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Report on the farmers' perception of biodiversity indicators associated to organic and low-input farming systems

First Version of Report

Eszter Kelemen[1], László Podmaniczky[1], Katalin Balázs[1] (editors), Jean-Philippe Choisis[2], Tiziano Gomiero[3], Maurizio Paoletti[3], Jean-Pierre Sarthou[4]

[1](SZIE) Szent Istvan University, Institute of Environmental & Landscape Management, (SZIE-KTI), Gödöllö, Hungary; [2](INRA) Institut National de la Recherche Agronomique, UMR Dynafor, Toulouse, France; [3](UP) Department of Biology, Padova University, Italy; [4](ENSAT) University of Toulouse, INP-ENSAT, Toulouse, France.

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Executive summary

1. A multi-criteria method, the KIPA technique, was used to discover the farmers' perceptions on biodiversity indicators for organic and low-input farming. The aim of the research was to test if laymen indicators are more preferred by farmers than scientific ones. The research also aimed at analysing similarities in the list of preferred and rejected indicators of farmers in the participating countries.
2. Eight indicators were selected for the KIPA analysis. Four laymen indicators were derived from the focus group discussions carried out in Task 3.2. (Crops and breeds in production; Emblematic species; Number of patches; Animal-plant relations). The four scientific indicators were chosen from the list of indicators reviewed in D2.1 in such a way that similar aspects of biodiversity would be covered by them as by the laymen indicators (Cultivars and landraces diversity; Keystone species; Landscape heterogeneity; Food-web structure). The above indicators were selected in order to represent the different levels of biodiversity: genetic, species, habitat diversity and the complexity approach to diversity (this latter one was emphasised during the focus group discussions).
3. Farmers participating in the BioBio project in three European case study areas (in France, Hungary and Italy) were contacted to provide data (total number of respondents was 52). A questionnaire format was used to ask farmers to compare eight selected biodiversity indicators (four laymen indicators and four scientific indicators). During the pairwise comparison farmers always had to choose the biodiversity indicator which they considered to be more important.
4. In France and Hungary the most preferred indicator by farmers was the "Animal-plant relationship" indicator, which was given the second place in the Italian sample after the indicator "Heterogeneity of the landscape". The "Animal-plant relationship" indicator referred to the complex nature of biodiversity. This indicator was derived from the focus group discussions organized in Task 3.4 and was phrased in laymen's language.
5. The participating countries were less homogeneous concerning the least preferred indicator. In France the "Emblematic species", in Hungary the "Crops and breeds in production", while in Italy the "Cultivars and landraces indicator" was the least preferred

by farmers. Neglecting the genetic level of biodiversity is in line with the focus group results where genetic diversity was hardly mentioned by participants.

6. Results of the KIPA analysis cannot reinforce our initial hypothesis that farmers are more familiar and thus more willing to choose those biodiversity indicators which are phrased in their (less scientific) language.
7. Results showed that the pairwise comparison of biodiversity indicators was a difficult task to participating farmers. Although the exercise itself was clear for them, interpreting the indicators was not at all evident, which suggest that the topic itself (the comparison of indicators) was unfamiliar and too abstract for them. Rather scientific communities should have been asked to rank the different indicators for biodiversity.

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1. Introduction

Biodiversity indicators are needed to assess the status of biodiversity and enable the comparison of the environmental performance of different farming systems such as organic, low-input and conventional farming. The core aim of the BioBio project is to select and test an appropriate set of biodiversity indicators. To reach this aim, the project mobilizes scientific knowledge from different sources, but also acknowledges that ***farmers themselves may have special attitudes and knowledge*** (local, ecological knowledge) ***concerning biodiversity and its benefits for farming***.

In Task 3.4 we developed a group based methodology to discover the attitudes and values farmers attach to biodiversity, and carried out a focus group study in four countries (France, Hungary, Italy and Uganda) to understand their way of thinking about biodiversity issues (see Deliverable 3.4). The results (Kelemen et al. 2011) showed that ***beside species and habitat diversity, farmers also acknowledged the inherent complexity of nature when they talk about biodiversity***. Biodiversity was mainly described as part of their everyday life and farming activity instead of a distinct concept expressed with scientific terms. Thus the joint conceptualization of biodiversity (drawing concept maps together) was extremely useful to understand how farmers observe, interpret and value this phenomenon.

Qualitative analysis methods were applied to discover the richness of farmers' understanding and attitudes towards biodiversity, and a wide range of values (social-ethical, ecologic and economic) was derived from the material. With the help of the qualitative analysis, we could identify ***how farmers "describe" and "measure" the biodiversity presented on their farm and in the surroundings***, which is a perfect source to define ***laymen indicators*** for biodiversity (indicators which are described with easily understandable expressions and which represent the interpretation of farmers).

In Task 4.5 we ***test these laymen indicators against scientific indicators for biodiversity*** with the so-called KIPA technique, which ranks factors of a complex system that cannot be measured on a simple quantitative basis. ***Qualitative biodiversity indicators identified with respect to a given biodiversity benefit could*** thus ***be assessed by local stakeholders with the help of the KIPA technique***, the result of which can be interpreted on an aggregated level.

The two major goals to achieve in Task 4.5 are the following:

1. Test the ***importance of different biodiversity indicators among farmers*** (covering all the three levels of biodiversity with an addition of the complex, global nature of biodiversity).
2. Compare scientific and laymen indicators relating to the same level of biodiversity in terms of their relative importance to farmers.

Deliverable 4.4 has five chapters. The introduction is followed by Chapter 2 containing the detailed explanation of the KIPA technique and its mathematical background. Chapter 3 gives a methodological overview: the initial hypothesis is described, then the sample of farmers and the method of data collection are presented. Chapter 4 details the analysis and interpretation of country specific data and the results of the aggregated analysis. The final chapter is divided into two distinct parts: the first part answers the a priori hypothesis defined in the preparatory phase, while the second part draws conclusions from the critical review of the methodology.

2. The KIPA technique

Multi-criteria analysis is often used in sustainability science when conflicting aspects of a decision have to be taken into account (Munda 2000, Funtowicz et al. 2002). As most of our environmental decisions are characterised by high (and even growing) uncertainty and complexity, multi-criteria analysis and decision supporting systems are getting more and more popular, especially since the Millennium. Practical applications of multi-criteria analysis range from forest management (Mendoza and Prabhu 2003, Sheppard and Meitner 2005) to renewable energy planning (Pohekar and Ramachandran 2004) or urban management (Munda 2006). In this research we use an early approach to multi-criteria analysis developed by Hungarian scientists: the KIPA technique (Kindler and Papp 1977).

2.1. The KIPA method for the assessment of biodiversity

The KIPA technique (Kindler and Papp 1977) provides an excellent alternative to mainstream neoclassical assessment methods thanks to its four major principles:

1) the criteria of the assessment are complete,
2) the criteria of the assessment are measured in ordinary scale,
3) the technique is able to determine the highest acceptable level of negative consequences of the decision (disqualification index),
4) the optimal advantages/drawbacks combination (Pareto optimum) is identified.

