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BIOBIO indicator factsheet

Total Direct and Indirect Energy Input (EnerIn)

Refers to Chapter 8 'Management related indicators' of the Guidebook 'Biodiversity Indicators for European Farming Systems'

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Total Direct and Indirect Energy Input (EnerIn)

Description

Consumption of direct energy (fuel, electricity) and indirect energy (synthetic fertilisers, pesticides, feedstuff and machinery) for production of crops and livestock is a measure of the energy intensity for farms.

Unit: GJ per ha Utilised Agricultural Area (UAA). Alternatively: equivalent litre of fuel per ha UAA

It is known that agricultural intensification over recent decades has raised energy use on farms. Almost each measure on a farm is connected with an input of energy. Especially the production of modern crops is characterized by high inputs of fossil energy. Indirect energy consumption of farm inputs like fertilisers, pesticides or feed stuff is often higher than direct energy consumption.

The energy intensity is mainly dependent on the individual farming system. There is a strong correlation between the energy intensity, the farming structure (cropping system, livestock grazing regime), the resources used, matter fluxes (imported fertilizer, forage and feedstuff), the yields and the operation practices (frequency of operations, machines used). High input systems are e.g., characterized by the heavy use of fertilizers, pesticides and labour-saving, high-power machines. The introduction of these techniques has led to a steep increase in the input of fossil energy. Farms that use a higher energy intensity have a greater impact on the agroecosystem. As a result, the potential for environmental effects increase and the farming system has a greater impact on biodiversity[1].

Surveyor skills

Data collection can be undertaken by technical staff (farm interviews, retrieval from databases). No specific expert knowledge is required for data appraisal.

Data collection method

Interviews with farmers via farm visits or telephone contact.

Calculation method

To calculate energy input on farm level, BIOBIO used DIALECTE, a tool for agri-environmental assessment of farms.

Input variables:

Annual consumption of

- diesel fuel
- natural gas/ propane
- electricity
- energy for irrigation
- NPK fertilisers
- fodder purchase
- plant protection & veterinary medicine
- farm machinery
- buildings

The direct energy comprises diesel consumption or electricity. Field work undertaken by external enterprises or the electricity consumed through a collective irrigation network are also included. The indirect energy includes mineral fertilisers, plastics and feedstuff purchased using the ratio per kg of product. For pesticides, it is the ratio per ha and treatment, for farm building the ratio per square metre and for machinery the ratio per hectare.

Energy units of direct and indirect forms of energy

Input	Unit	Equivalent Litre of Fuel (ELF)
Diesel	1 litre	1.17
Electricity	1 kWh	0.28
Mineral nitrogen	1 kg	1.63
Farm Machinery	ha	50
Pesticides	1 treatment/ha	2.87
Soja cake	1 kg	0.17

These inputs are converted to energy units using standard reference values (see Table) and are summed up to yield the total energy input per farm.

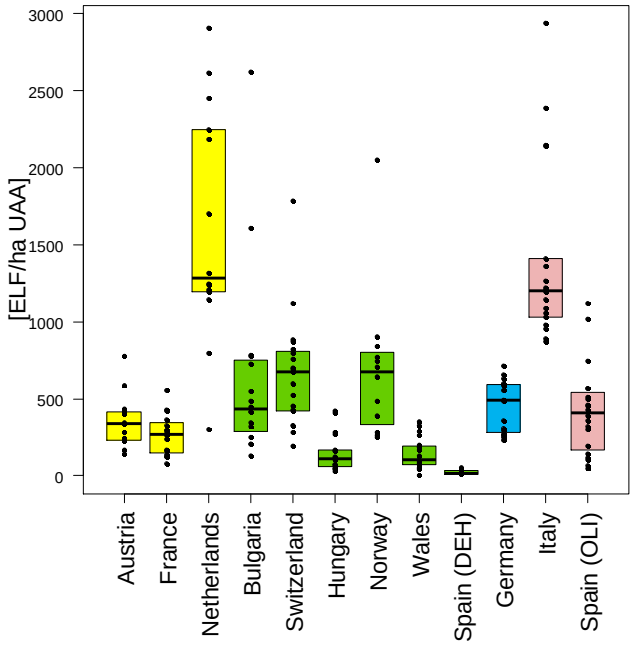
In DIALECTE, the energy indicator is measured as equivalent litre of fuel (ELF). The ELF unit can be converted to kWh (1 ELF = 9,8 kWh) or GJ (1 ELF = 0,035 GJ).

The total energy input can be related to hectare of UAA, per farm or per farm product (kg of cereal, litre of milk or kg of meat). The perimeter of the farm must be clearly defined (e.g. energy for food processing as wine or cheese and marketing for travelling costs).

