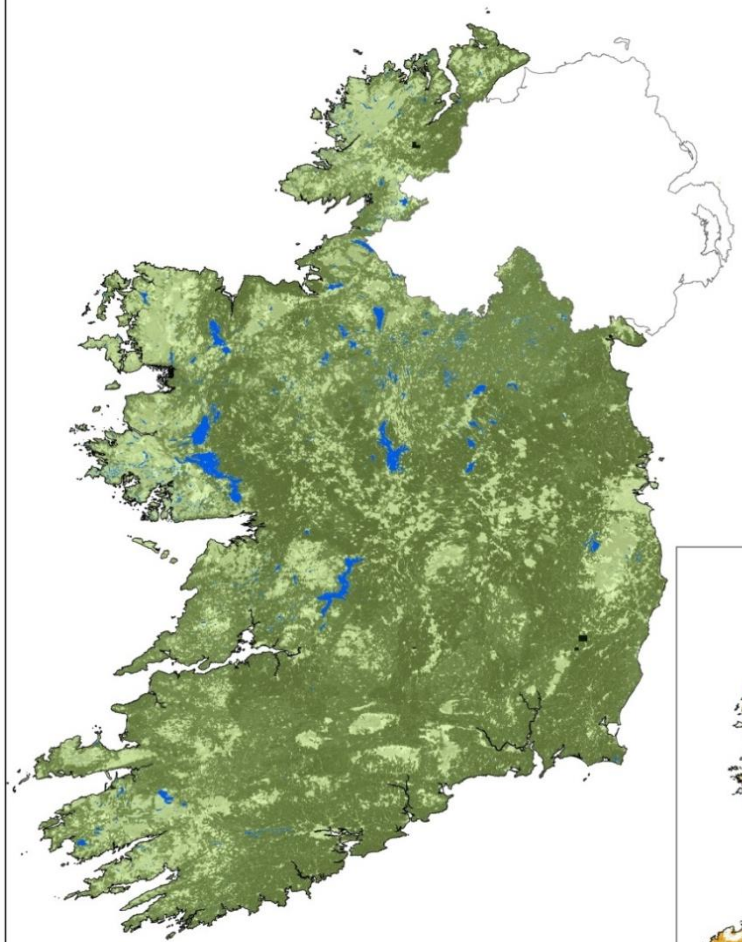
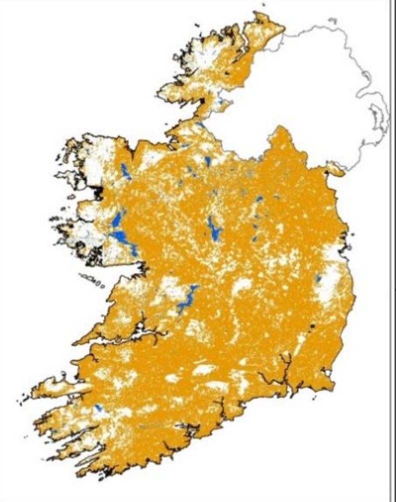
Terrestrial food: Indicator document - Ecosystem Service Modelling & Rule-base development

Areas of land supporting food production

Ecosystem service: **Nutrition from crops, livestock and wild foods**

29/03/2016





Legend

Higher contribution to food provision

Lower contribution to food provision

Both maps

Freshwater

Compromised data in urban input

Insert

Primarily cultivated land

How to interpret the map:
In the main map, the darkest colours represent areas where there is greater production of food such as cultivated crops and improved pasture. Lighter colours represent areas where the land provides lower amounts of food such as wild food gathering (fungi and game etc). The insert highlights area primarily under agricultural land use in orange.

Ecosystem service:
Nutrition (provisioning) – Terrestrial Food Provision

What the service is:
Land being used for producing crops, rearing livestock and which could be used to forage for wild foods such as fungi and berries or hunting game.

Why it is important:
Increasing populations globally and requirement for increase in housing and other resources such as timber and minerals is putting pressure on land use. Understanding current food provision resource is important in planning future land use strategy.

