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Report on the final indicator set after stakeholder audit

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Report on the final indicator set after stakeholder audit

Final Version of Report

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Contents

1. Introduction

This report summarizes the final selection of the BIOBIO indicators. This selection was conducted in an iterative process between stakeholders and researchers (Fig. 1). At the start of the project, stakeholders expressed their requirements (SAB I, Pointereau 2009). Then the researchers conducted a comprehensive literature review and expert consultation (Dennis *et al.* 2009). They identified 47 potential indicators which were again submitted to the Stakeholder Advisory Board (SAB II, Pointereau 2010). Following the stakeholders advice, the remaining 41 candidate indicators were tested in 12 case study regions across Europe. The results were analysed, including also an assessment of the practicality of data acquisition and analysis (Jeanneret *et al.* 2012), and a list of indicators was proposed to the Stakeholders (SAB III, Pointereau & Langevin 2012) for a final audit.
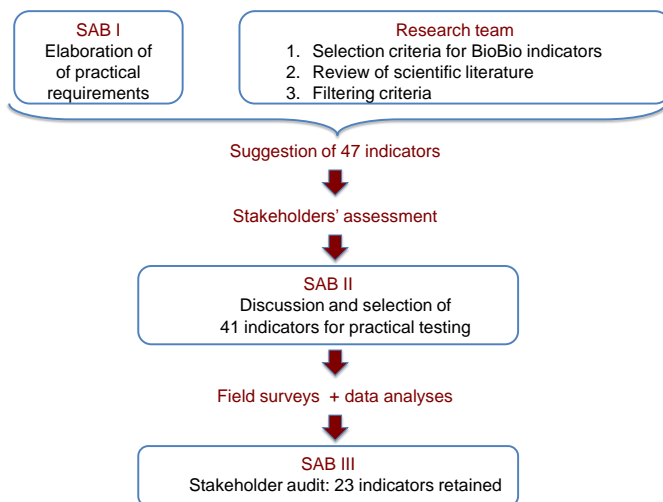
Figure 1: *Process of farmland biodiversity indicator selection in the research project BIOBIO.*

2. Stakeholder Advisory Board meeting in Bruxelles

The stakeholder advisory board consists of 20 experts from major interest groups (Table 1). In addition to the central SAB, local stakeholder groups were affiliated to each case study. They had been consulted and had had the opportunity to feed back their judgement on the indicators to the central SAB.

The SAB III meeting was held in Bruxelles, 25.-26.1.2012. Results from case study indicator evaluations were presented in detail and discussed. In addition to the scientific performance of the indicators, the cost and effort for their measurement was also presented. Major recommendations of the stakeholders were:

- All four categories of indicators need to be retained (genetic, species, habitat diversity and management indicators). Notably the importance of indicators for the genetic diversity of crops and livestock was stressed. These indicators had received relatively little interest at the preceding SAB II meeting.
- Indicators should be measured and communicated individually, it is not recommended to aggregate them into a single index.

Following the SAB III meeting, the Project Coordination Committee (the authors of this report) gathered in Bruxelles on 27.1.2012 and decided on the final indicator set to be proposed.

Table 1: Composition of the Stakeholder Advisory Board SAB.

