



Table: BIOBIO indicator set and applicability to major farm types.

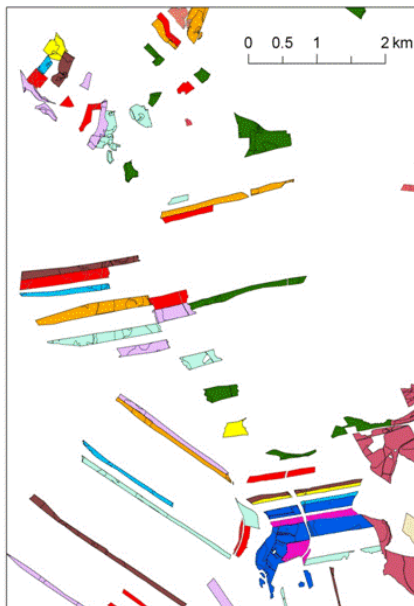
	Indicator	Farm type			
		Field crops & horticulture	Specialist grazing livestock	Mixed crops - livestock	Permanent crops
Habitat diversity indicators	Habitat richness	✓	✓	✓	✓
	Habitat diversity	✓	✓	✓	✓
	Average size of habitat patches on farm	✓	✓	✓	✓
	Length of linear elements	✓	✓	✓	✓
	Crop richness	✓		✓	
	Percentage of farmland with shrubs	✓	✓	✓	✓
	Tree cover	✓	✓	✓	
	Percentage of semi-natural habitats	✓	✓	✓	✓
Species diversity indicators	Vascular plants	✓	✓	✓	✓
	Wild bees and bumblebees	✓	✓	✓	✓
	Spiders	✓	✓	✓	✓
	Earthworms	✓	✓	✓	✓
Genetic diversity of livestock and crops	Number and amount of different breeds		✓	✓	
	Number and amount of different varieties	✓	✓	✓	✓
	Origin of crops	✓		✓	
Farm management indicators	Total direct and indirect energy input	✓	✓	✓	✓
	Intensification/Extensification	✓	✓	✓	✓
	Area on which mineral N-fertiliser is used	✓	✓	✓	✓
	Total nitrogen input	✓	✓	✓	✓
	Field operations	✓	✓	✓	✓
	Pesticide use	✓		✓	✓
	Average stocking rate		✓	✓	✓
	Grazing intensity		✓	✓	

Project context and objectives



Figure 1: The three components of farmland biodiversity: (a) Habitats in a gently rolling landscape of central Europe; (b) Plant species of a mountain meadow in the Alps; and (c) Traditional pig breeds of the Hungarian Puszta. Photos: (a) G. Brändle; (b) G. Lüscher; (c) F. Herzog.

a) Norway © W. Fjellstad



b) Spain © G. Moreno



Figure 2: (a) Unconsolidated smallholdings in Norway. Fields belonging to a specific farm are the same colour. (b) Scattered plots of an olive farm in Extremadura, Spain. Although they are not cohesive ecological units (in terms of biodiversity), farms represent decision-making units for farmers, administrative bodies and policy-makers.

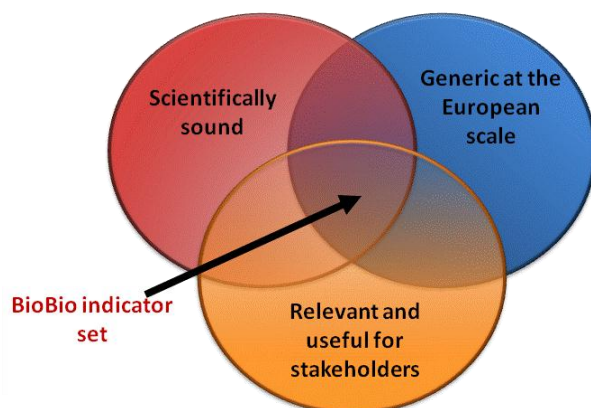


Figure 3: Criteria applied for indicator selection.

