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Report on the contribution of the stakeholders to the selection of the biodiversity indicators for organic and low input farming systems

Final Version of Report

Philippe POINTEREAU
(SOLAGRO) Initiatives and Innovations for Energy, Agriculture and Environment, Toulouse, France

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Executive summary:

The stakeholder advisory board (SAB) consists of 20 experts from major interest groups: NGO Nature protection and environment (5), NGO Consumers' association (1), farmer organisation (3), territorial and national administration (3), farmer adviser and Agrarian Institute (2) and European administration (6).

The SAB accompanies the project from the start (conceptual phase) to the end (dissemination), supports the BIOBIO R&D approach and will formulate their main expectations and criteria for relevant and useful biodiversity indicators for organic and low-input farming systems. This process has been launched during the SAB workshop I (March 25-27, 2009) in Zurich and pursued by the SAB workshop II in Brussels (October 21, 2009)

During the first SAB meeting, the stakeholders have formulated a set of recommendations which have been used later on to constitute a grid to analyse the proposed biodiversity indicators. The 18 recommendations have been condensed to 11 practical requirements. The biodiversity indicators should be easy to develop and not too expensive to apply, easy to use and be comprehensive and flexible. They should integrate emblematic species, take into account functional biodiversity/ecosystem services and be appropriated by farmers, consumers and administration. They should be able to assess the farmers' or management plans' progress and agricultural policies. They should contribute to evaluate all types of farming systems and be available for different scales (field, farm, landscape and Europe). At the end it is important to propose general indicators and not only specific indicators. A set of indicators would be better than to have only one or two aggregated indicators.

The objective of the second SAB meeting was to give recommendations on the 47 biodiversity indicators which the BIOBIO project research teams had identified as scientifically sound and potentially feasible. Based on the SAB's priorities, the set of potential indicators was to be narrowed and the indicators to be investigated in the 12 field studies to be carried out in 2010 across Europe were to be selected.

The 14 stakeholders present at the SABII meeting discussed the indicators and provided recommendations to the scientists of the project. They expect that indicators could be used in organic and conventional farming and all kind of farming systems and all sizes of farms.

They recommend providing an energetic balance and the GHG emissions. The effect of climate should also be considered. It differs between countries and is an important element.

Indicators on the Genetic Diversity of crops and husbandry animals (Group A) were generally rated as of lesser interest than the other indicator groups.

Concerning the Group B on species diversity indicators, stakeholders gave the best assessment to plants (B1 and B2), earthworms (B4) and bees and wasps (B9). Birds (B6) arrived before spiders (B8). Opinions were divided whether bird-related indicators should be tested in the case study regions. Whilst some argued that an indicator set without birds would not be credible, others suggested to rely on published material for this well investigated species group. Instead, available resources should be invested for testing less well-known indicators. Species indicators should be grouped in 2 categories considering the scale. Species have to be chosen according to the specific farming systems to be assessed. The indicators which will be proposed at the end of the project

should cover different spatial scales, represent ecosystems services and link farm management and species or habitat indicators.

Habitat and Farm Management indicators (Groups C and D) were given high priority by the stakeholders, given that they are comparatively easy to record and often used by them in their work. They asked to incorporate more indicators concerning the description of the farming practices such as the feeding system, manure management and tillage practices, and a better consideration of the indirect indicators, e.g. the ecological compensation area (landscape elements) which are commonly used by many stakeholders.

Stakeholders recommend also an improvement of fact sheets. The description of each indicator should be improved and the aim explained (what are the indicators expected to show?). Farm management indicators have to be better described in the fact sheets. It should be stated in the fact sheets how indicators work. How are indicators going to show biodiversity.

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1. The Methodology implemented to select the indicators

1.1. The different steps of the methodology

Figure 1 presents the different steps of the methodology implemented to select the biodiversity indicators which will be tested in 2010 and the contribution of the stakeholders to this process.

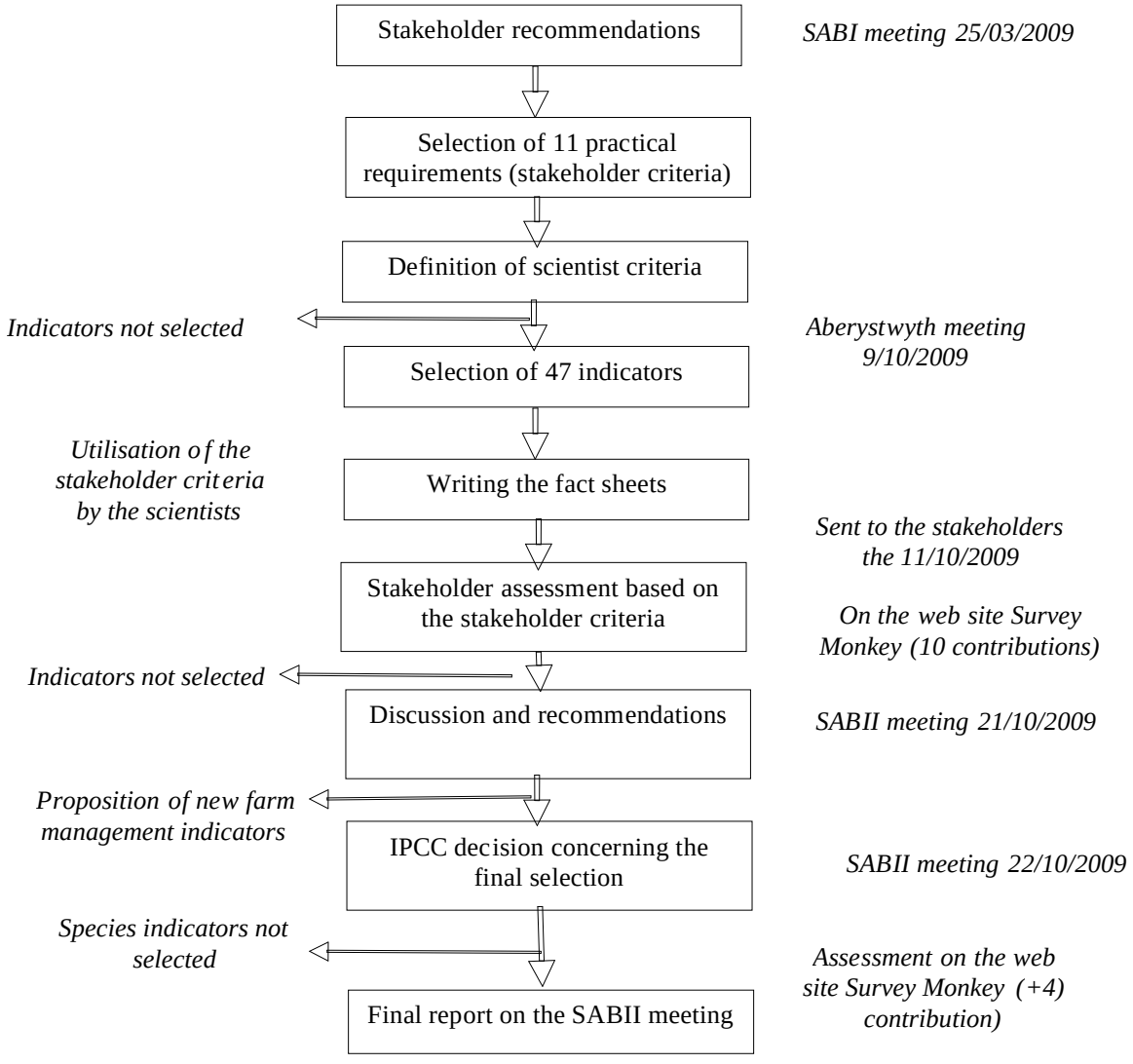

Figure 1 : Methodology concerning the stakeholder contribution to the indicator selection

The main contributions of the stakeholders were:

- Proposal of specific recommendations and practical requirements
- Co-redaction of the fact sheet Form

- First assessment and scoring of the indicators with the Survey Monkey tool
- Recommendations concerning the selected indicators.