NAME	ORGANISATION	DESCRIPTION	COUNTRY
NGO Nature protection and environment - 5 representatives -			
Schuboth Jörg	NABU	NGO, Nature protection and environment	Germany
De Miguel Beascoecha Eduardo	Fondation Global Nature	NGO, Nature protection	Spain
Still Kate	Plantlife International	NGO, Nature protection	England
Bruner Ariel	Bird Life International	NGO, Nature protection	Belgium
Marin Simeon	Green Balkans	NGO Nature Protection	Bulgaria
NGO Consumers' association – 1 representative -			
Oppliger Barbara and Klemm Urs	Consumer Forum	Consumers' association	Switzerland
Farmer organization – 3 representatives -			
Fabian Thierry	INAO/OriGIn	Farmer organisation (PGI and OF)	Europe
Corral Eva and Benithes Cyntia	Copa-Cogeca	Farmer organisation (OF)	Europe
Ruppol Patrick and Godden Bernard	IFOAM/BioForum Wallonia	Farmer organisation (OF)	Europe World
Territorial and national administration - 3 representatives -			
Mayrhofer Peter	Department for Rural Development of Lower Austria	Territorial administration, Agro-environment Policy	Austria
De Paola Claudio	Parco del Ticino - Team Europe	Territorial administration, Agro-environment actions	Italy
Baylis Mark	DEFRA	Agri-environmental Policy - ELS	UK
Farmer adviser and Agrarian Institute - 2 representatives -			
Walot Thierri	GIREA-UCL	Farmer adviser on biodiversity AEM	Belgium
Zemechis Romualdas	Lithuanian Institute of Agrarian Economics	Agrarian Institute	Lithuania
European institutions - 6 representatives -			
Biala Katarzyna	European Environment Agency	European Agency (Biodiversity)	Europe
Selenius Johan	DG ESTAT	European administration, (Agri-environmental indicators)	Europe
Paracchini Maria Luisa	JRC/EIS	European administration (LIFS, HNV),	World
Zaunberger Karin	DG Environment	European administration (Nature and Biodiversity)	Europe
Canenbley Christiane	DG agriculture	European administration (Environment, GMO and genetic resources)	Europe
Cinti Stefano	DG agriculture	European administration OF	Europe

3.   Final indicator set

The final set consists of 23 BIOBIO indicators (Table 2):
- 3 indicators for the genetic diversity of crops and livestock;
- 4 species diversity indicators;
- 8 habitat diversity indicators;
- 8 farm management indicators.

Table 2: Overview on the BIOBIO farmland biodiversity indicator set.

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

The indicators tested in the case study regions were ranked according to:
- The cost of indicator measurement;
- The scientific soundness of the indicators, given the results which were obtained in the case study regions;
- The practicability of indicator measurement;
- The attractiveness for stakeholders.

According to those rankings, the indicators were then grouped into three categories:
  a) Recommended indicators (the 23 indicators of the final set)
  b) Research indicators (which would need further development until they are operational and can be recommended; their suitability could not be fully assessed in the BIOBIO project);
  c) Discarded indicators (which proved too expensive, not practical or not scientifically solid enough).

In Tables 3 to 6 the indicators are listed according to those three categories.

Table 3: Indicators for the genetic diversity of crops and livestock: a) recommended indicators, b) research indicators and c) discarded indicators.

	Name	Unit	Data source	Cost	Scientifically sound	Practicable	Attractive	Sub-indicators	Comments
Recommended indicators									
Breeds	Number and amount of different breeds	Mean no. of breeds per farm	Farm interview	low	*	***	***	Rare breeds	
CultDiv	Number and amount of different varieties (cultivar diversity)	No. of varieties per species and farm	Farm interview	low	*	***	***	1) Average number of varieties across all crop species per farm 2) Percentage of endangered crop varieties per species per farm	Additional information and lists required
CropOrig	Origin of crops	Percentage of landraces (across all crop species and varieties) per farm	Farm interview	low	*	**	**	Percentage of landraces per farm	Very few landraces found
Research indicators									
CroPedDiv	Pedigree-based genetic diversity	Coefficient of parentage (index) per CS	Farm interview plus additional information	medium	**	*	***	Coefficient of parentage per case study	Low pedigree-data availability (i.e. only for major crops on case-study level) is limiting
GrassGenDiv	Genetic diversity of model grassland species	Genetic diversity index, Gene diversity (He) per plot/farm	Laboratory analysis	high	***	*	***	Gene diversity	Tested for one grass species in 3 CS, far from routine application
Discarded indicators									
Seedmulti	On-farm seed multiplication				*	*	**		Precise data cannot be gathered with questionnaire
CropCuPheDiv	Crop-cultivar phenotypic diversity				*	*	**		Data not available from questionnaire, field work required
ReSeed	Amount of re-seeding				*	*	**		Precise data cannot be gathered with questionnaire

Table 4: Indicators for species diversity: a) recommended indicators, b) research indicators and c) discarded indicators. Cost, scientific soundness, practicalities and attractiveness were only evaluated for the four taxa that were tested in the field.

