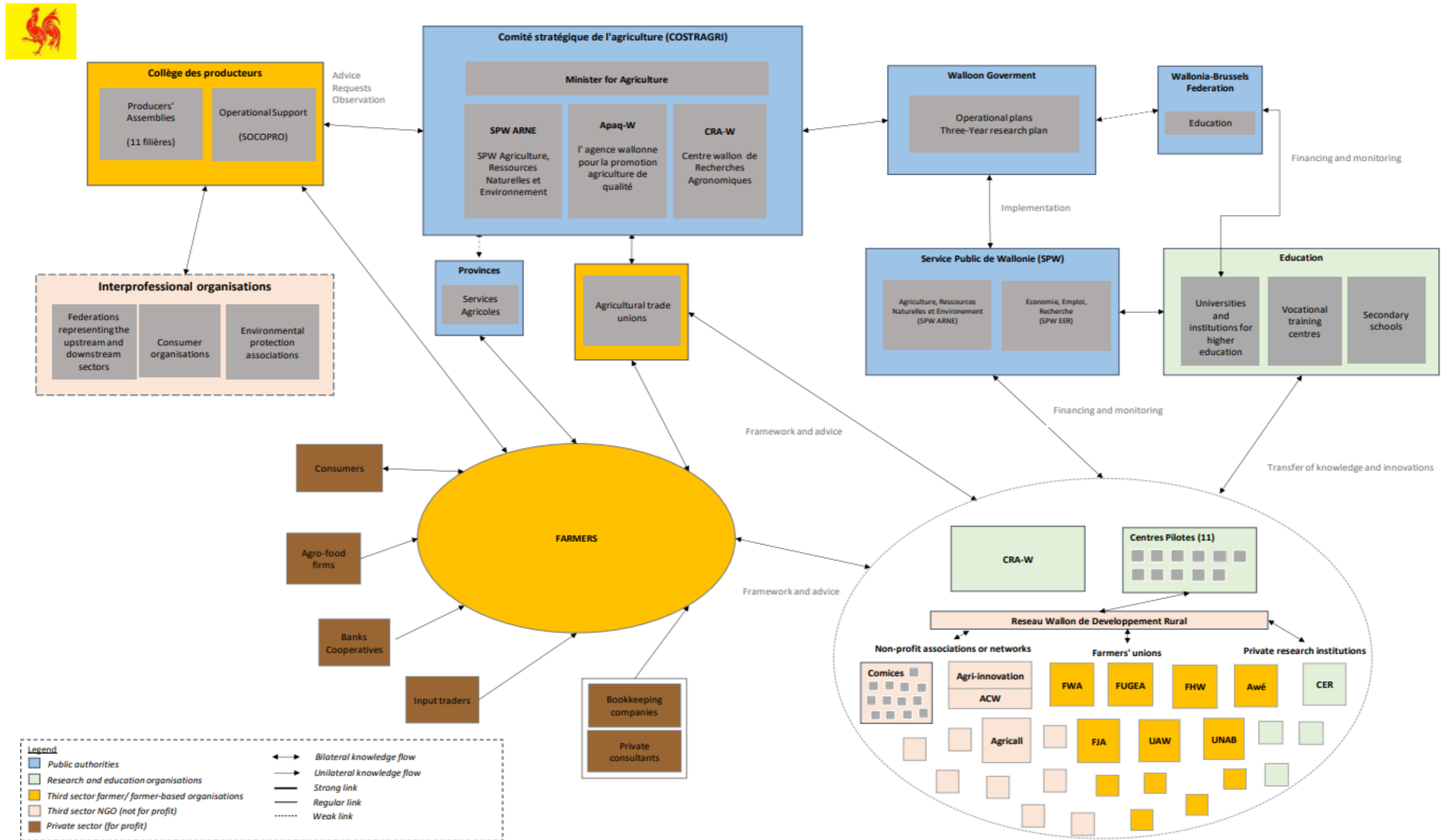
9.5 Belgian AKIS diagrams (Flanders and Wallonia)

AKIS structure in Flanders



Source: Lybaert and Debruyne (2020)

AKIS structure in Wallonia



Source: Lybaert and Debruyne (2020)