The method will be presented in the following with the help of an example. In this example we are looking for the answer to the question, **what rank of importance can be established among environmental condition categories and their combinations**. The examined categories are:

- **Breeds in production,**
- **Keystone species,**
- **Landscape heterogeneity**

Different characteristics of a certain region determine the relative importance of environmental conditions. In order to enable the measurement of the functional ability of a given region, all functions (tasks) are described by a group of specific features (variables). The above listed categories can be called evaluation variables because their ranking is based on different characteristics.

Evaluation of the relative importance of each variable is the first step of the presented method. In order to evaluate the relative importance of variables on the basis of expert personal opinions, Thurston's conjugate comparison and the Guilford method have been chosen (Thurstone 1927, Guilford 1936).

In our example eight experts have been involved to evaluate the function of nature protection.

Thurstone's conjugate comparison

Thurstone's conjugate comparison means that all combinations of evaluation variables are presented in a table, where pairs of each variable are listed in the first two columns and the 3rd and 4th columns are left for decision-making (Table 1). The number of pair-combinations is calculated by using the relevant combinatorial formula. Pairs obtained are listed in rows, one randomly after the other. For each pair of variables, the involved experts have to determine which variable is more important for the given objective.

In each case of combination the experts must choose the preferred factor concerning the question. Table 1 shows the decisions of the first expert:

Table 1: Thurston's conjugate comparison table of the first expert

In your opinion, which indicator is more important to measure the biological diversity of your farm? *Please compare the indicators listed in pairs in the table below, and choose always the indicator which you think is more important to measure the biological diversity present on your farm. Please tick or put an "X" in the column of the preferred indicator*			
A	**B**	**A**	**B**
Breeds in production	**Keystone species**	**x**	
Breeds in production	**Landscape heterogeneity**		**x**
Keystone species	**Landscape heterogeneity**		**x**

Guilford-method

In the next step the decisions of experts are processed into the so called ***individual preference matrix*** (IPM). The IPM shows the opinion of one expert. As there are eight experts in our example we have to create eight IPM. The individual preference matrix of the first expert as processed from Table 1 is as follows:

Table 2: The individual preference matrix of the first expert[1]

	Breeds in production	**Keystone species**	**Landscape heterogeneity**	**A**	**A^2**
Breeds in production		1	1	1	1
Keystone species				0	0
Landscape heterogeneity	1	1		2	4
			Total:	**3**	**5**

1: Preferred variables are in the rows, whereas deferred ones occupy the columns. It means that we have to read the Table from left (line) to right (column). I.e. Landscape heterogeneity is preferred over Breeds and Keystone species and Breeds is preferred over Keystone spices.

The IPM demonstrates the opinion of one expert, where the results of the paired comparison of variables are converted into an individual matrix of the expert. Names (or signs) of rows and columns of the preference matrix correspond to the names (or signs) of evaluation variables of Table 1. The following example describes how the results of the comparison are converted into a preference matrix.

In Thurstone's comparison table, as shown in Table 1, "**Landscape heterogeneity**" as a variable was preferred to "**Breeds in production**". This is shown in the preference matrix by putting number '1' into the row of "**Breeds in production**", where it meets the column of "**Landscape heterogeneity**" (see Table 2).

All other choices are converted into the table as described above. Then for each row, we sum up the 1-s so as to find out how often a given evaluation variable was chosen. This is called the ***frequency of preference*** and is indicated by **„A"**. Once all **'A'** values are known, one can determine the level of priority given to each variable. High values of **'A'** indicate a high preference.

In our example, which is evaluating farm related biodiversity variables, **Landscape heterogeneity** proved to be the most important variable. It is followed by "**Breeds in production**", and the expert ranked "**Keystone species**" as being the least important evaluation variable in this issue.

The individual preference matrix is also a tool to calculate the consistence of an expert in his/her opinion. The result is the 'K' index that expresses the ***reliability of the expert's opinion in percentiles***. Experts may form inconsistent decisions[1], because they have to ignore all their previous and future decisions during each pairwise comparison of the evaluation variables. The following formula calculates the actual number of inconsistent decisions (D) and the ***consistence index*** (K):

$$\mathbf{D = (\sum A^2_{max} - \sum A^2)/2}$$

$$\mathbf{K = (1 - D/D_{max})*100}$$

where:

D	Number of inconsistent decisions
D_{max}	Maximum of inconsistent decisions (based on N from Auxiliary table No 1)
A^2_{max}	Maximum value of A^2 (based on N from the Auxiliary table No 1)

As an example we show the calculation of consistence index for the first expert.

N	3
$\sum A^2$	5
A^2_{max}	4
D_{max}	1

$$\mathbf{D = (5-5)/2 = 0}$$

$$\mathbf{K = (1-0/1)*100 = 100}$$

In this case the number of inconsistent decisions (D) equals zero, which means that all decisions are consistent and that the consistence index of that expert (K) is 100%.

K indicates the lower limit of consistence of an expert (generally it is 80-90%), under which the decisions of that expert cannot be taken into consideration.

[1] A decision is inconsistent when factor 'A' is preferred to factor 'B' and factor 'B' is preferred to factor 'C', and at the same time, factor 'C' is preferred to factor 'A'.

The next step is the ***combined consideration of all experts*** when in each evaluation criterion class the frequency of preference of each expert is summed up. Table 3 shows the preferences of all the eight experts. On the basis of these one can determine the weight of each class.

Table 3: Group preference matrix

Variables / experts	**Breeds in production**	**Keystone species**	**Landscape heterogenety**
Expert – 1	1	0	2
Expert – 2	1	1	1
Expert – 3	1	0	2
Expert – 4	1	0	2
Expert – 5	1	0	2
Expert – 6	1	2	0
Expert – 7	2	0	1
Expert – 8	0	1	2
∑a (A_n)	8	4	12
Rank	2	3	1
P [%]	50	33	67
U	0	-0,44	0,44
Weight Percentiles	**50**	**0**	**100**
Simplified weight	**3**	**1**	**5**

P[%] is calculated according to the following formula based on Σa:

$$\mathbf{P = \{(\sum a + s/2)/s*n\} *100}$$

where:

∑a	Aggregated preference rate
S	Number of experts
N	Number of variables

The **U** value can be taken on the basis of **P**% by the following equation:

$$\mathbf{U = 9E\text{-}06P^3 - 0.00135P^2 + 0.0871P - 2.1109}$$

Weight percentiles (S) are obtainable with the following formula, called the Guilford-method:

$$\mathbf{S_X = [U_x\text{-}(U_{min})/U_{max}\text{-}(U_{min})] *100}$$

In our example the **„Landscape heterogeneity”** class got 100, the ***„Breeds in production”*** class got 50, and the **„Keystone species”** class got 0 weight percentiles.

The previously determined weights can be simplified so that we divide the 0-100 scale into equal intervals (0-20, 21-40, 41-60, 61-80, 81-100). Each value on the scale corresponds to a numerical value. If we have a five-grade vocal scale (for example: excellent, good, fair, poor, bad) then these correspond to grades from 5 to 1.

