

## Appendix 1. History of Agroecology

The term “agroecology” was first coined by Bensen in 1928. Bensen’s notion of agroecology referred to the ecological aspect of the term, a tendency that linked the disciplines of agronomy and ecology (Klages, 1928; Friederichs, 1930; Hanson 1939; Tansley 1935).

As described in Dalgaard et al. (2003) *‘the historical development of agroecology shows that it began originally as a part of crop physiology, agricultural zoology, and ecology but the term was adopted by a movement which wished to promote the development of sustainable agriculture through the integration of ideas and methods from other disciplines’* (Altieri, 1980, cited in Dalgaard et al., 2003).

It was not until the 1960s that the agroecology literature developed, and the definitions were raised and discussed. To understand the reason for this, it is important to remember that the origins of “agroecology” are to be found in rural societies and family farming practices that have been carried out for centuries (King 1911, Hernandez 1977, Pimbert et al. 2021). Some of the characteristics of these societies are:

- Food consumption is not dissociated from production.
- Local knowledge, passed through generations, of ecological processes is central to the management of ecosystems for food production.
- Natural and social systems are/were coupled.
- Intensive human workforce and co-evolution of ecological processes
- Crop domestication and genetic modification through time promotes conservation *in situ*.

It is, therefore, not surprising that the “formalisation” of old farming practices became a subject offering multiple facets. “Agroecology” continues to be defined and debated depending on the perspectives of those who study (natural and social scientists), practice or support these farming systems and food production paradigms.

Agroecology refers to *‘a science, a movement, [or] a practice’* (Figure 1: Wezel et al. (2009)). Agroecology implies systems-level thinking (Poux and Aubert, 2018; Hawes et al., 2021) as it is a discipline of integration (Dalgaard et al., 2003). Dalgaard et al. (2003) defines agroecology as the *study of the interactions between plants, animals, humans and the environment within agricultural systems*. It covers integrative studies within *agronomy, ecology, sociology and economics* (Dalgaard et al., 2003).

The agroecological literature has identified differences in the use of the term according to geographical location. In general, in the global south, agroecology has political connotations with social and economic justice goals and food sovereignty. In Europe and North America, agroecology is more a scientific discipline and has fewer associations with political and social goals.

Within Europe there are several differences. In France, agroecology aims to transform the social, economic and environmental performance of the agricultural sector by 2025 with a regulatory framework and research program (Gliessman, 2014; van Hulst et al., 2020). In Germany, agroecology is mainly a scientific discipline. In East Africa, agroecology is part of the sustainable development and focuses on increasing yields and rural incomes.

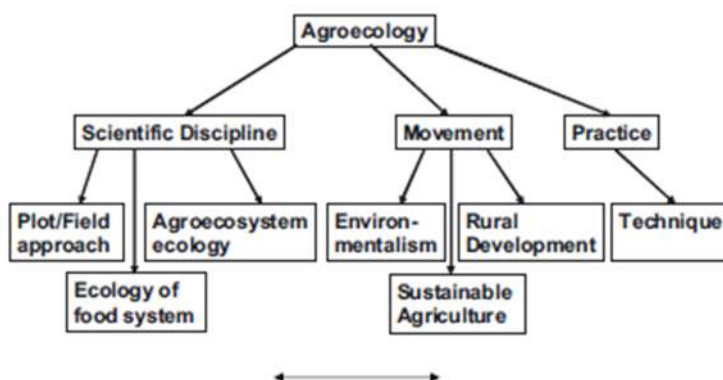


Figure 1. Diversity of current types of meanings of agroecology.

From a scientific point of view, Francis et al., (2003), defined agroecology as '*the integrative study of the ecology of the entire food system, encompassing ecological, economic and social dimensions, or more simply the ecology of food systems*'. It reflects the consideration of agricultural land as an ecosystem – a complex network of biotic (living) and abiotic (non-living) components. Farmed land is needed for food production, but also for a number of 'services' - soil health, water and air quality, pest and disease control, biodiversity preservation etc. Agroecological research aims to provide a scientific underpinning for new or alternative management practices that promote sustainability and resilience in production systems.

As a practice, "agroecology" is defined as a set of agricultural practices and systems which aims to enhance natural processes and can include (but is not limited to) organic farming, integrated farm management (IFM) and agroforestry' (Mottershead & Maréchal, 2017). More recently, the term 'regenerative farming' has entered common use, referring to farming that uses soil conservation to regenerate and deliver ecosystem services, and enhance the environmental, social and economic aspects of food production (Schreefel et al., 2020). As a movement, "agroecology" is used by some environmental groups more widely than the management of farming systems, but also '*encompassing far-reaching changes to social structures associated with the ownership and tenure of land and the distribution of raw materials and produce*' (Mottershead & Maréchal, 2017).

The agroecological literature is large and ranges from studies of the dynamics of power and governance (Anderson, et al., 2019) to examining the interactions between soils, plants, and invertebrates (Hawes et al. 2021).

In Scotland, a recent study found that scientists and farmers had a different understanding of what constituted agroecology (van Hulst et al., 2020). Farmers are unfamiliar with the term 'agroecology' and associate it with 'sustainable', 'organic' or 'environmental' farming, to which some may have negative attitudes. Agroecology was mainly understood as being a scientific discipline applying ecological analysis to agricultural systems, but not necessarily to the entire food system (van Hulst et al., 2020).

## Appendix 2. Comparison of Agroecology (FAO, 2018) with other approaches to sustainable production.

*Agroecology is an integrated approach that simultaneously applies ecological and social concepts and principles to the design and management of food and agricultural systems. It seeks to optimise the interactions between plants, animals, humans and the environment while taking into consideration the social aspect that need to be addressed for a sustainable and fair food system (FAO, 2018).*

			<b>'Agroecological' farming models (Cole et al., 2021)</b>		
<b>Agroecology 10 Elements (FAO)</b>	<b>Sustainable intensification</b>	<b>Ecological intensification</b>	<b>Regenerative Farming/ Regenerative agriculture</b>	<b>Organic farming</b>	<b>Integrated farm management</b>

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Agroecological Systems Characteristics	<p><b>Diversity.</b> Agroecological diversification for food security and nutrition while conserving, protecting and enhancing natural resources. Biological perspective: Optimise the diversity of species and genetic resources in different ways such as agroforestry systems, organised crops, shrubs and trees of different heights and shapes increasing vertical diversity. Intercropping to increase spatial diversity; crop rotation; crop-livestock systems</p>	sustainable intensification avoids further environmental damage and actively encourage environmental benefits. This includes addressing issues of consumption (including diets), waste, biodiversity conservation and resource use, while ensuring sufficient overall levels of production to meet human needs (Pearce et al., 2017).	ecological intensification of mainstream farming can safeguard food production while benefiting the environment (Vasconcelos et al., 2019)	<p>1. Agriculture should produce highly nutritional food, free from biocides, at high yields.</p> <p>2. Agriculture should increase rather than decrease soil productivity, by increasing the depth, fertility and physical characteristics of the upper soil layers.</p> <p>4. Crop production should be based on biological interactions for stability, eliminating the need for synthetic biocides.</p> <p>5. Substances which disrupt biological structuring of the farming system (such as present-day synthetic fertilizers) should not be used (Giller et al., 2021)</p>	A holistic system for enhancing soil fertility, water management, and natural control of crop pests and diseases, usually associated with low-input, small, diverse farms (Rose et al., 2019)	<p>Integrated farm management for agroecological design goes beyond substitution of chemical for biological inputs by combining best practice management to establish systems that can generate their own soil fertility, crop protection and yield stability. New cropping combinations result in synergisms and complementarities among components of the farming system which lead to optimal recycling of organic matter and nutrients and to balanced pest-natural enemy populations.</p> <p>This converges with agroecology but does not integrate the social sustainability dimension of agroecology in its wider sense as carried by FAO.</p>
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	<p><b>Co-creation and sharing knowledge.</b> Agricultural innovations respond better to local challenges when they are co-created through participatory processes. Context-specific knowledge. Ecological practices are tailored to fit the environmental, social, economic, cultural and political context. Traditional, indigenous, producers and traders and scientific Knowledge for co-creation processes.</p>	<p>Although sustainable intensification examples stress the need to work with farmers/producers, the stress is really on technological innovation and scientific ecological knowledge (Donovan/CINMYT)</p>				
	<p><b>Synergies.</b> Careful design of diversified systems that selectively combine annual and perennial crops, livestock and aquatic animals, trees, soils, water and other components on farm and agricultural landscapes. Building synergies across food systems, supporting production and multiple ecosystem services. Maximisation of synergies and managing trade-offs, emphasising the importance of partnership, cooperation, governance at multiple actors and scales.</p>	<p>Synergies are mainly focused on crop-combination, water, soil, biodiversity conservation and technological innovation.</p>	<p>Emphasises ecological processes that support production, such as nutrient cycling, biotic pest management, and pollination (Rose et al., 2019)</p>			<p>As a concept, IFM insists on ecological synergies and complementarities leading for efficient use of natural resources, In practice, specific farming methods may be combined to achieve such synergies (Rose et al 2019).</p>