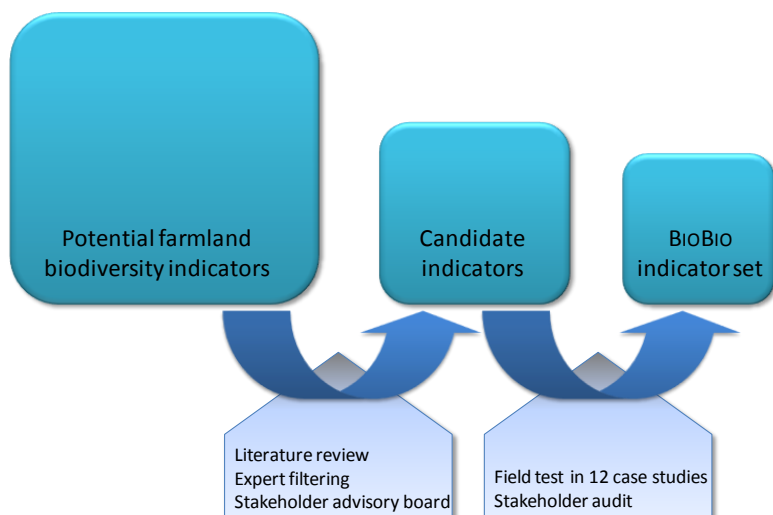
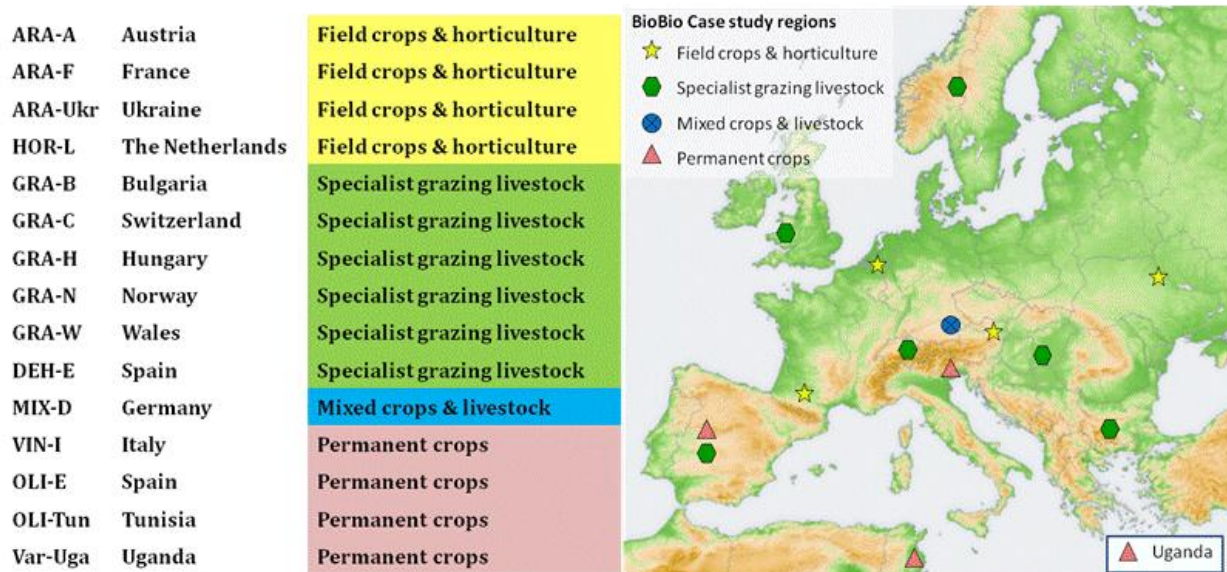


Figure 4: Process of indicator filtering in iterative interaction between researchers and stakeholders.

Figure 5: BioBio case study regions and farm types.



Project achievements: 23 farmscale biodiversity indicators for Europe

Table 1: BioBio indicator set. These indicators have passed scientific and practical testing as well as the stakeholder audit. Indicators which are restricted to specific farm types are indicated by (1) Field crops and horticulture, (2) Specialist grazing livestock, (3) Mixed crops – livestock, (4) Permanent crops.