1.2. Simplify the 18 recommendations to 11 practical requirements

During the first SAB meeting which took place in Zurich the 25th of March 2009, the stakeholders have proposed a set of recommendations which have been used later on to constitute a grid to analysed the selected biodiversity indicators.

In final the 18 recommendations have been reduced to 11 practical requirements. The biodiversity indicators should:

- ✓be easy to develop
- ✓not be too expensive to apply
- ✓be easy to use
- ✓be comprehensive and flexible,
- ✓integrate emblematic species,
- ✓take into account functional biodiversity/ecosystem services and
- ✓be appropriated by farmers, consumers and administration be able to assess the farmers' or management plans' progress and agricultural policies
- ✓contribute to evaluate all types of farming systems
- ✓be available for different scale (field, farm, landscape and Europe)
- ✓ take into account existing indicators, tools to assess biodiversity in agriculture and observatories.

Behind these recommendations, there are important questions concerning who is going to apply and use the biodiversity indicators (farmers, advisers, nature experts, scientists) and who is going to pay for it?

The objective of the second SAB meeting which took place in Brussels the 21th of October 2009 was to give recommendations on the 47 biodiversity indicators selected (candidate indicators) by the BIOBIO project research team. These indicators had been qualified as scientifically sound and potentially feasible by the scientists during a workshop in Aberystwyth, based on a comprehensive literature review (Delivierable D2.1, available at www.biobio-indicator.org).The 47 indicators proposed to the stakeholders were grouped into 4 categories :

- Group A Genetic Diversity indicators (10 indicators)
- Group B Species Diversity indicators (12 indicators)
- Group C Habitat Diversity indicators (13 indicators)
- Group D Farm Management indicators (12 indicators)

Two weeks before the meeting the stakeholders received fact sheets of each indicator and carried out a first assessment by internet (with the Survey Monkey tool).

1.3. Elaborate the indicator fact sheet form

The fact sheet form was built jointly by the scientists and the stakeholders and tested with 2 indicators. The fact sheet version 1 was conceived to present each indicator on 2 pages in a synthetic form :

- description of the indicator (unit, collection method, calculation method, skills required, synergies with other indicators, estimated costs)
- scientific criteria (biodiversity relevant, scientifically sound, sensitive, reproducible), links with agricultural practices, global scientific assessment (solid and well tested, woks reasonably well, tentative), potential weaknesses, difficulties
- stakeholder criteria, stakeholder recommendations (retain, tentative, skip)

An example of a fact sheet is presented in Appendix I.

2. The Survey Monkey Tool assessment

"Survey monkey" is available on the internet and allows to conduct online assessments. The assessment of each of the 47 indicators with the 11 stakeholder criteria was proposed.
The objective of this first assessment was firstly to contribute to a better appropriation of the selected indicators before the meeting, secondly to propose a contribution to the stakeholders who could not be present at the Brussels meeting and thirdly to give a first overview before the meeting to focus the discussion on the controversial indicators.

14 stakeholders contributed to a first assessment of the indicators to be evaluated at the Brussels meeting.
The detailed results of the survey Monkey assessment are presented in Section 3.3. The assessment per each indicator is also available in an Excel sheet.

Stakeholders focused mainly on the species diversity indicators and the farm management indicators. At this stage of the project it was difficult for them to understand and to assess the genetic diversity indicators (Group A). But 30% of the stakeholders want that genetic indicators are retained. Indicators should be developed to cover native breeds and crop variety diversity such as:

- Number and amount of different native breeds in the farm
- Number and amount of different native crop varieties /orchard tree species in the farm.

Concerning the 12 species diversity indicators (Group B) the best scoring concerns (see Section 3.3.2):

- Plants B1 and B2 present in the crops and in the grasslands
- Earthworms B4
- Wild bees and wasp B9
- Birds B6
- Spiders B8

- Carabid beetles B10
- Butterfly B3

Bats B12, Diptera/Syrphidae/Hoverflies B11, Ants B5, Small Mammals B7 get the lowest scores. Ants and small mammals are not considered as relevant indicators.

Concerning the habitat diversity indicators (Group C), they agreed with the necessity to describe and take into account the different habitats presents on the farms but they asked for a more simplified presentation. Ellenberg values (C9) and weeds (C10) indicators were not considered suitable indicators.

3. Recommendations of the SABII

3.1. Stakeholder participants to the Brussels meeting

14 stakeholders were present at the Brussels meeting.

Andrea Graham (Copa Cogeca)
Mario Fritz (DG Environment)
Stefano Cinti (DG Agriculture)
Eva Corral (Copa Cogeca)
Claudio de Paola (Parco del Ticino- Team Europe)
Thierry Fabian (Institut National de l'Origine et de la qualité)
Urs Klemm (Consumer Forum)
Peter Mayrhofer (Niederostereichische Agrarbezirksbehörde)
Maria Luisa Paracchini (Joint Research Centre)
Jörg Schuboth (Naturschutzbund Deutschland)
Johan Selenius (DG Estat)
Kate Still (Plantlife International)
Thierri Walot (Groupe Interuniversitaire de recherche en écologie appliquée - Universite catholique de Louvain)
Simeone Marion (Green Balkans)

Excused: Karin Zaunberger (DG Environment), Romualdas Zemechis (Lithunian Institute of Agrarian Economics), Eduardo De Miguel Beascoecha (Fundation Global Nature) and Bernard Godden (BioForum Wallonie)

3.2. Discussion and recommendations

General comments

This meeting was important as it was the last opportunity to give recommendations, give advices, and to add indicators if these are crucial and are missing in the actual list before the field investigation to be carried out in the 12 European case studies.

The 14 stakeholders present at the meeting discussed on all of the indicators and provided recommendations to the scientists of the project. They recommend that indicators could be used in conventional farming and all kind of farming systems and all sizes of farms. At the end it is important to propose rather general indicators and not only specific indicators. A set of indicators for organic would be better than to have only one or two. It is a system, therefore one cannot take only a part of it.

They recommend to provide an energetic balance and the GHG emissions. Effect of the climate should also be considered during the process of the project. It changes between countries and is an important element.

They recommend also an improvement of fact sheets. The description of each indicator should be improved and the aim explained (what are the indicators expected to show?). It should be stated in the fact sheets how indicators work. How are indicators going to show biodiversity? The BIOBIO research team conceded that in their presentation of indicators and factsheets, the distinction between data collection and the actual indicators was not always clear and sometimes blurred. E.g. a species diversity indicator will not be "Spiders" but rather "Number of spider species" or "Composition of spider community" or "Number of specialist spiders", etc.

We should keep in mind that the collection methods for many of the proposed indicators would be rather difficult and would require a lot of "Skills", more than 5 visits per farm and year, therefore high costs, there must be a good training of all fieldworkers, …and so on.

Concerning the selection of the farms and the regions, size of the farms has to be taken into account. It changes between countries and is an important element.

Genetic Diversity indicators (Group A)

These indicators were only very briefly discussed. They were not given high priority by the stakeholders.

Species Diversity indicators (Group B)

The stakeholders discussed on the interest to use aquatic species indicators. They accepted that it would be difficult to relate the management of an individual farm to the aquatic species observed e.g. at a specific location of a river (impact of upstream management).

Species indicators should be grouped in 2 categories considering the scale. Species have to be selected according to the specific farming systems we want to compare/research. They considered that birds and butterflies are useful only at a large scale and can represent biodiversity as a whole for farming. The indicators which will be proposed at the end of the project should cover different spatial scales, represent ecosystems services and link farm management and species or habitat indicators.

Stakeholders gave the best assessment to plants (B1 and B2), earthworms (B4) and bees and wasp (B9). Birds (B6) arrived before spiders (B8).

Habitat Diversity indicators (Group C)

There was a debate and diverging interpretations of the term "Habitat". For the scientists, any landscape feature (line, plot) of the landscape is considered a habitat, including arable fields such as maize or potato fields. For the majority of the stakeholders, "Habitat" refers to semi-natural structures where they expect comparatively higher species diversity, such as hedgerows or extensively managed grasslands. This interpretation of the term "Habitat" is further promoted by national and EU legislation, e.g. the "Habitats Directive", etc. – In the BIOBIO project, however, "Habitat" will be used in its first (scientific) sense. Still, in naming the indicators this potential misunderstanding has be be accounted for.