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	<p><b>Efficiency.</b> Resource-use efficiency by managing diversity to create synergies between different systems components. Reducing dependency on external resources empowers producers by increasing their autonomy and resilience to natural economic shocks.</p>	<p>"Sustainable intensification of agriculture aims to produce more with less: to increase harvests without using more resources" (IIED).</p> <p>It relies on ecological intensification, genetic intensification and socio-economic intensification. (The Montpellier Panel, 2013).</p> <p>The efficiency focus in SAI is to produce more with the same amount of resources, especially land (Pretty J, Bharucha ZP. 2014)</p>	<p>Efficiency in ecological intensification is focused on the efficient use of land, water, biodiversity and nutrients, Comment: there is a lot of cross-over with sustainable intensification and regenerative farming (FAO 2021).</p>	<p>3. Nutrient-flow systems which fully integrate soil flora and fauna are more efficient and less destructive of the environment, and ensure better crop nutrition. Such systems accomplish a new upward flow of nutrients in the soil profile, reducing or eliminating adverse environmental impact. Such a process is, by definition, a soil genesis process.</p> <p>8. Animals in agriculture should be fed and housed in such a manner as to preclude the use of hormones and the prophylactic use of antibiotics which are then present in human food (Giller et al., 2021).</p>		<p>Beyond ecological synergies and complementarities leading for efficient use of natural resources, integrated farm management (IFM) also insists on business efficiency and efficient use of energy (see for instance the LEAF standard for IFM).</p> <p>IFM is often seen as a method, a set of practices that may lead to sustainable intensification and/or regenerative farming.</p>
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	<p><b>Recycling.</b> Waste is a human concept – it does not exist in natural ecosystems. By imitating natural ecosystems, agroecological practices support biological processes that drive the recycling of nutrients, biomass and water within production systems, thereby increasing resource- use efficiency and minimizing waste and pollution. Recycling can take place at both farm-scale and within landscapes, through diversification and building of synergies between different components and activities.</p>	encourages environmental benefits. This includes waste management and recycling.		7. Integrated systems which are largely self-reliant in nitrogen through biological nitrogen fixation should be utilized (Giller et al., 2021).		IFM integrates effective recycling of <b>farm</b> waste for productive purposes (Simavugan et al. 2008).
	<p><b>Resilience</b> Diversified agroecological systems are more resilient – they have a greater capacity to recover from disturbances including extreme weather events such as drought, floods or hurricanes, and to resist pest and disease attack. By maintaining a functional balance, agroecological systems are better able to resist pest and disease attack.</p>	Resilience is seen as associated with farm productivity, profitability, stability, production and market risks (Donovan/CINMYT) Acting against food insecurity is often considered as one of the main objectives of S.A.I (Garnett, T., Appleby, M.C. et al 2013)		To increase biodiversity and ecosystem health and resiliency is one of the main objectives (Regeneration International 2017) This is mainly focused on soil and other ecological interactions on the farm.		

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Context features	<p><b>Human and social values</b></p> <p>Agroecology places a strong emphasis on human and social values, such as dignity, equity, inclusion and justice all contributing to the improved livelihoods dimension of the SDGs. It puts the aspirations and needs of those who produce, distribute and consume food at the heart of food systems.</p> <p>As a bottom-up, grassroots paradigm for sustainable rural development, agroecology empowers people to become their own agents of change.</p>	<p>It is not limited to environmental concerns, but also includes social and economic criteria such as improving livelihoods, equity and social capital.</p> <p>(Donovan/CINMYT)</p>		<p>Regenerative agriculture requires, in its biological structuring, an intimate relationship between man- ager/participants of the system and the system itself (Giller et al., 2021).</p>		
	<p><b>Culture and food traditions</b></p> <p>Agriculture and food are core components of human heritage. Hence, culture and food traditions play a central role in society and in shaping human behaviour. However, in many instances, our current food systems have created a disconnection between food habits and culture. This disconnection has contributed to a situation where hunger and obesity exist side by side, in a world that produces enough food to feed its entire population. Cultural identity and sense of place are often closely related.</p>	<p>This isn't a particular focus in Sustainable Agricultural Intensification (SAI).</p>		<p>Regenerative farming focused more on farming and grazing practices from an ecological point of view (see Fenster et al. 2021) and doesn't integrate wide considerations on food systems and cultural and social aspects.</p>		

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Enabling environment	<p><b>Responsible governance</b> Agroecology calls for responsible and effective governance to support the transition to sustainable food and agricultural systems. Transparent, accountable and inclusive governance mechanisms are necessary to create an enabling environment that supports producers to transform their systems following agroecological concepts and practices. Successful examples include school meals and public procurement programmes, market regulations allowing for branding of differentiated agroecological produce, and subsidies and incentives for ecosystem services.</p>	<p>Although governance is not at the centre of its approach S.A.I. does take into consideration creating enabling environments, enhancing social and human capital to improve producers' livelihoods (The Montpellier Panel, 2013).</p>		<p>Regenerative Agriculture requires national-level planning but a high degree of local and regional self-reliance to close nutrient-flow loops (Giller et al., 2021).</p>		
	<p><b>Circular and solidarity economy</b> Agroecology seeks to reconnect producers and consumers through a circular and solidarity economy that prioritizes local markets and supports local economic development by creating virtuous cycles.</p>	<p>This isn't a particular focus in SAI</p>		<p>Agricultural production should generate increased levels of employment (Giller et al., 2021).</p>	<p>Organic farming is regulated by certification and control systems (national and international) with the objective of obtaining higher prices on the market through specific labelling. Organically farmed food can be labelled as such and exported across the globe, gathering a significant carbon footprint.</p>	

					<p>This is a major difference with agroecology. Likewise in some cases of large agro-industrial operations food can be produced according to “organic” certification criteria and yet deplete local water and soil resources (Müller and Boutié, in press).</p>	
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## Appendix 3. Online survey.

# Scottish Farming Practices Survey 2021

### Introduction

**Farming Practices.** Thank you for participating in this online survey, your contribution is very important. We would be grateful for your opinion and experience on whether the use of certain farming practices, that aim to improve sustainability can provide enduring benefits for long term land productivity and the resilience of agricultural businesses in Scotland, including their response to crises such as COVID-19 or climate change. The aim is to review the current adoption of practices that fit within the 'agroecological principles' (as defined by the United Nation's Food and Agriculture Organisation) by farmers/land managers in Scotland. Your participation in this survey is voluntary. You may choose not to participate and may withdraw at any time.

