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Summary of Stakeholder engagement

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Executive summary

As part of this SEFARI project we have engaged with a range of Scottish Government stakeholders to ensure that the indicators and metrics developed in the experimental publication meet the needs of end users. Information collected from stakeholders and end users will be used to inform current and future Farm Business Survey (FBS) publications.

Findings from our stakeholder engagement sessions showed that the most common indicators found in our literature review also most commonly meet the needs of our stakeholders and end users. These indicators (shown below) will be selected for the first experimental publication and will be presented over time and by farm type.

- absolute emissions (t CO₂-e / ha)
- emissions intensity (kg CO₂-e / kg output)
- nitrogen use efficiency (% N outputs / N inputs)
- nitrogen surplus (kg N surplus / ha)

Other indicators that can be estimated from the Scottish FBS but will not be included in the first experimental publication are volumes of used fertilizers, correlation between economic and environmental performance, individual GHG (CH₄|NO_x|NH₃|CO₂) emissions, and farming practices. Although these indicators were requested by end users, the demand was not high enough to be included in the current experimental publication. Moreover, some of these metrics, such as correlation between economic & environmental performance, are not clearly defined and therefore further investigation is required to develop them. To include indicators for farming practices in future publications, we might need to rearticulate the existing behavioural questions in the FBS, link FBS to other behavioural surveys (e.g., Farmer Intention Survey) and/or collect additional (proxy) data. For next publication, we expect that volumes of used fertilizers and some of the individual GHG emissions (namely methane and nitrous oxide) are the first to be included as these indicators are well defined and their data are readily available.

Finally, there are indicators in areas of interest where data are currently not captured (at all or sufficiently) but could be collected in the future. These include woodland area in farmland, biodiversity, soil health, feed additives, wind turbines in farmland, and efficiency & productivity improvements.

We recommend that future development work should consider data being collected through the survey related to environmental initiatives, future conditionality for support payments, and the likely mitigation pathways towards the emissions reduction targets in Scottish agriculture.

1 Introduction

This document describes the second research activity of the SEFARI fellowship on spatially referenced data relevant to land-based policy evolution in Scotland. In this research work, we have engaged with a range of stakeholders to ensure that environmental indicators and metrics developed through the Farm Business Survey (FBS) meet user needs. Stakeholders consulted include policy makers and analysts from different departments of the Scottish government (e.g. RESAS: Science Advice, Science and Advice For Scottish Agriculture (SASA): Policy and Pesticide Survey Unit, Common Agricultural Programme Replacement, Agriculture Transformation for Environment and Climate Change, Agriculture Food and Drink Analysis).

To gather user needs, we ran a series of in-person and online workshops and meetings. The workshops and meetings consisted of two structured discussions with specific questions. Stakeholders often answered the questions by drawing insights from their own work experiences. The first discussion gathered information on policy questions that stakeholders face and need to answer (e.g. What do you need to know about farm GHGs and nitrogen? What questions do you have?). In the second discussion, stakeholders were asked to determine the format of the information (best metrics and indicators) needed to answer their policy questions (e.g. How could your question be answered? What data/information do you need?).

Prior to this research activity, we have undertaken a systematic literature review of environmental indicators and metrics that are currently used in farm level surveys (Soliman 2023). The literature review alongside the information on stakeholder and end user needs, will inform the production of environmental indicators for farms in the Scottish Farm Business Survey (FBS). Environmental data estimated for the Scottish FBS currently includes greenhouse gas (GHG) emissions and nitrogen (N) use. In the next section we will present our findings from the stakeholder engagement sessions. We will then show the degree in which this information is aligned with the findings from the literature review. We then present our conclusion and discuss next steps of this project.

