Indicators and trends

Monitoring climate change adaptation

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Indicator name			Version
NA8 Sustainable intensification index (Scottish LFA beef sector)			**21/03/16**

Indicator type:	Risk/opportunity	Impact	Action
			X

SCCAP Theme	SCCAP Objective	CCRA risk/opportunity
Natural Environment	N3: Sustain and enhance the benefits, goods and services that the natural environment provides	BD21: Agricultural Intensification AG26/AG27: Biodiversity/wildlife changes

At a glance

- Climate change and other drivers are projected to lead to an intensification of agricultural activity in Scotland
- Unsustainable agricultural intensification will negatively impact biodiversity, adding to other pressures including climate change
- Sustainable agricultural intensification enables increased production, helping secure food supply in a changing climate, while maintaining/improving ecological, economic and social sustainability
- A sustainable intensification index has been developed for the Scottish LFA beef sector (and is under development for other farming sectors)
- This index will help us track the amount of intensification and its sustainability, both of which are important for climate resilience

Latest Figure	Trend
N/A	No significant change in sustainable intensification in beef farming during 2001-2010, attributed to lack of policy drivers for either increased production or improved sustainability

Why is this indicator important?

As well as providing food and other crops, agricultural land provides a number of ecosystem services and provides habitat for species. Additionally agriculture provides cultural value such as valued landscapes and land for recreation.

A number of drivers are expected to lead to intensification of agriculture. Globally, demand for food is

forecast to rise by 50% by 2030 and by nearly 70% by 2050 (Foresight, 2011a; cited in Knox et al, 2012). Climate change is likely to lead to widespread areas increasing in Land Capability for Agriculture (LCA), so more areas will be suitable for arable farming. There is concern that this will lead to loss of habitat, a change in wildlife species present, and a negative impact on biodiversity. Areas of currently marginal farming land could become more viable. Historically, agricultural intensification has been the primary driver in depleting the range of ecosystem services delivered by agriculture (Firbank et al., 2011: Storkey et al., 2011, cited in Barnes and Thomson, 2014).

At a national and international policy level, there is considerable support for sustainable intensification as a means to achieving agricultural intensification while sustaining the ecosystem services upon which agricultural production depends and meeting societal needs in an equitable way (Barnes, 2012b).

'Sustainable agricultural intensification is defined as producing more output from the same area of land while reducing the negative environmental impacts and at the same time increasing contributions to natural capital and the flow of environmental services' (Pretty et al., 2011, cited in Barnes, 2012c).

This indicator utilises the Index for sustainable intensification for the Scottish Less Favoured Area (LFA) Beef Sector developed by Dr Andrew Barnes of SRUC's Rural Policy Centre. This sector is particularly relevant because of its dominant size and potential for growth in Scottish agriculture (Barnes and Thomson, 2014) and because the landscape and ecosystem services associated with that land use could be fundamentally changed if climate change leads to a higher LCA combined with other factors such as increased demand. LFA cattle farms in Scotland 'are characterised by large areas of rough grazing which offer significant ecological benefits and by high remoteness factors, thus embedding social factors within their existence' (Barnes & Poole, 2012). Beef farms are also very diverse, covering all of the country including remote areas (Holland et al., 2011, cited in Barnes and Thomson, 2014).

Agriculture takes up 73% of Scotland's land area (Scottish Government, 2013). Much of this area is only useful for livestock grazing and is therefore dedicated to Less Favourable Area (LFA) cattle and sheep farming, shown in Figure 1.