Returning to our example, **„Landscape heterogeneity”** would rank high (5), **„Breeds in production”** would rank medium (3) and **„Keystone species”** would rank low (1). So for our example, the question „In your opinion, which indicator is the more important to measure the biological diversity of your farm?, the opinions of 8 experts yielded the following answer: ***the most important indicator is the „Landscape heterogeneity“.***

3. Data collection

3.1. The hypothesis and the indicators compared

The focus group study (D 3.4) reinforced that ***farmers*** – being either organic or conventional ones – ***have a complex understanding of biodiversity***, although their knowledge is quite heterogeneous. During the focus group discussions we also realized that farmers enjoyed the brainstorming and concept mapping exercise because they could conceptualize this inherently scientific term with their own words. Based on this we could suppose that scientific indicators for biodiversity have less meaning to farmers than those laymen indicators which are expressed with their own words. This is important because ***the better understanding of the specific meaning of biodiversity indicators may increase the effectiveness of their use in farm management.*** Thus, we formulated the following hypothesis as the first step of Task 4.5:

> Hypothesis (KIPA): Farmers consider those biodiversity indicators more important which are expressed in "laymen's language" and reflect their local knowledge.

In Task 4.5 we test this hypothesis with the KIPA methodology by ***comparing laymen indicators derived from the focus groups and expert indicators developed in BioBio WP2***. For the pairwise comparison of laymen indicators and scientific indicators we choose ***one scientific indicator for each level of biodiversity (genes, species and habitat)*** and another one from the focus group study.

Possible laymen indicators were derived from the qualitative analysis of the focus groups. Since no indicators were named directly by farmers during the focus groups, we started from ***how they talked about the different levels of biodiversity*** – what words and expressions they used and how they differentiated among genetic, species and habitat diversity –, and formulated both a short name and a more detailed description for each indicator. Furthermore, because ***farmers heavily addressed*** the complexity of natural systems and the ***mutual relationship between natural processes and their farming practices*** during the focus groups, we decided to include a ***fourth category of indicators*** in the comparison – "biodiversity interactions" – to cover this issue.

Scientific indicators were chosen from D2.1 where the proposed set of direct indicators for biodiversity was explained in detail. From the detailed list of D2.1 we tried to choose those ***scientific indicators which fit best to our laymen indicators*** (that is, where the divergence of the meaning/content of the laymen and scientific indicator is the smallest). The list of indicators prepared for the pairwise comparison was discussed among partners in an iterative way until we reached consensus in both the short name and the detailed description of each indicator. This process resulted in the following list of indicators (at the end of the description of each indicator the abbreviation SCI refers to scientific, while LM refers to laymen indicator).

Table 4: Scientific and laymen indicators used for pairwise comparison

Group	Indicator short name	Description
Genetic diversity	Cultivars and landraces diversity	The number and amount of different landraces / cultivars on the farm. (SCI)
	Crops and breeds in production	The presence of various crops and breeds on your farm which are brought into production. (LM)
Species diversity	Keystone species	The presence of keystone species on your farm. A keystone species can be both animal and plant species that has a disproportionate effect on its environment because it plays a critical role in maintaining the structure of the ecosystem. (SCI)
	Emblematic species	The presence of emblematic animal or plant species on your farm, which are locally important and well-known, but becoming rare or endangered. (LM)
Habitat diversity	Landscape heterogeneity	Heterogeneity of the landscape – the number of mosaics within your farm and the variety of their shape, size, surface, border etc. (SCI)
	Number of patches	The presence of various different patches – e.g. mosaics of grassland, arable land, bushes or woody vegetation etc. – on your farm. (LM)
Biodiversity interactions	Food-web structure	The complexity of the food-web structure of plants and animals living on your farm (that is: the relationship between primary producers, herbivores, carnivores and decomposers). (SCI)
	Animal-plant relations	The interdependencies (mutual relationships) between different species – plants and animals – present on your farm. (LM)

3.2. The method of data collection

Data collection was organised in a questionnaire format. The questionnaire was divided into two parts: in the first part we ***described the context of the exercise***, listed the indicators and provided explanation for each indicator, while in the second part we ***posed the key question*** (In your opinion, which indicator is the more important to measure the biological diversity of your farm?) with a short explanation of the task and then listed the indicators in a pairwise comparison format. Thus, data providers could ***easily go through the comparison***, choosing the more important one in each row of the comparative table (see the full questionnaire in Annex 1). Before data gathering the questionnaire was translated into native languages and was checked once more if the wording was appropriate.

In each participating country ***farmers were first approached through a phone call*** to ask for their help and offered ***two options for filling in the questionnaires: either personally via e-mail (normal mail), or in a face-to-face interview*** where a researcher could help to interpret the questionnaire.

Only a small proportion of questionnaires was filled in personally and sent back via mail, due to two major reasons. First of all, data gathering was scheduled to late summer which is a high season for farm works (harvesting), thus farmers did not have enough time to think over the questionnaire. Second, some farmers indicated already during the second round of phone calls and then again during the face-to-face interviews, that they found it difficult and sometimes boring to fill in the questionnaire, thus in most cases the help of researchers was needed.

Both the discussions with farmers after the face-to-face interviews (done in Hungary) and the consistency checks (in Italy we interviewed also personally some of those farmers who had already filled in the questionnaires independently and checked for differences) reinforced that the ***face-to-face questioning helped to avoid misunderstanding*** and probably ***increased the reliability of data***. Nevertheless, ***for most of the farmers it was still a difficult and artificial (and thus sometimes boring) exercise to interpret the questionnaire*** and choose between the indicators. In the second part of the concluding chapter we discuss these methodological difficulties and the possible solutions more in detail.

Data collected through either oral interviews or mail were processed and the analysis was prepared by a ***computerized on-line system for data preparation and analyses for KIPA***. The main steps of data processing and analysis (which followed the logical structure described above) are presented in Annex 2 through a series of print screen shots.

3.3. The sample of farmers

The questionnaire was translated into three native languages and was distributed in the following case study areas: Midi-Pyrénées (France), Homokhátság (Hungary) and Veneto (Italy).

Although in the focus group research there was also a Ugandan case study, we decided not to include it in the KIPA exercise since the Ugandan focus group results were highly different from the European results mainly due to different socio-economic and cultural background. Originally we also planned to carry out this exercise in the Welsh case study area, but due to time and resource constraints, and because the focus groups were also relinquished there, the idea was skipped.

In each of the participating case study areas only BioBio farmers (whose farm were studied in detail) were asked to fill in the questionnaires. The arguments behind this decision are the following: 1) farmers' lack of time because of high season of farm works, 2) relatively similar level of existing experiences with biodiversity research within the BioBio group (but very heterogeneous knowledge and attitudes outside of this group), and 3) high refusal ratio expected among non-BioBio farmers. The total number of data providers was 52 and Table 5 shows its distribution in the participating countries.

Table 5: The sample of BioBio farmers

	France	Hungary	Italy	Total
Organic	8	9	9	26
Conventional	8	9	9	26
Total	16	18	18	52

4. Data analysis

4.1. Country specific results

Country specific results of the KIPA exercise show which indicators are the most important for the farmers in the given case study area, and which indicators seem less important for them.

French data (Table 6) suggest that the ***indicator referring to the animal-plant relations within the farm is the most preferred***: this indicator was chosen in each comparison regardless of the other indicator placed as its pair in the comparison. The second most preferred indicator by the French farmers was the '***Cultivars and landraces diversity***' indicator.