2 Results

2.1 Key findings of stakeholder engagement sessions

Results of the workshops and meetings showed that the most common indicators found in our literature review (absolute emissions and emissions intensity as well as both nitrogen use efficiency and nitrogen surplus) also most commonly meet the needs of our stakeholders and end users. These indicators will be selected for the first experimental publication of these results. Moreover, it was highlighted that it will be useful to clarify the difference in the calculation methodology between the estimated FBS environmental values and the national inventories estimates (e.g. national-level GHG inventory and nitrogen balance sheet). The project team is also looking into how to accurately communicate the intended uses of the data as well as the limitations of the methodology. Other indicators highlighted by stakeholders could be classified into two main categories (Table 1):

- (1) indicators that can be estimated from the Scottish farm business survey (FBS) but will not be included in the first experimental publication,
- (2) indicators that cannot currently be parameterised from the Scottish FBS but could be considered for future data collection or development work.

Table 1. Environmental indicators and information requested by stakeholders and the ability to be included in current and future farm business survey (FBS) publications

Category	Indicators/information needs
Indicators that will be included in the current experimental publication	Absolute emissions
	Emissions intensity
	Nitrogen surplus/balance
	Nitrogen use efficiency
Indicators that can be estimated from the Scottish FBS but will not be included in the first experimental publication	Volumes of used fertilizers
	Correlation between economic and environmental performance
	Individual GHG (CH ₄ NO _x NH ₃ CO ₂) emissions
	Farming practices
Indicators that are currently cannot be estimated from the Scottish FBS but is	Woodland area in farmland

possible to collect data for them in future FBS	Biodiversity
	Soil health
	Feed additives
	Wind turbines in farmland
	Efficiency & productivity improvements

A short description and examples of each category are presented below.

1) indicators that can be estimated from the Scottish farm business survey (FBS) but will not be included in the first experimental publications

While the indicators of this category were requested by end users, the demand was not high enough to be included in the current experimental publication. These indicators include fertilizer usage, correlation between farm economic and environmental performance, and individual GHG (CH₄|NO_x|NH₃|CO₂) emissions. Moreover, some of these metrics are not clearly defined and therefore further investigation is required to develop them.

Stakeholders were interested in information related to fertilizer and slurry use. This includes volumes, timing, and sources of fertilizer and slurry. While the main interest was on fertilizer application, there was also interest in farming practices that are related to fertilizer use. For instance, the use of crop mixtures to reduce reliance on fertilizer use, impact of legumes on nitrogen use, other options that farmers are using to replace (or use alongside) chemical fertilizers, and slurry use and storage practices. Although detailed information on the timing and methods fertilizer use are not possible to provide, it is however possible to provide data on volumes of fertilizer used in each farm.

Indicators that represent the relationship between economic (farm profit and outputs) and environmental (GHG emissions and nitrogen use) performance were also highlighted. In particular, the trade-offs between environmental pollutants and farm incomes were requested by stakeholders. This will help in determining the best intervention that can reduce GHG emissions and nitrogen use whilst having a minimum adverse impact on food production and farm income. Although the analysis provided in the first publication is not anticipated to address this question directly, the

FBS farm level data set can be used to model the current economic and environmental state of the Scottish farms and how it is changing over time. Moreover, published statistics may provide data towards monitoring the trade-offs being made by farms between environmental initiatives (e.g., use of technologies and sustainable agricultural practices) and farm incomes. Future development work should consider data being collected through the survey related to environmental initiatives, future conditionality for support payments, and the likely mitigation pathways towards the emissions reduction targets in Scottish agriculture (Eora et al 2022).

Information and indicators related to individual GHGs (CH₄|NO_x|NH₃|CO₂) emissions were also requested by stakeholders and end users. It is possible to develop some of these indicators as they are estimated by AgreCalc. However, this information has not been prioritised by stakeholders for this first experimental publication.