	Name	Unit	Data Source	Cost	Scientifically Sound	Practicable	Attractive	Sub-Indicators	Comments
a)	**Recommended indicators**								
Plants	Vascular plants	N° of species per farm	Field survey	***	***	***	***	(see bellow)	
Earthworms	Earthworms	N° of species per farm	Field survey	***	***	***	***	(see bellow)	
Spiders	Spiders	N° of species per farm	Field survey	***	***	***	***	(see bellow)	
Bees	Wild bees and bumblebees	N° of species per farm	Field survey	***	***	***	***	(see bellow)	
Birds[a]	Birds of farmland habitats	N° of species per farm – Specialist species	Field survey	n.a.	n.a.	n.a.	n.a.	(see bellow)	
Sub-indicators for all four indicator species groups: 1) Gamma diversity - species of cultivated forage, food crops and semi-natural habitats 2) Alpha diversity - species of cultivated forage, food crops and semi-natural habitats 3) Area weighted diversity - species of cultivated forage, food crops and semi-natural habitats 4) Rarefied richness - species of cultivated forage, food crops and semi-natural habitats 5) Chao estimated richness - species of cultivated forage, food crops and semi-natural habitats 1.1) Gamma diversity - species of cultivated forage and food crops 2.1) Alpha diversity - species of cultivated forage and food crops 3.1) Area weighted diversity - species of cultivated forage and food crops 1.2) Gamma diversity - species of semi-natural habitats 2.2) Alpha diversity - species of semi-natural habitats 3.2) Area weighted diversity - species of semi-natural habitats **Comments:** Gamma diversity: Total number of species aggregated over the habitats Alpha diversity: Average number of species over the habitats Area weighted diversity: Number of species over the habitats weighted by the area of the habitats Rarefied richness: Average number of species over the smallest number of plots found in a farm Chao estimated richness: Extrapolated number of species based on the accumulated number of species found in plots									

* Birds were not tested in the BIOBIO project because they are already well researched and the SAB recommended at its second meeting (SAB II) that the research funds be used for other purposes / other indicators. It is nevertheless recommended that farmland birds be part of the final indicator set.

Table 4 (continued)

	Name	Unit	Data source	Cost	Scientifi-cally sound	Practicable	Attractive	Sub-Indicators	Comments
b) Research indicators and c) Discarded indicators (not differentiated)									
Butterflies	Rhopalocera of farmland habitats	N° of species per farm	Field survey	n.a	n.a.	n.a.	n.a.	(see Recommended Indicators)	Much data available. Observations are weather dependent (as for bees). Indicators of grassland conditions.
Hymenoptera - Ants	Ants of farmland habitats	N° of species per farm	Field survey	n.a.	n.a.	n.a.	n.a.	(see Recommended Indicators)	Lack of information. Require much laboratory work. Require further consideration due to functions (ecosystem engineering, biological properties of soils, pest control).
Small mammals	Small mammals of farmland habitats	N° of species per farm	Field survey	n.a.	n.a.	n.a.	n.a.	(see Recommended Indicators)	Lack of data. Difficult to survey. Include pests.
Carabid beetles	Carabids of farmland habitats	N° of species per farm	Field survey	n.a.	n.a.	n.a.	n.a.	(see Recommended Indicators)	Biocontrol agent. Well investigated in agro-ecosystems. Require much laboratory work.
Diptera, Syrphidae, Hoverflies	Hoverflies of farmland habitats	N° of species per farm	Field survey	n.a.	n.a.	n.a.	n.a.	(see Recommended Indicators)	Biocontrol agent. Require much laboratory work.
Bats	Bats of farmland habitats	N° of species per farm	Field survey	n.a.	n.a.	n.a.	n.a.	(see Recommended Indicators)	Lack of information. Difficult to survey.

Table 5: Indicators for the diversity of farmland habitats: a) recommended indicators, b) research indicators and c) discarded indicators.