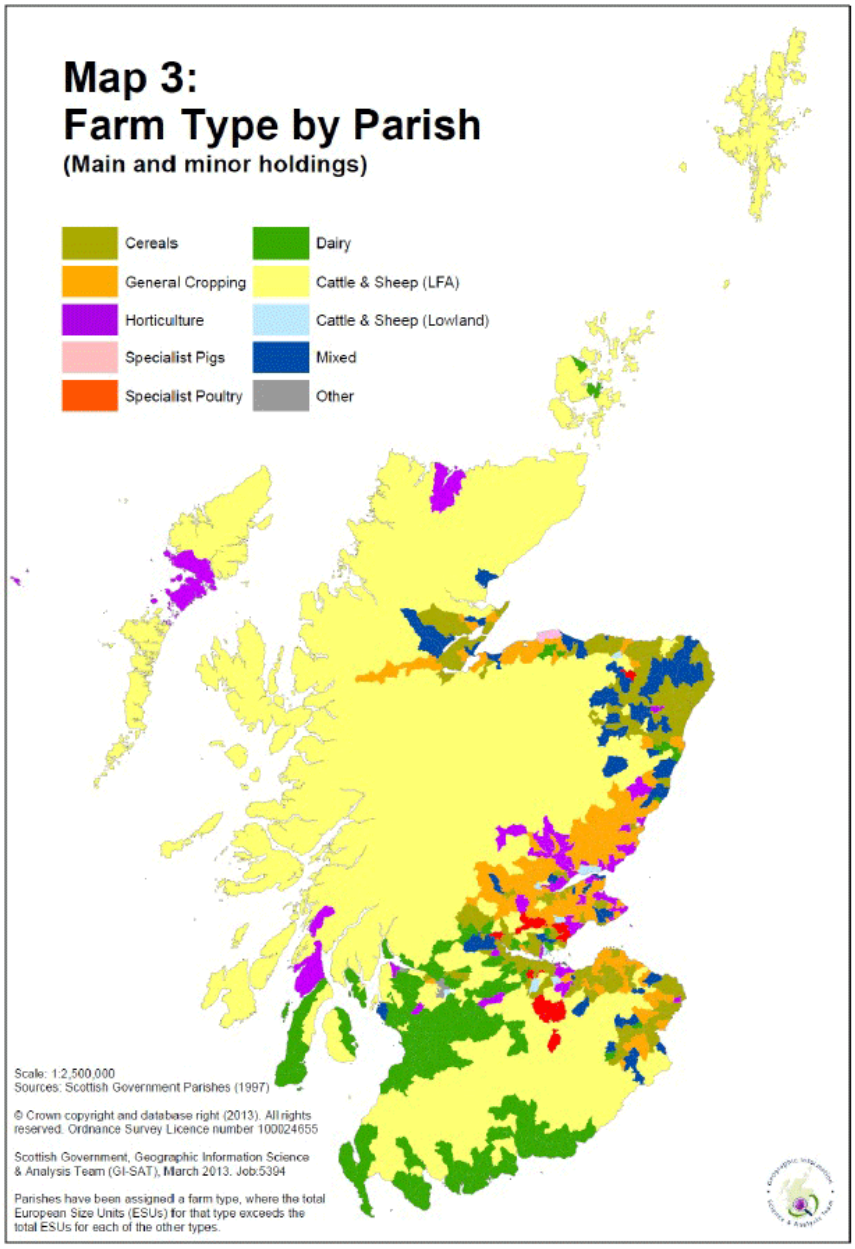

Figure 1. Farm Type by Parish
Source: Scottish Government, 2013 http://www.scotland.gov.uk/Publications/2013/06/5219/3

What is happening now?

Over 2001-2010 the index for sustainable intensification for LFA beef farmers has remained fairly static. Intensification (measured by stocking density) has not increased (Barnes and Thomson, 2014). The fluctuations recorded may be the result of changes to support payments (Barnes, 2012c). The lack of change appears to reflect policy that has neither supported intensification nor increased ecosystem, economic and social sustainability during this period. The index is shown in Figure 2, depicting annual changes in sustainable intensification.