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Notice Privacy notice. Please note this survey does not require you to include your name or any other information that will identify you. We will ask you for some biographical details [e.g. gender, age group] and geographic details about your farm to help us produce summary statistics but these will not be used to reveal your identity. Your responses will be kept confidential and you will not be identifiable in any outputs resulting from this survey. If you do choose to share any personal data in your free text responses, we will treat this with confidentiality. The James Hutton Institute ("Hutton", "us" or "we") will be the data controller over your personal data and will use this data only for the purposes of the research undertaken in this project "Farming practices- Agroecological principles". Further information about Hutton processes your personal data and what your rights are in relation to your data, can be found in our full privacy notice, [www.hutton.ac.uk/terms](http://www.hutton.ac.uk/terms). Or, if you have any queries about your personal data you can contact our Data Protection Officer at [dpo@hutton.ac.uk](mailto:dpo@hutton.ac.uk). If you would like to know more about this research, or would you like to be interviewed about this research, please contact [maria.lozada@hutton.ac.uk](mailto:maria.lozada@hutton.ac.uk).

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### FS Characteristics

#### Age group.

(Please feel free to select "I prefer not to answer" at any time).

- ☐ 35 and under. (1)
- ☐ 36-50. (2)
- ☐ 51-65. (3)
- ☐ 66 and over. (4)
- ☐ I prefer not to answer. (5)

#### Gender.

(Please feel free to select "I prefer not to answer" at any time).

- ☐ Male. (1)
- ☐ Female. (2)
- ☐ Prefer to self-describe. (3) \_\_\_\_\_
- ☐ I prefer not to answer. (4)

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Location Where is your farm located? Please enter your postcode.

Type of tenure?

(Please feel free to select "I prefer not to answer" at any time).

- ☐ Owned. (1)
- ☐ Tenant. (2)
- ☐ Contract Farming. (4)
- ☐ Croft. (5)
- ☐ Other. (6) \_\_\_\_\_
- ☒ I prefer not to answer. (7)

Tenancy If you are a tenant, what type of tenancy do you have?

\_\_\_\_\_

Holding time Number of years you or your family have occupied this farm/holding/croft?

\_\_\_\_\_

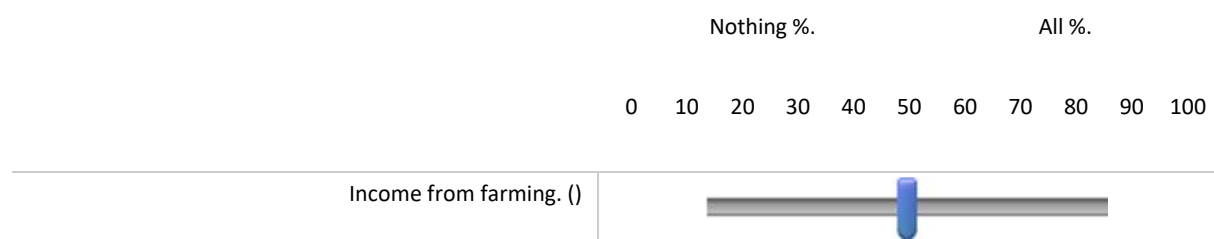
Area What is the area of land you farm? (In acres OR hectares).

- ☐ Acres. (1) \_\_\_\_\_
- ☐ Hectares. (2) \_\_\_\_\_

Are you the first generation in farming?

- ☐ No, my grandparents were in farming. (1)
- ☐ No, my parents were in farming. (2)
- ☐ No, I took over the farm from another family member (example: aunt/uncle). (3)
- ☐ Yes, I was a new entrant to farming. Year commenced farming. (4) \_\_\_\_\_
- ☐ I prefer not to answer. (5)

What percentage of your income comes from farming/crofting?



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Farming system.

(If you have more than one holding please tick more than one box if applicable).

- ☐ Lowland. (1)
- ☐ Upland. (2)
- ☐ Hill. (3)
- ☐ Registered Croft. (4)
- ☐ Other. (5) \_\_\_\_\_

What are the main enterprises in your business?

(Please select more than one box if applicable).

- ☐ Combinable Crops. (1)
- ☐ Intensive cash crops [example: Potatoes, Vegetables]. (2)
- ☐ Dairy. (3)
- ☐ Breeding Cows. (4)
- ☐ Breeding Sheep. (5)
- ☐ Finishing Livestock. (6)
- ☐ Pigs /Poultry. (7)
- ☐ Soft-fruit & trees. (8)
- ☐ Renewable Energy/Biomass. (9)
- ☐ Tourism (B&B, self-catering, etc). (10)
- ☐ Farm Shop. (11)
- ☐ Other. (12) \_\_\_\_\_

What term best describes the way you manage your land? (Please select more than one box if applicable).

- ☐ Organic certified or conversion. (1)
- ☐ Conventional. (2)
- ☐ Regenerative farming. (3)
- ☐ Permaculture. (4)
- ☐ LEAF. (5)
- ☐ Pasture for Life. (6)
- ☐ Agroecological. (7)
- ☐ Other. (8) \_\_\_\_\_

End of Block: FS Characteristics

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Start of Block: Agroecology Principles

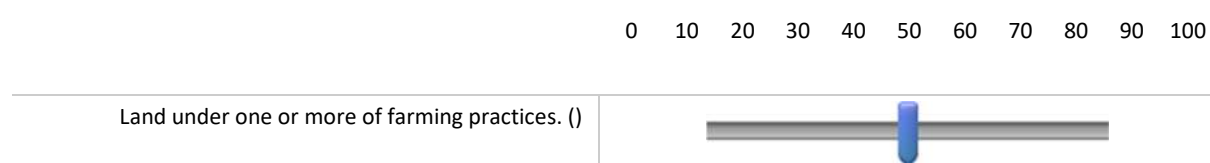
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Which of the following farming practices have been carried out on your farm?  
(Please select more than one box if applicable).

- ☐ Reduced tillage practices. (1)
- ☐ Using less synthetic fertiliser. (2)
- ☐ Increasing biomass in soil. (3)
- ☐ Precision agriculture (soil mapping, variable rate sowing or inputs). (4)
- ☐ Drainage and water management (to raise or lower the water table). (5)
- ☐ Nitrogen fixation measures (eg. planting legumes, red and white clover). (6)
- ☐ Recycling organic material (e.g. green manure, compost, slurry). (7)
- ☐ Mob grazing. (8)
- ☐ Encouraging foraging by reducing feed inputs. (9)
- ☐ Monitoring and surveillance. (10)
- ☐ Cultural and biological control of pests and diseases. (11)
- ☐ Natural pest repellence by crops. (12)
- ☐ Microbial insecticides. (13)
- ☐ Barrier crops to deter pests (Push and Pull systems). (14)
- ☐ Selective/targeted use of antibiotics. (16)
- ☐ Polyculture/intercropping. (17)
- ☐ Cover crops. (18)
- ☐ Crop rotation. (19)
- ☐ New or novel crops. (20)
- ☐ Agroforestry/vertical diversity (cropping or animal grazing under trees). (21)
- ☐ Habitat modification (e.g. field margins, beetle banks, hedgerows, trees). (22)
- ☐ Varietal mixing. (23)
- ☐ Increased diversity in grass species. (24)
- ☐ Crop-livestock systems. (25)
- ☐ Other. (26) \_\_\_\_\_

What percentage of your land falls under these practices (In total).

% of land under these practices.



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What are the main reasons for carrying out one or more of these practices?