Indicators for the Genetic Diversity of Livestock and Crops	
Breeds (2), (3)	Number and amount of different breeds
CultDiv	Number and amount of different varieties
CropOrig (1),(3)	Origin of crops
Species Diversity Indicators	
Plants	Vascular plants
Bees	Wild bees and bumblebees
Spiders	Spiders
Earthworms	Earthworms
Habitat Diversity Indicators	
HabRich	Habitat richness
HabDiv	Habitat diversity
PatchS	Average size of habitat patches on the farm
LinHab	Length of linear elements
CropRich (1), (3)	Crop richness
ShrubHab	Percentage of farmland with shrubs
TreeHab (1), (2), (3)	Tree cover
SemiNat	Percentage of semi-natural habitats
Farm Management Indicators	
EnerIn	Total direct and indirect energy input
IntExt	Intensification/Extensification
MinFert	Area on which mineral N-fertiliser is used
NitroIn	Total nitrogen input
FieldOp	Field operations
PestUse (1), (3), (4)	Pesticide use
AvStock (2), (3), (4)	Average stocking rate
Graze (2), (3)	Grazing intensity

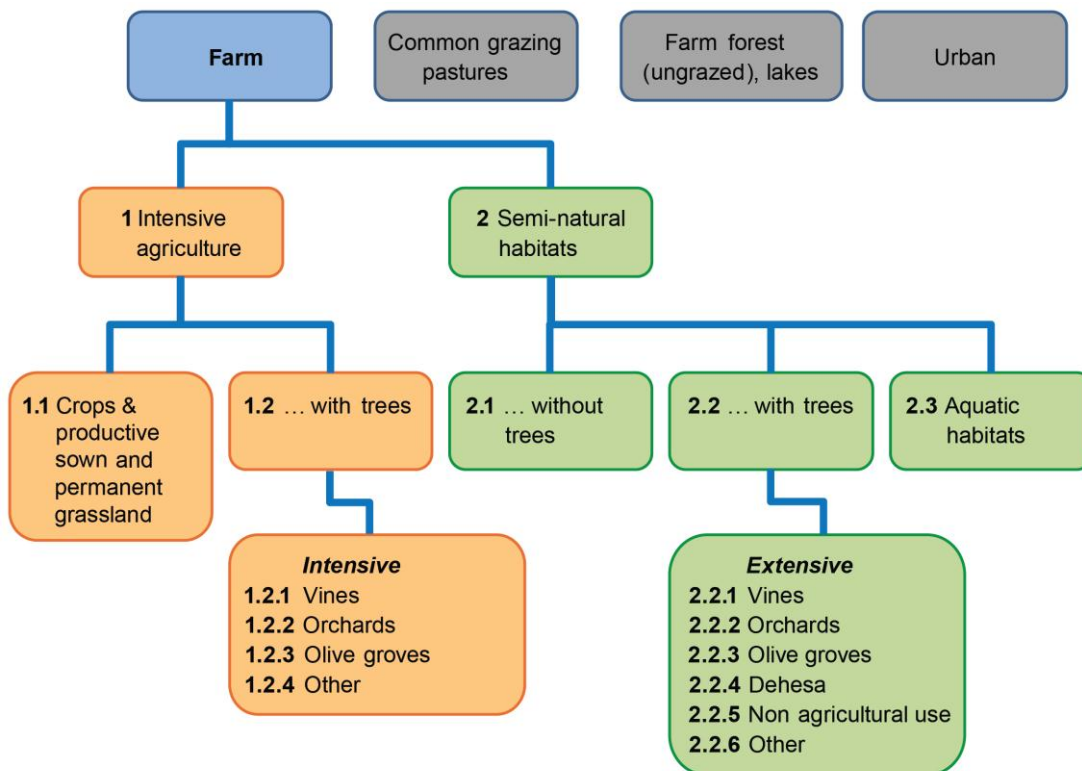


Figure 6: Farm habitat types are classified into categories. The majority of the farmland of most farms consists of category-1 land – ‘Intensive agriculture’ – interspersed with ‘Semi-natural habitats’ (category 2) consisting mainly of linear elements with or without trees or shrubs.



Figure 7: Habitat map for a case study farm in France. Habitats were mapped according to a European approach based on [General Habitat Categories](#). It shows the observed linear and areal habitats. Areal habitats consist mainly of different crop types “Tested areas” refers to habitats which were selected for species sampling.