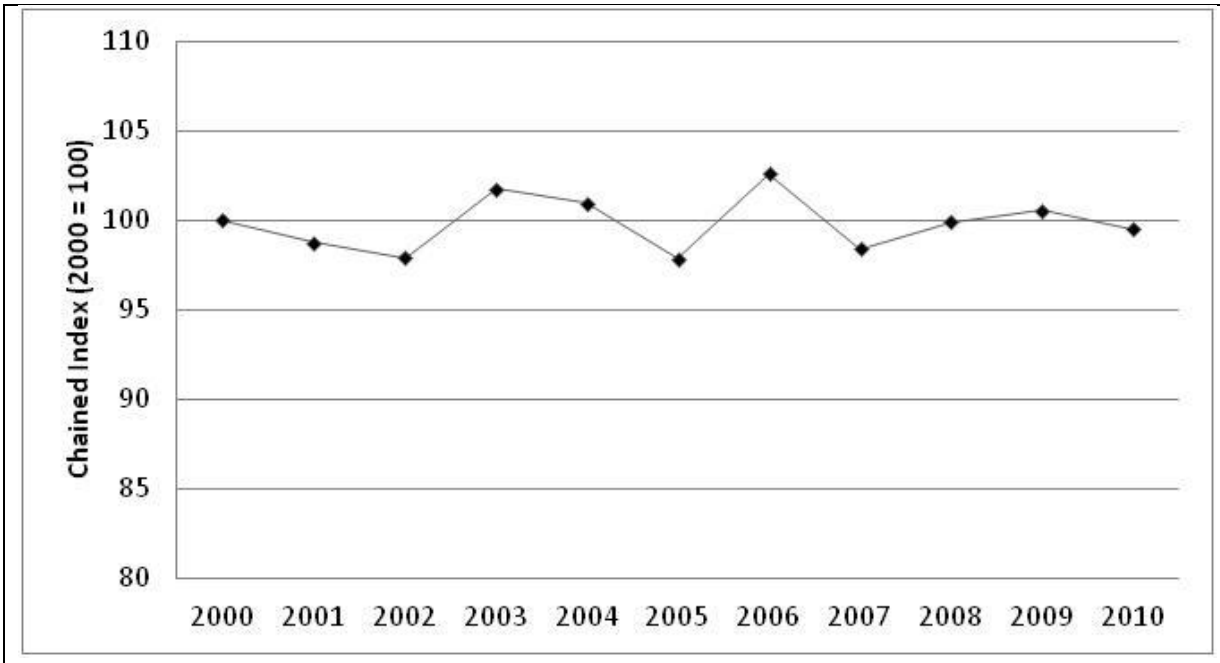

Figure 2. Index of sustainable intensification for beef farmers
Source: Barnes, 2012c

What has happened in the past?

Historically, agricultural intensification has been the primary driver of losses in the ecosystem services delivered by UK agriculture (Firbank *et al*., 2011 cited in Barnes and Poole, 2012).

Analysis for LFA beef farms has been conducted for the period 2001-2010 only.

What is projected to happen in the future?

It is thought that the sustainable intensification index may have remained relatively static due to the lack of clear policy goals over the period monitored (Barnes, 2012c). Future changes in sustainable intensification are likely to be influenced by the policy measures taken as well as drivers such as changing LCA due to climate change.

Patterns of change

Agri-climatic condition changes may lead to an increase in the amount of land used for agriculture, and changes to type of agricultural use, for instance arable production becoming viable in upland areas. The resultant increased intensity of farming in upland areas could impact biodiversity, greenhouse gas emissions and other ecosystem services.

Scotland's biogeography limits the scope for increased output in some areas, necessitating a regional approach in appraising trends. 'Hot-spots' of intensification exist in lowland cattle and dairy farming on the east coast and the south-west, and in cropping. However, in recent years hill and upland cattle farms have tended to more extensification (Barnes, 2012b).

The index of sustainable intensification has remained stable over the period monitored. The variations recorded are possibly due to changing subsidies/financial incentives. Specifically, the financial incentives within the EU CAP are a strong driver determining patterns of land use change.

Interpretation of indicator trends

Limitations

An analysis of 42 LFA beef farms informed the index. Primary data are not available, so a set of three proxy indicators were used to assess environmental, economic and social sustainability.

