Agriculture, aquaculture and fishing:
impact of food standards on biodiversity

Summary of the scientific report of the study
Version 2 - July 2025

The 2021 French Climate and Resilience Act introduced an Eco-labelling display on food products to inform consumers of the environmental cost of their purchases. The construction of this eco-labelling scheme has given rise to significant methodological work with stakeholders. An interim assessment highlighted the difficulty of capturing all the dimensions of biodiversity. With this in mind, the Ministries of Ecological Transition and Agriculture and Food, along with ADEME, called on INRAE and Ifremer in 2022 to better document this biodiversity component, focusing on production practices. In order to inform public policy more widely, the public authorities have chosen to rely on voluntary standards that require the certification of practices. The development of these voluntary standards are also at the heart of many debates on the relationship between sustainable production and consumption. The study, entitled «BiodivLabel», was carried out by a multidisciplinary committee of scientific experts from public research and higher education organizations.

A joint «land and sea» analysis, complementary approaches

As the BiodivLabel study concerns all food products, it covered agriculture (including livestock farming), aquaculture and fishing. These three activities have different relationships to biodiversity. Fishing takes individuals directly from wild populations, while agriculture modifies a largely anthropized environment to cultivate and raise domesticated plants and animals, generally exogenous to the adjacent natural environment. Aquaculture stands between the two, using artificial (ponds) or natural (sea cages) environments and animals who are purposively bred for these production systems or taken from wild populations.

In order to gain a comprehensive view of the subject, the study approach employed four methods: a review of the literature on the impact of voluntary standards on biodiversity; an analysis of production practices with an established impact on biodiversity (favorable or unfavorable) and an examination of the standards' criteria and indicators with regards to the practices identified; the exploration of methods for estimating the impact of labeled production on biodiversity based on the practices considered in the standards; and finally, an investigation into the social, economic and regulatory dimensions that can modulate the standards' impacts.

Biodiversity and voluntary standards: objects of the study

The scientific community agrees on the extent of the decline of biodiversity. The Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) notes that the entire functioning of ecosystems is changing as a result of human activities. In marine environments, biodiversity degradation is caused primarily by overfishing. In terrestrial environments, agriculture plays a role in the degradation and fragmentation of natural environments. As for aquaculture, it impacts both coastal and freshwater environments rich in biodiversity. To analyze impacts, the BiodivLabel study adopted the framework of Essential Biodiversity Variables (EBV), which cover all scales of living organisms. They are increasingly being used in dialogue between scientists and decision-makers, and offer the advantage of being able to capitalize on new knowledge within a common framework.

The analysis focused on a sample of thirteen voluntary standards representing a diversity of products, statuses and production contexts. Public or private, national or global in scope, general or industry-specific, they are all certified. The share of labelled products in consumer markets is generally low, but significant for organic products (around 6% of all food products consumed) or for certain types of product such as wild caught fish (the MSC - Marine Stewardship Council - label represents 22% of wild caught fish landed in France), cheese (*e.g.* Comté AOP) or animal products with Label Rouge or Bleu-Blanc-Cœur label. The Rainforest Alliance, RSPO for palm oil and RTRS for soy are representative of a movement that saw the dramatic increase in the number of private voluntary standards in global supply chains at the turn of the 2000s, and which only concern imported products.

CONTEXTUALIZATION

EMERGENCE OF NATIONAL STANDARDS WITH LABELS

- **1936** French framework of Appellations d'Origine Contrôlée — PU FR
- **1965** Label Rouge — PU FR
- **1972** Nature & Progrès label (trademark registered in 1993) — PU FR
- **1979** Demeter — PR EU
- **1985** French Agriculture Biologique label — PU FR

DEVELOPMENT OF MULTI-STAKEHOLDER SUSTAINABLE STANDARDS

- **1990** Rainforest Alliance — PR IN
- **1991** European regulation on organic products — PU EU
- **1992** European framework for geographical indications : AOP and IGP — PU EU
- **1997** Marine Stewardship — PR IN

STRONG GROWTH IN THE NUMBER OF PRIVATE VOLUNTARY STANDARDS, THEIR CREDIBILITY IS CONTESTED

- **2000** Bleu-Blanc-Cœur label — PR FR
- **2005** Round Table on Sustainable Palm Oil (RSPO/CSPO) — PR IN
- **2009** Round Table on Responsible Soy (RTRS) — PR IN
- **2010** Aquaculture Stewardship Council (ASC) — PR IN
- **2012** High Environmental Value certification (HVE) — PU FR
- **2014** Sustainable Fishing (PD) — PU FR