How the map was created:
The map was created using information on cropping types from the Land Parcel Information System, soil data from Teagasc and habitat data from NPWS. Arable crops and improved grassland (permanent pasture) are shown as high whilst land that provides for wild food provision only is scored low. The map is intended for use at a strategic scale and not at individual farm level. Current activity on an individual land parcel would need to be assessed to give a complete field scale result.
The map should be interpreted as showing the best information using the data currently available.

Valuation example:

Ecosystem Service Typology	Significant effects	Data used	Example attributes	Indicative scoring
Agriculture: Crop, livestock and wild food resources	Land cover that supports crop production	Habitats	Arable	high
			Not arable	low
	Land managed for rearing livestock	Habitats and Management	Improved grassland	High
			Permanent and temporary pasture	
			Crops for feed stock	low

0 20 40 60 80 100
Kilometres

N

Cartography by Environment Systems Ltd, May 2016.
Ordnance Survey Ireland Licence No EN 0059216

Contains data prepared by the Environmental Protection Agency based on Ordnance Survey Ireland information.
For full list of datasets used for this map, please refer to the final project report.

An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht

National Parks & Wildlife Service

Environment Systems
evidence and insight

Indicator	CICES classification
TERRESTRIAL FOOD PROVISION **Areas of land supporting food production (Nutrition from crops, livestock and wild food)**	**Section**: Provisioning **Classes:** • Cultivated crops • Reared animals and their outputs • Wild plants, algae and their outputs • Wild animals and their outputs • Animals from in-situ aquaculture **CICES IE Sub-class:** • Multiple classes (see CICES for Ireland_fordb.xlsx for details)
Scale	**CICES Cascade Level** [1]
Strategic/National/~~Regional/Local~~	~~Structure/Function/~~Service/~~Benefit/Value~~

[1] Potschin, M. and R. Haines-Young (2016): Frameworks for ecosystem assessments. In: Potschin, M., Haines-Young, R., Fish, R. and Turner, R.K. (eds) Routledge Handbook of Ecosystem Services. Routledge, London and New York, pp 125-143.

What the service is

The service mainly comprises land being used for producing crops and rearing livestock. In addition land which could be used to forage for wild foods such as fungi and berries or hunting game is included. Species used for food inhabiting freshwater bodies, and those which spend part of their lifecycle in freshwater and part in marine waters are also included.

Service indicator(s) mapped

This ecosystem service was mapped using the habitat conflation layer which includes data on cropping and land used for more intensive grazing. In addition habitats were considered where they formed a proxy for where species used as wild food (e.g. mushrooms for gathering) would occur. Also of relevance as they affect the amount of food produced are substrate, landform and land management.

Landform has been considered on the basis that steep slopes are more difficult to cultivate meaning they are mainly restricted to rearing livestock. Land management can moderate or enhance each of the other indicators. For example, intense grazing regimes can lead to soil compaction, resulting in lower soil pore space. A long history of cultivation can degrade the level of soil organic matter through oxidisation.

Datasets used	**Dataset requirement**[2]
Habitat Asset Register[3]	Essential
NextMap 5m DTM	Desirable
Teagasc Soil	Desirable
Teagasc Subsoil	Desirable
Conservation Designation	Desirable

[2] 'Essential' datasets are needed to map the service, whilst 'beneficial' datasets will increase model accuracy but are not necessary requirements for mapping.

[3] The Habitat Asset Register only contains habitats suitable for national scale mapping; for details, please refer to the project report.

How the map was created

The map was created from the Habitat Asset Register (Level II) which used information on cropping types from the Land Parcel Information System as well as data habitats supporting wild food provision such as moorland and lakes. In addition soil data from Teagasc and habitat data from NPWS were considered. The map shows areas of horticultural, fruit and vegetable crops as high, as these in general have the highest nutritional value per unit of land. Arable crops and improved grassland (permanent pasture – which support grazing animals) are shown as higher than land that provides for wild food provision only, which is scored low.

The map should be interpreted as showing ecosystem service information based on the data currently available; when new data become available the maps can be updated. The maps are intended for use at the strategic/national scale and not at individual farm level. A field visit should be conducted before decisions are made regarding a particular location, to confirm land use at the field level.