Table 6: Weight percentages of indicators in the French case study area

ID	Name	Weight percentage
1	Cultivars and landraces diversity (SCI)	73,9
2	Crops and breeds in production (LM)	4,4
3	Keystone species (SCI)	38,3
4	Emblematic species (LM)	0
5	Landscape heterogeneity (SCI)	33,9
6	Number of patches (LM)	27
7	Food-web structure (SCI)	22,6
8	Animal-plant relations (LM)	100

It is interesting to see that two indicators - 'Emblematic species' and 'Crops and breeds in production' - were hardly ever chosen, while all the others were more or less indifferent (they were almost as many times chosen as neglected in the comparisons).

Regarding our initial hypothesis, although the most preferred indicator is a laymen indicator, the second most preferred is a scientific one and the two least preferred are laymen indicators again. Thus, the above information favours the rejection of the hypothesis.

Hungarian data (see Table 7) is quite parallel with the French results. Here ***the most preferred indicator*** is again the one which ***refers to the animal-plant relations within the farm***. The second most preferred is also 'Cultivars and landraces diversity', with almost the same weight, while the least preferred is the 'Crops and breeds in production'. However, there are two more indicators which were more often chosen than rejected, their weight percentage being similar. These are the 'Number of patches' and the 'Food-web structure' indicators. The indicators referring to 'Emblematic species' and 'Landscape heterogeneity' were more or less neutral for the farmers, while the 'Keystone species' indicator was less preferred.

Among the most preferred four indicators three are scientific ones, only one laymen indicator (although the most popular one) is in the top four. As for the French results, ***there is no evident relationship between the choices of the farmers and the phrasing of the indicators***.

Table 7: Weight percentages of indicators in the Hungarian case study area

ID	Name	Weight percentage
1	Cultivars and landraces diversity (SCI)	72,7
2	Crops and breeds in production (LM)	0
3	Keystone species (SCI)	29,8
4	Emblematic species (LM)	53,7
5	Landscape heterogeneity (SCI)	56,2
6	Number of patches (LM)	72,7
7	Food-web structure (SCI)	70,3
8	Animal-plant relations (LM)	100

Italian farmers (see Table 8) found '***Landscape heterogeneity' the most important indicator***. This indicator was preferred in each comparison against any other indicator. The second most preferred indicator was the one referring to the animal-plant relations, which is in line with the first choice of both the French and the Hungarian farmers.

Table 8: Weight percentages of indicators in the Italian case study area

ID	Name	Weight percentage
1	Cultivars and landraces diversity	0
2	Crops and breeds in production	15,3
3	Keystone species	61,1
4	Emblematic species	43,1
5	Landscape heterogeneity	100
6	Number of patches	50
7	Food-web structure	45,8
8	Animal-plant relations	84,7

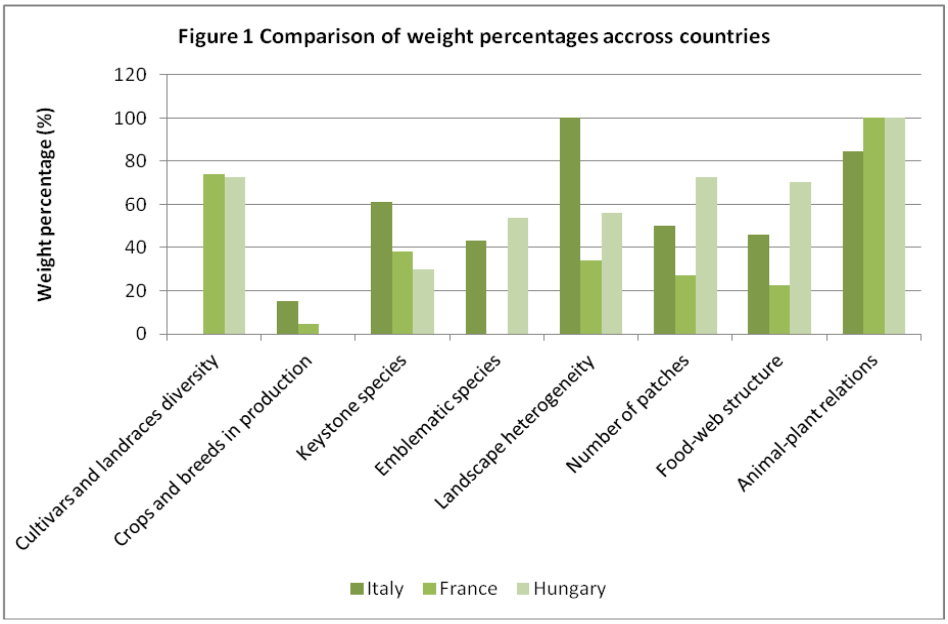
Here the two least preferred indicators are those referring to genetic diversity. While the 'Crops and breeds in production' indicator was also often rejected by the French and Hungarian farmers, the 'Cultivars and landraces diversity' indicator was among the most important ones in the corresponding countries.

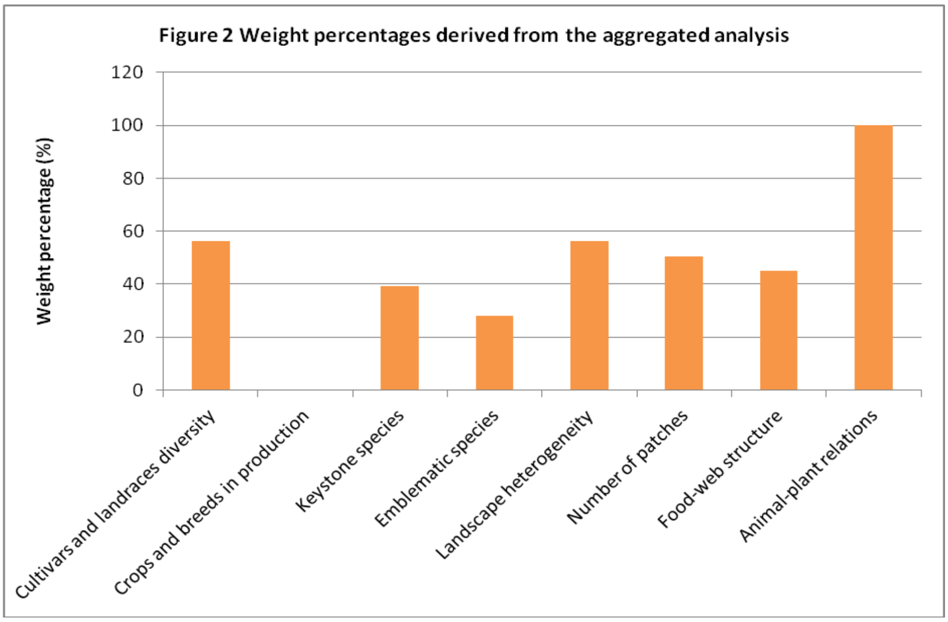
This difference may be traced back to ***different farming structures***: in arable crop production and animal husbandry it is easier to maintain a larger variety of different crops and breeds, and perhaps it is also easier to experience the positive effects of landraces diversity e.g. in the stability of yields or in the resistance against pests, but wine producing usually requires a standard quality and thus it is not so evident to maintain a large pool of different landraces. The four remaining indicators diffuse around the 50%, which means that they were rather neutral for farmers. The Italian case also reinforces that ***there is no visible relationship between the farmers' preferences and the laymen or scientific framing of indicators:*** both among the most and least preferred indicators there is one laymen and one scientific indicator.

