



A closer look at Farm Management Indicators

Jürgen K. Friedel, Michaela Arndorfer

BIOBIO Conference, 21.-22.06.2012



[Introduction

Why farm management indicators?

- Management largely **determines pressure on species diversity** that is assessed by direct biodiversity indicators, mainly on the managed area of the farm;
- Farming practices are key points to **maintain and restore biodiversity**;



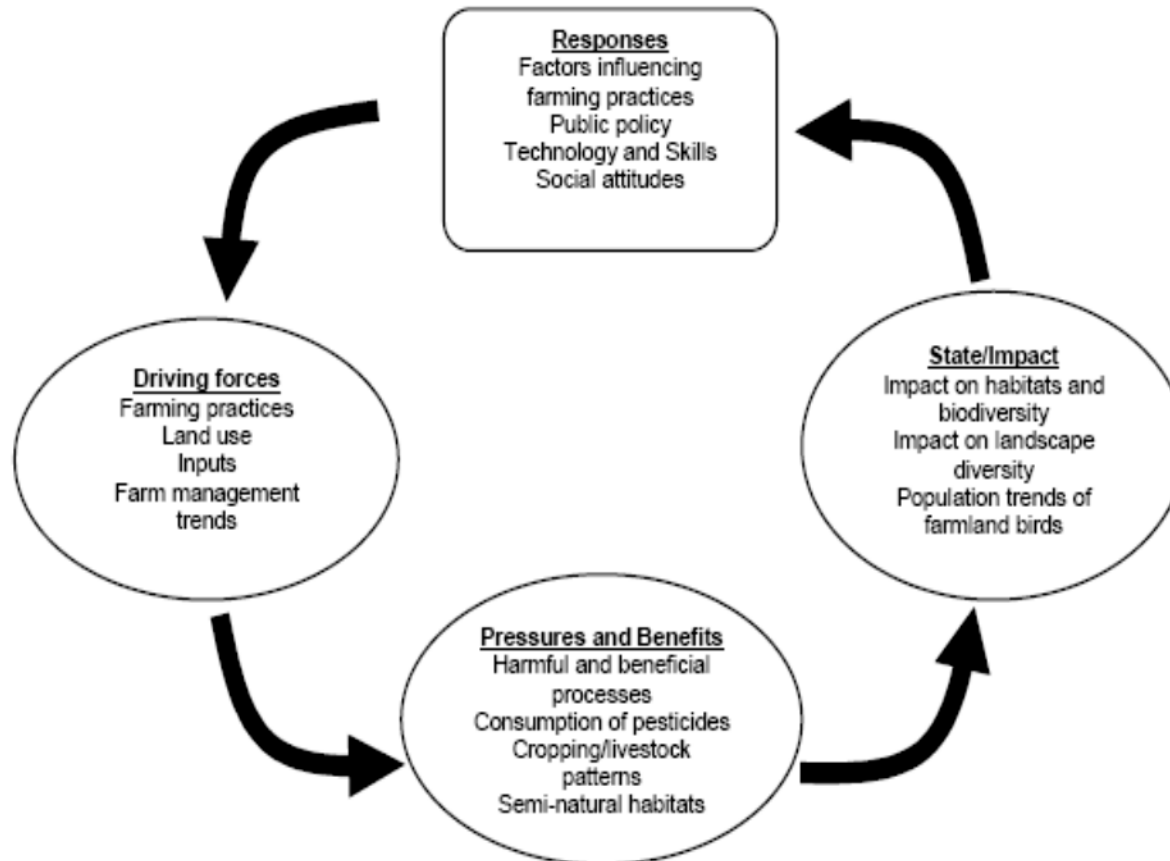
[Introduction

Criteria for choice of farm management indicators

- They reflect the **level of farming intensity**;
- They represent **different relevant categories of pressure**;
- They show **correlation to species indicators**;
- They are **applicable** to case study regions;