Scoring

Significant Effects	Datasets used	Example attributes	Indicative scoring[4]
Habitat capability to provide food	Habitat Asset Register	Arable	High
		Rough Grazing (LPIS) Mosaic	Medium
		Marsh	Low
Land suitability for food production	NextMap 5m DTM	None	High
		None	Medium
		None	Low
		>18°	Disbenefit
Soil suitability for food production	Teagasc Soil	None	High
		None	Medium
		AminDW (Acid Deep Well Drained Mineral)	Low
Soil suitability for food production	Teagasc Subsoil	None	High
		None	Medium
		Alluvium, Silty	Low
Some level of wild food gathering in areas visited by many people	Conservation Designations	None	High
		None	Medium
		[whole layer]	Low

[4] The indicative scoring in this table gives overview-type information on how the individual data layers were incorporated into the ES maps. For full scoring, please refer to the spreadsheet containing the full rules-base.

Data gaps associated with this map during the pilot project

The contribution of land to food provision does not solely depend on whether or not crops are grown or livestock reared on it. Additional information that would enhance this map are stocking density, the type of crop grown and estimated tonnage, or the management techniques the crop is grown under. Combining wild food and cultivated food may lead to some difficulties with map interpretation and it would be useful to break this map into its component parts. The wild food mapped element could then be supplemented with additional information of hunting licences and returns. DAFM and Teagasc may hold additional knowledge which could help build this mapping to a further level of accuracy.

Note that this map has been prepared at a strategic level and is not suitable at zoom levels showing individual holdings or fields.

LPIS data, regarding grassland: The manner in which the LPIS system categorises Permanent Pasture may lead to an overestimation of the amount of grassland that is actually heavily improved. The Guide to Land Eligibility Direct Payment Schemes 2015[5] states that "Permanent grassland includes productive ryegrass dominated swards, less productive swards that include rush and other non-grass herbaceous species and grassland that includes heather which is grazable and where grass and herbaceous species are not predominant". This may lead to areas that are not overlain by better resolution habitat data being categorised as Permanent Pasture when it may contain other habitats such as Heaths or Blanket Bogs.

Additionally, as the data does not record percentage cover of the individual classes, the classes used are conservative best estimates. In the case of a mix of an arable class and a grassland class, the area will appear as arable, even though in reality 90% of the area could be grassland. However, in the final HAR only ~1.5% or Ireland's terrestrial extent are covered by mosaic classes from LPIS, making this a minor issue with regards to overall accuracy for ecosystem service mapping.

[5]http://www.agriculture.gov.ie/media/migration/farmingschemesandpayments/basicpaymentscheme/LandEligibility2015Booklet010515.pdf

Scientific framework for modelling 'terrestrial food provision'

Overview:	Food provision is an important ecosystem service that relies on a range of supporting services provided by various habitats (both natural as well as managed) and the species associated with them (Swinton et al., 2007; Parikh and James, 2012). There is good supporting evidence regarding the role of agriculture, other land management, semi-natural areas, substrate and landform on terrestrial food provision. The most relevant material is summarised here.
Soil and soil systems	Agriculture varies from intensive production of arable crops in lowland areas and extensive permanent grazing regimes on open moorland to intensive small-scale horticultural fruit and vegetable production on allotments and in gardens (Foley et al., 2005). Enclosed farmland is managed for food production and underpins the agri-food sector, which contributes approximately 7% to Ireland's GVA (gross value added) (Teagasc, 2015).