Label type — PU Public, PR Private

Scale — FR France, EU Europe, IN International

STUDIES LABELS

THE INSTITUTIONAL CONTEXT OF FOOD ECO-LABELLING PRODUCTS

- **2009** The French Grenelle 1 Law introduces the objective of eco-labelling, obliging manufacturers to provide objective information on the environmental impact of their products
- **2013** In France, the Agribalyse database is created, using the LCA method to calculate the environmental impact of agricultural products.
- **2019** The European Commission bases its *Product Environmental Footprint* (PEF) on the LCA method
- **2021** The French Climate & Resilience Law introduces voluntary eco-labelling for food products in France
- **2019** Media campaign by WWF, Greenpeace, UFC-Que Choisir on promises unfulfilled labels
- **2020 → 2021**
  Phase 1: Call for proposals
  • Of the 12 proposals, 2 were pursued beyond phase 1 :
  • Planet Score (used by NGOs and companies) and Green Score (used by Yuka and other consumer apps)
- **End 2022**
- **2022 → 2024**
  Phase 2: Workging groups
  • Prefiguration of environmental cost (Ministry of Ecological Transition, Ademe) and Ecobalyse calculator
  • Designers modelled and tested 550 products
  • Work on methods and scientific advice
- **Experimentation with eco-labelling of food products consultation with partners on display methods and procedures**
- **2023** European directive on Zero imported deforestation France's national biodiversity strategymentions eco-labelling
- **2024** Proposal for a European directive on ecological claims to combat greenwashing, known as 'Green Claims'
- **20??** Directive introducing eco-labelling in France and Europe
- **BiodivLabel Study**
- **mid-2025**

INDICATORS OF THE COLLAPSE OF BIODIVERSITY

- **1964** IUCN creates the *Red List of Threatened Species*
- **1997** WWF creates the Living Planet Index
- **2002** Creation of the European Common bird index
- **2009** • Rockström et al. create the concept of planetary limits
  • The sustainability limit of biosphere integrity is largely exceeded
- **2013** GEO-BON, the international biodiversity observation network, defines the concept of Essential Biodiversity Variables (EBVs), similar to the climate variables created by the IPCC
- **2019** First IPBES report on global biodiversity
- **2022** COP15 Biodiversity Kunming-Montreal agreement to achieve 30%protected areas on land and at sea

28% of species threatened with extinction worldwide (2024)

-73% decline in populations of animals since 1970

-60% of birds in agricultural areas since 1980 in Europe

33% fish stocks overfished

Characterize practices according to their impact on biodiversity

A four-family typology

The expert committee defined an innovative typology cutting across all three activities (farming, aquaculture and fishing). They organized practices into four families that impact biodiversity and ecological processes in different ways.

1) **Spatial and temporal allocation of activities** rrelates to the configuration of the agricultural landscape, aquaculture sites on the coast or in watersheds, and the collective management of fishing rights and quotas by maritime zone. Some activities, such as the supply of feed for livestock, may be relocated. This family also covers the seasonality of fisheries and crop rotations.

2) **The addition of physical and chemical factors** includes inputs such as fertilizers, pesticides and drug treatments, as well as agricultural tillage and the alteration of the seabed by fishing gear.

3) **The addition of organisms** includes seedlings and plantations, the introduction of livestock and other living organisms used for biological control in agriculture and aquaculture.

4) **Removal of organisms** primarily concerns fishing (including for aquaculture feed), and to a much lesser extent larvae, juveniles or wild breeders taken for aquaculture breeding. In agriculture, harvesting, mowing and grazing affect biodiversity, directly or indirectly through the deprivation of resources and habitats.

