

➤ PRODIGE

Integration of user perceptions and environmental quality in the design of an indicator of biodiversity in agricultural landscapes

Metaprogramme BIOSEFAIR

Project review: 2021 - 2024

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Context and aims of the project

Numerous studies show the central role played by agricultural systems in the decline of biodiversity. Assessing the performance of agricultural systems in terms of biodiversity conservation is an essential step in supporting their agroecological transition. However, few predictive biodiversity indicators are available, particularly at the landscape level, which is the most appropriate level for assessing the effect of agricultural systems on biodiversity. One example of such an indicator is the NIVA-Biodiversity indicator, developed in a previous project.

The PRODIGE project aims to: i) analyse the needs of potential users of biodiversity indicators and their position in relation to the NIVA-Biodiversity indicator; ii) assess the extent to which integrating into the indicator landscape elements (crops, semi-natural environments, etc.) at a quantitative level (e.g. number of crops, percentage of semi-natural environments) and qualitative level (functional characteristics incorporating agricultural practices) improves the consideration of ecological mechanisms and therefore the relevance of the indicator, its usability and its suitability for the needs of users of the NIVA-Biodiversity indicator.

Method

We characterised the profiles of potential users, their approaches to assessing biodiversity in their activities, and their needs and expectations with regard to such indicators, using both the usability framework based on the criteria of salience, credibility, legitimacy, institutional embeddedness and feasibility, and the diagnosis of usage situations. This was conducted at the territorial level for the usability analysis framework, in the Vallées et Coteaux de Gascogne region, in the PYGAR LTER, and at the national level for the diagnosis of usage situations, which also incorporated aspects of usability.

At the same time, the functional diversity of landscape elements and crops was characterised using ecological concepts and agronomic knowledge. The effects of these variables on biodiversity were studied using a large pre-existing dataset (FarmLand project).

Finally, this knowledge was integrated into a predictive indicator of impacts on biodiversity. It is within this context that a method for aggregating variables, named CONTRA, was computerised on the INRAE MEANS platform to facilitate the use of CONTRA in the design of predictive indicators.

Main results

The implementation of usability and usage diagnosis frameworks highlighted divergent expectations and perceptions among users, depending on whether they are potential users or data providers. The definition of biodiversity is one example, between a more heritage-based approach focused on species conservation, supported by environmental protection stakeholders, and a more functional approach based on services, supported by agricultural stakeholders. However, a consensus emerged on the need for consultation between stakeholders on the indicator.

The functional characterisation of crops led to the establishment of a database for 288 crops (with a more complete version for 57 crops). The relevance of including variables addressing functional diversity in the indicator was then explored.

The feasibility of calculating the indicator was improved in the Tier 1 version through a QGIS plugin. Work is to be continued to produce a consolidated version of Tier 2.

Detailed results

Expected features of a biodiversity impact indicator and operational and policy conditions for its use

Interviews were conducted with 16 local (Nord Comminges, Haute-Garonne region) and regional stakeholders with a potential interest in using biodiversity indicators in agriculture. These stakeholders include public bodies (local authorities, DRAAF, water agency, etc.), semi-public institutions (departmental and regional chambers of agriculture), economic institutions (a cooperative) and associations (agricultural and environmental). Interviews focused on perceptions of biodiversity indicators in agriculture in general and of the NIVA-Biodiversity indicator in particular.

Interviews aimed to analyse these stakeholders' perceptions of biodiversity and to identify usability criteria:

- Salience: consistency between stakeholders' perceptions of the issues addressed by the indicator and their own issues,
- Credibility: perception of the indicator's scientific soundness,
- Legitimacy: perception of the procedural fairness of the indicator's design,

- Institutional integration: this concerns both the way in which its development, updating and publication are based on recognised institutions or public policies, for example,
- Feasibility of implementing the indicator.

The results are as follows:

- Salience covers several aspects: on the one hand, the indicator's ability to reflect the impact of agricultural practices on biodiversity and, in particular, the indicator's sensitivity to changes in agricultural practices; and, on the other hand, the impact of biodiversity on agriculture, particularly through the services it provides to agriculture (pest control and pollination). The components of biodiversity measured must also reflect those components considered most important by stakeholders. Some regretted that soil biodiversity was not addressed by the NIVA-Biodiversity indicator. Finally, for agricultural advisory stakeholders, it must be easy for farmers to understand and even use for self-assessment.
- With regard to credibility, two views emerged among the stakeholders interviewed. Stakeholders from the agricultural sector emphasise the importance of involving stakeholders perceived as scientifically credible in the design of the indicator, ensuring that the indicator's values correspond to the reality on the ground, and ensuring that it is actually used by farmers. Stakeholders from agencies specialising in biodiversity (e.g. Regional Biodiversity Agency, Conservatory of Natural Areas) emphasise the robustness of the data, the standardisation of data collection protocols, the representativeness of data samples and the transparency of the method used to construct the indicator.
- With regard to legitimacy, the stakeholders interviewed agreed on the need for consultation between the various stakeholders involved in this domain, who have different and legitimate interests, as well as future users.
- Institutional embeddedness requires political recognition of the importance of biodiversity and financial support for farmers whose practices promote biodiversity. Stakeholders involved in biodiversity conservation emphasise the need to establish standardised protocols at the national level.
- Finally, with regard to feasibility, the risks of overburdening farmers with data collection and the time spent on collection are the main issues raised by stakeholders.