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By carrying out these practices, have you achieved one or more of the following.  
(Please select more than one box if applicable).

- ☐ Improvement in soil health. (1)
- ☐ Increased biodiversity. (2)
- ☐ Reduced inputs. (3)
- ☐ Reduced pollution. (4)
- ☐ Weed management. (5)
- ☐ Plant disease management. (6)
- ☐ Improve finances. (7)
- ☒ None of these. (8)

Rural Stewardship Have you participated in any environmental schemes or rural stewardship in the past?

- ☐ No. (4)
- ☐ If yes, please give further information. (5) \_\_\_\_\_

In your experience have these practices helped the farm to better cope with shocks and challenges?

- ☐ Yes, by improving the land (e.g. soil health, conserving plants and wildlife). (1)
- ☐ Yes, by improving the financial strength of the business. (2)
- ☐ Yes, in another way (please give details). (3) \_\_\_\_\_
- ☒ None of these. (4)

Regarding new farming practices, where do you get advice/information from? (Please select more than one box if applicable).

- ☐ Own research, reading, web and experimentation. (1)
  - ☐ Family, friends, or neighbours. (2)
  - ☐ Farm adviser/agronomist. (3)
  - ☐ Co-op, farm groups, farming network. (4)
  - ☐ Trade. (5)
  - ☐ Other. (6) \_\_\_\_\_
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Statements Which of the following statements do you agree or disagree with? (Please tick the box).

It is possible to produce healthy food, on the same piece of land, whilst protecting the environment and mitigating and adapting to climate change. (1)	<input type="radio"/> Strongly agree (1)	<input type="radio"/> Agree (2)	<input type="radio"/> Unsure (3)	<input type="radio"/> Disagree (4)	<input type="radio"/> Strongly disagree (5)
Diversification, sustainability and agroecology farming systems are the future for farming in Scotland. (2)	<input type="radio"/> Strongly agree (1)	<input type="radio"/> Agree (2)	<input type="radio"/> Unsure (3)	<input type="radio"/> Disagree (4)	<input type="radio"/> Strongly disagree (5)
Ecological measures and recycling practices within the farming system reduce costs and dependency on external resources, making farmers more independent and better prepared for external crises (economic, climate, or other). (3)	<input type="radio"/> Strongly agree (1)	<input type="radio"/> Agree (2)	<input type="radio"/> Unsure (3)	<input type="radio"/> Disagree (4)	<input type="radio"/> Strongly disagree (5)
Modern food habits are disconnected from local food production, local food traditions and sense of place. (4)	<input type="radio"/> Strongly agree (1)	<input type="radio"/> Agree (2)	<input type="radio"/> Unsure (3)	<input type="radio"/> Disagree (4)	<input type="radio"/> Strongly disagree (5)
Scotland needs more diversified farming systems that produce food, protect the environment and are resistant to external shocks. (5)	<input type="radio"/> Strongly agree (1)	<input type="radio"/> Agree (2)	<input type="radio"/> Unsure (3)	<input type="radio"/> Disagree (4)	<input type="radio"/> Strongly disagree (5)
Advice and training need to be more readily available to make farming systems more sustainable. (7)	<input type="radio"/> Strongly agree (1)	<input type="radio"/> Agree (2)	<input type="radio"/> Unsure (3)	<input type="radio"/> Disagree (4)	<input type="radio"/> Strongly disagree (5)
The farming business is more robust to external forces when it is strongly linked with the local community and involves a diversity of people. (8)	<input type="radio"/> Strongly agree (1)	<input type="radio"/> Agree (2)	<input type="radio"/> Unsure (3)	<input type="radio"/> Disagree (4)	<input type="radio"/> Strongly disagree (5)
Sustainable farming approaches can reduce certain workloads and improve the work-life balance. (10)	<input type="radio"/> Strongly agree (1)	<input type="radio"/> Agree (2)	<input type="radio"/> Unsure (3)	<input type="radio"/> Disagree (4)	<input type="radio"/> Strongly disagree (5)

Sustainability What does sustainability mean for you?

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Definition Agroecology is defined as an: "integrated approach that applies ecological and social principles to the design and management of food and agricultural systems. It seeks to optimise the interactions between plants, animals, humans and the environment and the social aspects that need to be addressed for a sustainable and fair food system".

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(Please read the definition above and select more than one box if applicable).

- ☐ I am not familiar with this system (agroecology). (1)
- ☐ I share these values but they are difficult to put into practice. (2)
- ☐ I would like to implement agroecological practices in my farm system. (3)
- ☐ I have some experience of using agroecological practices. (4)
- ☐ I have a great deal of experience of using agroecological practices. (5)
- ☒ I agree but it is not for me. (6)

Please comment on your answer.

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Do you know someone practicing one or more of the following?

(Please select more than one box if applicable).

- ☐ Permaculture. (1)
- ☐ Agroecological principles. (2)
- ☐ Organic farming. (3)
- ☐ Regenerative farming. (4)
- ☐ Other. (5) \_\_\_\_\_
- ☒ I do not know anyone (6)

Remarks Would you like to add any comments?

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End of Block: Agroecology Principles

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Start of Block: End paragraph

Once we completed the research you will receive a link through the same channel you received the invitation to enable you to access the results.

If you would like to know more about this research or to be contacted to be interviewed, please contact [maria.lozada@hutton.ac.uk](mailto:maria.lozada@hutton.ac.uk)

**THANK YOU VERY MUCH FOR YOUR TIME AND HELP IN THIS RESEARCH. YOUR INPUT IS ESSENTIAL FOR US.**

If you know someone who would like to participate please forward the link (copy and paste) [Scottish Farming Practices Survey 2021](#)

End of Block: End paragraph

Appendix 4. Additional results from the online survey.

General characteristics of respondents

Figure S1.