The country-specific analysis suggests that farmers' choices vary across countries even if there are a few similar patterns in their ranking. The specific environmental context, the production system, the general agricultural situation may be all influencing factors which determine the relevance of certain biodiversity indicators in certain context. This warns us that looking for a set of biodiversity indicators which is appropriate and easily adaptable all over Europe may lead to miss local-regional characteristics.

4.2. Results of the aggregated analysis

Beside analysing and comparing the country specific data, the ***aggregated data analysis*** of the KIPA questionnaires ***provides a further possibility to check the consistency of results among countries.*** Figure 1 gives a graphic illustration of how the weight percentages of different indicators were shaped in the case study areas, while Figure 2 illustrates the weight percentages derived from the aggregated analysis.





The key messages of the two figures is that ***the most important biodiversity indicator for farmers at the general level is the 'Animal-plant relations',*** while the least important indicator is the 'Crops and breeds in production'. The aggregated analysis shows that the majority of other indicators diffuse around the middle, which is either because there was relatively high variation among the countries (e.g. in case of the cultivars and landraces diversity or the landscape heterogeneity indicators) or because farmers in each country placed that given indicator into the middle (e.g. keystone species or number of patches where the variance is relatively small). This reflects that farmers are mostly interested in the functions of biodiversity, i.e. how wild species interact with their crop (directly and indirectly) and thus affect production through, for instance, enhancing pest management.

Other biodiversity indicators seem less characteristic for farmers, either because there are large differences within the sample or because these indicators seem neutral to farmers. The source of this "neutrality" may be on the one hand the lack of significance of these indicators from the point of view of the farm (e.g. keystone species or the number of patches may be regarded as having no real impact on the farm's performance), and on the other hand the lack of knowledge of farmers (perhaps it is not clear for farmers how to measure and observe these manifestations of biodiversity). It is also important to see that the ***'Crops and breeds in production indicator' is the least popular,*** while the other genetic diversity indicator (cultivars and landraces diversity) is much relevant (and especially important for the French and Hungarian farmers). This may suggest that ***farmers hardly identify biological diversity with the conscious diversification of their farming structure*** (the variability of the crops and breeds they bring into production); ***instead they link it to more "natural" indicators which less directly depend on farming decisions*** or which are rooted in the traditions. However, we should acknowledge that the specificities of the studied farm types may also contribute to this result. For instance, vineyards are long term crops and only a few varieties can optimize the investment of farmers in any areas. Therefore, vine growers may have a limited choice when they decide about the crops and breeds in production (at least in our Italian case study).

5. Conclusions

5.1. Hypothesis testing

Our initial hypothesis was that farmers are more familiar with those indicators of biodiversity which are framed in laymen's language, thus they are more willing to choose these indicators if they have the option of choosing between a scientific and a laymen indicator. As we could see from the data analysis, ***there was no clear relationship between farmers' preferences and the phrasing of the indicator in any of the participating countries***. Laymen indicators could be found both among the most preferred indicators and the least preferred ones.

The ***different levels of biodiversity seemed to have more explanatory power than the used language***: the complex approach to biodiversity was important in each country, while at least one of the genetic biodiversity indicators was among the least preferred ones. This ***echoes the results of the focus group analysis***. In D3.4 we found that in each group, and especially among organic farmers, ***biodiversity was understood in a complex and holistic way referring to the mutual relationship between plants and animals which maintains life***. On the other hand, ***genetic diversity was hardly ever mentioned*** during the focus groups, and if it was mentioned at all, farmers referred to the valuable gene pool of traditional land races and breeds which are part of their cultural heritage.

Concerning the hypothesis testing we have to admit that ***the lack of reinforced relationship may be also the result of some methodological challenges.*** On the one hand, the KIPA methodology follows the logic of pairwise comparison where each alternative is compared to all the others. This means that not only laymen and scientific indicators were compared, but ***there were comparisons between laymen-laymen and scientific-scientific indicators as well***. The methodology thus creates a general sequence of indicators, where indicators are ranked by their importance and not by their familiarity or understandability. The rank of laymen indicators within this general sequence provides information on farmers' choices, but it cannot clearly explain why farmers chose a given indicator against the others. On the other hand, in each case study area the interviewers were asked to be as clear as possible when they explained the meaning of the listed indicators to farmers in order to enhance farmers' understanding of the exercise and to make their choices more consistent. However, the detailed descriptions given for each indicator could obscure the differences between laymen and scientific indicators (especially because the indicators were chosen to represent the same phenomena at each level of biodiversity). Thus, the hypothesis may have been properly tested, if the farmers were not supplied with any additional information apart from the list of indicators attached to the questionnaire. But in this case we would have risked that they did not understand exactly the entities they were asked to rank.

5.2. Methodological implications

As we already indicated in the methodological part (Chapter 3.2) ***farmers found the questionnaire difficult to fill in***, even if personal support was provided by scientists, which raises the question if the results are reliable. Our doubts are clearly indicated by the Italian case, where we had the possibility to cross-check some of the questionnaires. Here, some of the questionnaires were sent back via mail, but after receiving them a face-to-face interview was conducted where the questionnaire was repeated. About 30% of the answers differed if we compare the personally filled-in questionnaires and those which were completed during the face-to-face interviews with the same farmers. In a case where the questionnaire was filled in by both the farm owner and his agronomist the divergence of choices reached 50%. In the Hungarian case, ***most of the farmers asked directly for the face-to-face interviews after receiving the questionnaire***, because they could not understand the task. In one case the farmer explained that he had no clue about the indicators and especially about the comparison of indicators, even if we provided a clear description of indicators for farmers. This and the discussions after filling in the questionnaires reinforced that ***comparing biodiversity indicators*** (which are not used in the daily routine of farming) ***is an abstract and unfamiliar task for farmers***, which is often boring for them (as it was reported by the French team). The following implications can be drawn from these experiences:

(1) Farmers often provide "***fluctuating" answers***, so it is hard to consider their answers fixed and reliable. They seem to have ***no a priori preferences about biodiversity indicators***; rather they form their preferences right on the spot. Moreover, their preference formation may be ***influenced by several uncontrolled factors*** (e.g. the specific environmental context, the production system, the time a farmer allocated for filling in the questionnaires, how clear the description was, and what has happened on the farm in the previous days. etc.).

(2) Different people working in the same farm (e.g. the agronomist and the farmer) may provide very different answers, which shows that ***preferences are*** less ***dependent*** on the ecological circumstances but more ***on the personal attitudes and knowledge of the respondent***. This underlines the importance of conscious and precisely planned sampling.

(3) Agricultural experts working on the farms (e.g. technicians, agronomists) seem to be a bit more consistent in their answers than farmers themselves (reinforced by the Italian tests). The reason for this may be that experts may have a more precise idea of what is important to check and what to study.