Farm Management indicators (Group D)

Stakeholders suggested incorporating more indicators concerning the description of the farming practices as feeding system, manure management and tillage practices, and a better consideration of the indirect indicators as the ecological compensation area (landscape elements) which are commonly used by many stakeholders. This surface could be calculated by adding the surface of the different habitats of the habitat diversity indicators (trees+ linear elements+ extensive grasslands+…). Farm management indicators have to be better described in the fact sheets.

It was also suggested to label this group as "Parameters" instead of "Indicators".

Final propositions

Group A agreed
Group B

- Ants (B5) not agreed.
- *Plants (B1 and B2) agreed*
- Ants (B5) not agreed.
- Bats (B12) not agreed, very controversial
- Small mammals (B7) not agreed, very expensive.
- Syrphids (B11) not agreed.
- Lepidoptera (B3) not agreed.
- *Wild bees (B9) agreed*.
- *Earthworms (B4) agreed.*
- *Spiders (B8) agreed*
- *Carabid beetles (B9) agreed*
- Birds (B6) (test birds next year: 2 votes against 8, have in the final recommendation: 10 votes and 0 against). Birds will therefore not be investigated in the field study. They might still be part of the final indicator set.

Group C agreed
Group D agreed but needs more indicators on the farm

3.3. Comments on each indicator

The detailed comments are synthesized in the following tables

3.3.1. Group A Genetic Diversity indicators

		Remarks
A1	Livestock breeds	Is not only the number of breeds, but also if there is more species diversity on e.g. grassland. Extremely difficult to obtain the information. Not relevant indicator. Number and amount of native/indigenous breed's indicator should be developed. Contribution to each farmer to races with low population (see FAO indicators : critical, endangered, vulnerable, rare, or indicators used in each MS to access to AEM). We will get a lot of different and not comparable stock types all over Europe with no clear link to species diversity. It is a Convention on Biological Diversity indicator (CBD) . There often is a high heterogeneity in the phenotype of old breeds (in many cases without herding book). Need to know the status of each livestock species (landrace). What is the environmental impact of the landrace? Is it possible to join a landrace with livestock practices (breeding, feeding, ...).
A2	Livestock breeding practices	Not a relevant indicator. No clear link with species diversity. Farmers with rare breeds are more likely to use artificial insemination, to get new genes, why the indicator would most likely be not useful. It has to be connected with N-input. Not only breeding practices should be considered, but also feeding, indoor/outdoor, transhumance.
A3	Livestock pedigrees	In some countries it is not applicable. There is no link in whole Europe, comparability is impossible. Information not available at all. Extremely difficult to obtain. Not a relevant indicator. Pedigree of cows and horses is well known, but sheep, pigs, rabbits, poultry a.s.o.?
A4 +A5	Cultivar diversity	Take into account the varieties of the fruit trees (native, rare). Not a relevant indicator. Number and amount of native/indigenous varieties indicator should be developed. Different cultivars do not a priori imply high genetic diversity. The origin of cultivars is crucial to allow for reliable estimation of genetic diversity. This indicator has to be elaborated based on published knowledge. Indicator should refer to crops, etc and not to cultivars, landraces and accessions per species. Surface of the farm should be taken into account. Please replace "legumes and trees" in the heading by vegetables, fruits and crop trees (forest trees are out of scope). It could be difficult to determine the origin of cultivars. How to build a relevant indicator?
A6	On-farm seed multiplication	Is it allowed to produce it by yourself? Not a relevant indicator. The more on-farm seed multiplication the better it seems. Important element for the conservation of some rare arable plants.
A7	Crop cultivar phenotypic diversity	Needs more details and explanations.
A8	Pedigree based on genetic diversity	Pedigree information is only available for few species and mostly for publicly available cultivars. Collection of information is labour intensive. If we also take into account the estimated high costs in comparison to other indicators it seems not worth to select this indicator ("Skip"). Not a relevant indicator. Criteria very difficult to use.
A9	Genetic diversity of grassland species	Is a good indicator to be used. May be a valuable indicator if it is benchmarked with natural occurrence. Cultivars are difficult to identify. Indicator should refer to grassland species. Is molecular genetics an adapted skill? Pedigree information is only available for few species and mostly for publicly available cultivars. Collection of information is labour intensive. See the comment "Potential weaknesses,…" above: "Pedigree information is only available for few species and mostly for publicly available cultivars. Collection of information is labour intensive". If we also take into account the estimated high costs in comparison to other indicators it seems not worth to select this indicator ("Skip").
A10	Reseeding of grassland	Should be an indicator under Group B. It is a good indicator. Very easy and simple, but a good and precise indirect indicator showing the (intensity and environmentally soundness of) grassland management of farms. Complicated to obtain viable information and there is no need of such indicator when A10 is retained.