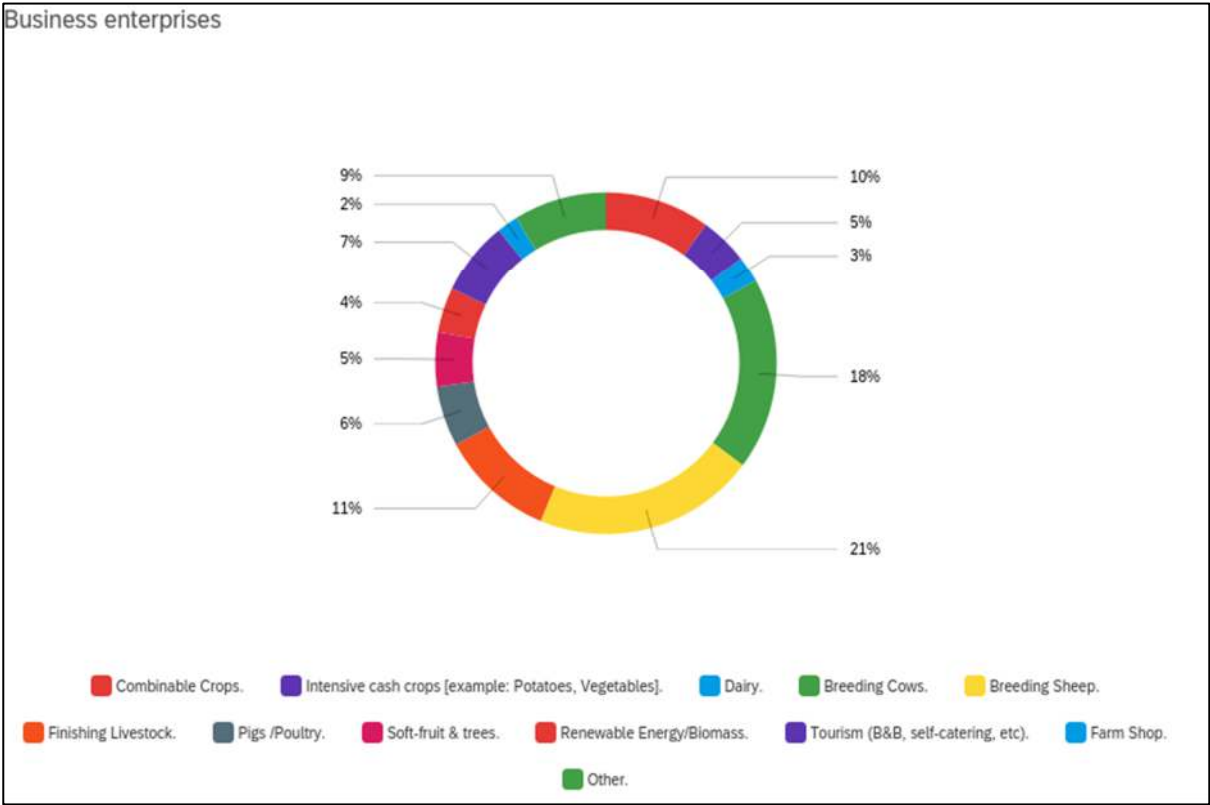
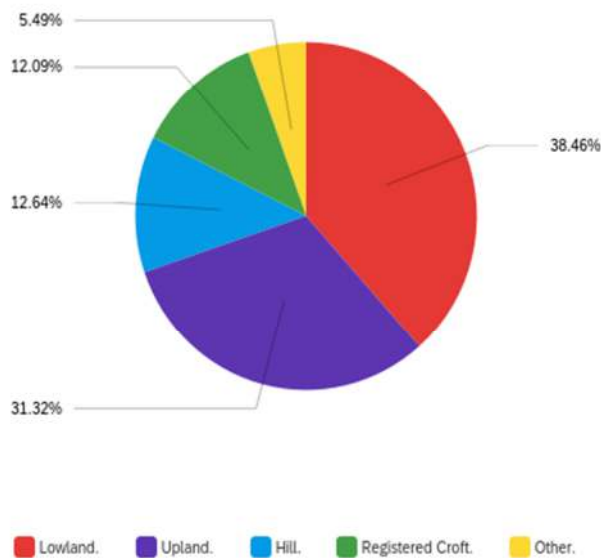


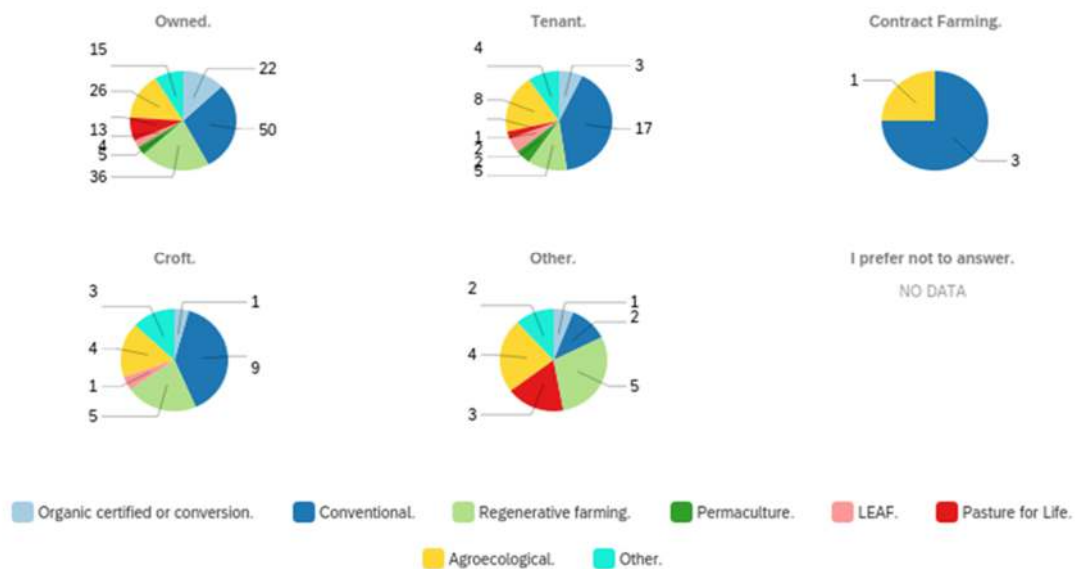
Figure S2.