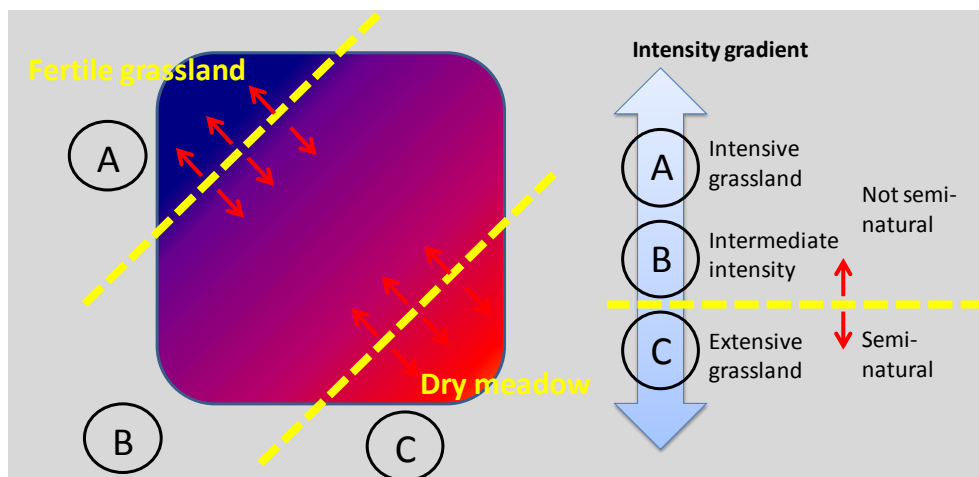


Figure 8: Conceptual graph illustrating the difficulties when classifying habitats as semi-natural or not. Grassland is taken as an example but similar problems occur in other habitat types.

Figure 9: Percentage of plant, earthworm, spider and bee species exclusively found in semi-natural habitats (green stack), cultivated forage and food crop fields (yellow stack) or in both (grey stack).
 ARA = arable,
 HOR = horticulture,
 GRA = grassland,
 DEH = Dehesa,
 MIX = mixed farming,
 VIN = vineyard,
 OLI = olive plantation.

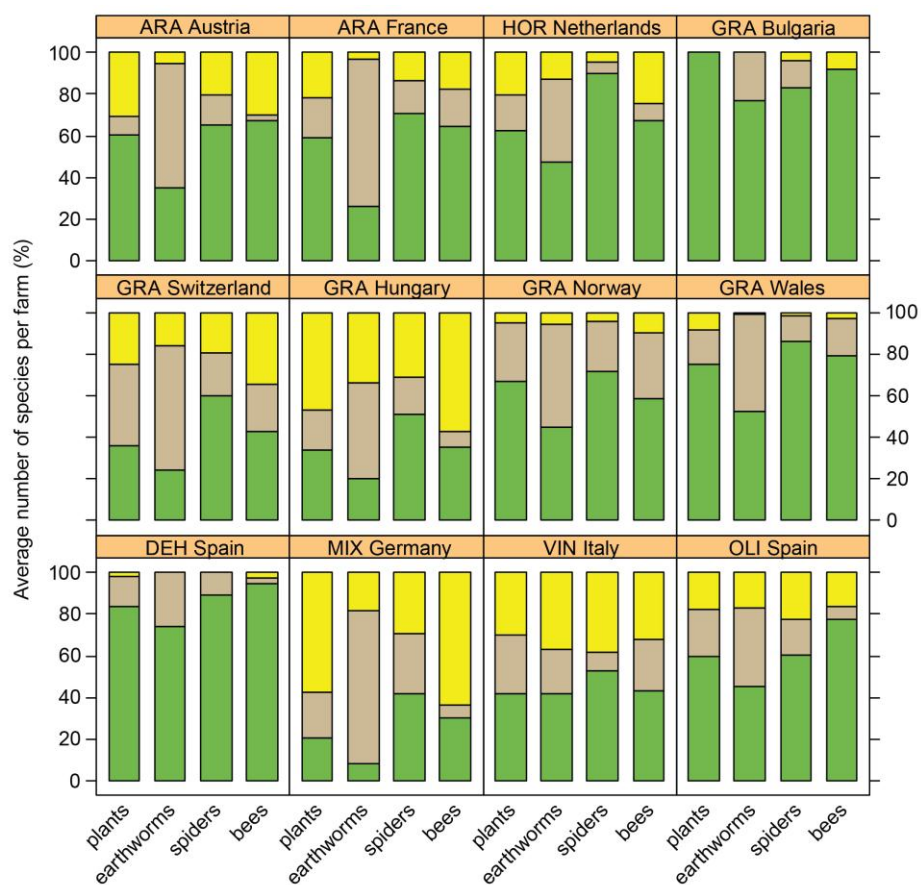


Table 2: Average number of specimen and of species recorded per case study region and per farm.