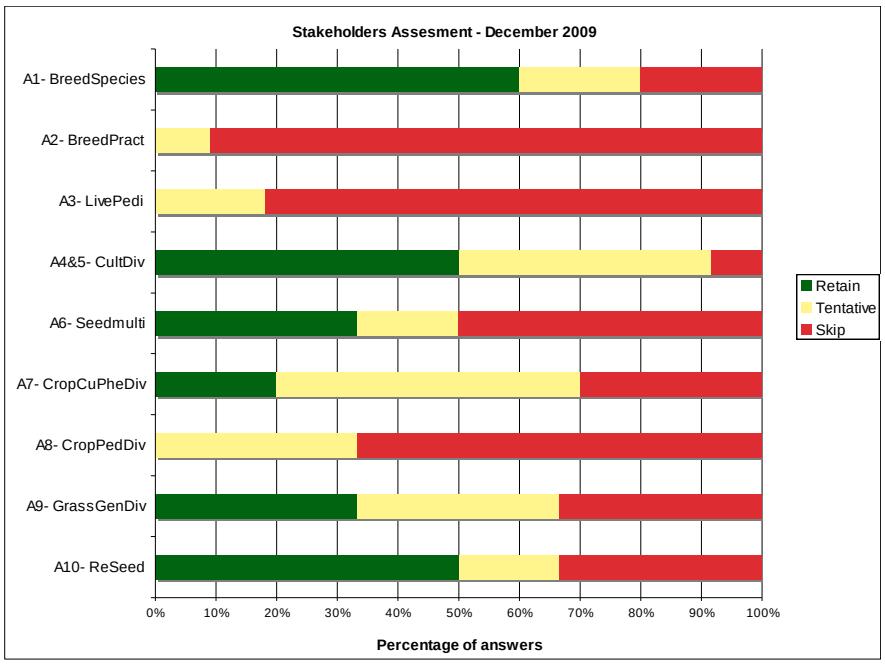

Figure 2 : SAB Global assessment of genetic diversity indicators

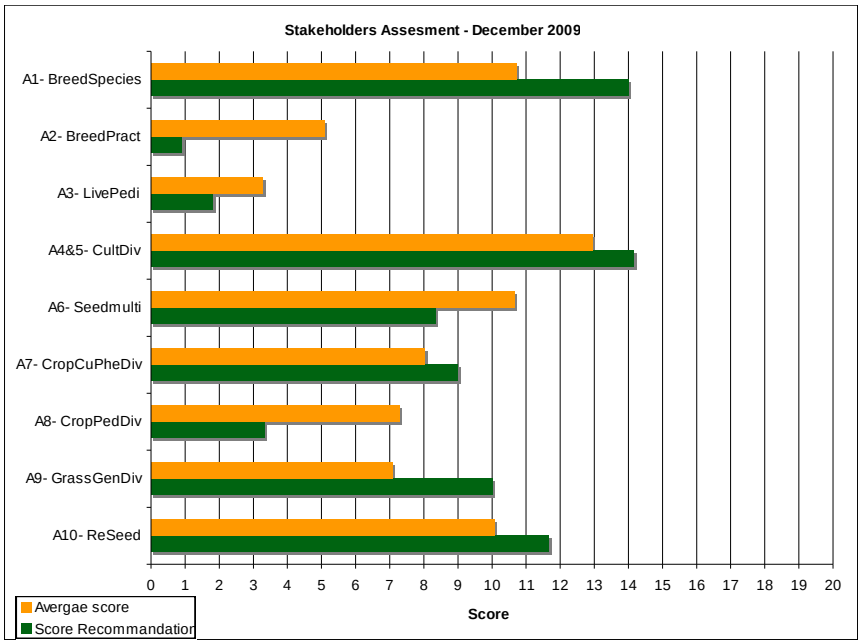

Figure 3 : SAB Global assessment of genetic diversity indicators

** average score : fully applied (3 pts), applied (2 pts), applies somewhat (1 pt)*

** Score recommendation: 2 points for retain, 1 point for tentative, 0 point for skip*

3.3.2. Group B Species Diversity indicators

		Remarks
B1	Flowering plants of cultivated forage and food crops	Overlap with WEED, which could be considered a sub-indicator under PlantCUL (C10). And what about gramineous? It could also be made the assumption that if you have some kind of plant then you will have certain birds or bees, etc. We should take into account for the traits of the plants as for butterflies or bees. Explain the relation with C10 Weeds in crops and C2 Habitat richness. Relation with C15 Grassland quality. Gives too much attention to the cultivated lands. Pernicious weed is not a good terminology to be used in this project. The issue "are all species equal" is very pronounced for this group, where many of the species are "weeds". The analysis will account for this, distinguishing between species of conservation concern and pernicious weeds. Strengths: Well established link to faunistic diversity, sensitive to agricultural practices affected by organic farming regulations, can include highly emblematic species. Weaknesses: Care needed to differentiate between threatened species and common weeds. Farmers may be reluctant to appreciate weeds (which reduce yield) as a positive feature. This indicator is very important and can be divided in different indicators using the plant traits which relate to animals (bees, syrphidae, butterflies, …). Needs adjustment (regionalization)/development. This should include all wild flowering plants - there is no need really to have the additional WEEDS indicator - as dominant species can just be identified within this species status assessment. Very relevant to assess pesticide pressure in an area. Relevant information linked to agricultural practices. Need to find relevant indicators (number of seeds/m2, number of species, scoring with the plant status, functional groups based on specific traits, ...)
B2	Flowering plants of semi-natural habitats	Explain the relation with C2 Habitat richness. Good for Bulgaria, needs adjustment (regionalization)/ development. Indicator could be retained if a clear definition of semi-natural habitat is given.
B3	Butterfly	Butterflies should be applied. There is a lot of data available. If we look at biodiversity as a whole for farming we should include butterflies. There are many things that are unknown, therefore we should concentrate on the things we know a little bit and in this case butterflies should be included. Butterflies are weather dependent. So we need a trend. Butterflies are popular. Very appropriated by consumers. Too costly. Needs a lot of capacity development. It gives a good indication of the regional biodiversity but not useful at farm level. If we select B1, B2 (including grassland) and C15 (ecological quality of grassland) we will get enough information on floristic and faunistic diversity and we can spare all the rather difficult and expensive indicators B3, B5, B6, B7, B8, B9, B10 B11 B12. Could be used to assess the natural value of permanent grasslands. Measure the impact of ecological infrastructure.
B4	Earthworms	Too costly. Needs a lot of capacity development. Needs a lot of additional laboratory work for determination of the species. A lot of farms in the mountain range (Bulgaria) are with stony and sandy soils where this method is not applicable. This is an interesting indicator, of which there are not many examples in literature. It would be relevant to keep it. The absolute weight of earthworms without regionalisation is not a good indicator (e.g. there are big differences depending on earthworm species, soil type, seasonality, etc). The question is, if to count the number and weight of the biomass per unit is enough or if a species list of the earthworms is necessary. Depends of the climate conditions. Very interesting indicator because related to soil activity and soil fertility. But how to build a relevant indicator (biomass/m2, number of species, specialist species, ...)
B5	Hymenoptera-Ants	If biodiversity is important to the market other indicators should be applied. Ants, for example, are in this sense not important at all. Not so many people have information compared to bees. Ants do not really occur in many agricultural lands; therefore they should be left aside. Needs a lot of additional laboratory work for determination of the species. Needs a lot of capacity development. Very good if can be simplified (to eliminate laboratory work and to adapt/develop a method only using field survey).
B6	Birds	Birds should be applied; there is a lot of data available. Birds are a widely recognised biodiversity indicator. It is necessary to consider other birds than those included in the farmland birds index. There are many things that are unknown, therefore we should concentrate on the things we know a little bit and in this case bird should be included. Bird should not be assessed once more. Per se this is a relevant indicator, but many data already exist. So the project partners should decide whether investing in this indicator or try to shed light on other -less

		investigated- indicators. The only reason to use the birds is because of their popularity and acceptance by public and relatively low costs and available expert capacity. Weather dependent, so we need a trend. You can just get the available data and try to link it to the farmland system and somehow analyse it. Birds are only used because they are emblematic but not because they are important for the farming system. Birds are not good indicators for farms activities. Can be used only on landscape scale. Why using them if there are separate "habitat" indicators. The only reason to use the birds is because of their popularity and acceptance by public and relatively low costs and available expert capacity. Species richness is not always the best indicator. Better to focus on specialist species as the community specialization index or the farmland bird indicator (trend).
B7	Small mammals	Small mammals: are not very popular and not nice as well. It is a very expensive indicator which needs a lot of expertise. Good for Bulgaria, needs expert's capacity development. Should try to keep it – trough choosing acceptable species (hares) or easy field methods - counting voles (Apodemis spp.) holes/density. Abundance can be confused with a pest promoted by bad farm practices (monocultures for example). It would be best to deal with mammals diversity.
B8	Spiders	Expert's capacity is restricted (at least in Bulgaria and UK). Good but low expert's capacity. Needs a lot of additional laboratory work for determination of the species. Needs a lot of capacity development. It is a very interesting group to test but very few taxonomists can develop this work. It is only feasible if it is paid and promoted by the Administration as a global research.
B9	Wild bees and wasps	Given the raising importance of the ecosystem services approach, this indicator (which relates to pollination) is very relevant. Very important for the farming sustainability. They play an important role as pollinators. What more is scientific proof of their positive correlation with biodiversity (especially if considering the wild species). Bees are easier to catch and cheaper, do not need too much field work. Good but low expert's capacity. Needs a lot of additional laboratory work for determination of the species. Needs a lot of capacity development. The link to landscape structure and variety should be tested in some case study areas.
B10	Carabid beetles	Good but low expert's capacity. Needs a lot of additional laboratory work for determination of the species. Needs a lot of capacity development. It seems necessary to explain the place of carabid species in biological control.
B11	Diptera, syrphidae, hoverflies	Good but low expert's capacity. Needs a lot of additional laboratory work for determination of the species. Needs a lot of capacity development. Very useful in fruit production.
B12	Bats	Can be used only on landscape scale. Expensive indicator due to equipment used and special skills needed for identification afterwards. But worthwhile using it where national bat monitoring schemes are implemented. Bat richness may be based, not only on insect diversity, but also on insect pests due to other factors. (see mosquito outbursts)