Farming System



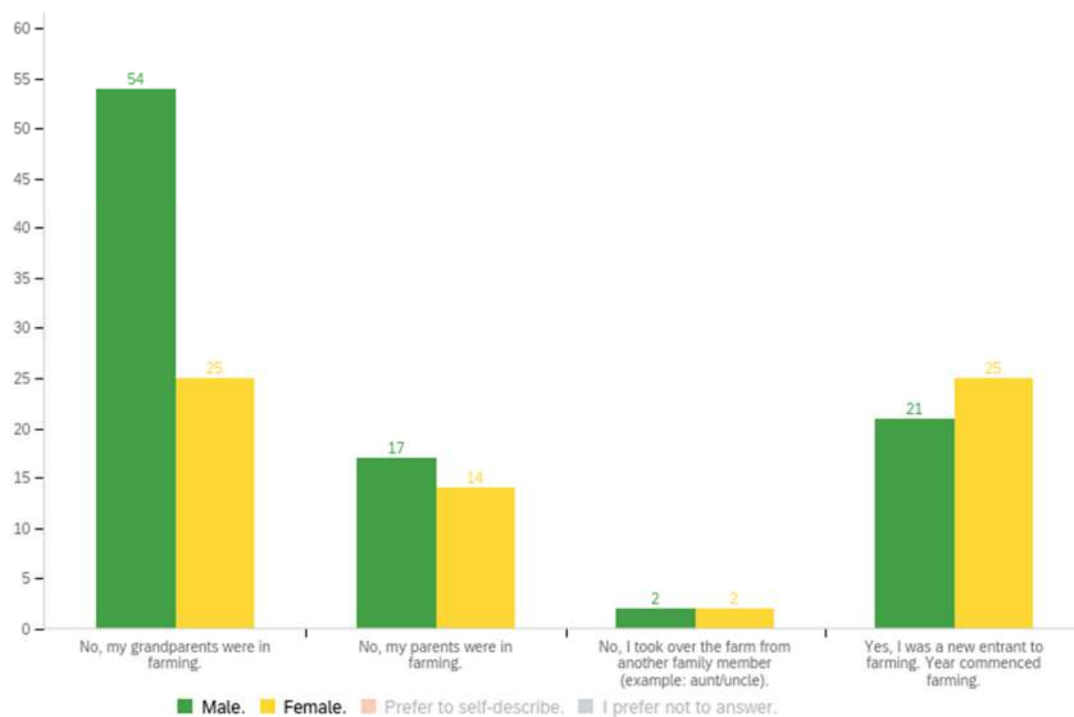
**Figure S3.**

System management by type of tenure



**Figure S4.**

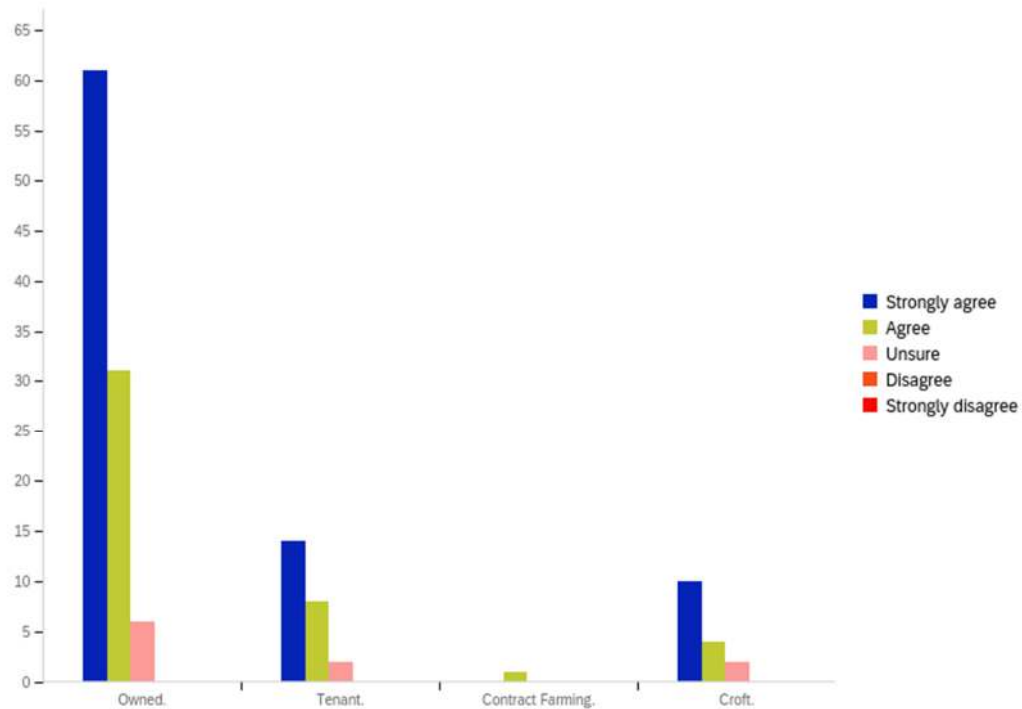
Gender by generation



**Figure S5.**

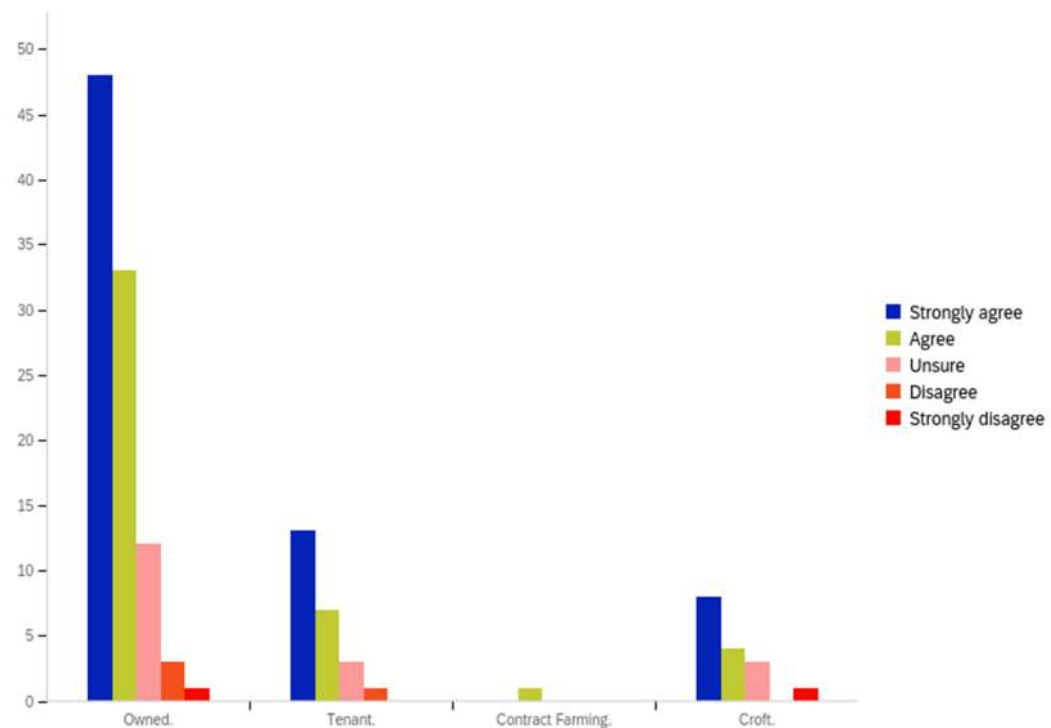
Statements by land tenure

It is possible to produce healthy food, on the same piece of land, whilst protecting the environment and mitigating and adapting to climate change.



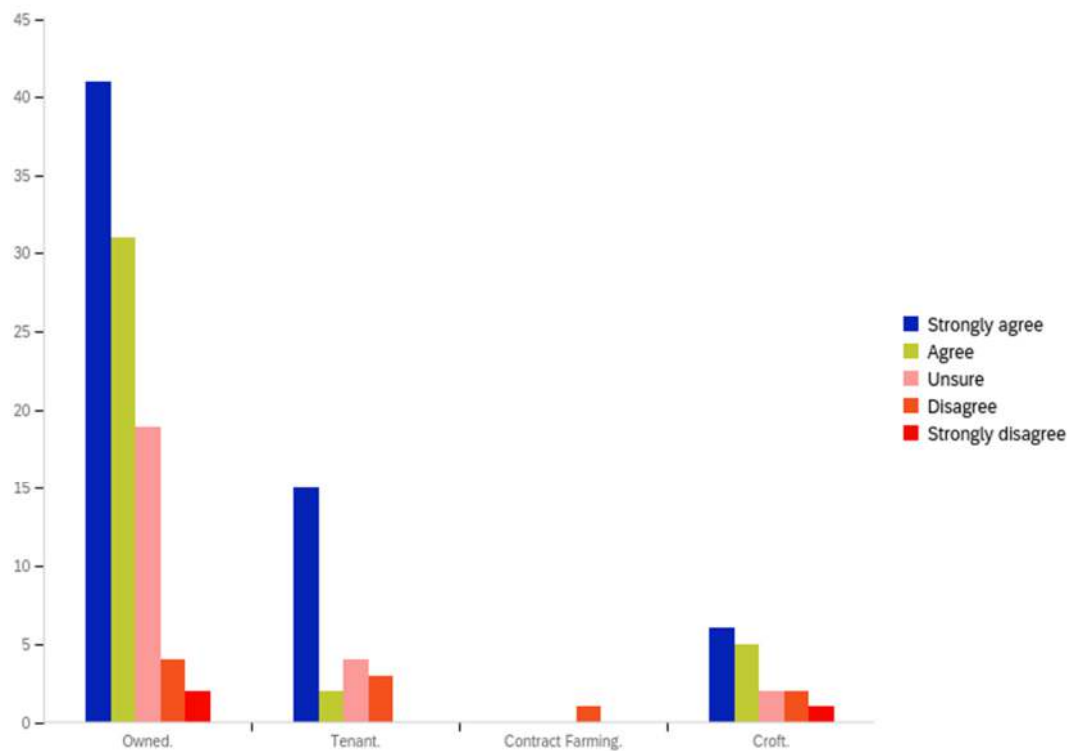
**Figure S6.**

Diversification, sustainability and agroecology farming systems are the future for farming in Scotland.