Results from BioBio case studies

Farms in Italy and the Netherlands have the highest input levels for energy consumption. The range in the Dutch horticultural farms is rather varied. Some farms consume energy far beyond the other 10 case studies which is related to the cultivation of intensive crops (fruits, strawberries). The high input level in Italian farms is related to wine processing. The least energy-consuming production system was the Dehesa with a minimum of external inputs. Sheep production in Norway showed a higher use of energy per ha in comparison to Wales where animals graze outside all year round. Organic farms showed a lower energy consumption per ha.

[1] Dennis P. *et al*., 2009. Deliverable 2.1 of the EU FP7 Project BioBio. ISBN 978-3-905733-16-7.



Range of energy input in BioBio case study farms (equivalent litre of fuel per ha UAA)
Legend: the colour of the bars signify the type of land management. Yellow: arable including horticulture; green: grassland; blue: mixed arable and grassland; pink: tree-based systems.

Synergies with other indicators

In data collection, there are synergies to the soil surface nitrogen balance applied for 'Nitrogen Input', to 'Nitrogen Balance' and to 'Average Stocking Rate'.

Estimated effort and costs (labour effort required, analysis)

An average of 8 hours per farm must be calculated for the collection of the BioBio farm management indicators. This includes the farm interview, data processing and data check. However, there is considerable variation in time effort depending on the complexity of farms and the implementation (telephone interviews or farm visits).

Correlation with other indicators

'Vascular Plants' decreased with increasing energy input in 6 out of 12 BioBio case studies, with the other, mainly less intensive case studies like grassland in Bulgaria and Hungary or Dehesas in Spain, showing no significant relationship. Correlations with fauna species indicators were less consistent. Negative relationships predominated (for all fauna species indicators) in Olive groves in Spain and mixed farming in Germany and for 'Wild Bees and Bumblebees' (in all case studies).

Energy Input change as an indicator

An increase in energy input indicates the intensification of management practices on a farm. This may be due to progressive mechanisation of field operations, enlargement of livestock housing facilities and, thus, increase in farm livestock or the expansion of crops that require higher inputs of fertiliser and/or pesticides. Faster and more efficient field operations (soil cultivation, harvesting, mowing etc.) often entail the use of larger machines that have a greater range of operations. This facilitates field enlargement and the removal of landscape elements.

Interpretation

The effect of increased energy inputs on biodiversity depends upon the farming system. For example, machinery expansion may negatively affect faunistic species through changes in habitat structure (e.g 'Patch size', 'Habitat richness') on the farm. Changes in the input of indirect energy through the increased application of fertiliser and pesticides may directly affect species diversity.

Strengths and weaknesses

Farmers were often unable to provide data on fuel and energy consumption during the interview and many instead gave estimates for their farms.

Family farms were unable to distinguish private consumption from the energy used for agricultural production. Electricity consumption includes generally 1-2 households. An estimation was made to record only the farm consumption.

Major equipment for processing and storage on farms (e.g. drying equipment, wine processing, cooling chambers) can greatly influence energy consumption. In such cases the total energy consumption poorly reflects other areas of consumption such as the intensity of crop and livestock production. Often farms do not keep separate records of major energy-consuming processes.

This factsheet is part of the Guidelines **Biodiversity Indicators for European Farming Systems**.
More detailed information on the set of indicators developed in the EU FP7 research project BIOBIO (Biodiversity indicators for organic and low input farming systems, KBBE-227161) is given in a printed report, published as ART Publication Series Nr. 17. The report can be downloaded from the BIOBIO website.
Printed versions can be ordered at www.agroscope.admin.ch or at Agroscope, Reckenholzstrasse 191, 8046 Zurich, Switzerland

BIOBIO Indicator Factsheets

Genetic diversity	
Breeds:	Number and amount of different breeds
CultDiv:	Number and amount of different varieties
CropOrig:	Origin of crops

Species diversity	
Plants:	Vascular plants
Bees:	Wild bees and bumblebees
Spiders:	Spiders
Earthworms:	Earthworms

Habitat diversity	
HabRich:	Habitat richness
HabDiv:	Habitat diversity
PatchS:	Average size of habitat patches
LinHab:	Length of linear habitats
CropR:	Crop richness
ShrubHab:	Percentage of farmland with shrubs
TreeHab:	Tree habitats
SemiNat:	Percentage of semi-natural habitats

Indirect management indicators / parameters	
EnerIn:	Total direct and indirect energy input
IntExt:	Intensification/Extensification - Expenditure on inputs
MinFert:	Area with use of mineral nitrogen fertiliser
NitroIn:	Total nitrogen input
FieldOp:	Field operations
PestUse:	Pesticide use
AvStock:	Average stocking rate
Graze:	Grazing intensity