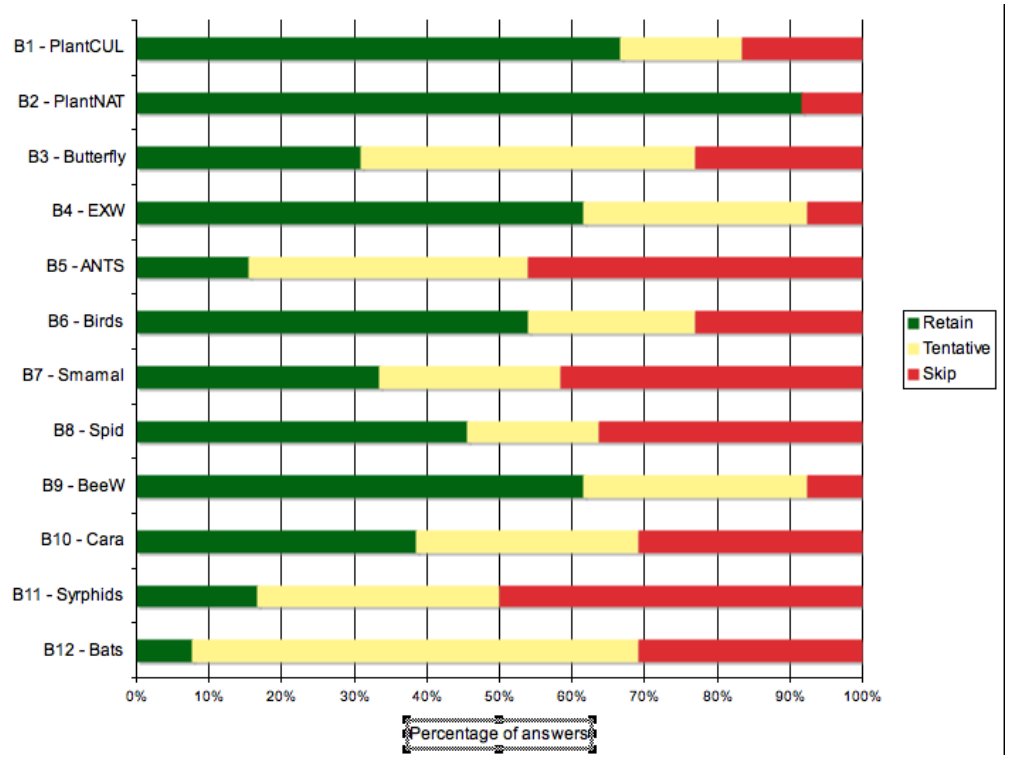

Figure 4 : SAB Global assessment of the species diversity indicators

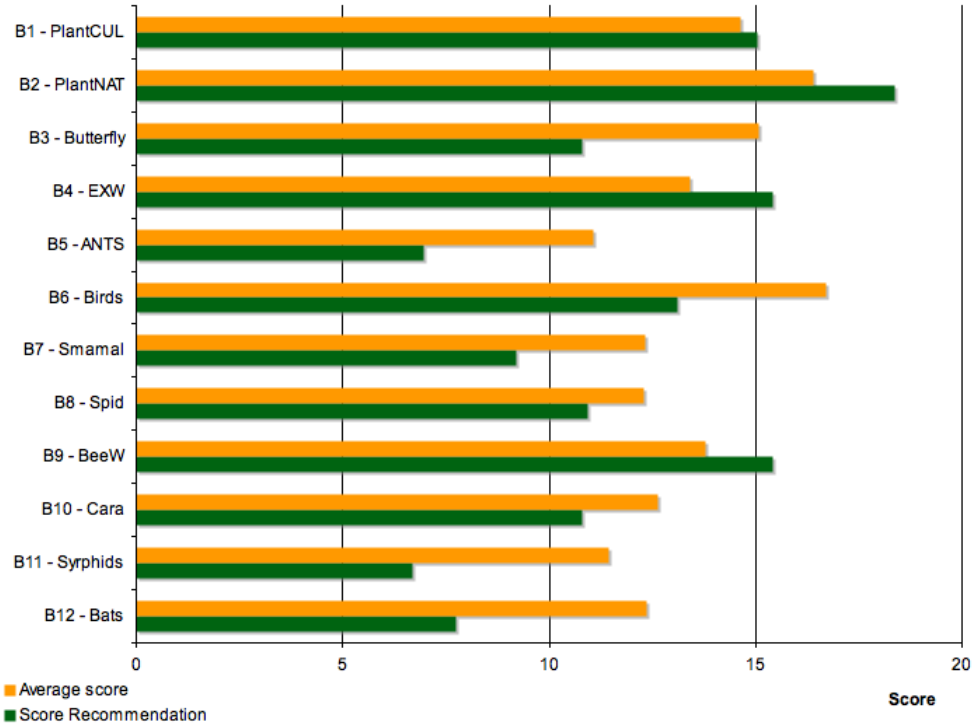

Figure 5 : SAB Global assessment of the species diversity indicators

3.3.3. Group C Habitat Diversity indicators

		Remarks
C1	Habitat Patch density	It should not be retained as single indicator. It should be part of a combined indicator on landscape features. Can be used only on landscape scale. Expensive indicator due to equipment used and special skills needed for identification afterwards. But worthwhile using it where national bat monitoring schemes are implemented. Where are the limits between semi-natural habitats and crops ? In Lower Austria there is also a method to count (number and size) of different habitats respectively landscape elements developed. This method of the "Ecopoints program" could be useful for standardisation for an European wide indicator within the BIOBIO project. Increase in habitat patch density can have very different meaning in different landscapes (fragmentation of grassland which tends to be negative or increase in landscape elements which is often positive). This criteria does not account for the "ecological value or "Ecological quality" of the habitat
C2	Habitat richness	Explain the relation with B2. Needs development of a clear definition of "habitats" used here. Take into account the state of conservation of habitats versus N2000. No clear definition for this indicator and great regional variation. To be replaced by indicator on landscape features. Much more difficult to apply to grassland systems than to arable, mixed and permanent crops. It seems necessary to take in account only the utilised agricultural area of the farm.
C3	Habitat diversity	Needs development of a clear definition of "habitats" used here. Its relevance depends very much on which indicator is selected. Shannon index, for example, is not easily understood by non experts. No clear definition for this indicator and great regional variation. To be replaced by indicator on landscape features.
C4	Number of crops in the rotation	The description is yet to be developed, and more details must be collected for the indicator to be useful, for example types of crops in a rotation (wheat on maize on wheat is not good). Needs too much data collection which makes its implementation costly and difficult. Different rotations can exist in a single farm. Integrate the % of permanent grassland. For example, short rotation in mountains but the crops account for less than 10% of the UAA. How to calculate a relevant indicator? Scoring taking into account the percentage of each crop, grouping similar crops (durum wheat and spring wheat, maize grain and silage maize, ...).
C5	Percentage area of arable land	C5 is important, however do they really describe biodiversity in order to be considered? Are there not other indicators that describe the link better? Very general and will give an overview on the farm. Very useful basic indicator. For this and other indicators the European level is very interesting, but information must be available at EU level on an appropriate reference area (landscape, 1 km, 5 km or 10 km cells). Retain only if establishing a combined indicator including C4, C5 and C6. Easy to measure as all farms record this information. Can be misleading in landscapes dominated by grasslands, permanent crops, forests etc. Also should be checked the average size of field plots (in ha).
C6	Percentage area of permanent grassland	Retain only if establishing a combined indicator including C4, C5 and C6. Easy to measure as all farms record this information. C6 is important, however do they really describe biodiversity in order to be considered? Are there not other indicators that describe the link better? Very general and will give an overview on the farm. Very useful basic indicator. The "community" pastures (outfields, common lands) should be counted as separate "farms" in the whole landscape. Only grazed areas should be counted (because usually close pastures are used instead of distant one. Usually herds don't graze further than 3 km from settlements). For these grazed pastures grazing density could be found dividing grazed area by the number of livestock in the settlement. Not enough as quality of grassland (semi natural/ heavily modified) is often even more important. Recorded in national agricultural census statistics at NUTS5 level.
C7	Percent of tree cover	C7 is important, however do they really describe biodiversity in order to be considered? Are there not other indicators that describe the link better? Very useful basic indicator. It has to be clearly defined what is crop and what is tree. Every shrub which is higher than 5 meters is considered tree. Traditional orchards and extensive fruit production systems (high-stem systems only). Indicator is good and necessary for completing the lists of habitats and landscape elements. Can be a very useful indicator of intensity and habitat quality in olive groves etc. This indicator is not related to native trees or shrubs, so it would be interesting if it is associated with another sub-indicator: Tree species diversity.