DPSIR Framework

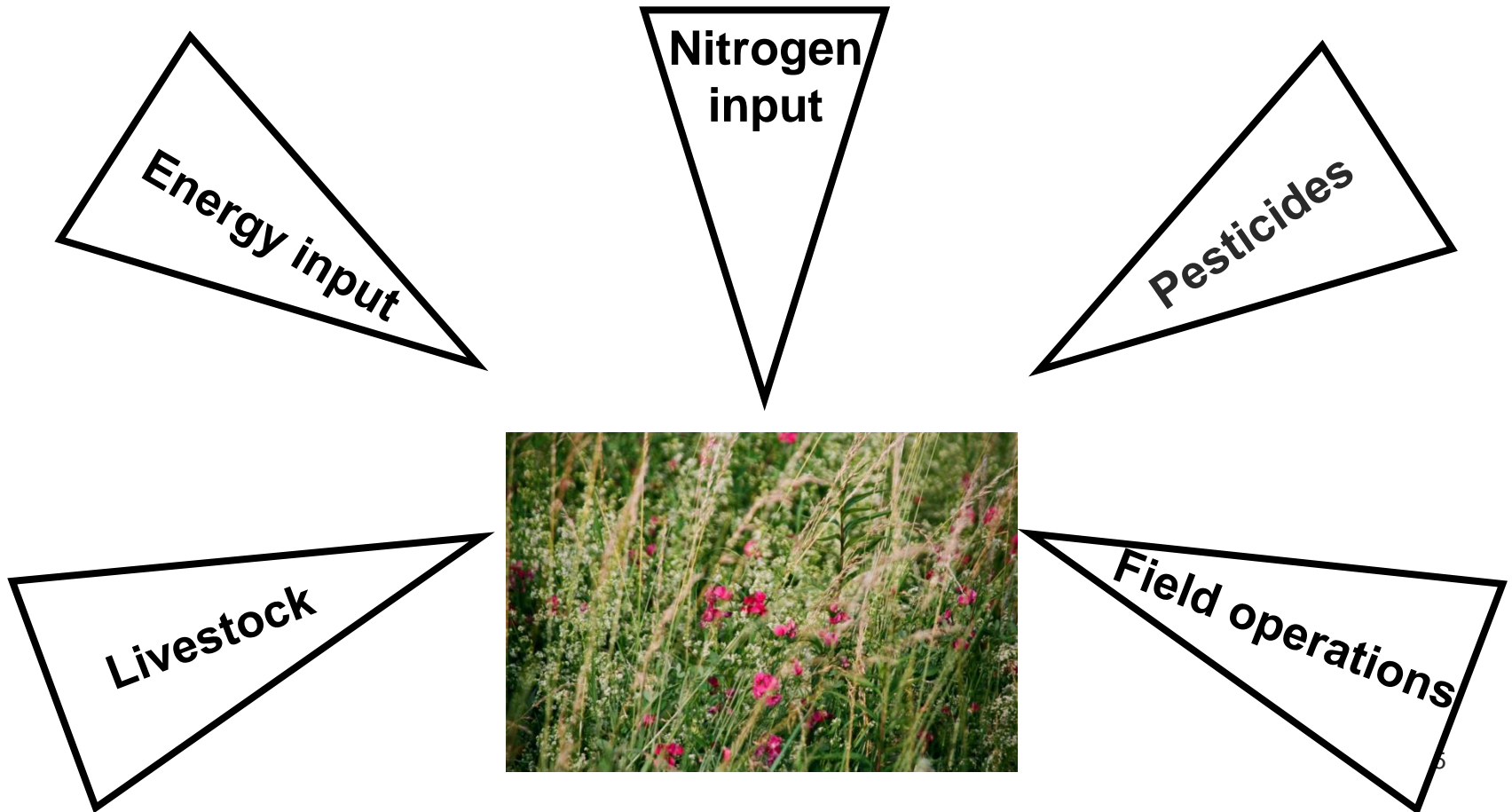


DPSIR framework for developing farming and biodiversity indicators



Indicator overview

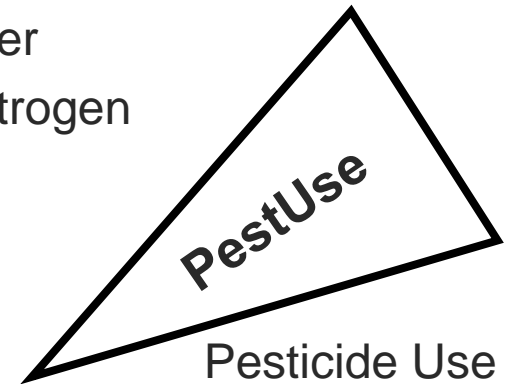
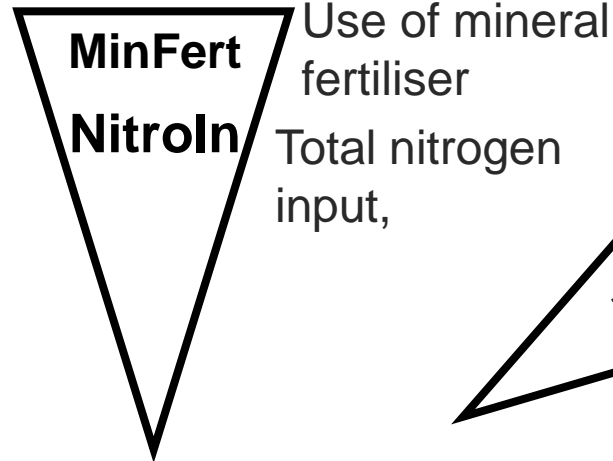
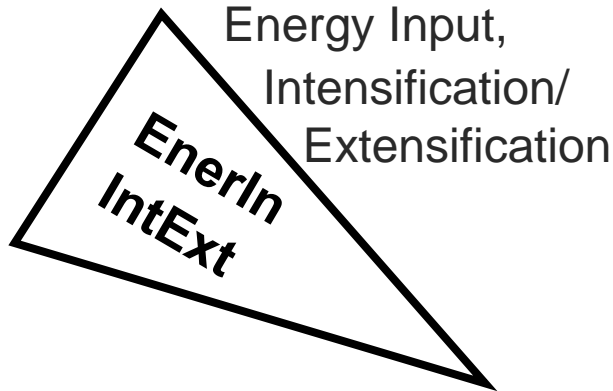
Relevant categories of pressure



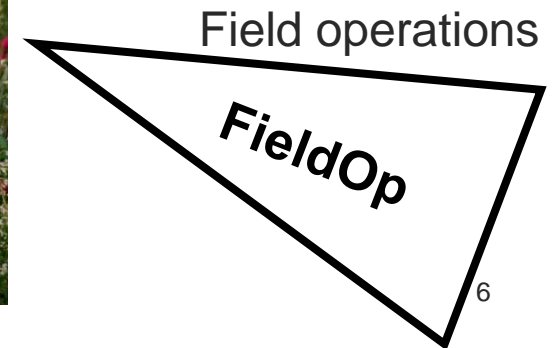
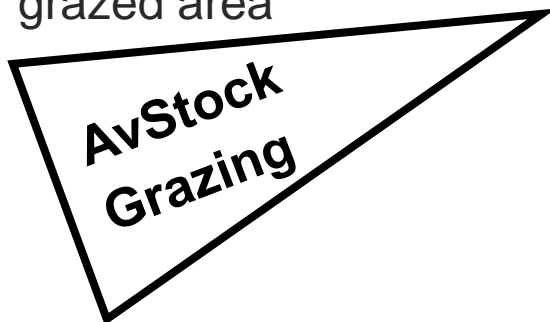


Indicator overview

Categories of pressure & related indicators



Average stocking rate,
Av. stocking rate per
grazed area





Data collection

Questionnaire

- Data collection to **assess management**;
- Cover all **relevant management practices** on different types of farms;
- Information on **farm and field plot level**
- Information to the farmers to keep **records of management measures** beforehand;