There was an interest in indicators representing farmer's behaviour towards the adoption of sustainable farming practices. This information is crucial in determining the likely effect of policy interventions that aim to reduce environmental pollutants. Specific information highlighted by stakeholders were the effect of different practices on methane emissions from livestock, uptake of regenerative farming techniques, and the diffusion of agriculture knowledge (e.g., whether farmers utilise soil analysis when applying fertilizers). While some of this information is currently collected by FBS, it is not yet in the right format that is required by end users. To develop these indicators, rearticulating the existing behavioural questions in the FBS survey, linking FBS to other behavioural surveys (e.g., Farmer Intention Survey), or collect additional (proxy) data could be considered.

(2) indicators that are currently cannot be parameterised from the Scottish FBS but is possible to collect data for them in future FBS

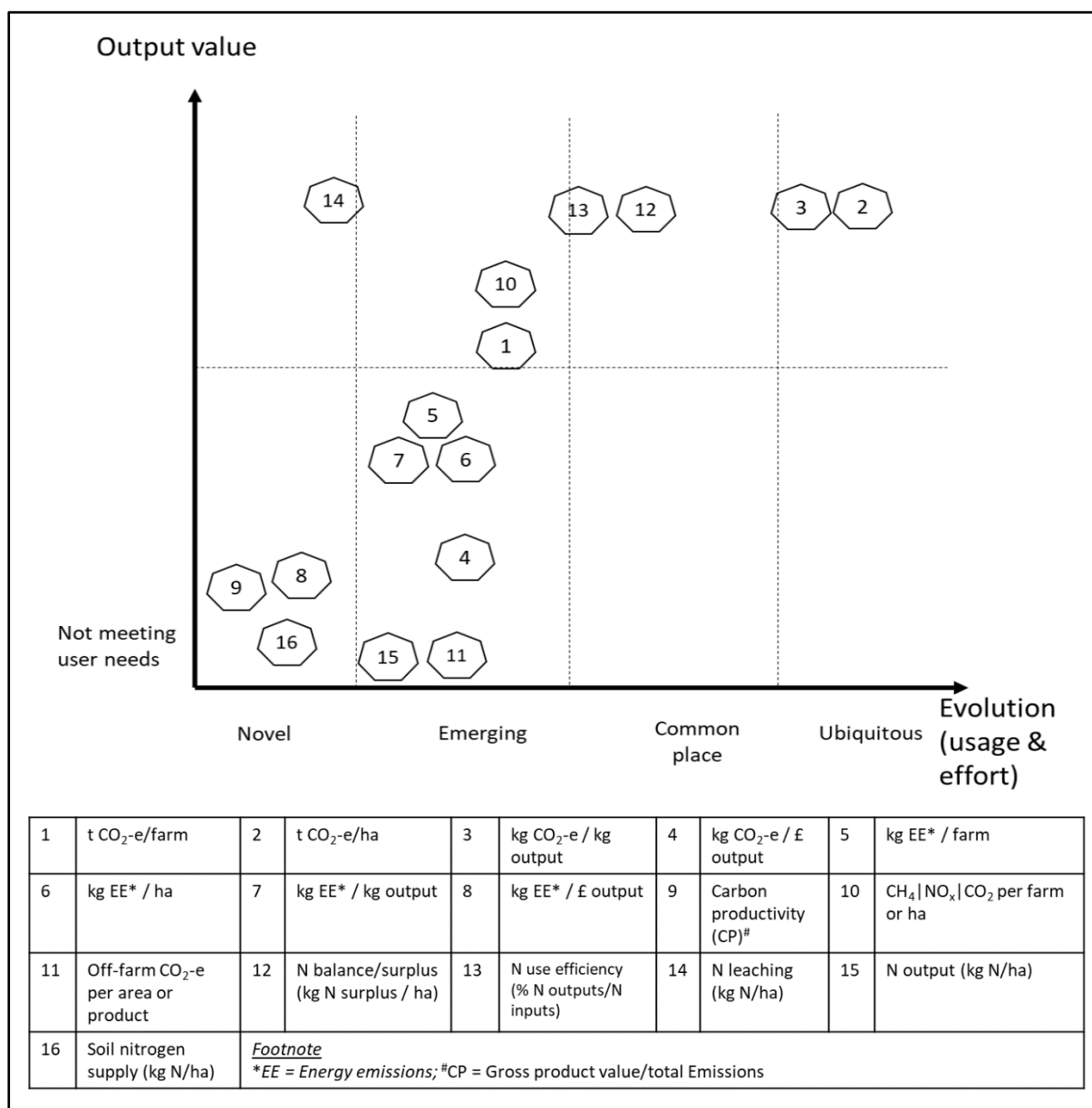
Indicators suggested in this category are quite diverse. These include woodland area in farmland, biodiversity, soil health, feed additives, wind turbines in farmland, and the impact of improving farm's efficiency and productivity on adverse environmental outputs. Knowing woodland area in each farm will help in determining the farm's GHG sequestration rate and therefore the possibility to estimate net emissions and not only gross emissions. Similarly soil data (such as depth, stoniness, and clay content) could