9.6 PESTEL analysis: analysing the general environment for future AKIS

Political

- Ongoing uncertainty and impact of BREXIT, e.g., loss of easy access to export market, potential impact on future collaborative projects, impact on labour, loss of CAP and subsidies schemes
- New international trade deals with Australia and New Zealand may disrupt home market for lamb, especially if there is future uncertainty with their trading arrangements with China and far east, leading to increased supply to UK markets¹
- Deviation in approaches to AKIS within UK governments
- Opportunities for public consultation and engagement in the development of future AKIS encouraging debate and stakeholder buy-in to future structure;
- New related strategies and policies, eg: Vision for Agriculture, Biodiversity Strategy, National Park Strategy; Climate Change Plan, Farmer-led climate change groups
- Development of Agricultural Transition Plan in Scotland identifies the requirement for a joined-up and inclusive approach for land use and land use change being required to deliver food sustainability, whilst also tackling climate change and seeking to enhance biodiversity.
- Current uncertainty over emerging Scottish policy that may impact scope and quality of AKIS delivery
- Lack of alignment of policy objectives across different Scottish Government departments to provide a clear and consistent operating framework for AKIS
- Lack of long-term cross-party commitment to AKIS
- New principles for responsible investment in natural capital being developed by the Scottish Government to create a values-led, high-integrity market for responsible investment in natural capital²

Economic

- Lack of long-term funding for AKIS
- Loss of income and uncertainty post-CAP until new schemes and incentives are in place
- Role and impact of green finance on land ownership and management
- Rising/unstable energy costs and significant impact on energy-intensive parts of the sector
- Rising/volatile input costs
- Potentially increasing complexity in incentive schemes as environmental schemes are introduced and the risk of corresponding increase in the administrative burden on farmers

Sociocultural

Demographics:

- Majority of the agricultural workforce are farm occupiers, who own or rent the farm they work on. The majority of these (including spouses) as are over 55 years old
 - 40% of males are over 64
 - 32% of females are over 64

- Working occupiers are getting older: only 10% of males and 11% of females are under 41 years
- Levels of migrant workers have fallen which may have impacted production
- Ability to engage young people in the sector and provide meaningful jobs/careers
- Above average incidence of dyslexia amongst farmers and crofters; associated impact on this cohort of an increasingly bureaucratised system. Growing awareness of this, e.g., NFU Scotland's Farming with Dyslexia campaign
- Skills shortages in certain areas, e.g., environmental management
- New areas of specialism emerging that require education and training to be developed
- Increasing complexity in achieving balance in land use between food production and addressing climate and nature crises
- Increasing complexity of land management/land use decision making
- Increasing mainstreaming of need to move to Net Zero and consequent impact on consumer choices
- Vocal and interventionist vegan lobby concerning farmers
- Rise of climate activism
- New protein sources emerging (e.g., insects)
- Diversification of farms to create additional income streams
- Ensuring strong reputation of produce in home and international competitive market
- Impact on rural communities of change of land use

Technological

- Public financial support for relevant R&D
- Private investment in R&D, e.g., climate-change resistant crops
- Increasing support for innovation to tackle challenges
- Increasing role of technologies within sector
- Introduction of new technologies, e.g., Artificial Intelligence
- Growth of electronic tools for decision support, benchmarking and recording results
- Automated data collection, data platforms
- Increasing interoperability of technical systems
- Introduction of vertical and container farms to allow high quality year-round production of specific crops, e.g., salads and herbs, anywhere; increase growing season through early production of hardy young plants, isolate production from extreme weather events
- Availability of technologies to support training and skills development, e.g., gamifying learning

Environmental

- Climate crisis and biodiversity loss as both threats and drivers for change
- Emergence of measuring and valuing natural capital
- Push to involve private finance in addressing nature crisis and development of blended finance models.
- Increase in land prices driven by carbon finance
- Perceived and actual trade-offs between profit and environmental public good
- Emergence of new "green jobs" supporting Just Transition

- Increase in use of renewables, emergence of Hydrogen as an energy source
- Increase in uptake of nature-based solutions

Legal

- Complex regulatory framework
- New legal requirements for exporting to the EU
- Impact of changes in taxation on land-based businesses e.g., tax treatment of long-term land use changes for environmental schemes
- Emerging legislation in Scotland: Agriculture Bill.

9.7 Academic literature review methodology and references

Rapid literature review was performed in the following steps:

1. An in-depth study of the most recent academic papers on AKIS (Sutherland et al., 2017, 2023, Gabel et al., 2018, Labarthe et al., 2022), a set of key words dealing with farmer advisory services was identified (altogether 82 keywords).
2. The keywords were selected as many possible elements of AKIS and to operationalise the research were divided into seven domains (Domain 1: Agricultural knowledge and innovation (16 keywords), Domain 2: Stakeholders (7 keywords), Domain 3: Method of advisory service provision (14 keywords), Domain 4: Environmental (18 keywords), Domain 5: Farm economy (11 keywords), Domain 6: Diversification (11 keywords), Domain 7: Life on farms (5 keywords)).
3. The keywords (Table 1) were combined the search terms into the following search strings: i) (Agricultur* OR farm* OR croft*) AND advi* AND keyword, ii) (Agricultur* OR farm* OR croft*) AND AKIS AND keyword. This approach enabled us to capture as many combinations of the keywords as possible (Domain 1: 48 strings, Domain 2: 14 strings, Domain 3: 28 strings, Domain 4: 36 strings, Domain 5: 22 strings), Domain 6: 22 strings, Domain 7: 10 strings).