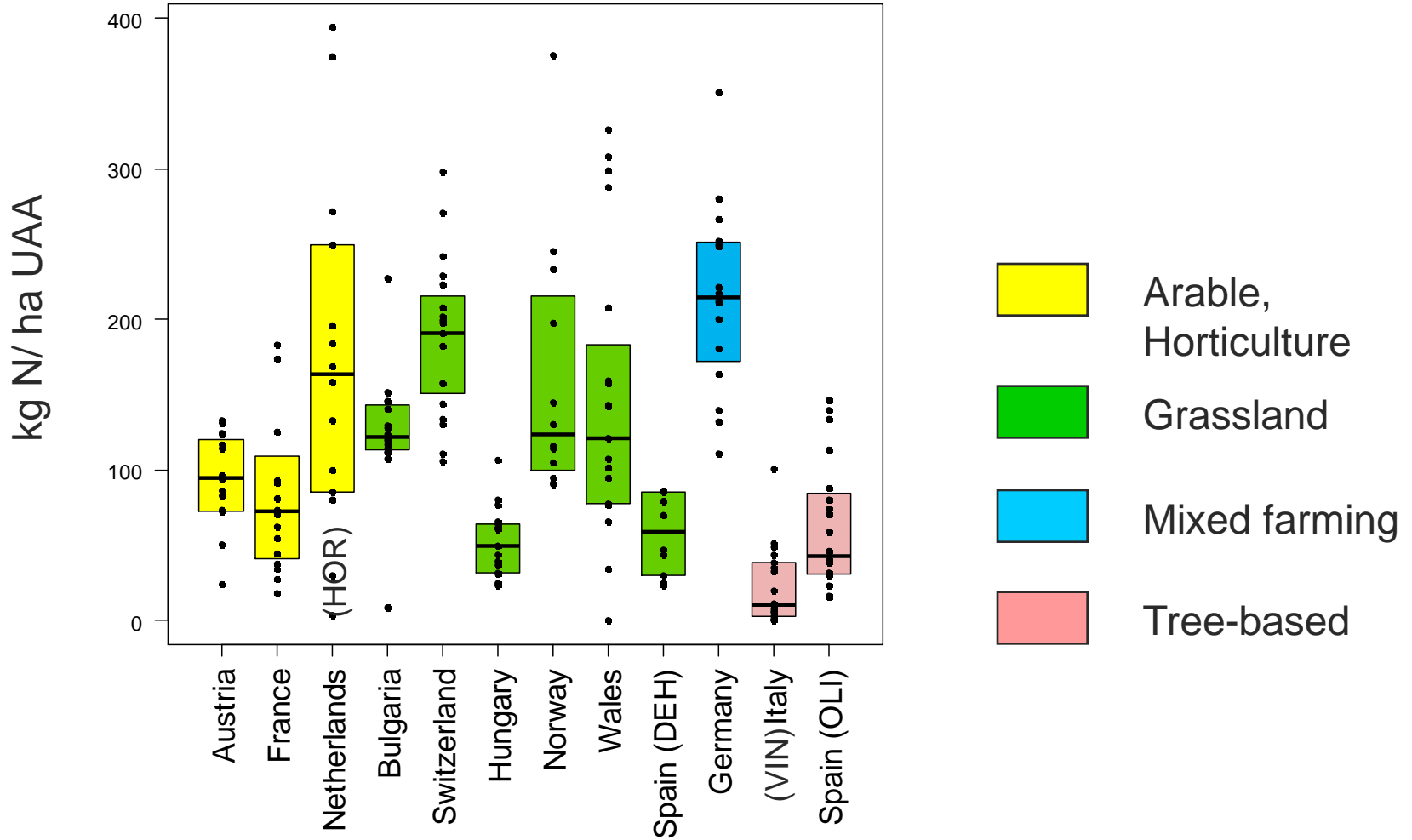


Scales of survey

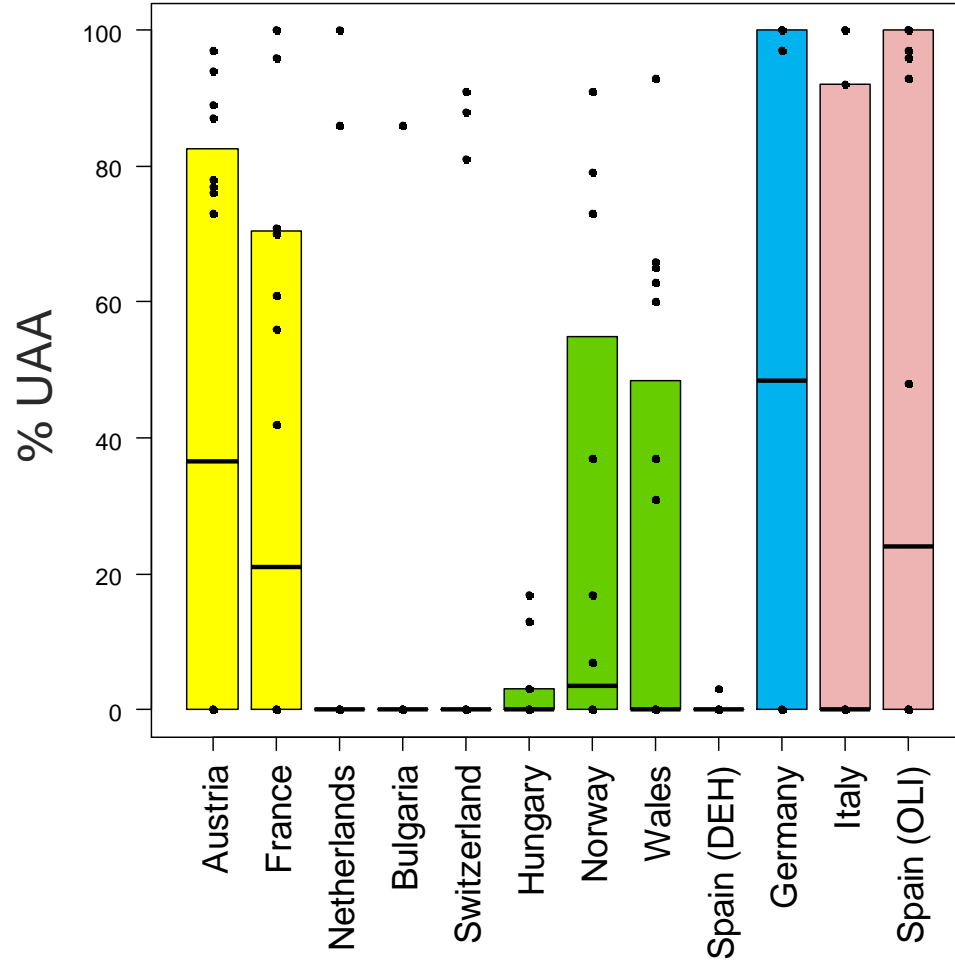
	Biodiversity <i>direct Indicators</i>	Farm management <i>indirect indicators</i>
FARM	Habitat Survey Crop cultivars & livestock breeds	Energy consumption, agri-environment measures etc. Management data: aggregated for utilised agricultural area (crops, grassland)
PLOT	SPECIES Plants Earthworms Spiders Bees	Management of crops and grassland <i>Selected indicators</i>