Diagnosis of use situations consisted of 13 semi-structured interviews conducted with national stakeholders (ministries of agriculture and ecology, public bodies (ASP, OFB, IGN), agricultural technical institute (Arvalis), consulting firms and NGOs). The diversity of the stakeholders surveyed on the issue of biodiversity made it impossible to establish typical cases through cross-referencing. As a result, 11 stakeholder profiles were created to organise and reflect this diversity, with sections on how they understand biodiversity, their relationship to biodiversity and its assessment in their activities, their relationship with other stakeholders in their actions, and their position on the NIVA-Biodiversity indicator and its use. These profiles were supplemented by a representation of the division of labour from the perspective of the various stakeholders, highlighting the relationships between actors grouped according to their position in relation to the assessment (sponsor, operator/assessor, or facilitator/subject of the assessment) and their status (political, industrial, territorial actor) and/or their expertise (biodiversity, data, support), based on data collected during interviews (Fig. 1). Compared to a typology of actors proposed in the literature, which distinguishes between sponsor, designer, implementer and beneficiary, the project highlighted the important role of data providers, who act as facilitators.

As with the assessment of usability, two visions of biodiversity emerge, one functional and the other heritage-based (or naturalistic), while for some other stakeholders, biodiversity is considered one goal among several, particularly at the regulatory level, without necessarily having a precise definition. While some stakeholders already use their own indicators, others are not yet at the assessment stage. More specifically, with regard to the NIVA-Biodiversity indicator, one of the consulting firms surveyed was asked by the Ministry of Ecology to implement it, which highlighted certain difficulties encountered in real-world use. Others expressed an interest in using it and/or helping to develop it, while others positioned themselves as data providers.

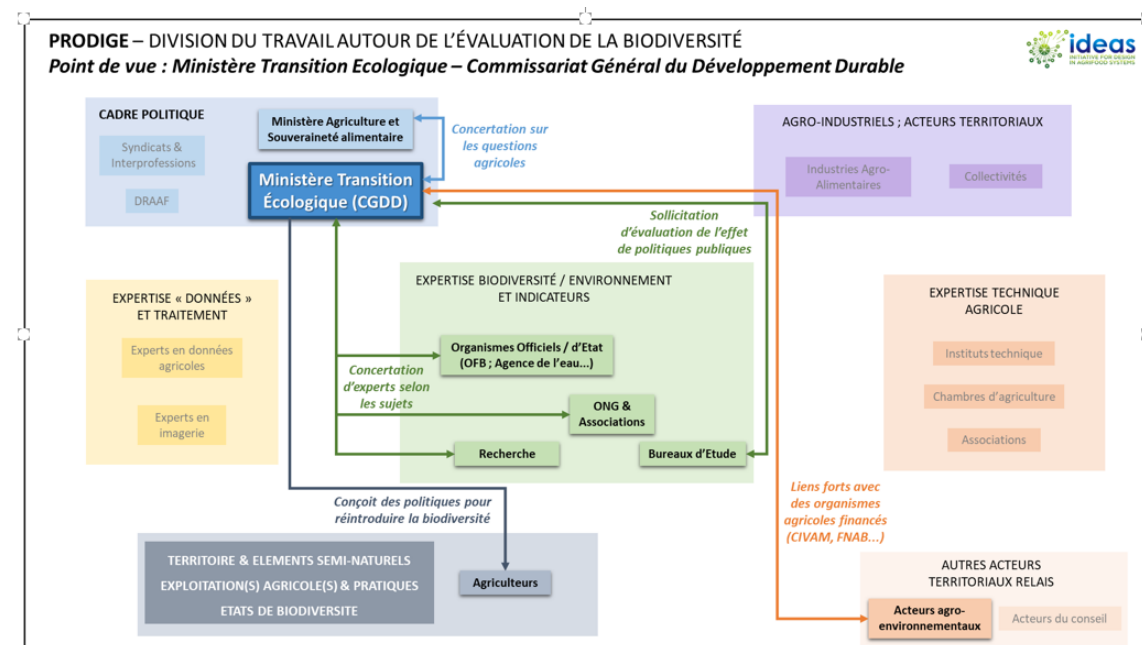


Fig. 1: Example of the division of labour in biodiversity assessment.

Characterisation of the quality of semi-natural elements and crops and impact on biodiversity

The designers of NIVA-Biodiversity have:

- Developed a strategy for the dissemination and implementation of tier 1: documentation, development of a QGIS plug-in (in progress), adaptation of the tool to the data processing skills of users (specialised design offices vs. other actors)
- Adapted Tier 1 at the farm level (with the Arvalis Technical Institute)
- Developed a first version of Tier 2 that takes greater account of agricultural practices.