		ARA Austria	ARA France	HOR The Nether- lands	GRA Bulgaria	GRA Switzer- land	GRA Hungary	GRA Norway	GRA Wales	DEH Spain	MIX Germany	VIN Italy	OLI Spain	Total
	Farms	16	16	14	16	19	18	12	20	10	16	18	20	195
	Habitat types	15	36	19	51	19	58	23	45	31	14	11	14	n.a.
	Habitat types per farm	7.7	9.8	7.4	8.3	5.7	8.2	9.8	10.7	11.1	7.9	4.1	3.7	7.9
Plants	Species	247	360	207	364	269	388	200	321	403	211	246	288	1581 ^a
	Species per farm	50.4	101.2	49.6	78.0	84.5	90.9	88.0	84.0	164.1	70.1	60.4	71.9	82.8
Bees (<i>Apis mellifera</i> excluded)	Individuals	101	2'127	73	356	570	298	812	588	485	115	453	252	6'230
	Species	49	153	22	91	64	101	23	13	51	34	64	44	382 ^a
	Individuals per farm	6.3	132.9	5.2	22.3	30.0	16.6	67.7	29.4	48.5	7.2	25.2	12.6	403.8
	Species per farm	5.2	33.6	2.6	11.4	14.0	10.4	10.6	5.7	12.2	5.1	9.4	6.6	10.6
Spiders	Individuals	1'470	4'879	500	770	2'200	1'816	3'175	9'214	2'921	4'272	466	1'446	33'129
	Species	128	215	76	106	125	163	104	158	116	110	86	123	603 ^a
	Individuals per farm	91.9	304.9	35.7	48.1	115.8	100.9	264.6	460.7	292.1	267.0	25.9	72.3	2'079.9
	Species per farm	30.2	64.5	11.6	19.8	28.9	29.3	36.8	45.8	38.0	35.9	12.2	22.5	31.3
Earthworms	Individuals	1'164	7'962	671	293	2'321	474	928	4'226	2'337	2'664	219	924	24'183
	Species	10	16	16	8	17	8	10	18	17	11	14	19	49
	Individuals per farm	72.8	497.6	47.9	18.3	122.2	26.3	77.3	211.3	233.7	166.5	12.2	46.2	1'532
	Species per farm	4.7	10.4	4.4	3.4	10.4	2.3	5.8	8.6	6.4	7.8	3.4	4.5	6.0