Measuring sustainable intensification is problematic, as it requires simultaneous improvements in sustainability and more intensive production. An interdisciplinary approach is required, as indicators for economic, ecosystem, social and ethical sustainability need to be considered (Barnes, 2012a). Barnes also advocates the inclusion of an ethical dimension within sustainable intensification that would include land ownership and access issues as well as the welfare of animals under intensification (Barnes & Poole, 2012). The secondary data used, from farm account networks, is focussed on production aspects of farming which is a central aspect in measuring sustainable intensification. However the high level of variation found within the score illustrates the need for caution in interpreting a single indicator to quantify sustainable intensification (Barnes and Thomson, 2014). There are also simplifications made due to limitations in the data available in the Scottish Farm Accounts Survey; for example intensification is measured solely by stocking density, although other factors such as increased use of concentrate feed might also indicate a change in intensification. It is recognised that further work is required in developing both the concept and actual measurement of indicators (Barnes & Poole, 2012).

References

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Further information

Acknowledgements

This indicator utilises the Index for Sustainable Intensification for the Scottish Less Favoured Area (LFA) Beef Sector developed by Dr Andrew Barnes, SRUC.

All the research and analysis described in this document was carried out by Dr Andrew Barnes, SRUC.

Appendix One: Indicator metadata and methodology

Table 1: Indicator metadata

	Metadata
Title of the indicator	Sustainable intensification index (Scottish LFA beef sector)
Indicator contact: Organisation or individual/s responsible for the indicator	Ruth Monfries (Royal Botanic Garden Edinburgh/ClimateXChange)
Indicator data source	Dr A.P. Barnes, Rural Policy Centre, SRUC
Data link: URL for retrieving the indicator primary indicator data.	http://ageconsearch.umn.edu/bitstream/134710/2/Andrew_Barnes_Barnes_Poole_AES.pdf

Table 2: Indicator data

	Indicator data
Temporal coverage: Start and end dates, identifying any significant data gaps.	2001-2010
Frequency of updates: Planned or potential updates	An update is planned for a range of Scottish farms; also a comparative index across European farming systems later in 2015.
Spatial coverage: Maximum area for which data is available	Scotland (42 farms)
Uncertainties: Uncertainty issues arising from e.g. data collection, aggregation of data, data gaps	The index is based on secondary data. Further information is provided in the 'Limitations' section and in Barnes and Thomson, 2014.
Spatial resolution: Scale/unit for which data is collected	Farms
Categorical resolution: Potential for disaggregation of data into categories	
Data accessibility: Restrictions on usage, relevant terms & conditions	Not publically available

Table 3 Contributing data sources

Contributing data sources Data sets used to create the indicator data, the organisation responsible for them and any URLs which provide access to the data.

Table 4 Indicator methodology

Indicator methodology The methodology used to create the indicator data
To develop an Index of Sustainable Intensification for the Scottish LFA Beef Sector, the Scottish Farm Account Survey 2001-2010 was used. This survey collects data for a sample of approximately 500 farms each year, under EU FADN quality guidelines (Barnes and Thomson, 2014). Indicators were developed for three components of sustainable intensification: environmental sustainability, economic sustainability and social sustainability. Sustainable intensification implies a temporal element. The indicator is designed not to measure a single point in time but to identify a trend over time that will indicate the impact of policy. The Index has been developed using a statistically weighted scheme across the three components measured: environmental sustainability, economic sustainability and social sustainability. The weighting varies over time, for example economic conditions can change markedly with fluctuating subsidies and societal priorities change over time. A chain linked index is used to reconcile changing weightings over time into a single index reflecting annual change (Barnes, 2012c, Barnes & Thomson, 2014). Further discussion of the methodology can be found in: Barnes, A.P. and Thomson, S.G. (2014) Deriving an index of sustainable intensification: how far can secondary data go. *Ecological Indicators* **36**, 213-220