	Name	Unit	Data Source	Cost	Scientifically Sound	Practicable	Attractive	Sub-Indicators	Comments
a) Recommended indicators									
HabRich	Habitat richness	N° of habitat types per hectare	Habitat mapping	**	***	***	***	1) Habitat richness of cultivated forage and food crops 2) Habitat richness of semi-natural habitats	Further division into sub-indicators is possible
HabDiv	Habitat diversity	Shannon diversity	Habitat mapping	**	***	***	***	1) Habitat diversity of cultivated forage and food crops 2) Habitat diversity of semi-natural habitats 3) Habitat diversity of areal habitats 4) Habitat diversity of linear habitats	Further division into sub-indicators is possible
PatchS	Average size of habitat patches	ha	Habitat mapping	**	***	***	***	1) Patch size of cultivated forage and food crops 2) Patch size of semi-natural habitats	Can also be calculated for further sub-categories
LinHab	Length of linear habitatss	m / ha	Habitat mapping	**	***	***	***	1) Length of grassy linear features 2) Length of woody linear features 3) Length of auqatic linear features 4) Length of wall linear elements	Can be individually calculated for mapped categories
CropRich	Crop richness	N° of crops per farm / per hectare	Interviews	*	***	***	***	Most relevant for arable systems	
ShrubHab	Percentage of farmland with shrubs	% of farmland	Habitat mapping	**	***	***	***		Interpretation in context. Can be positive in intensively cultivated areas, but negative in areas of agricultural abandonment

Table 5 (continued)

	Name	Unit	Data Source	Cost	Scientifically Sound	Practicable	Attractive	Sub-Indicators	Comments
TreeHab	Tree cover	% of farmland	Habitat mapping	**	***	***	***	1) Share of cultivated forage and food crops with trees (%) 2) Share of semi-natural habitats with trees (%) 3) Share of area with trees (%) 4) Share of lines with trees (%)	Further division into sub-indicators is possible
SemiNat	Percentage of semi-natural habitats	% of farmland	Habitat mapping	**	***	***	***	1) ... without trees 2) ... with trees 3) Semi-natural aquatic habitats	Includes all linear habitats and areal habitats classified as semi-natural. Can also be calculated for further sub-categories
b) **Research Indicators**									
TreeDens	Tree density	N° of trees per ha	Habitat mapping	** / *	***	***	n.a.		Can be used to differentiate between intensive and extensive orchards and olive plantations. Cannot be tested in BIOBIO, as only extensive plantations observed
Weed	Cover of non-crop plants on arable fields, at the plot level	Share of crop field covered by weeds	Vegetation relevé or habitat mapping	*** / **	*	**	n.a.		Could be derived from vegetation sample or noted during habitat mapping but would require several visits per season
ValueHab	Percentage of valuable habitats on the farm	% of farmland	Habitat mapping	**	**	*	n.a.		Annexe I habitats are easy to measure but hardly differentiate between farms. Additional quality criteria could be used, e.g. national priority habitats, target habitats, etc.

Table 5 (continued)

	Name	Unit	Data Source	Cost	Scientifically Sound	Practicable	Attractive	Sub-Indicators	Comments
Multigrass	Area covered by multi-grass swards	% of farmland	Vegetation sample	***	*	*	n.a.		European definition not meaningful, would require regional definitions
Aggregation	Ratio of total farm size to minimum bounding polygon, i.e. the smallest polygon that encloses all patches belonging to the farm		Habitat mapping	**	**	***	n.a.		Easy to compute from farm plot maps but more relevant for classifying farm types, rather than having direct ecological significance
CropFlower	Ratio of non-flowering to flowering crops on the farm	%	Habitat mapping	**	**	***	n.a.		For arable farming systems. Crop categories in habitat mapping defined as flowering / non flowering; test against arthropod data
c) Discarded Indicators									
HabDensity	Habitat density	N° of habitat patches per ha of farm	Habitat mapping	**	***	***	*		Consistent correlation with patch size (consistent also for sub-indicators), therefore redundant and not needed.
ArableArea	Percentage area of arable land	% of farmland	Habitat mapping	**	**	*	n.a.		Cannot be reliably measured. The difference between permanent and sown grassland is difficult to detect in the field (survey); farmers have difficulties in differentiating between the two categories (interview)

Table 5 (continued)

	Name	Unit	Data Source	Cost	Scientifically Sound	Practicable	Attractive	Sub-Indicators	Comments
GrassArea	Percentage area of permanent grassland	% of farmland	Habitat mapping	**	**	*	n.a.		Cannot be reliably measured. The difference between permanent and sown grassland is difficult to detect in the field (survey); farmers have difficulties in differentiating between the two categories (interview)
Ellenberg	Ellenberg values indicating environmental conditions of farm grasslands	Ellenberg scores	Vegetation relevé	***	**	*	n.a.	For differerent characteristics (soil moisture, pH, nutrient status, etc.)	Discarded because Ellenberg values are not systematically available across Europe

Table 6: Indicators for farm management practices: a) recommended indicators, b) research indicators and c) discarded indicators.