Total Nitrogen Input

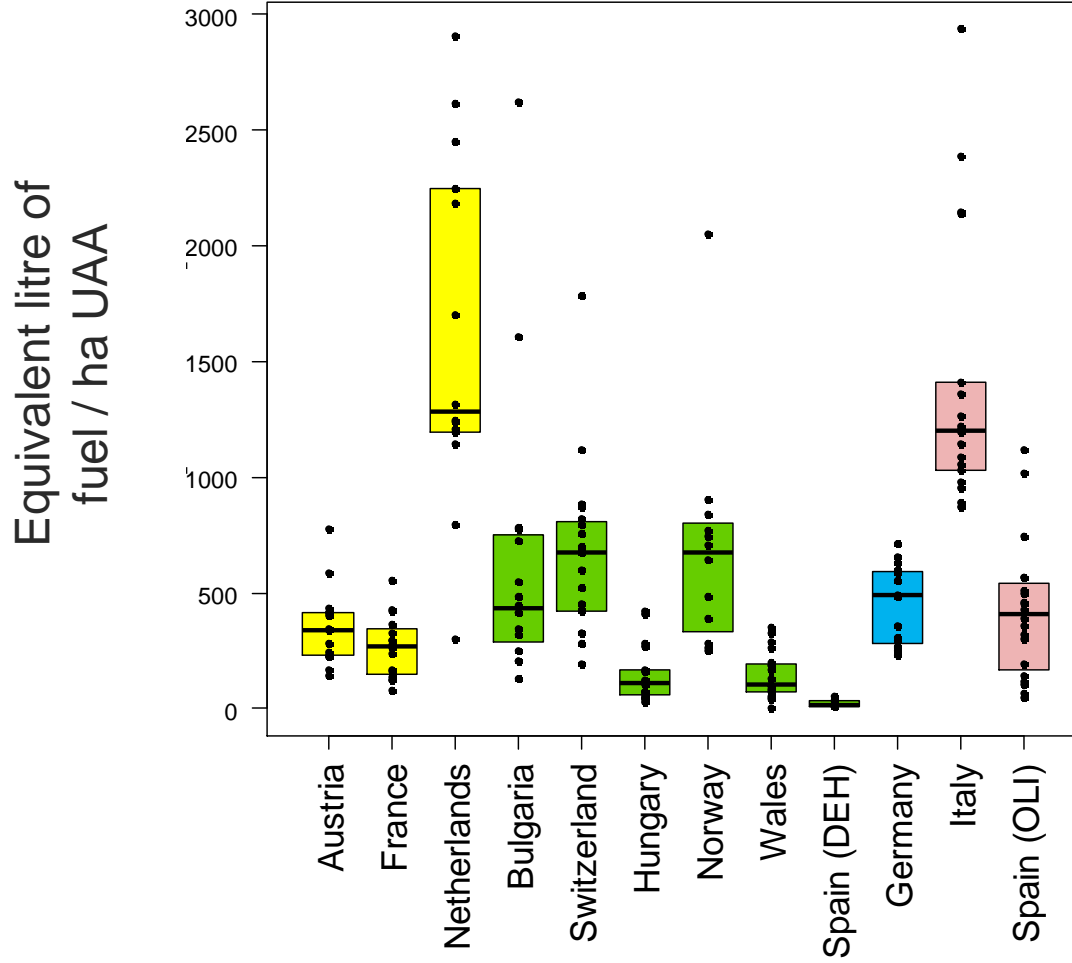


Use mineral N fertiliser



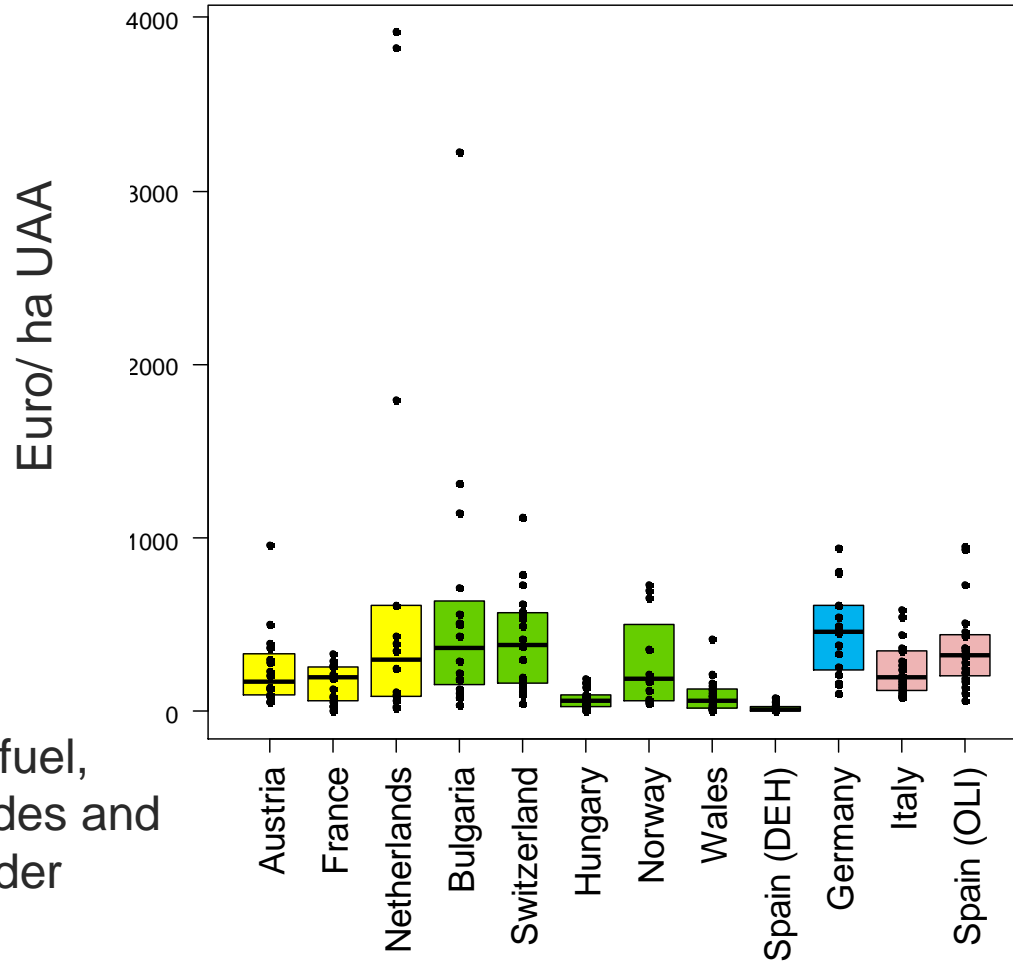


Energy Input





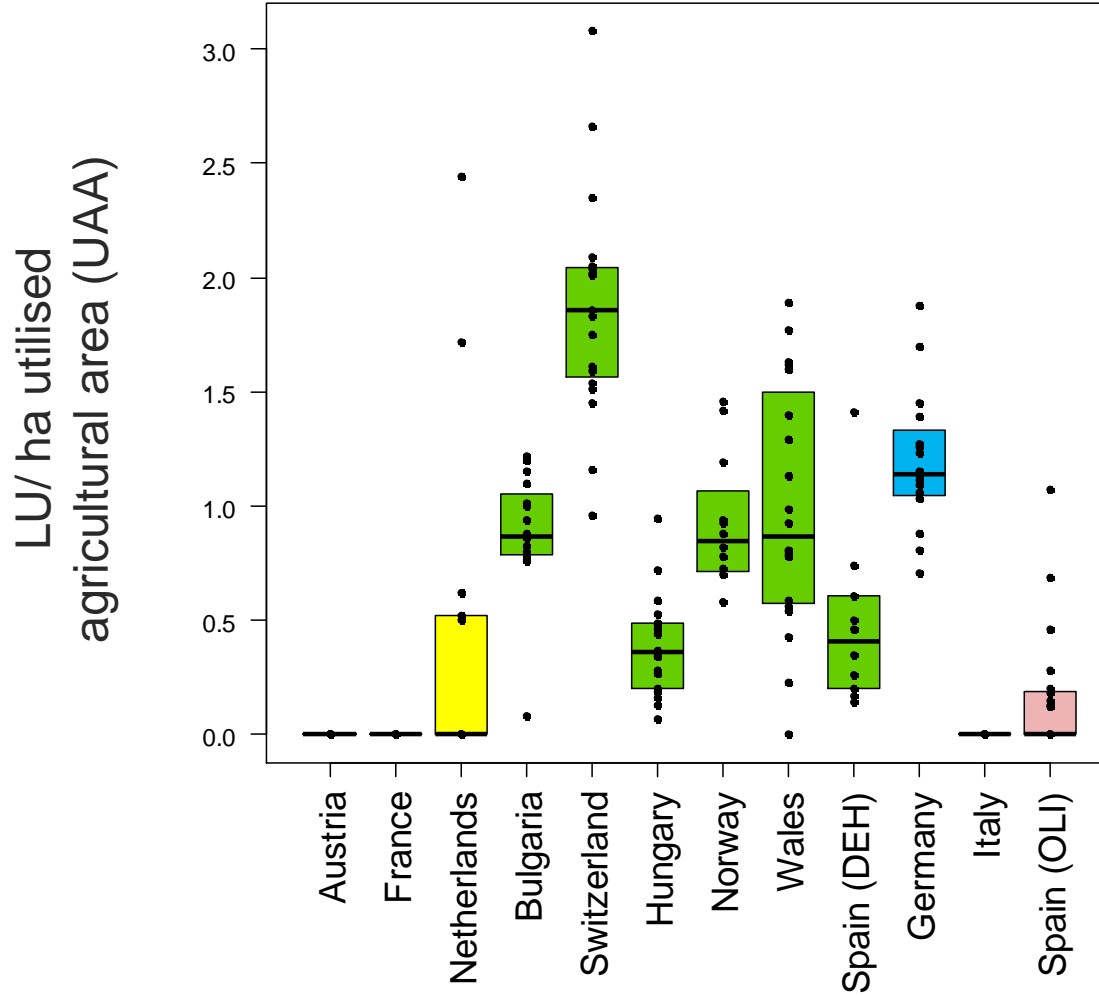
Intensification/Extensification



Expenditure on fuel, fertiliser, pesticides and concentrate fodder

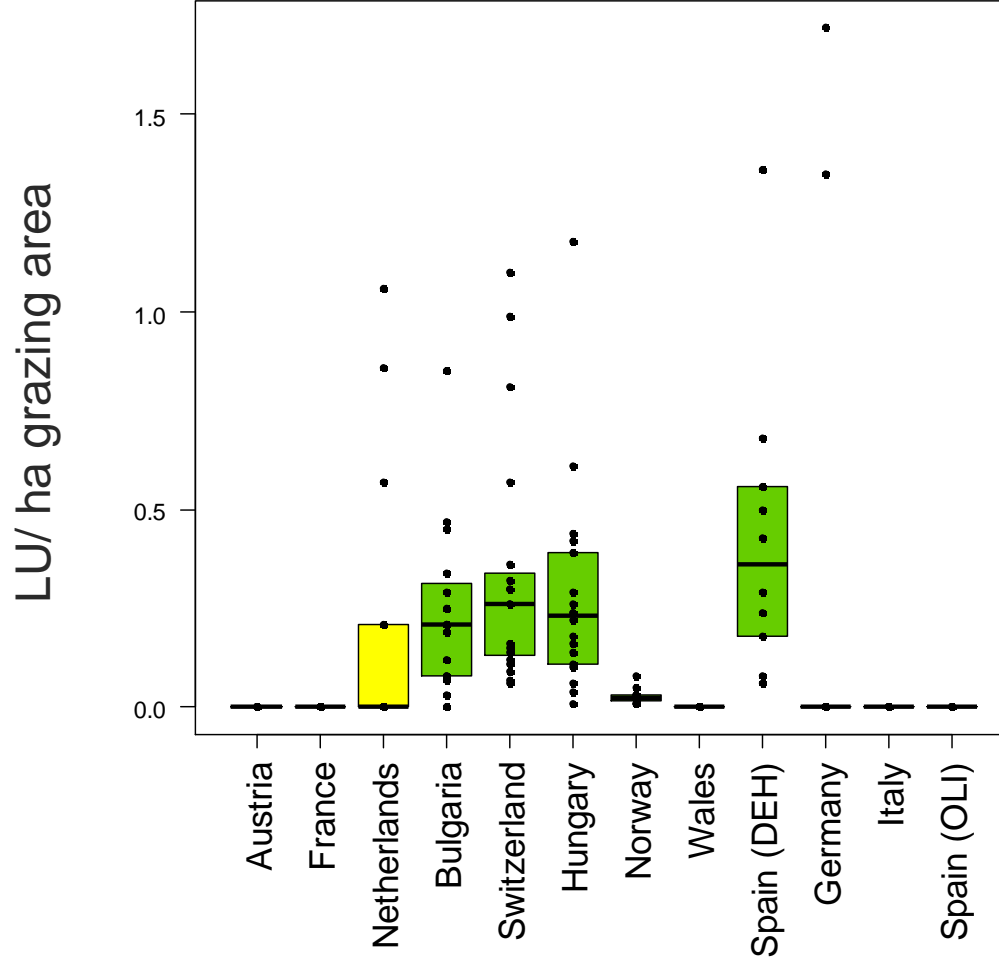


Average stocking rate



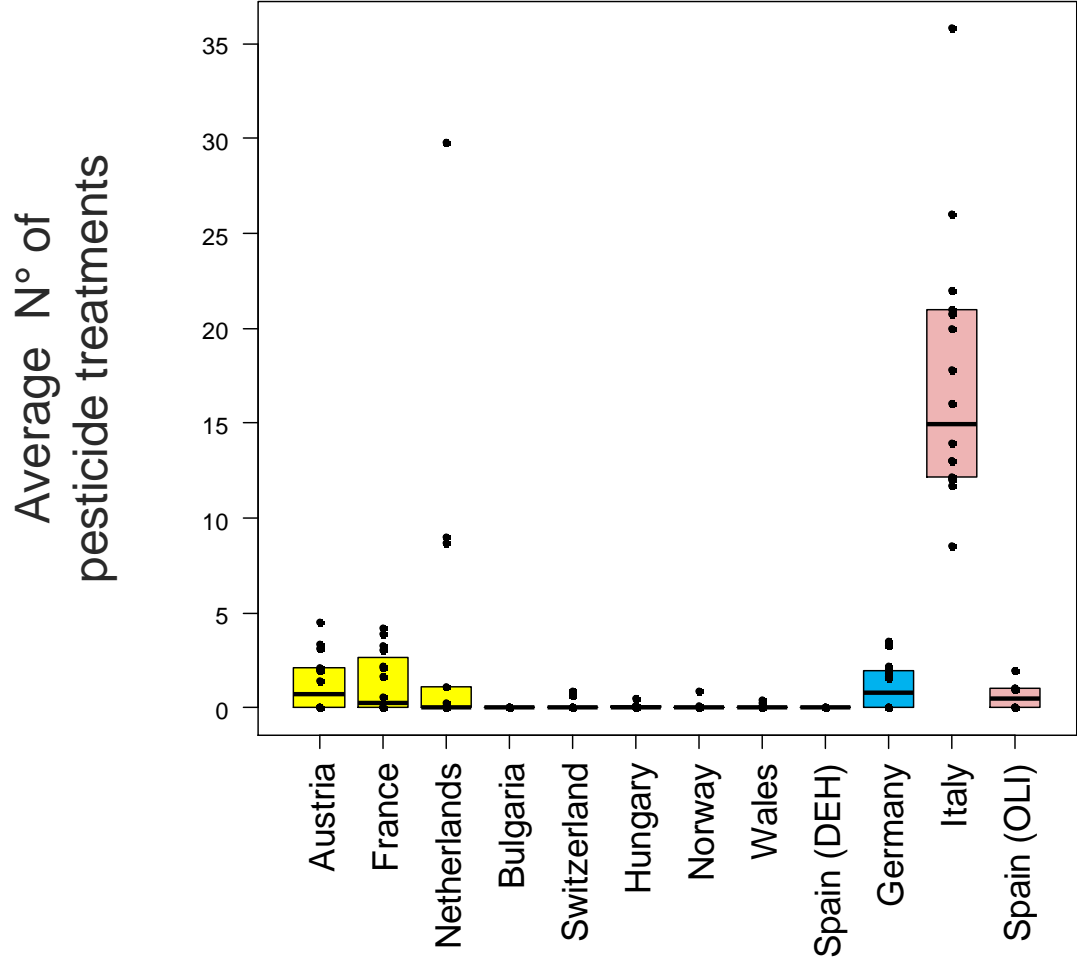


Grazing Intensity



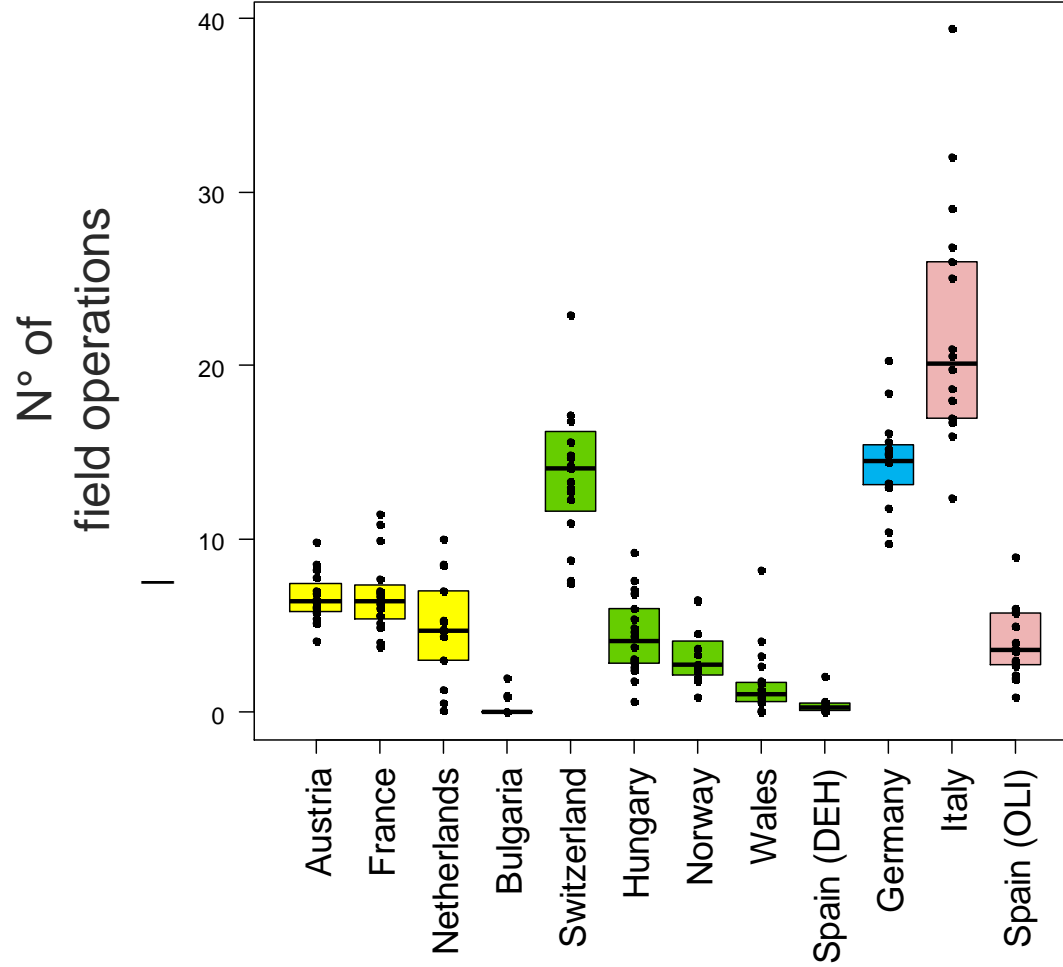


Pesticide Use





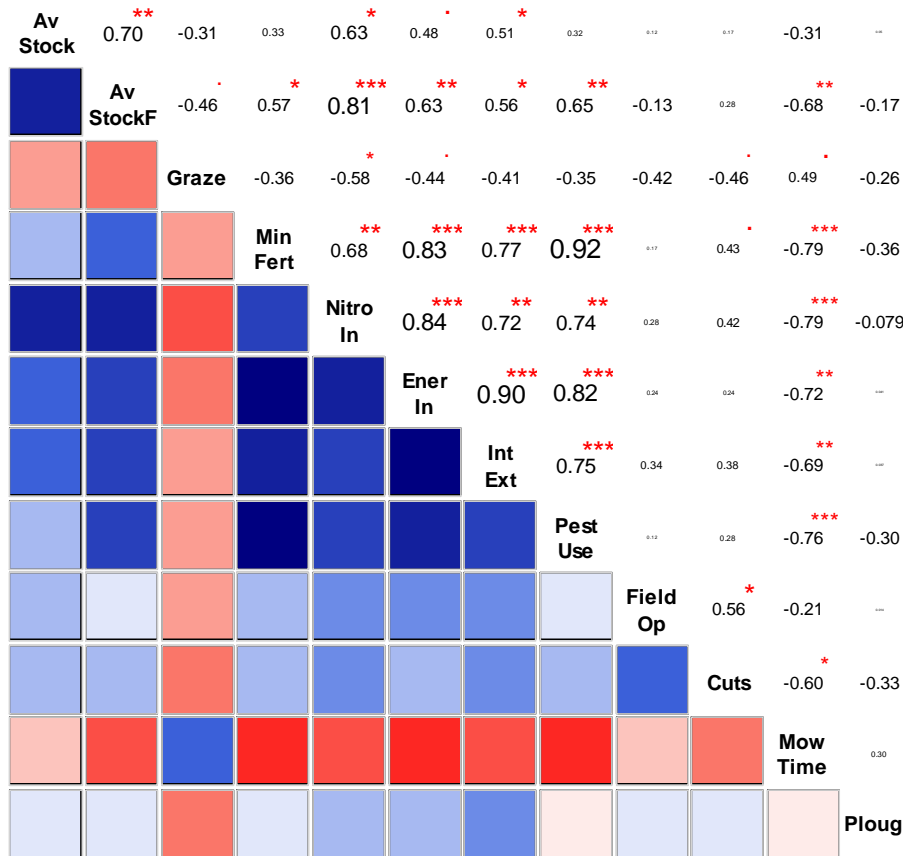