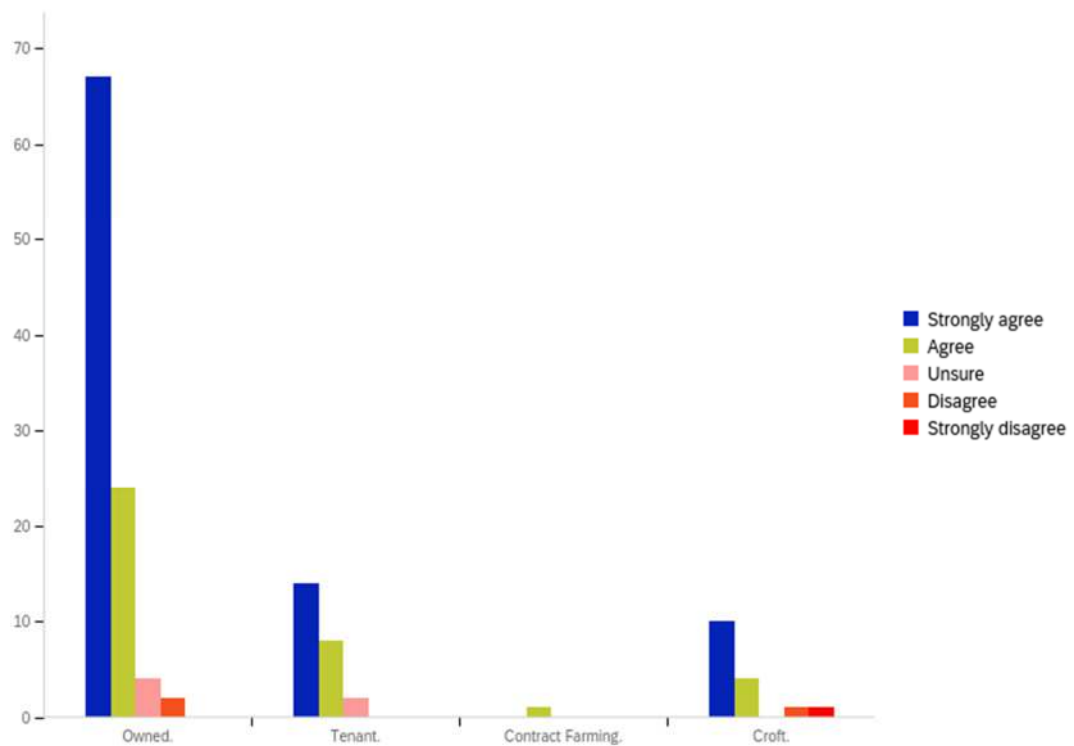
**Figure S7.**

Ecological measures and recycling practices within the farming system reduce costs and dependency on external resources, making farmers more independent and better prepared for external crises (economic, climate, or other).



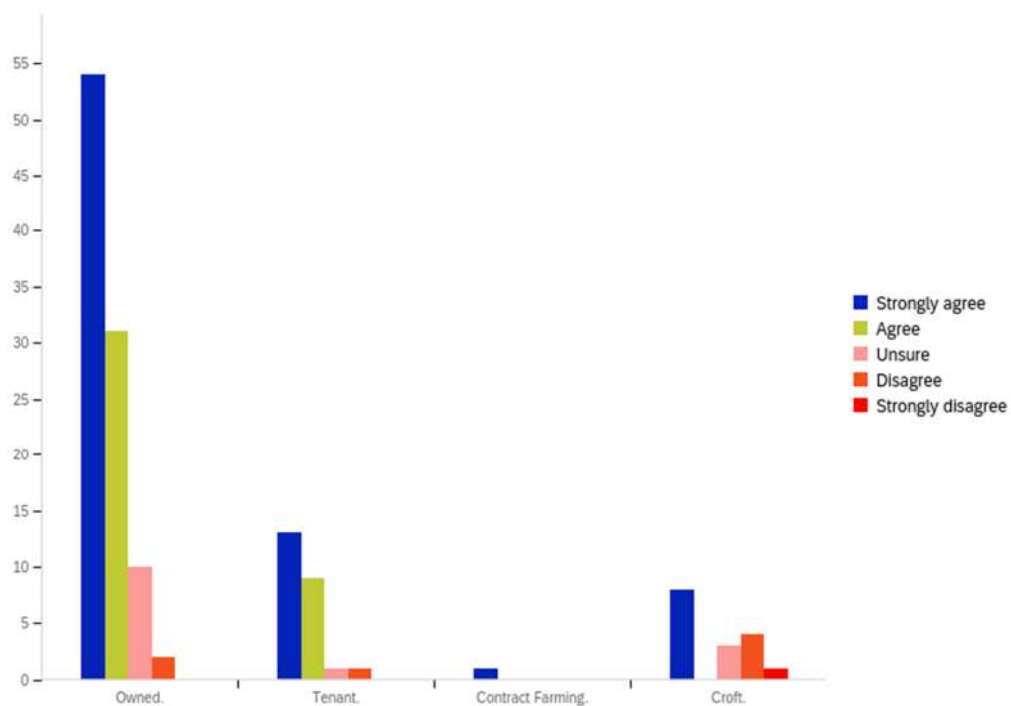
**Figure S8.**

Modern food habits are disconnected from local food production, local food traditions and sense of place.



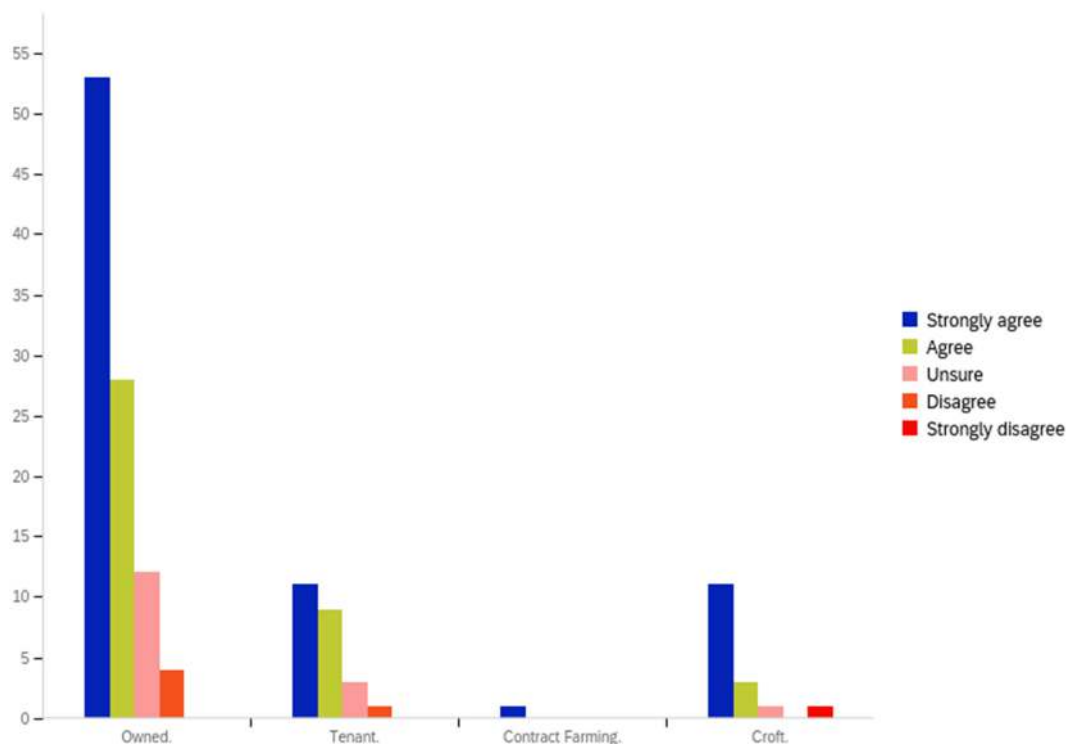
**Figure S9.**

Scotland needs more diversified farming systems that produce food, protect the environment and are resistant to external shocks.