Keywords identified in academic literature

Domain 1 - Agricultural knowledge and innovation	Domain 2 - Stakeholders	Domain 3 - Method of advisory service provision	Domain 4 - Environmental	Domain 5 - Farm economy	Domain 6 - Diversification	Domain 7 - Life on farms
innovation	"stakeholder engagement"	"peer-to-peer learning"	"environmental stewardship"	efficiency	diversification	succession
"farm advisory services"	collaborative	"on-farm demonstration"	"regenerative agriculture"	suppliers	agroforestry	wellbeing
networks	actors	"co-learning"	risk	finance	"renewable energy"	health
"interactive innovation"	"new entrants"	collaboration	livestock	investment	energy	"mental health"
modernisation	women	"co-operation"	"integrated land use"	"cost effective"	contracting	families
farm	inclusive	network	"integrated land management"	bioeconomy	"short food supply chain"	
public	diverse	"digital tools"	organic	"crop management"	"alternative enterprise"	
"EIP Agri"		digitalisation	woodland	veterinary	"direct marketing"	
"agricultural extension"		"digital skills"	"pest management"	agronomy	"food processing"	
"knowledge exchange"		"big data"	biodiversity	"precision farming"	tourism	
governance		connectivity	"just transition"	"bench marking"	multifunctional	

Domain 1 - Agricultural knowledge and innovation	Domain 2 - Stakeholders	Domain 3 - Method of advisory service provision	Domain 4 - Environmental	Domain 5 - Farm economy	Domain 6 - Diversification	Domain 7 - Life on farms
land		"social media"	"net zero"			
research		"field school"	"circular economy"			
agronomy		"monitor farm"	carbon			
"evidence based practice"			"land management"			
"research to practice"			"nature restoration"			
			sustainability			
			climate change			

1. By performing individual search in the Web of Science database (the function 'search in the abstracts' was used, only academic papers were taken into account) for the keywords in seven domains, we identified 13,326 papers.
2. We focused on the period after 2010, which gave us 10,459 papers. After elimination of duplicates accross individual domains, we identified 3,671 papers.
3. In the next step, we narrowed our interest on the papers on farmer advisory services published in the most developed countries. After clearing of the database, we identified 350 relevant papers. These were analysed for individual options, how AKIS has developed in other contexts and what options seem to be successfully in place. Individual options were categorised into the following topics: i) Creating a more unified AKIS, ii) Regionalisation and Specialisation, iii) Supporting peer-to-peer learning and farmer collaboration, iv) Promote diversity and generational renewal, v) Digital Opportunities and Upskilling, and vi) AKIS Skill building.
4. Individual options were identified in circa 170 papers. Not relevant papers were not taken into account.

9.8 Grey literature review methodology

The grey literature review consisted of a multi-pronged approach: a targeted search of websites, as identified in expert discussion, a search of relevant public consultation responses and a search of documentation relating to the Scottish Farm Advisory Service. The period of focus was post-2010. All sources were checked for potential options, as well as relevant contextual information, to ensure an adaptive and reflexive approach to review. An analysis table of options, sources and salient features was produced, categorised under the following headings:

- AKIS governance, structure, data, and funding
- Increasing collaboration
- Training, skills development, and CPD for those delivering services
- Access to high quality advice, training, and innovation support
- Bridging the gap between research and farming practice

The grey and academic literature review results were then brought together and refined into 35 options within 6 option categories to facilitate SWOT analysis in stakeholder workshops.

Sources reviewed in the grey literature review

European project websites	UK FAS organisation websites	Public consultation responses	Supplied documents
SOLINSA (FP7)	Farming Advice Service England (DEFRA/Ricardo)	Climate Change Plan	FAS one-to-one review
FarmPath (FP7)		Scottish Climate Change Adaptation Programme	FAS one-to-many review
PRO AKIS (FP7)	Farming Connect Wales (Mentor a Business and Lantra)	Just Transition Plan for Land and Agriculture	FAS monthly reports
VALERIE (FP7)		Land Reform Bill	FAS one-to-one annual reports
AgriSpin (H2020)	Rural Support Knowledge Advisory Service Northern Ireland (CAFRE and DAERA Countryside Management Unit)		FAS one-to-many annual reports
PLAID (H2020)			FAS one-to-one annual business plans
AgriDemoF2F (H2020)	A selection of Scottish stakeholder websites		FAS one-to-many annual business plans
NEFERTITI (H2020)			FAS and AKIS in different countries report
LIAISON (H2020)			FAS Consultation/SWOT
i2connect (H2020)			
FAIRshare (H2020)			
NEWBIE (H2020)			
AgriLink (H2020)			

9.9 Detailed options appraisal

[see separate document]

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