ART Schriftenreihe 17 | September 2012

BioBio indicator factsheet

Field Operations (FieldOp)

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

Agroscope

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Federal Department
of Economic Affairs FDEA
Agroscope Reckenholz-Tänikon
Research Station ART

Field Operations (FieldOp)

Description

Quantifies the number of mechanised field operations in crop fields and grassland. The **unit** of measurement is the total number of field operations. On farm-level the area-weighted average is calculated.

Sub-indicators:

The indicators 'Mowing frequency', 'Mowing timing' and 'Soil Cultivation: ploughing' are no genuine sub-indicators because they use different input variables. However, they are treated in this fact sheet because they are thematically related.

It is a **pressure indicator**. Generally, trends in the intensification of production are strongly connected to processes that will increase the use of machinery on the parcels and the number of passages that is required in the cultivation of agricultural land. In grasslands, productivity increases with the number of cuts that are possible (1 to 2 cuts in extensive grassland, 4 to 6 cuts in intensively managed grassland). Equally in arable land or horticulture the number of operations from weeding, fertilisation or pesticide treatments increases with intensification.

Surveyor skills

Data collection can be implemented by technical staff (farm interviews, retrieval from databases). For data validation, skills in the interpretation of farm balances and background knowledge in agriculture are necessary to examine the plausibility of both the input and output variables.

Data collection method

In farm-level surveys, farmers must be interviewed using a structured questionnaire. Regional surveys can retrieve available data from official farm accounting databases**.**

Calculation method

Total number of field operations (FieldOp)

Input variables:

Number of mechanised field operations from

- Soil cultivation and seeding (S_i)
- Fertilisation (F_i)
- Mechanical weeding (W_i)
- Pesticide treatments (P_i)
- Mowing / harvesting (M_i)
- Other operations (O_i)
- Area for each crop or grassland type (Ai)

The number of operations must be added up for each crop or grassland. Subsequently, an **average weighted by the area** that each crop/grassland covers on the farm is calculated.

$FieldOp = \Sigma(S_i + F_i + W_i + P_i + M_i + O_i) * A_i / A_{UAA}$

Mowing Frequency of Grassland or Perennial Fodder Crops (MowFreq)

Input variables:

- Number of cuts per year (differentiated by grassland type) (C_i)
- Area of each grassland type (A_i)

An **average weighted by the area** that each grassland type covers on the farm is calculated.

$MowFreq = \Sigma C_i * A_i / A_{UAA}$

Mowing Timing (for grassland or perennial fodder crops) (**MowTime)**

Input variables:

- First cutting (calendar week) – differentiated by grassland type (Wk_i)
- Area for each grassland type (A_i)

An **average weighted by the area** that each grassland type covers on the farm is calculated.

$MowFreq = \Sigma Wk_i * A_i / A_{UAA}$

Soil Cultivation: Ploughing (% arable land) (**Plough)**

Input variables:

- Arable land ploughed in periodical intervals (A_p)
- Total arable land (A_a)

$Plough = A_p / A_a$

Results from BioBio case studies

With regard to the number of field operations (FieldOp) the most intensive systems were Italian vineyards (frequency of pesticide operations), as well as Swiss grassland farms (mowing operations) and German mixed farms (operations in arable fields and grassland). In Bulgarian and Welsh grasslands as well as in the Dehesas, mechanized field operations were at a minimum, close to zero, indicating that the farm area is mainly used by grazing.

Grassland management was most intensive in Swiss and German farms, indicated by the number of cuts (average between 3 and 4 cuts per year) and the early date of the first cut (calendar week 20; mid-May). Most other farms with grassland had fewer cuts: 1 to 2 cuts or below 1. The indicator 'Mowing frequency' in stockless arable systems is connected with the management of rotational grassland which is managed in an extensive way (only 1 or 2 cuts per year, often for green manure).

Synergies with other indicators

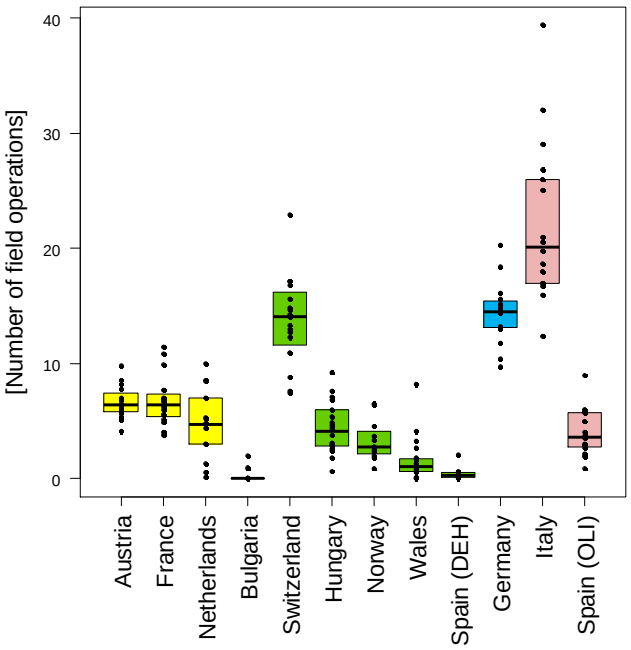
In interviews, data collection can be implemented in a joint questionnaire form along with the appraisal of indicator 'Pesticide Use'.