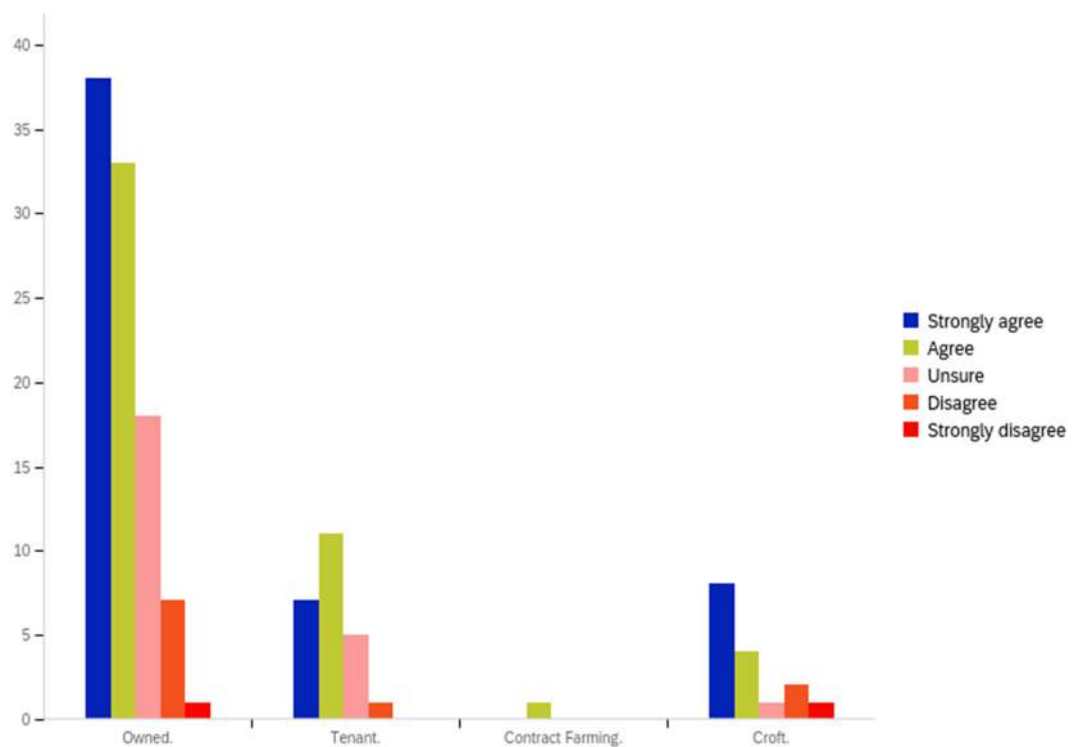
**Figure S10.**

Advice and training need to be more readily available to make farming systems more sustainable.



**Figure S11.**

The farming business is more robust to external forces when it is strongly linked with the local community and involves a diversity of people.



## Appendix 5. Interview guide.

# Farming practices.

## Guide for semi-structured interviews.

Please use this document as a safe note of the interview. The transcription of the interview will be added to this note.

We should have the consent form back before the interview. **Please do not do the interview** if you do not have the consent form back.

- Thank participants and start conversation chatty and relaxed, maybe ask how they are doing or something to warm people up.
- Explain briefly the project objectives, as an introduction to the interview ask if they have questions regarding the project aims and objectives, about how the information will be processed, etc.
- Confirm consent for recording the interview

**If the interviewee would like to know more about the project or have questions, please explain and be sure they do not have more doubts.**

## Characteristics.

Please feel free to let me know if you prefer not to answer.

We might have part of this information in advance. Otherwise briefly go through the general characteristics as in the online survey (See online survey).

## Farming Practices

### Element 1: Diversity

1. Use the table in question 1 of the online survey and discuss them:
  - which practices are you implementing or have you implemented in your farm?
  - what has been the reason: to improve soils, increase biodiversity etc../financial?
  - Have your objectives been achieved?
  - have you been paid for carrying out these practices? Have you received AES/which?
  - What are the (dis)advantages/(dis)benefits of implementing these practices?
2. What does resilience mean to you?
3. Weather extremes events, disease and other events and crises are more frequent nowadays, how do you manage these shocks? Do some of these practices help you in some way in terms of addressing ecological and/or economic constraints?

### Element 2: Co-Creation of Knowledge

1. How do you normally acquire new knowledge if/when needed?
2. How was the process of implementation (re knowledge)? Do you experiment on the basis of what you already knew about your farm? Or was it through collaboration with scientists or training, talking with friends? Or a mixture of all? Could you tell me more about it?
3. Are there areas of knowledge you would like to explore, know more about? Could you explain?
4. Do you participate in farmers' networks or other associations where you can ask questions and share your knowledge?
5. In addition to food production, do you have other "less tangible" production outcomes? E.g ecosystem services/public goods: biodiversity conservation, carbon storage?
6. How would you measure these types of environmental production outcomes from your land?

### Element 3: Synergies

1. What is your experience or opinion about managing land in a more holistic, integrated way? (if applicable?) For instance: integrating the management of annual and perennial crops, livestock, trees, soils, and other components of the farm system?
2. Do you see economic advantages or disadvantages of these management practices? Why?

#### **Element 4: Efficiency**

1. What is your opinion about the following statement?

*"by enhancing biological processes and recycling biomass, nutrients and water, producers [i.e. farmers] are able to use fewer external resources, reducing costs and the negative environmental impacts of their use".*

Do you think adopting practices that lead to these outcomes can increase your autonomy and resilience to natural and economic shocks?

#### **Element 5: Recycling**

1. Do you have recycling practices in place? Specifically recycling farm waste (biomass, manure, slurry, green manure, used water, woodchips)? Can you tell me if you see benefits? (Prompts: Has this led to lower dependency on external resources/less reliance on others/cost savings etc.)

#### **Element 6: Resilience**

1. In your opinion what are the advantages of implementing ecological practices, such as encouraging organism interactions that lead to weed suppression or regulate pest and disease outbreaks? And disadvantages?

#### **Element 7: Human and Social Values**

1. What is it like to be a farmer at the moment?/what do you think that the general public think of the farming community?

2. Do you think farmers feel able to take charge of decisions that affect them?/if not, what is needed to make this happen? (e.g. collaboration and cooperation between farmers, better social infrastructure, different forms of governance, cooperative production, cooperative landscape management, cooperative marketing?).

3. How do you engage with the community? Should farmers engage with their communities?

4. In your opinion, what are the barriers for younger people and women entering farming? What can be improved? How? What are the main challenges and long-term consequences of lacking young people and women in farming?

#### **Element 8: Culture and food traditions.**

1. How do you see your farming system fit within a bigger system of food security? Do you think it has an influence on wider ecosystems and landscapes? At what level? (e.g. only farm, catchment, national?)

2. Do you think the landscape of your farm and local area is an important element of your production and adds value to your products?

3. How do you see your role (and the role of farming as a whole) in terms of maintaining Scottish cultural identities and culinary traditions?' (Prompts: how does this happen/is this important to you, why/why not?)

**Element 9: Responsible governance**

1. Do you think there are any changes needed in farming in Scotland? (Prompts: what are the problems, what's already happening to solve them, is there a need for a change towards more sustainable/regenerative practices?)
2. In your opinion do we have the right infrastructure and government support to maintain or increase sustainable/regenerative farming systems?

**Element 10: Circular and solidarity economy.**

1. Have you sold or are you selling some of your products locally? Directly to consumers?
2. Has the way you sell your products changed with the COVID-19 pandemic and lockdown rules? What are the benefits or disbenefits?
3. In your opinion do you receive a fair enough income from your production (food or ecosystem services)? Why? If your answer is no, how can this be improved?

**OTHER RELATED QUESTIONS AND FINAL REMARKS.**

Would you like to add any other final comment or remarks?

Once we have the results of this research you will receive a copy of the final report.

**THANK YOU VERY MUCH FOR YOUR TIME AND HELP IN THIS RESEARCH. YOUR  
INPUT IS ESSENTIAL FOR US.**

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