To overcome these difficulties – or rather to understand more of the above mentioned challenges of preference formation and rational choice – it would be interesting to repeat the KIPA exercise and check whether there are some indicators which remain constantly important (or neglected). The consistency in the ranking would indicate that farmers have a stable preference and a deeper understanding of those indicators, while the always fluctuating indicators would refer to larger uncertainty in the choices. It would be also useful to extend the sample and involve also scientists in the exercise to check whether they have more established preferences.

6. References

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7. Annexes

7.1. Annex_1: The KIPA questionnaire

Project no. 227161

BIOBIO

Indicators for biodiversity in organic and low-input farming systems

Thematic Priority: Food, Agriculture and Fisheries and Biotechnology

Funding scheme: KBBE-2008-1-2-01

Assessment of biodiversity indicators

with the KIPA method

in 4 BIOBIO Case Study Areas

Questionnaire

Imagine that your farm's environmental performance can be expressed by measuring different biodiversity indicators on the farm, thus detailed information can be provided to farmers about how their farming activity contributes to biodiversity preservation. In the next table we listed some indicators which can be used by scientists to measure the on-farm biological diversity.

Group	**Indicator short name**	**Description**
Genetic diversity	Cultivars and landraces diversity	The number and amount of different landraces / cultivars on the farm.
	Crops and breeds in production	The presence of various crops and breeds on your farm which are brought into production.
Species diversity	Keystone species	The presence of keystone species on your farm. A keystone species can be both animal and plant species that has a disproportionate effect on its environment because it plays a critical role in maintaining the structure of the ecosystem.
	Emblematic species	The presence of emblematic animal or plant species on your farm, which are locally important and well-known, but becoming rare or endangered.
Habitat diversity	Landscape heterogeneity	Heterogeneity of the landscape – the number of mosaics within your farm and the variety of their shape, size, surface, border etc.
	Number of patches	The presence of various different patches – e.g. mosaics of grassland, arable land, bushes or woody vegetation etc. – on your farm.
Biodiversity at global level	Food-web structure	The complexity of the food-web structure of plants and animals living on your farm (that is: the relationship between primary producers, herbivores, carnivores and decomposers).
	Animal-plant relations	The interdependencies (mutual relationships) between different species – plants and animals – present on your farm.

In your opinion, which indicator is the more important to measure the biological diversity of your farm?

Please compare the indicators listed in pairs in the table below, and choose always the indicator which you think is more important to measure the biological diversity present on your farm. Please tick or put an "X" in the column of the preferred indicator.

A	B	A	B
Crops and breeds in production	Food-web structure		
Crops and breeds in production	Keystone species		
Crops and breeds in production	Number of patches		
Crops and breeds in production	Landscape heterogeneity		
Crops and breeds in production	Emblematic species		
Crops and breeds in production	Cultivars and landraces diversity		
Crops and breeds in production	Animal-plant relations		
Keystone species	Food-web structure		
Keystone species	Landscape heterogeneity		
Keystone species	Cultivars and landraces diversity		
Keystone species	Animal-plant relations		
Keystone species	Number of patches		
Keystone species	Emblematic species		
Emblematic species	Landscape heterogeneity		
Emblematic species	Food-web structure		
Emblematic species	Number of patches		
Emblematic species	Cultivars and landraces diversity		
Emblematic species	Animal-plant relations		
Landscape heterogeneity	Number of patches		
Landscape heterogeneity	Animal-plant relations		
Landscape heterogeneity	Cultivars and landraces diversity		
Landscape heterogeneity	Food-web structure		
Number of patches	Cultivars and landraces diversity		
Number of patches	Animal-plant relations		
Number of patches	Food-web structure		
Food-web structure	Animal-plant relations		
Food-web structure	Cultivars and landraces diversity		
Animal-plant relations	Cultivars and landraces diversity		

7.2. *Annex_2: Computerized on-line system for data preparation and analyses for KIPA*

Internet address: **http://kipa.hopto.org**

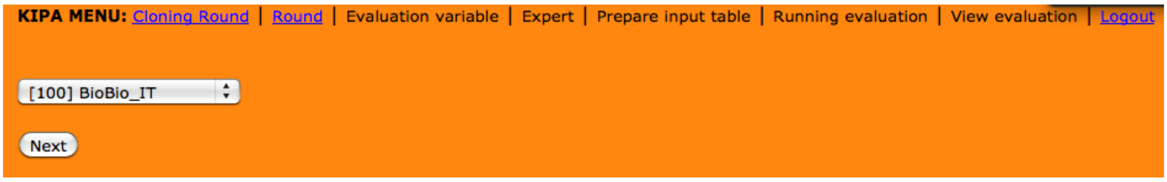
Terminology of the system:

- **ROUND**: the „problem" to be evaluated
- In BioBio the „problem" is the evaluation of value of biodiversity in the 3 case study regions (IT, HU, FR) respectively
- **EVALUATION VARIABLE**: indicators for the evaluation of the problem
- **EXPERT**: who is filling in the evaluation table
- **ADMIN**: who is managing the programme (prepares the evaluation table, manages expert logins, runs the analysis and provides the result)

Steps of using the KIPA on-line system:

Step 1: Admin login

Step 2: Choosing Round



Round details: [100 / BioBio_IT] choose

Evaluation variables	Experts
Cultivars and landraces diversity	expert_IT_1;
Crops and breeds in production	expert_IT_10;
Keystone species	expert_IT_11;
Emblematic species	expert_IT_12;
Landscape heterogeneity	expert_IT_13;
Number of patches	expert_IT_14;
Food-web structure	expert_IT_15;
Animal-plant relations	expert_IT_16;
	expert_IT_17;
	expert_IT_18;
	expert_IT_2;
	expert_IT_3;
	expert_IT_4;
	expert_IT_5;
	expert_IT_6;
	expert_IT_7;
	expert_IT_8;
	expert_IT_9;

Step 3: Managing evaluation variables

KIPA MENU: Cloning Round | Round | Evaluation variable | Expert | Prepare input table | Running evaluation | View evaluation | Logout