	Name	Unit	Data source	Cost	Scientifically sound	Practicable	Attractive	Sub-indicators	Comments
a) Recommended indicators									
EnerIn	Total direct and indirect energy input	GJ/ha UAA	Farm interviews	Low	***	***	***		Alternatively, the unit *Equivalent litres of fuel/ha UAA can be used for communication.*
IntExt	Intensification/Extensification: Expenditures on fuel, pesticides, fertiliser and animal fodder	€/ha UAA	Farm interviews	Low	***	***	***		

Table 6 (continued)

	Name	Unit	Data source	Cost	Scientifically sound	Practicable	Attractive	Sub-indicators	Comments
MinFert	Area on which mineral nitrogen fertiliser is used	% of UAA	Farm interviews	Low	***	***	***		
NitroIn	Total nitrogen input	kg N/ha UAA	Farm interviews	Low	***	***	***		
FieldOp	Field operations	N° of field operations	Farm interviews	Low	***	***	***	1) Cuts Mowing frequency (No. of cuts); 2) MowTime Mowing timing (Date of first cut); 3) Plough Ploughing (% arable land)	
PestUse	Pesticide use	N° of applications	Farm interviews	Low	***	***	***	1) PestH Herbicide use; 2) PestI Insecticide use; 3) PestF Fungicide use	
Av Stock	Average stocking rate	N° of livestock units/ha UAA	Farm interviews	Low	***	***	***	AvStockF Average stocking rate per ha forage area	
Graze	Grazing intensity	N° of grazing livestock units/ha grazing area	Farm interviews	Low	***	***	***		
b) **Research indicators**									
Norg	Organic nitrogen fertiliser input	kg N/ha UAA	Farm interviews	Low	***	***	***		A subindicator of 'Total nitrogen input'. Of potential relevance for earthworm indicator.
	Energy output	GJ per kg grain sold	Farm interviews	Low	***	***	***		To be tested as case study specific indicator (arable case studies).

Table 6 (continued)

	Name	Unit	Data source	Cost	Scientifically sound	Practicable	Attractive	Sub-indicators	Comments
Irrig	Irrigation	% of UAA	Farm interviews	Low	***	***	***		Relevant for few case studies only. A candidate for merging with indicator 'Irrigation' indicator to form new 'Intensity water management' indicator (working title).
Drain	Drainage	% of UAA	Farm interviews	Low	***	***	***		See Irrigation.
c) Discarded indicators									
DivEnt	Diversity of enterprises	N° of enterprises	Farm interviews	Low	*	***	*		No consistent trends, so indicator was dropped.
CertOrg	Certified organic farming	yes/no	Farm interviews	Low	*	***	*		Specific farm management characteristics are more reliable indicators. But CertOrg can be an important additional explanatory variable.
AgrEnv	Agri-environmental measures on the farm	N° of agri-environmental measures	Farm interviews	Low	*	***	*		Correlations with biodiversity indicators for 2 case studies only (France – plants: positive, Italy – bees: negative). No consistent trend, so indicator was dropped.

Table 6 (continued)

	Name	Unit	Data source	Cost	Scientifically sound	Practicable	Attractive	Sub-indicators	Comments
AeNature	Agri-environmental support related to nature conservation	% of UAA under nature conservation measures	Farm interviews	Low	*	***	*		Correlations with biodiversity indicators for 2 case studies only (Germany – habitats: positive. Austria – plants: negative.). No consistent trend, so indicator was dropped. But perhaps worthwhile for specific analysis of German CS.
PestUse-Area	Reduced use of chemical pesticides	% of UAA without use of chemical pesticides	Farm interviews	Low	***	***	*		Correlates strongly with PestUse.
Zero	Soil cultivation: Zero tillage	% of UAA	Farm interviews	Low	***	***	*		Relevant in one BIOBIO case study (France) only.

4.   Outlook

The indicators are explained in more detail in the "Guidebook and Factsheets" (Herzog 2012), which consists of:
- a report with explanations on the indicator set, including context information on indicator selection and interpretation;
- a factsheet for each of the 23 recommended indicators;
- a summary of 20 pages which is available in 10 languages.

The Guidebook is available at www.biobio-indicator.org, together with all Deliverables and publications of the project.

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