Field Operations





Farming Intensity

MIX Germany



Mixed farming, Germany; medium – high intensity

Strong positive correlations (■) of several indicators for input intensity:

- NitroIn: Total nitrogen input
- MinFert: Use of mineral fertiliser
- EnerIn: Energy Input
- IntExt: Intensification/Extensification
- PestUse: Pesticide Use
- AvStockF: Average Stocking rate on fodder area



Farming Intensity

OLI Spain



Olive groves, Spain

Strong positive correlations (■) only in individual cases:

- { NitroIn: Total nitrogen input & MinFert: Use of mineral fertiliser
- { EnerIn: Energy Input & IntExt: Intensification/Extensification
- { AvStock: Average Stocking rate on UAA & Graze: Grazing intensity
- { PestUse: Pesticide Use & Field operations



Summary of selected indicators with highest correlations

	Ara		Hor	Mix	Gra						Tree- based	
	A	F	L_H	D	C	B	H	N	W	Ed	Eo	I_V
EnIn-NIn	.75**	.75**	n.s.	.71**	.62**	.61*	n.s.	n.s.	.59**	n.s.	n.s.	n.s.
EnIn-IntExt	.89***	.79***	.57*	.83***	.68***	.86***	.54*	.65*	.81***	.91***	.74***	n.s.
EnIn-Pest	.81***	.83***	.74**	.83***	n.s.	Nd	n.s.	n.s.	ns	Nd	n.s.	n.s.
NIn-IntExt	.72**	.77***	n.s.	.59*	n.s.	n.s.	n.s.	.68*	.60***	n.s.	n.s.	n.s.
NIn-Pest	.78***	.78***	n.s.	.67**	n.s.	Nd	n.s.	n.s.	n.s.	Nd	n.s.	n.s.
IntExt-Pest	.92***	.51*	.75**	.75***	n.s.	Nd	n.s.	.64*	ns	Nd	.62**	n.s.
AvStock- AvStockF	Nd	Nd	.90***	.70**	.99***	.95***	.99***	1.0***	Nd	1.0***	Nd	Nd

Strong correlations of several indicators for input intensity in arable & mixed farms;

Strong correlation of Energy Input & Intensification/Extensification in all types of farms;