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 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

In four case studies negative relationships between field operations and species indicators were established: Austrian arable systems (plant diversity), German mixed farms (earthworm diversity), Norwegian grassland systems (plant diversity) and Spanish olive farms (diversity of plants, bees and earthworms).



Average number of field operations in BioBio case study farms

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

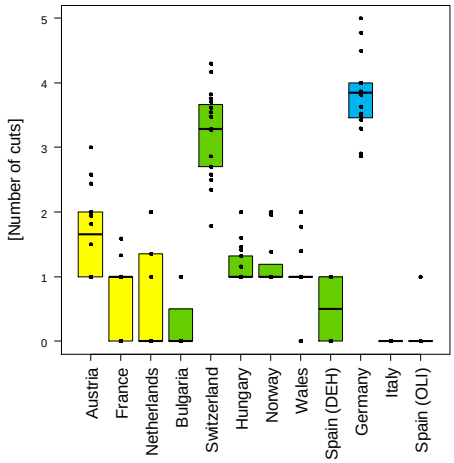
The date of the first cut (Mowing timing) was positively correlated with 'Vascular Plants' in German mixed farms and Swiss grassland systems, i.e. delayed timing of the first cut promoted species diversity. Furthermore, 'Wild Bees and Bumblebees' was positively related with late cuts in German farms and French arable farms.

Quite unexpectedly, certain species indicators were related positively to mowing frequency in the arable farms of Austria and France ('Wild Bees and Bumblebees'), the Dehesas ('Vascular Plants', 'Earthworms', 'Spiders') and the Hungarian grassland farms ('Vascular Plants', 'Wild Bees and Bumblebees'). Generally, the mowing frequency in all these case studies was low (< 2 cuts). Mowing operations were rare and restricted to species-rich land-use types (meadows, lucerne).

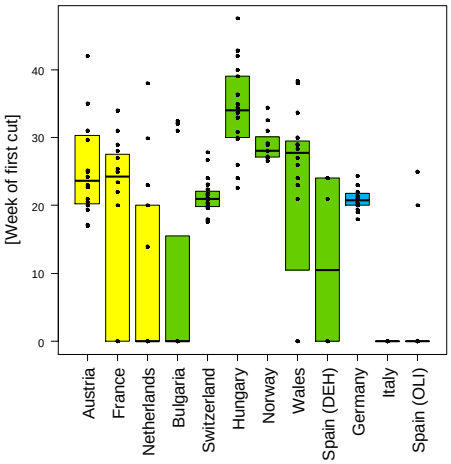
The type of soil cultivation showed hardly had relationships with species indicators. Only in the Austrian arable farming system, plant, bee and spider diversity increased with increasing percentage of ploughing. As the main increase related to semi-natural habitats, a causal relationship is unlikely. Presumably, this correlation is an artifact. In the French arable farms, 'Earthworms' decreased with increasing ploughing.

Field operations change as an indicator

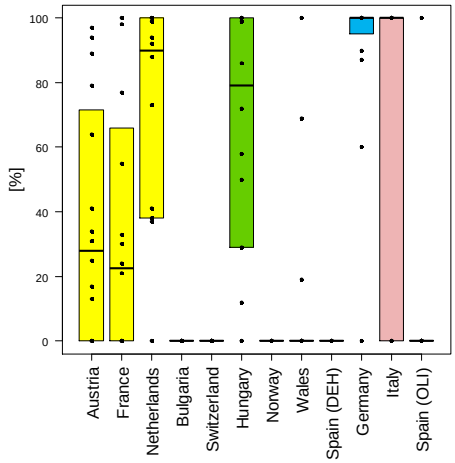
An increase in the indicators summarized under 'Field Operations' would be related to an intensification of field passages in the course of crop cultivation or grassland management. Most likely this will lead to disruptions and disturbances of plant and animal populations on the plot that should also be reflected in animal counts.



Average number of cuts in BioBio case study farms



Average date of the first cut (calendar week) in BioBio case study farms



Proportion of ploughed area (% arable area) in BioBio case study farms

'Mowing timing' (date of the first cut) must be interpreted differently, as diversity tends to increase with late cuts, i.e. increasing indicator values.

Strengths and weaknesses

The headline indicator 'Field Operations' is applicable across all types of production systems.

Sometimes progressive mechanisation brings a reduction in field operations (eg. equipment for direct sowing).

Soil cultivation intensity hardly differed with varying percentages of ploughing because the frequency of field cultivator use increased with decreased ploughing in most of the case studies. The only exception was the arable farms in France, where reduced ploughing was associated with an increased percentage of minimum tilliage.

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