help in determining water holding capacity as well as nitrogen leaching and erosion risk. Biodiversity indicators such as proportion of farmland set aside, and other farmland wildlife attributes (e.g., natural habitats) are other policy area of importance and could be collected in future FBS (Hennessy et al 2013). Wind turbines in farmland is also one of the key mechanisms to generate renewable energy. Moreover, there was an interest in knowing the impact of improved productivity and efficiency on reducing GHG emissions and nitrogen use. The potential for linkage to livestock productivity data was noted, and there may be productivity related metrics that could serve as proxies, but these would need further development and analysis.

2.2 The relationship between literature review indicators and user needs

Based on the information gathered in the literature review and the stakeholder engagement sessions, we have classified the indicators found in our literature review by their frequency of use and the degree in which they meet user needs (Figure 1). It should be noted that some of the metrics and indicators that were requested by stakeholders and end users are not in Figure 1 as they were not used in previous studies. As concluded in our literature review, absolute emissions and emissions intensity as well as nitrogen use efficiency and nitrogen surplus (indicators 2, 3, 12, 13 in Figure 1) are the most common indicators found in our literature review and they also meet user needs to a high degree. For instance, nitrogen use efficiency is a new key indicator that will be used in the annual monitoring report of the “Climate Change Plan” which makes it highly needed by public stakeholders and end users (CCP 2022). Besides the four indicators highlighted above, stakeholders and end users indicated that emissions by farm type (indicator #1), individual greenhouse gases (indicator #10), and N leaching (indicator #14) are also needed, although to a lesser extent. Stakeholders also mentioned that estimates of carbon emissions from farm machinery are useful. This information roughly corresponds to indicator 5 (emissions from energy use per farm).

Figure 1. List of indicators used in previous studies and their classification according to frequency of use and meeting user needs.



3 Conclusion

Stakeholder engagement in this project was conducted to ensure that the indicators and metrics developed in this experimental publication meets the needs of end users. Information collected from stakeholders and end users will be used to inform current and future FBS publications. Findings from our stakeholder engagement sessions showed that the most common indicators found in our literature review (absolute emissions and emissions intensity as well as nitrogen use efficiency and nitrogen surplus) also most commonly meet the needs of our stakeholders and end users.

In the next steps of this SEFARI project, we will design a web publication for the four selected indicators for GHG emissions and nitrogen use. The indicators will be presented over time and across farm types. We will also include documentation of the methodology that was used to estimate these indicators, a clear definition of the indicators, and why it is important to estimate them. Limitations of the methodology used to estimate the environmental outputs (Agrecalc) as well as the difference between the FBS estimated environmental values and the national inventories estimates (e.g. GHG national inventory and nitrogen balance sheet) will be illustrated. Finally, the estimated values of the indicators will be presented in different visualisation forms such as tables and graphs.

4 References

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