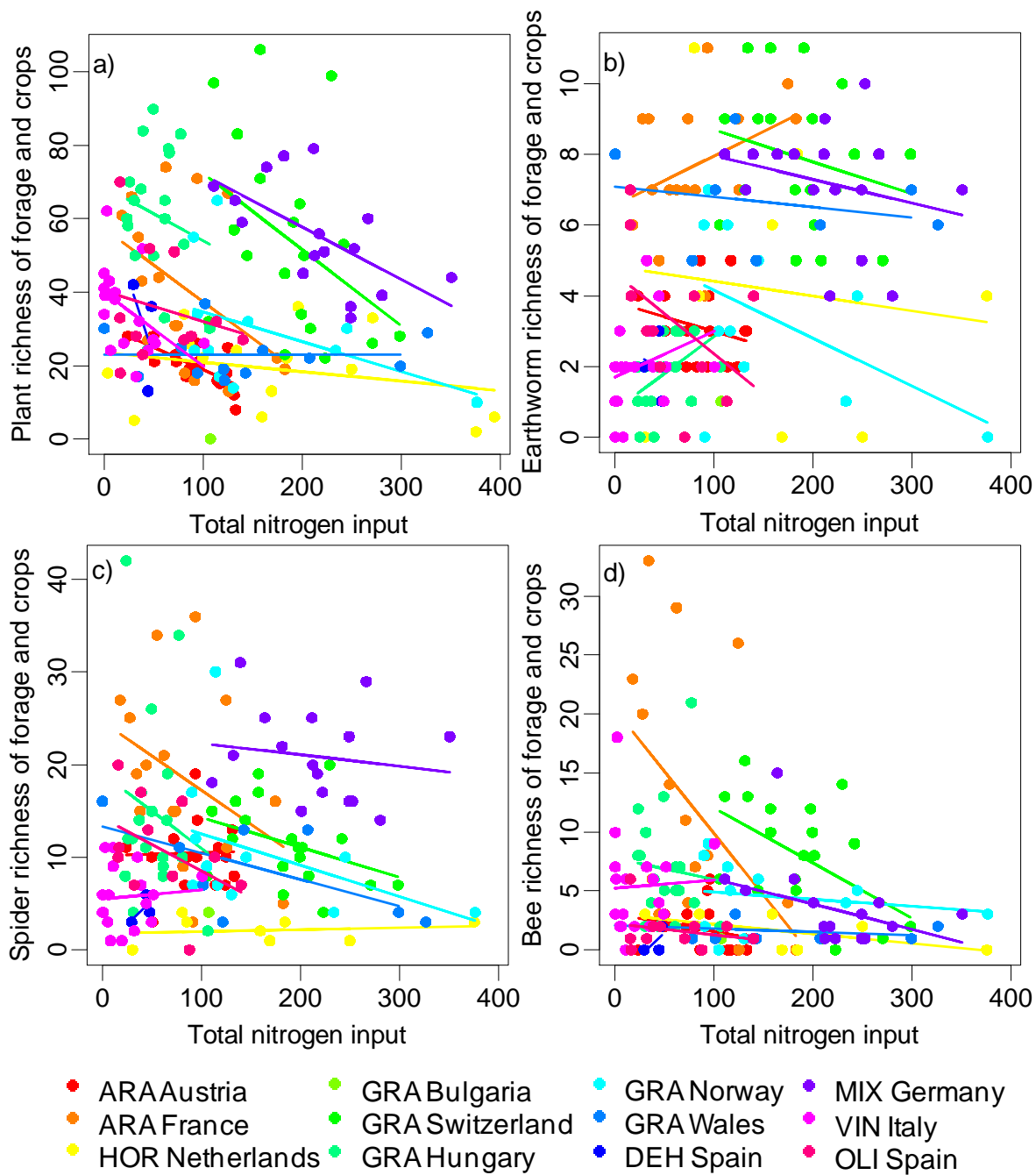


Figure 10: Gamma diversity of plants, earthworms, spiders and bees on farms (overall species richness) collected or observed in cultivated forage and food crops, related to the Total nitrogen input in 12 BioBio case study regions. ARA = arable CS, HOR = horticulture CS, GRA = grassland CS, DEH = Dehesa CS, MIX = mixed farming CS, VIN = vineyard CS and OLI = olive plantation CS.