C8	Cover of shrub layer	Very useful basic indicator. The definition/description needs to be improved considerably. Use as unit the % of shrubs of all habitats respectively % of farmland area covered by shrubs. If the size of all habitats is also counted (indicator C1) it is easy to count the % of shrubs of the habitats. Can be a useful indicator of abandonment at one end and of habitat heterogenity and extensive use at the other. But needs careful interpretation according to context. Is it an indicator for increasing biodiversity or for loss of biodiversity. It depends on the situation. Erosion control is a must in the South of Europe. The maintenance of shrub and grassland coverage is very interesting in some systems (olive yards, dehesas, etc.)
C9	Availability of nitrogen, humidity	It is a very detailed indicator. A very complex indicator and therefore difficult to use, not useful. More work will be needed. If to be used then to be classified under B Species Diversity indicators. Needs adjustment (regionalization) /development. Needs a lot of capacity development which can be worthwhile after all. High costs, needs specialists and exact definition, seems rather difficult to install.
C10	Weeds in crops	Explained the relation with B1. Generally weeds could be refuges for animal species and play a role of stepping stones. It is good to motivate farmers to have them – through leaving uncultivated poor soil patches etc. What is the relation between intensification and weeds? To be replaced by a indicator on soil seedbanks, This indicator gives good information about the potential for biodiversity at local level. The higher the amount of seeds (especially the smaller ones), the easier it is to increase biodiversity by changing land use practices. Generally weeds could be refuges for animal species and play a role of stepping stones. It is good to motivate farmers to have them – by leaving uncultivated poor soil patches etc. This criterion is difficult to interpret. An organic farmer can obtain crop without weeds and let grow weeds in other places.
C11		In final not selected
C12	Vegetation composition	Very good, but only applicable to farms falling into Natura 2000 sites. Could be left and applied only to those farms which are located in the Natura 2000 sites. Could be used in those countries which have their national habitat mapping. Anyway, in relation to Art.17 of the Habitats Directive, states should have such mapping so that it could be used for this indicator. Habitat mapping is very expensive and complicated. Difficult to envisage as general tool outside Natura 2000 sites. In addition to the Habitats of Annex I of Dir 92/43/EEC habitats of national importance could be taken into consideration (Germany, Spain, …). "Black-and-white" indicator, but simple and good for a coarse level.
C13	Linear elements	The most important and valuable indicator. Must remain in any conditions. How to operate with field coppices, how to integrate woodland fringes. Good and necessary indicator in addition to C1 "Habitat patch density" and C7 "Tree cover" to complete the lists of habitats and landscape elements. To be replaced by indicator on landscape features. Would this also include culltivated margin habitat or sown strips of pollen & nectar or wild bird seed mix?
C14		In final not selected
C15	Grassland quality	No clear definition of quality of grassland; different possible definitions (ecologic vs. economic). Not applicable in Bulgaria. This kind of indicator will need the development of capacity. There is no information on production or potential of grassland. Ecological quality is not of much interest. Production potential would be interesting and it is also linked to ecological quality. Quality should be defined by the type of plants. Plant communities have to be considered. Grassland Quality: the name is not correct; because farmers will not necessarily understand what is really meant. Good. Needs capacity development. This indicator is described as "based on the structure of grasslands, on the abundance and diversity of colours of flowers and butterflies, the abundance of grasshoppers, land snails and additional arthropod groups two weeks before the first cut, the ecological quality of a meadow or pasture is assessed"), there will be enough information on floristic and faunistic biodiversity. If we can find a key for all European countries, this indicator could be the faunistic key indicator in combination with the indicators B1 "PlantCUL" and B2 "Plant"Nat" (extended to all grassland). Only few other faunistic indicators additionally necessary. Very heavy data collection and processing so unlikely to be useful for large scale monitoring though can be for monitoring based on careful sampling. To check the ecological quality of grassland swards could be the faunistic key indicator in combination with the species indicators B1 and B2 (both including all agriculturally used areas). Only few other faunistic measurements are additionally necessary (see therefore also the comment to B3).