Round details: [100 / BioBio_IT] choose Table: Evaluation variables

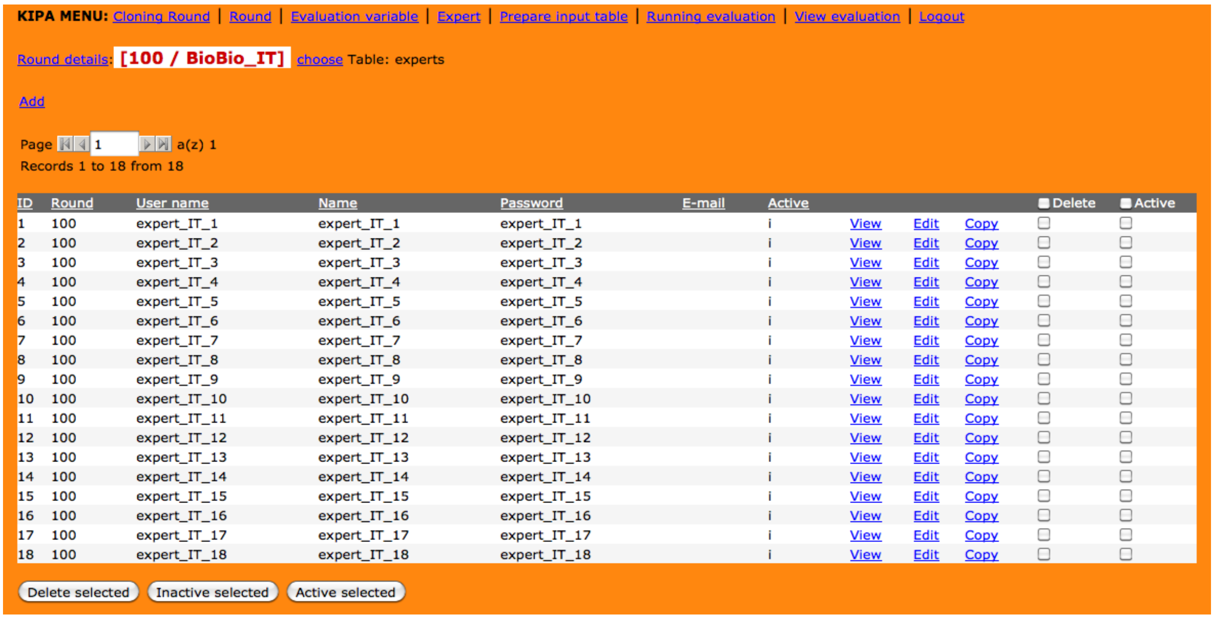
Add

Page 1 a(z) 1
Records 1 to 8 from 8

ID	Round	Evaluation variables	Description		
9	BioBio_IT	Cultivars and landraces diversity	The number and amount of different landraces / cultivars of species on the farm	ViewEditCopy	Delete
10	BioBio_IT	Crops and breeds in production	The presence of various crops (e.g. various kinds of maize) and breeds (eg. cattle of the different type) on your farm which are brought into production.	ViewEditCopy	Delete
11	BioBio_IT	Keystone species	The presence of keystone species on your farm. A keystone species can be both animal and plant species that has a disproportionate effect on its environment because it plays a critical role in maintaining the structure of the ecosystem.	ViewEditCopy	Delete
12	BioBio_IT	Emblematic species	The presence of emblematic animal or plant species on your farm, which are locally important and well-known, but becoming rare or endangered.	ViewEditCopy	Delete
13	BioBio_IT	Landscape heterogeneity	Heterogeneity of the landscape – the number of mosaics within your farm and the variety of their shape, size, surface, border etc.	ViewEditCopy	Delete
14	BioBio_IT	Number of patches	The presence of various different patches – e.g. mosaics of grassland, arable land, bushes or woody vegetation etc. – on your farm.	ViewEditCopy	Delete
15	BioBio_IT	Food-web structure	The complexity of the food-web structure of plants and animals living on your farm (that is: the relationship between primary producers, herbivores, carnivores and decomposers).	ViewEditCopy	Delete
16	BioBio_IT	Animal-plant relations	The interdependencies (mutual relationships) between different species – plants and animals – present on your farm.	ViewEditCopy	Delete

Delete selected

Step 4: Managing expert logins


KIPA MENU: Cloning Round | Round | Evaluation variable | Expert | Prepare input table | Running evaluation | View evaluation | Logout

Round details: [100 / BioBio_IT] choose Table: experts

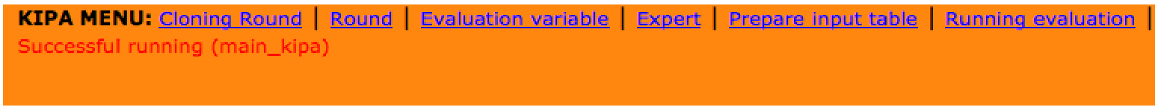
Add

Page 1 a(z) 1
Records 1 to 18 from 18

ID	Round	User name	Name	Password	E-mail	Active				Delete	Active
1	100	expert_IT_1	expert_IT_1	expert_IT_1		i	View	Edit	Copy		
2	100	expert_IT_2	expert_IT_2	expert_IT_2		i	View	Edit	Copy		
3	100	expert_IT_3	expert_IT_3	expert_IT_3		i	View	Edit	Copy		
4	100	expert_IT_4	expert_IT_4	expert_IT_4		i	View	Edit	Copy		
5	100	expert_IT_5	expert_IT_5	expert_IT_5		i	View	Edit	Copy		
6	100	expert_IT_6	expert_IT_6	expert_IT_6		i	View	Edit	Copy		
7	100	expert_IT_7	expert_IT_7	expert_IT_7		i	View	Edit	Copy		
8	100	expert_IT_8	expert_IT_8	expert_IT_8		i	View	Edit	Copy		
9	100	expert_IT_9	expert_IT_9	expert_IT_9		i	View	Edit	Copy		
10	100	expert_IT_10	expert_IT_10	expert_IT_10		i	View	Edit	Copy		
11	100	expert_IT_11	expert_IT_11	expert_IT_11		i	View	Edit	Copy		
12	100	expert_IT_12	expert_IT_12	expert_IT_12		i	View	Edit	Copy		
13	100	expert_IT_13	expert_IT_13	expert_IT_13		i	View	Edit	Copy		
14	100	expert_IT_14	expert_IT_14	expert_IT_14		i	View	Edit	Copy		
15	100	expert_IT_15	expert_IT_15	expert_IT_15		i	View	Edit	Copy		
16	100	expert_IT_16	expert_IT_16	expert_IT_16		i	View	Edit	Copy		
17	100	expert_IT_17	expert_IT_17	expert_IT_17		i	View	Edit	Copy		
18	100	expert_IT_18	expert_IT_18	expert_IT_18		i	View	Edit	Copy		

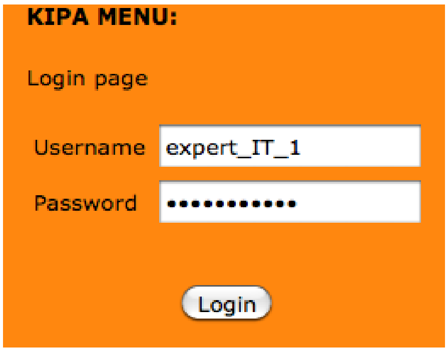
Delete selected | Inactive selected | Active selected