Strong correlation of Av. stocking rate / UAA & Av. stocking rate / fodder area in all livestock keeping farms;



[FM – Plant diversity

	Ara		Hor	Mix	Gra						Tree-based	
	A	F	L_H	D	C	B	H	N	W	Ed	Eo	I_V
NitroIn	neg	x	x	neg	x	x	x	x	x	x	x	x
MinFert	neg	neg	x	neg	x	x	x	x	x	x	neg	neg
EnerIn	x	neg	neg	neg	x	x	x	neg	neg	x	neg	x
IntExt	x	x	x	neg	x	x	x	neg	x	x	neg	x
AvStock	na	na	x	neg	x	x	x	x	na	x	na	na
Grazing	na	na	x	x	x	x	neg	x	na	x	na	na
PestUse	neg	neg	neg	neg	x	na	x	x	x	na	neg	x
FieldOp	neg	x	x	x	x	x	x	neg	x	x	neg	x



[FM – Bee diversity

	Ara		Hor	Mix	Gra						Tree-based	
	A	F	L_H	D	C	B	H	N	W	Ed	Eo	I_V
NitroIn	x	neg	x	neg	neg	x	x	x	x	x	neg	x
MinFert	x	neg	pos	neg	x	x	x	x	x	x	neg	x
EnerIn	x	neg	x	neg	neg	x	x	x	pos	pos	neg	x
IntExt	x	neg	x	neg	x	x	x	x	x	pos	neg	x
AvStock	na	na	x	x	neg	x	x	neg	na	x	na	na
Grazing	na	na	x	x	x	x	x	x	na	x	na	na
PestUse	x	neg	pos	neg	neg	na	x	x	x	na	x	x
FieldOp	x	x	pos	x	x	x	x	x	x	x	neg	x



[FM – Spider diversity

	Ara		Hor	Mix	Gra						Tree-based	
	A	F	L_H	D	C	B	H	N	W	Ed	Eo	I_V
NitroIn	x	x	x	x	neg	x	x	x	x	x	x	x
MinFert	x	x	x	neg	x	x	x	neg	x	x	neg	x
EnerIn	x	x	x	neg	x	x	x	neg	x	x	neg	x
IntExt	x	x	x	x	x	x	x	neg	x	x	neg	x
AvStock	na	na	x	x	x	x	x	neg	na	x	na	na
Grazing	na	na	x	x	x	x	x	x	na	x	na	na
PestUse	x	x	x	neg	x	na	x	neg	x	na	x	x
FieldOp	x	x	x	x	x	x	x	x	x	x	x	x

[FM – Earthworm diversity]



	Ara		Hor	Mix	Gra						Tree-based	
	A	F	L_H	D	C	B	H	N	W	Ed	Eo	I_V
NitroIn	x	x	x	x	neg	x	pos	x	pos	x	x	x
MinFert	x	x	x	x	x	x	x	x	x	x	neg	x
EnerIn	x	x	x	x	x	x	x	x	pos	x	neg	x
IntExt	x	x	x	neg	x	x	x	x	x	x	neg	x
AvStock	na	na	x	x	x	pos	x	x	na	x	na	na
Grazing	na	na	x	x	pos	x	x	x	na	x	na	na
PestUse	x	x	x	x	neg	na	x	x	x	na	neg	x
FieldOp	x	x	x	neg	x	x	x	x	x	x	neg	x

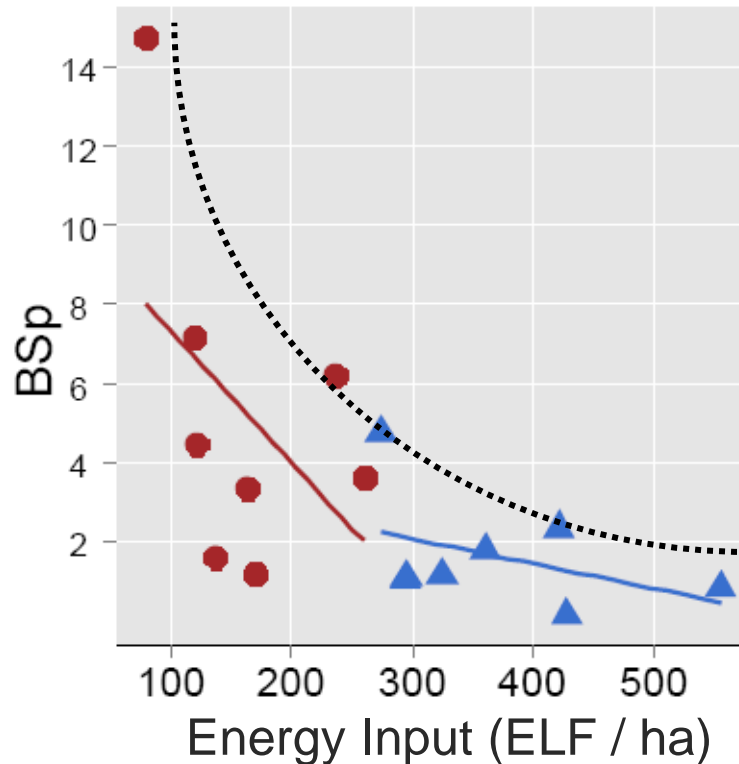


FM – Species Indicators

Spearman's rho = -0.724, p-value = 0.002 **

• organic

▲ conventional



Arable farming, France

Significant correlation
between Energy Input and
Bee species richness

Energy Input limits Bee species diversity values;
no simple linear relationship!



[Summary & Conclusion

- Management indicators cover **farm and field plot** level
- Selected management indicators **differentiate** between case studies and within case studies.
- **Correlations** between management and species indicators **varied** among the case studies.
- **General pressure** on species indicators is represented by management indicators.
- BioBio case studies covered low to medium farming intensity. Relations between management and species indicators are **more difficult to establish at low intensity level.**



University of Natural Resources and
Life Sciences Vienna



Thank you!

A closer look at
Farm Management Indicators

Jürgen K. Friedel, Michaela Arndorfer

BIOBIO Conference, 21.-22.06.2012



[Methodology



- Farm selection:

Same **bio-geographic region**, similar **soils**, similar **altitude**

Same **type of farm** within case study, e.g. stockless arable or grassland dairy farm

- Organic farms:

Minimum **5 years** after conversion