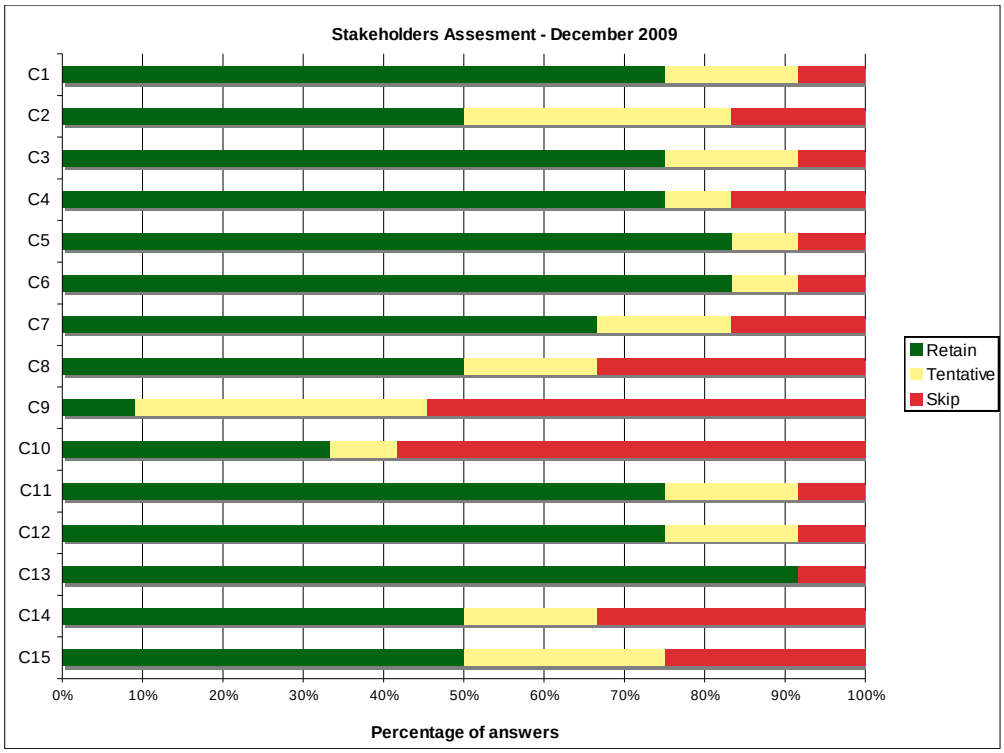

Figure 6 : SAB Global assessment of Habitat diversity indicators

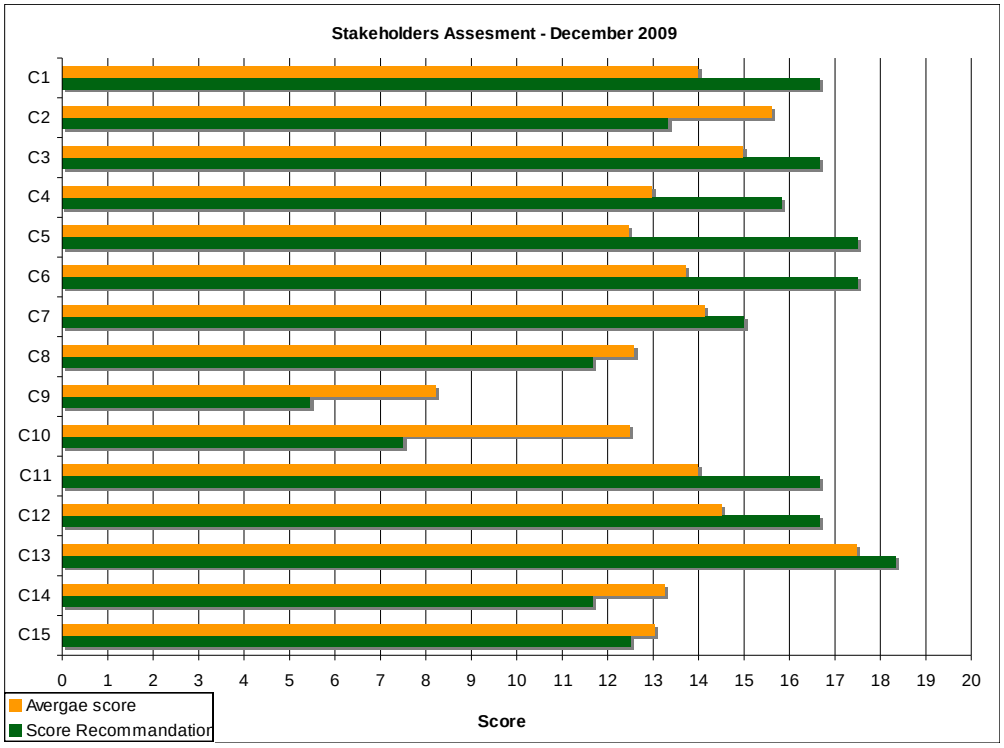

Figure 7 : SAB Global assessment of Habitat diversity indicators

3.3.4. Group D Farm Management indicators

		Remarks
D1	Diversity of enterprises	The term "enterprises at the farm" should be changed to "activities at farm level". D1 is not important at all for biodiversity. The more enterprises the higher the enterprise diversity the better it is. Good indicator. Easy to collect.
D2	Average stocking rates	Two stocking rates are to be distinguished: 1. LU/ha UAA, 2. LU/ha forage land. Very useful. Livestock Units (stocking density) per ha are a very good indicator. Should be put in relation to grassland and be considered in connection with A9. Average grazing load can hide important differences in timing, pattern, herbivorous species. Relates to environmental zones.
D3	Area of land without use of mineral fertilisers	Is allowed under European legislation. In the Fact sheets the definition is misleading. Difficult to prove. Data from farmers questionnaire are not reliable. Why only mineral fertilisers ? Some farmers can spread large amount of organic nitrogen. The indicator should be extended: 1. % of UAA without mineral-based fertiliser, 2. % of UAA not fertilised.
D4	N input	Useful to assess low input systems. Very good indicator for the degree of intensification of a farm. Should be associated to a nitrogen balance. Difficult to prove. Data from farmers' questionnaire is not reliable. Should include organic and mineral N, but also symbiotic N. Never forget when calculating the N input the amounts of N out of manure and also N brought into the system by grazing. Overall a very good indicator to characterise the intensification level of farms. N-surplus is a better indicator and it is recorded (e.g. in Nitrates Vulnerable Zones, NVZ).
D5	Input or Direct and Indirect Energy for crop production	Energy indicator (D5) has not a direct link to biodiversity. But it can describe the intensity level of the farming system. An interesting indirect criteria to assess the input. The whole system should be taken into account and not only the crops. Go to an energetic balance at farm scale. Consider if this indicator should also include all the Energy input for animal husbandry (e.g. via concentrated feed stuff) and for the future consider if this indicator should be extended to an indicator for green house gas emissions (then there should be also included CH4 emissions from animal keeping and N2O emissions out of dung). Good indirect indicator for intensity of land use.
D6	Certified as Organic	Should not be in the list. It should be the baseline for selecting the farm. Farm practises do not only depend on a certification as organic
D7	Area under agri-environment support	Is a not a good indicator at the farm scale. Some AEM are not liked to a surface. Some AEM do not have any impact on biodiversity. I am against selecting the area under AEM support as an indicator, because the AEM all over Europe are not comparable. For example in Austria (almost) all areas are under contract. But there is per se no significant relation to farmland practises or biodiversity. Coverage by AE schemes is mostly meaningless as schemes' quality, ambition and objectives are extremely variable. 100% of a region may be covered by AE commitments but this gives no real insight if these schemes are effective, controlled, etc.
D8	Intensification/ extensification	There is no clear definition of intensification and extensification. What more is there would be important differences between different regions in the definition. Is a very difficult indicator, because it has to be linked to the area. D8 could be provided by a set of indicators (D2, D3, D4, D5, D9).
D9	Pesticide use – treatment frequency indicator	If you want to address pesticides (D9, D10) you have to have the substance, if not it does not have sense to integrate it. Frequency of application is very important. Pesticides used in organic farming should be taken into account? Difficult to prove. Data from farmers' questionnaire is not reliable. What about the treatment for animals as ivermectine and seed treatment? I fear that we will not get the right information by this indicator. In my opinion the indicator D 8 (Costs for pest control) is the better indicator.
D10	Area of land without or reduced use of chemical pesticides	The basis to which this indicator relates is unlcear. It is necessary to precise "with reduced use of chemical". D10 can be provided by D9 if the farming practices are registered cropwise. We should not count the land with "reduced" application (reduced in comparison to which level ?), only the land "without pesticide use" is a good indicator.
D11	Frequency and timing of field operations	No clear link with biodiversity, many different types of field operations with different impacts on biodiversity. Likely to become less and less meaningful as more farming types are aggregated. Tillage practices are missing. Tillage: more clarity on the amount (more, less...). Application of manure (mechanical used, mowing, timing); mechanical weeding

		system? The field operations must be specified, otherwise not much use. Severely disruptive operations such as mechanical weeding and mowing should be reintroduced. Especially so as they are frequently used in low-input and organic farming and are of high risk to biodiversity. Otherwise we risk being accused of bias towards these types of farming. Some extensive and traditional farming systems include elaborated field operations, and they are considered good habitats. Other intensive systems may have less but more dangerous operations.
D12	Grazing intensity	Feeding system is missing as an indicator. Is grazing activity going to be assessed as an average? Because this can be misleading. Grazing intensity will not be seen as an average. It will be done according to the stocking density. Good indicator but seems to overlap with D2. It seems difficult to get good data on grazing per plot. So the better indicator is to count species richness on all grassland (indicator B2) in combination with the ecological quality of grassland (C15). Grazing intensity depends on the region's climate. It's difficult to compare Normandy and south of Spain.