	The most important supporting service for agricultural production is the maintenance of soil fertility, which is fundamental to sustaining agricultural productivity (Watson et al., 2002; Altieri and Nicholls, 2003; Parikh and James, 2012). Soil carbon plays a major role in soil structure, one of the major components of soil fertility (Swinton et al., 2007; Parikh and James, 2012). Mineral soils provide good productivity and afford some of the best soils for food production, due to the balance between mineral components, organic matter, oxygen supply and water retention (Parikh and James, 2012). Organo-mineral soils are generally poorer for food production, often associated with acid upland soil and cooler, wetter climatic conditions (Brady and Weil, 2002). Organic soils can provide very good food production conditions. However, they require artificial drainage, agro-chemicals are needed to maintain a neutral pH and high nutrient levels and cause peat wastage, resulting in loss of carbon stored in the soil (Holman, 2009). Well drained and nutrient rich brown earth soils require the fewest artificial inputs to allow for them to be used for cultivation. However, any intensive use depletes soils of nutrients, which can be countered by rotation or external inputs (Parikh and James, 2012). Due to the coarse structure causing large pore spaces, sandy soils tend to drain fast and not retain enough water and nutrients for effective agricultural usage (Brady and Weil, 2002). Waterlogged systems can require substantial drainage operations to allow for them to be suitable for cultivation (Robinson and Armstrong, 1988; Ritzema, 1994; Holman 2009). The underlying geology is an important determinant of food production capability through its effect on soil type and texture (Jenny 1994; Brady and Weil, 2002). Underlying geology also affects other features of soil type, such as depth and stone content, both of which have an impact on food production (Jenny, 1994; Brady and Weil, 2002). Good information regarding soil composition, particle size, pore spaces, and peat content in Ireland have been recorded by Teagasc (Teagasc Soils Guide[6]; Teagasc, 2007).

[6] http://gis.teagasc.ie/soils/soilguide.php

Landform	Landform has an important influence on food production. Intensive agricultural production is limited to flat or gently sloping ground (Spencer, 1978). The maximum cut-off for the effect of slope on agriculture are generally recognised as >18° - Land too steep for arable production (machinery cannot operate) and with limited suitability for grazing (MAFF, 1988). This is particularly important when considering additional areas where agriculture could take place, whilst, when looking at existing agriculture, the relevant information is mostly contained within the land cover information.
Semi-natural habitats	Food provision is an important ecosystem service that relies on a range of supporting services provided by various habitats, natural as well as managed, and the species associated with them (Swinton et al., 2007; Parikh and James, 2012). Some semi-natural habitats are not commonly used for intensive food production and are mostly associated with wild food provision. However, many habitats are maintained by agricultural grazing systems. In these cases, maintenance of the habitat is the priority, but the area does still contribute to food production (Bullock et al., 2011). Some habitats contribute to wild food production in minor ways, such as bilberries from moorlands (Acreman et al., 2011).
Management	Management systems are one of the most important factors for food production and also influence the impact of agriculture on the delivery of other ecosystem services (Swinton et al., 2007; Davari et al., 2010). Conservation management on farmland can be seen as reducing inputs, particularly on grassland based systems. This can have the effect of lowering productivity and, therefore, food production (Lichtfouse, 2011). Grazing (both cattle for dairy and beef, and sheep) is the major land use in Ireland. Managing grassland for grazing can affect biodiversity (Anderson, 2013) as well as the provision of ecosystem services (particularly water quality) through nitrogen application, slurry, pollution, and methane. This effect can be mediated through agri-environment management (Van Rensburg et al., 2009). Below ground physical features can be modified by machinery and by some specialist grassland types to develop deep rooting systems and an open soil structure (Carter, 2004; Pagliai et al., 2004). This improves the soil aeration, drainage and nutrient availability for the grasses themselves and for subsequently planted crops, improving growth and yield (Fitter, 1991; Carter, 2004).

	The ecological assemblages of soil fauna and flora can be important factors in maintaining soil structure by encouraging strong root systems (Brussaard, 1997; Wall and Moore, 1999) and, therefore, more productive crop growth. Earthworm numbers are particularly significant for soil system health (Brussaard, 1997; Lavelle et al., 2006). Additionally, some crops are selectively bred to have a well-developed root system (Fitter, 1991). In some instances the soil is prepared to enhance below ground biodiversity, which encourages crop growth (Brussaard et al., 2007). Crops are generally monocultures and, therefore, low in species richness (McCracken et al., 2011). However, hedgerows, beetle banks and headlands provide a greater abundance of flora species diversity to be present within the intensive agricultural environment (Benton et al., 2003). This in turn can support more birds and insects, which provide natural pest control and pollination (Carvell et al., 2007; Osborne et al., 2008; Blake et al., 2011; Fabian, 2013).

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