Step 5: Preparig the input table

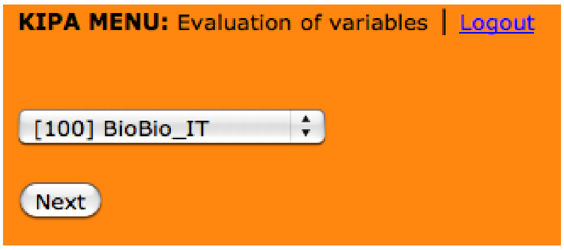


Step 6: Admin logout

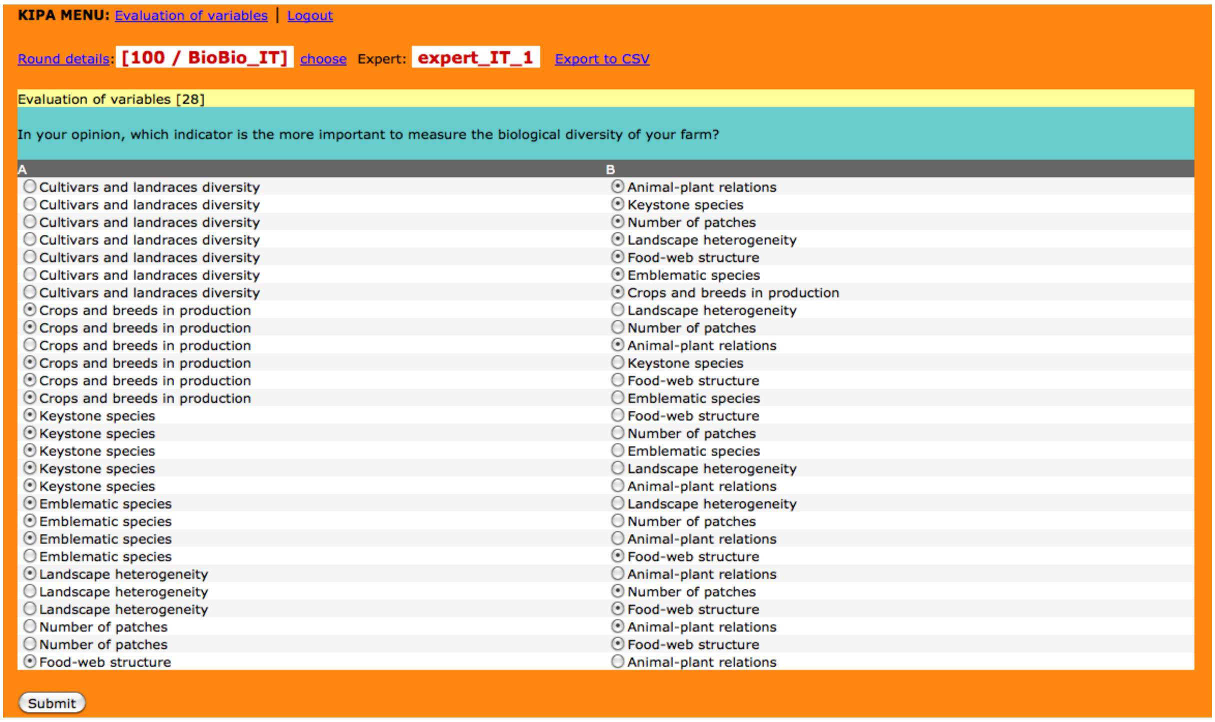
Step 7: Expert login



Step 8: Choosing Round



Step 9: Filling in the evaluation table


KIPA MENU: Evaluation of variables | Logout

Round details: [100 / BioBio_IT] choose Expert: expert_IT_1 Export to CSV

Evaluation of variables [28]

In your opinion, which indicator is the more important to measure the biological diversity of your farm?

A	B
( ) Cultivars and landraces diversity	(•) Animal-plant relations
( ) Cultivars and landraces diversity	(•) Keystone species
( ) Cultivars and landraces diversity	(•) Number of patches
( ) Cultivars and landraces diversity	(•) Landscape heterogeneity
( ) Cultivars and landraces diversity	(•) Food-web structure
( ) Cultivars and landraces diversity	(•) Emblematic species
( ) Cultivars and landraces diversity	(•) Crops and breeds in production
(•) Crops and breeds in production	( ) Landscape heterogeneity
(•) Crops and breeds in production	( ) Number of patches
( ) Crops and breeds in production	(•) Animal-plant relations
(•) Crops and breeds in production	( ) Keystone species
(•) Crops and breeds in production	( ) Food-web structure
(•) Crops and breeds in production	( ) Emblematic species
(•) Keystone species	( ) Food-web structure
(•) Keystone species	( ) Number of patches
(•) Keystone species	( ) Emblematic species
(•) Keystone species	( ) Landscape heterogeneity
(•) Keystone species	( ) Animal-plant relations
(•) Emblematic species	( ) Landscape heterogeneity
(•) Emblematic species	( ) Number of patches
(•) Emblematic species	( ) Animal-plant relations
( ) Emblematic species	(•) Food-web structure
(•) Landscape heterogeneity	( ) Animal-plant relations
( ) Landscape heterogeneity	(•) Number of patches
( ) Landscape heterogeneity	(•) Food-web structure
( ) Number of patches	(•) Animal-plant relations
( ) Number of patches	(•) Food-web structure
(•) Food-web structure	( ) Animal-plant relations

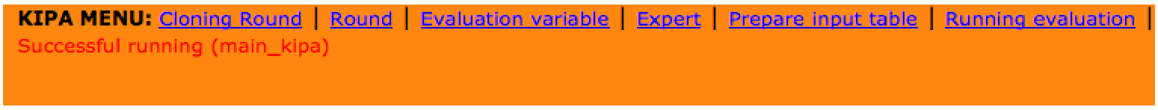
Submit

Step 10: submit the table

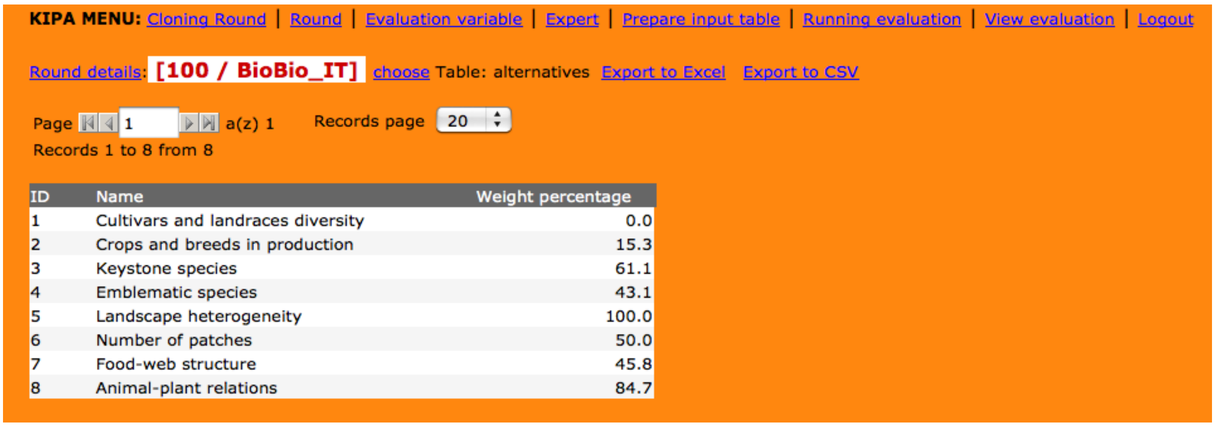
Step 11: expert logout

Step 12: admin login

Step 12: Running evaluation



Step 12: Viewing results of the evaluation


KIPA MENU: Cloning Round | Round | Evaluation variable | Expert | Prepare input table | Running evaluation | View evaluation | Logout

Round details: [100 / BioBio_IT] choose Table: alternatives Export to Excel Export to CSV

Page 1 a(z) 1 Records page 20

Records 1 to 8 from 8

ID	Name	Weight percentage
1	Cultivars and landraces diversity	0.0
2	Crops and breeds in production	15.3
3	Keystone species	61.1
4	Emblematic species	43.1
5	Landscape heterogeneity	100.0
6	Number of patches	50.0
7	Food-web structure	45.8
8	Animal-plant relations	84.7