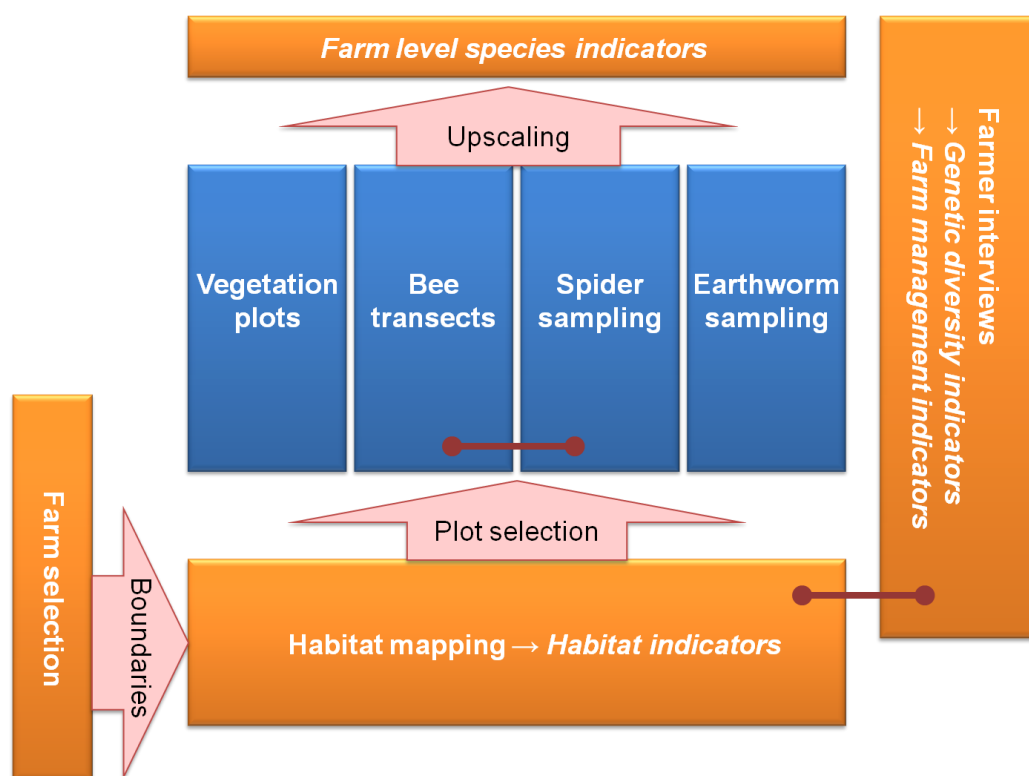


Figure 11: Workflow of a BioBio indicator campaign.

Figure 12: Focus group meeting in Hungary.
Photo: Á. Kalóczkai, SIU



Figure 13: Large scale arable farming systems in Ukraine, intercropped olive plantation in Tunisia and intercropping with pineapple and banana in Uganda. Photo: S. Yashchenko, BTNAU, S. Garchi, INRGREF, Ch. Nkwiine, Makarere

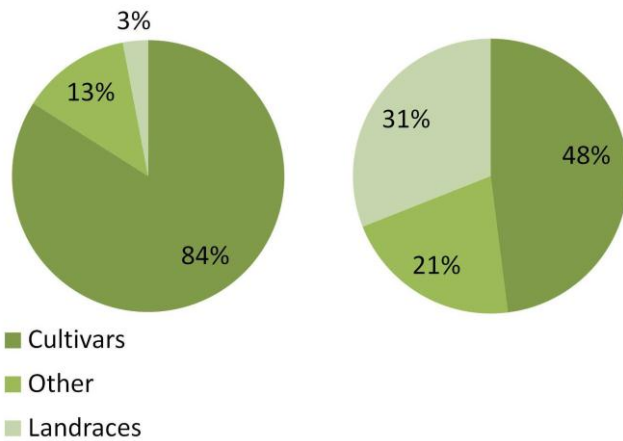


Figure 14: The indicator Crop Origin (CropOrig) seems more useful in traditional subsistence farming in Uganda than in modern European farming. Germany, Dehesa and Olive plantations in Spain, 46 farms, 5 landraces (left); Uganda, 16 farms, 58 landraces (right).