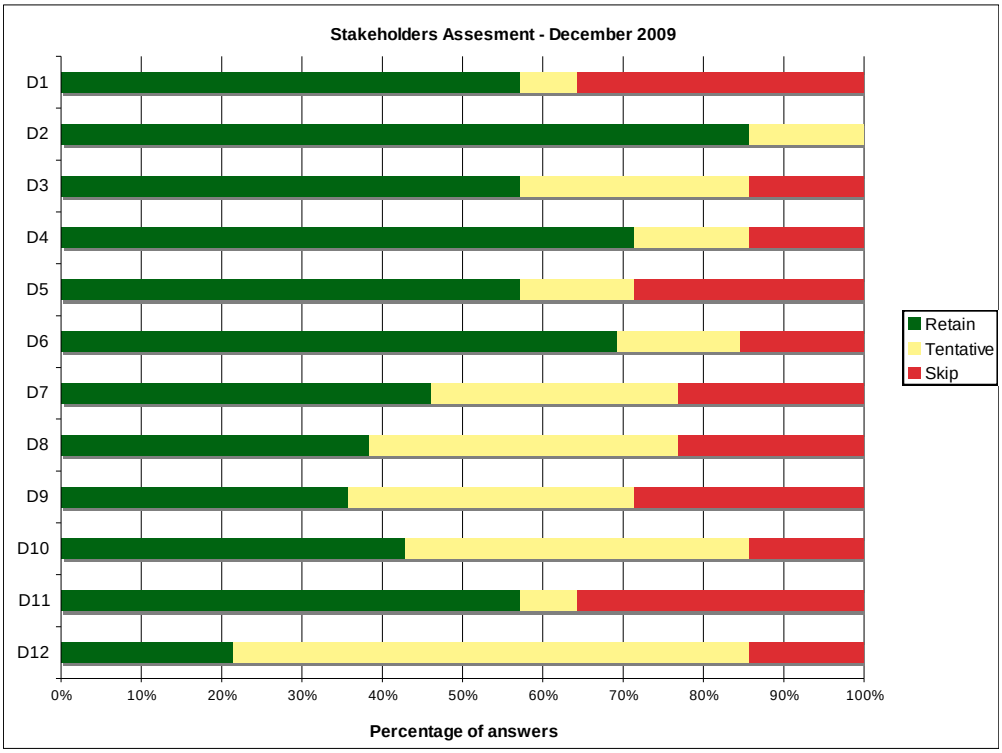

Figure 8 : SAB Global assessment of Farm management indicators

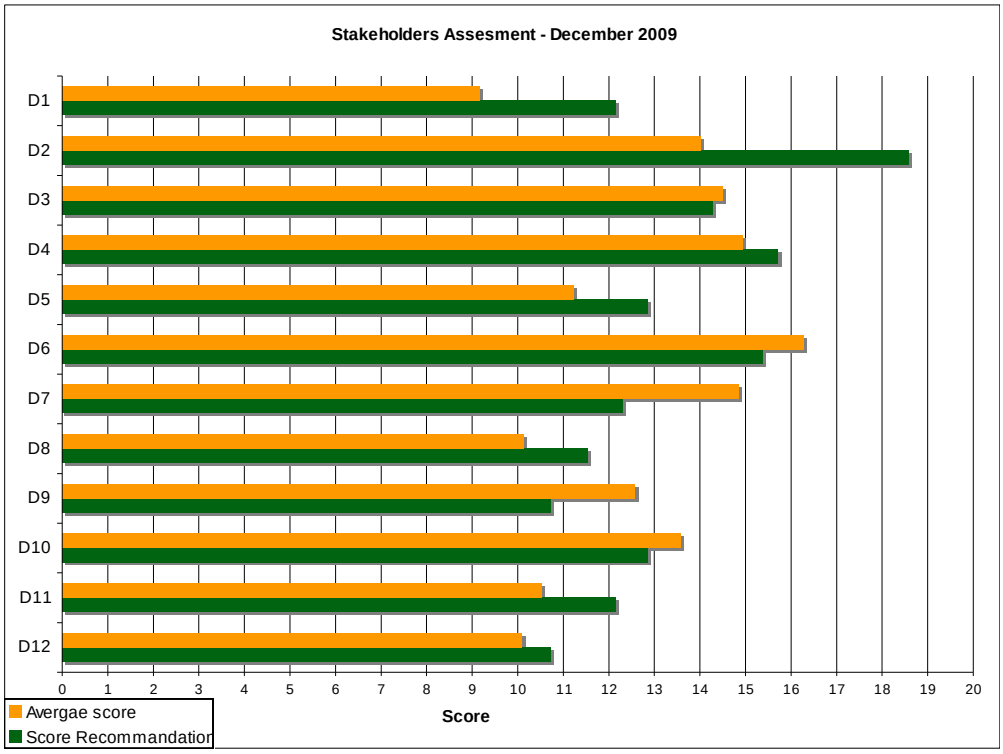

Figure 9 : SAB Global assessment of Farm management indicators

4. Appendix 1 : Example of the fact sheet form

Name of the indicator: B3 Butterfly species and populations Akronym: **BUTTERFLY**

A) Description: Counts of adult butterfly species and their individual abundance in representative habitats of each farm

Unit[1]: Number of species and relative abundance

Collection method: The method requires the setting up of a standard transect through the habitats represented on a farm, often following existing boundaries or paths. The transect walk should be of 0.5 to 1.5 hours duration at a steady pace. The route should be walked 26 weeks a year when weather conditions are benign (rules about time of day, temperature range, sunlight and rainfall must be met before the transect can be walked). Counts of butterflies are made in a 5 x 5 x 5 m box of airspace in front of the recorder for each section of the transect.

Calculation method: … Species richness and diversity derived per habitat and density of species is estimated from the 'volume' searched per habitat.

Skills required: Competency in field identification of local and national butterfly species both in flight and with wings folded when resting on vegetation or feeding on flowering plants of cultivated and semi-natural habitats.

Synergies with other indicators: The adult butterflies feed on numerous nectar producing flowers, many being territorial within specific habitats and where courtship and egg laying requires specific habitat structures along with the presence of the caterpillar food plant. Butterfly caterpillars can also be sensitive to microhabitats in which the required thermal regime accompanies the availability of a suitable food plant.

Estimated costs (labour effort required, analysis): ☐ (**) Field work or ☐ Questionnaire
If field work: Number of farm visits required per year[2]: 26
Additional lab work needed (e.g. identification of species): ☐ No ☐ Yes (which? …..)
Comparative estimated costs to other indicators of the same level[3]: Low to moderate

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[1] For species diversity indicators, indicators will be derived from the species list: species composition, species richness, specialists/generalists, threatened and emblematic species, umbrella species.

[2] 0 (information recorded on existing database or derived from postal questionnaire), 1, 2-3, 3-4, >5.

[3] Levels are genetic, species and habitat. *** high cost, ** moderate cost, * low cost.

B) Scientific criteria

*Rate as follows: *** applies fully / ** applies / * applies somewhat / - does not apply*

Biodiversity relevant: *** Scientifically sound: ** Sensitive: ** Reproducible: **

For species diversity indicators:

Taxonomy well known: Yes Standard method known and simple: Yes

At family (order) level, occurrence over a broad geographical range and breath of habitat types: Yes

At species level, specialization within a narrow habitat to detect change: Yes

Predictable, rapid, sensitive, analysable and linear response to disturbance: Understood for many species

High taxonomic and ecological diversity (many species in each system): Moderate to low species diversity in upland or montane areas

Food chain level: Primary consumers – nectar feeders

Sensitive to agricultural practices in agro-ecosystems: Yes

Indication of environmental conditions at spatial scale: … Local to national geographic relevance

Links with agricultural practices: Indirectly through management of fields (cultivation and herbicide use), field margins and semi-natural habitats (grazing intensity) affecting floral distribution and density of flowers. Direct effects through insecticide application to fields and spray drift into semi-natural habitats.

Complementary to national records/inventories[4]: ☐ No, ☐ Yes: which one? ….

[4] If two indicators have similar qualities but one of them is used in national / EU inventories, this is an argument to use the same indicator

Global scientific assessment: ☐ solid indicator, well tested; ☐ indicator works reasonably well;

☐ tentative indicator, but deserves testing

DPSIR: ☐ Pressure indicator ☐ State indicator ☐ Response indicator

Potential weaknesses, difficulties, drawbacks: Necessity to regularly repeat surveys throughout the year to encounter favourable weather and different emergence periods of species. Paucity of species and generally lower densities in northern locations and at higher altitudes. Overall numbers of species counted can be strongly influenced by weather conditions in addition to farming practices.

C) Stakeholder criteria

*Rate as follows: *** applies fully / ** applies / * applies somewhat / - does not apply*

Easy to develop and not too expensive to apply: **

Easy to use (for farm management, for assessment): *** Comprehensive and flexible: ***

Integrate emblematic species (or races, habitats): ***

Appropriated by farmers: ** Consumers: *** administration and local authorities: ***

Assesses the farmer's progress : ** Assesses the agro-environmental project progress : **

Assesses the agricultural policies (AEM, Biodiversity Action Plans, cross-compliance, …): ***

Adapted to all type of farming ☐ Yes ☐ No: which one (grazing system, arable land, …): …

Viable at ☐ field scale ☐ farm scale ☐ landscape scale ☐ European level

Takes into account functional biodiversity/ecosystem services ☐ No or

☐ Yes which one (biological control, pollination, organic matter recycling…): …

Comments (strengths and weaknesses):
A popular and charismatic insect group currently monitored in many national and international schemes (UK Butterfly Monitoring Scheme set up to monitor changes in butterfly abundance in the UK since 1976; UK BMS website). The UKBMS method has been adopted by many Butterfly Conservation bodies across Europe (Butterfly Conservation Europe website), and is second only to the Pan-European Common Bird Monitoring scheme in scale. Recently, The Helmholtz Centre for Environmental Research (UFZ website) was successful in developing butterfly monitoring schemes in Israel, Australia and China).

Recommendations: ☐ Retain ☐ Tentative ☐ Skip

Date, author (scientist): Peter DENNIS, 30 September 2009

Date, author (stakeholder): ....

Stakeholder representing[5]: ☐ Nature protection ☐ (Organic) Farming ☐ Consumers

☐ Regional / natial administration ☐ EU Commission ☐ Other: ….

[5] Tick several if you wish