The integration of a number of variables (heterogeneity of semi-natural elements, number of patches, length of hedges, mineral nitrogen dose, functional diversity of crops) has been tested.

The initial results of the mixed linear model and variance partition analysis show percentages of explained variance in descending order: 10.2% for field size, 8.1% for the heterogeneity of semi-natural elements, 6.8% and 4.7% for crop diversity and the proportion of semi-natural elements, both interacting, 4.4% for hedge length and 2.6% for practices (fertilisation, pesticide treatments). Variables such as functional crop diversity were not included in the model but this analysis should be continued to see to what extent the lack of variability of certain variables explains their low weight. This work proposes additional variables to be included in a Tier 2 indicator and indications on the weights to be assigned to these variables. However, the work of constructing Tier 2 using the CONTRA method (Bockstaller et al., 2017) has yet to be finalised. For the computerisation of the CONTRA method, an initial version with basic functionalities has been developed, which should result in a user-friendly tool for constructing fuzzy decision trees using the CONTRA method and providing highly visual outputs (Fig. 2), while allowing results to be exported to Excel.

This version was used for a DEPE study (BiodivLabel) to assess the impact of practices derived from food standards specifications on plant diversity (chapter 4 of the study). The CONTRA tool was also used to facilitate the calculation of another biodiversity indicator at the plot level, developed by the LAE with ITAB. Finally, a number of functional improvements were added to the tool with external financial support.

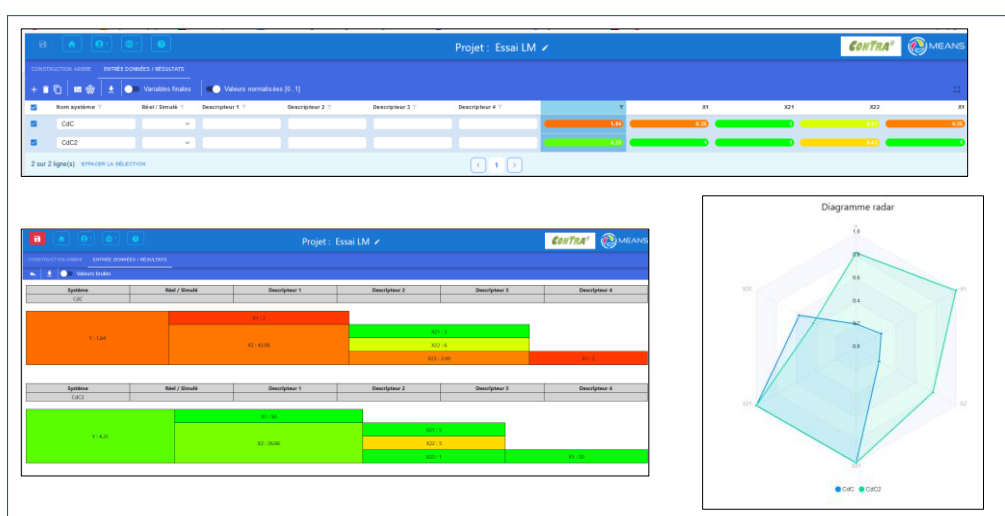


Fig. 2 : Examples of output from the tool developed on the INRAE MEANS platform.

Conclusion

The joint implementation of the usability assessment framework and a diagnosis of usage situations around the NIVA-Biodiversity indicator has strengthened the co-design process for the indicator. This has led to improvements in the tool to enhance the feasibility of calculating the indicator, one of the dimensions of usability, and thus facilitate its use. In terms of the indicator's design, work to improve the NIVA-Biodiversity indicator has been completed with regard to the addition of new input variables, but not yet achieved with regard to aggregation, which will ultimately improve its relevance.

The creation of a database on functional traits of crops and associated practices is an additional outcome of this work.

Valorisation

Bockstaller, C. Soulé, E., Dallaporta, B., Sirami, C. (2024). Assessing impacts of farming systems on biodiversity using predictive indicators: a gradient of complexity. *EGU 2024*, Apr 2024, Vienne (AUT), Austria. [10.5194/egusphere-eGU24-21429](https://doi.org/10.5194/egusphere-eGU24-21429). [hal-04573356v2](https://hal.archives-ouvertes.fr/hal-04573356v2)

Lefeuvre, T., Cerf, M., 2023. Représenter des situations d'usage pour concevoir des outils d'évaluation : retour sur l'accompagnement de la plateforme d'IDEAS de 3 projets de conception. Séminaire IDEAS "L'évaluation dans les processus de conception" 12.12.2023, Palaiseau, France (oral)

➤ Technology transfer

Database (Excel file) on functional traits and associated agricultural practices for crops

CONTRA tool on the MEANS platform <https://pfmeans.inrae.fr/contra/home>