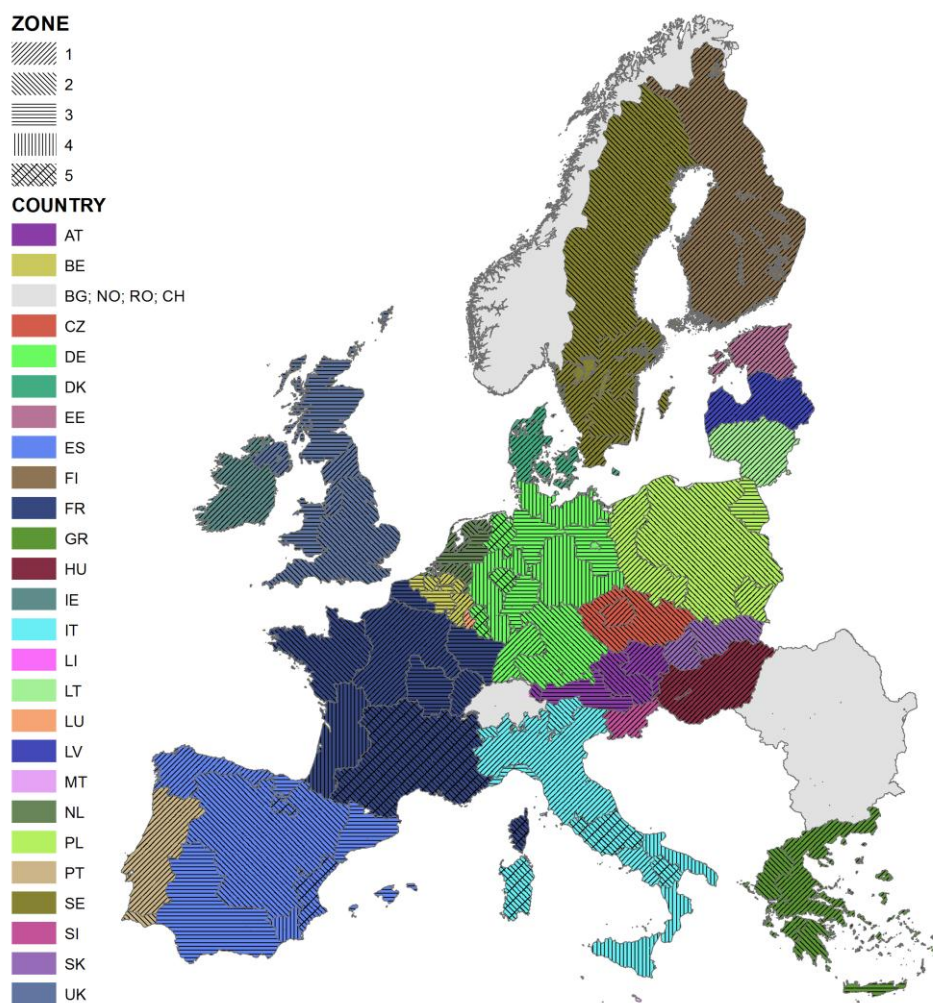


Figure 15: BioBio monitoring zones based on farm statistics (NUTS2) and on environmental regions. Their intersection leads to up to five zones per country. In each zone eight farm types are differentiated. Results could be reported per farm type per zone.

A video produced in the frame of the project “Earthworms for sustainable agriculture” can be watched here: <http://www.youtube.com/watch?v=hSyX8g1V3bc>

List of all Beneficiaries

Beneficiary Number *	Beneficiary name	Beneficiary short name	Contact name	Country	Date enter project	Date exit project
1 coordinator	Federal Department of Economic Affairs FDEA Research Station ART	FDEA-ART	Felix Herzog	CH	month 1	month 42
2	Szent Istvan Egyetem	SIU	Laszlo Podmanicky	HU	month 1	month 42
3	Aberystwyth University	ABER	Peter Dennis	UK	month 1	month 42
4	Norsk Institutt for Skog og Landscap	NFLI	Wendy Fjellstad	NO	month 1	month 42
5	Universitaet fuer Bodenkultur Wien	BOKU	Jürgen K. Friedel	AT	month 1	month 42
6	ALTERRA B.V.	ALTERRA	Rob Jongman	NL	month 1	month 42
7	Technische Universitaet Muenchen	TUM	Maximilian Kainz	DE	month 1	month 42
8	Universidad de Extremadura	UEX	Gerardo Moreno	ES	month 1	month 42
9	Universita degli Studi di Padova	UP	Maurizio Paoletti	IT	month 1	month 42
10	SOLAGRO	SOLAGRO	Philippe Pointereau	FR	month 1	month 42
11	Institute of Plant Genetic Resources	IPGR	Siyka Stoyanova	BG	month 1	month 42
12	Alma Mater Studiorum – Universita di Bologna	UNIBO	Davide Viaggi	IT	month 1	month 42
13	Institut Nationale de la Recherche Agronomique	INRA	Jean-Pierre Sarthou	FR	month 1	month 42
14	Bila Tserkva National Agrarian University	BTNAU	Tetyana Dyman	Ukraine	month 1	month 42
15	Institut National de Recherche en Génie Rural, Eaux et Forêts	INRGREF	Salah Garchi	Tunisia	month 1	month 42
16	Faculty of Agriculture, Makerere University	MAKARERE	Charles Nkwiine	Uganda	month 1	month 42