Agriculture

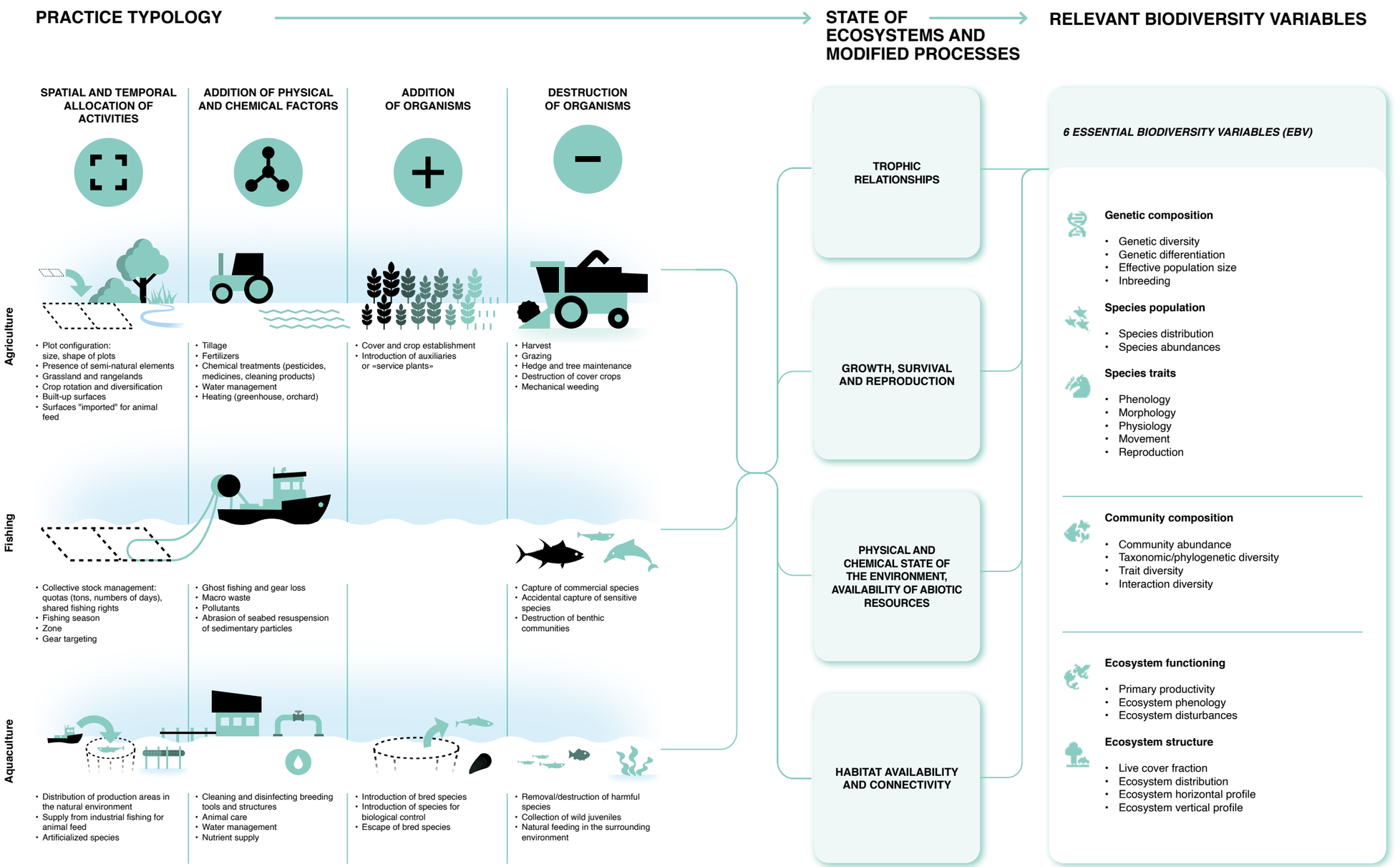
The analysis was based on meta-analyses and large studies comparing practice modalities. Some 1,500 «effects» were identified, *i.e.* an effect observed for a combination of practice modality, taxon (or taxonomic group) and EBV. The most favorable practices were ranked according to their degree of confidence. Thus, when the favorable impact covered at least two taxa and both the EBVs «community composition» and «species richness», the practice was qualified as favorable with high confidence (PHC). This classification is therefore not based on the size of the effect, but on its documentation of several dimensions of biodiversity. In the bibliography analyzed, eight practices were rated as PHC: the presence of semi-natural elements and grasslands in the agricultural landscape, diversified crop rotations, the absence of synthetic pesticide treatments, reduced tillage, organic fertilization, plant cover and intercropping. Other favorable practices, proven on fewer taxa or EBVs, were ranked with a moderate level of confidence. These include crop diversification and reducing field size.

Aquaculture

The scientific literature on the impact of aquaculture on biodiversity is limited. Analysing the negative effects of some practices, it focuses mainly on practices associated with the rearing of fish in sea cages, fed by industrial fishing and/or plant pellets. Nutrient enrichment (feed and feces) of the environment surrounding the cages disrupts the state and functioning of the ecosystem (life traits of individuals, species populations, community composition). The risk of escape also threatens species diversity. The impact of shellfish farming is less marked, as the animals can be taken from the local environment and fed there naturally. The impacts of inland aquaculture on biodiversity are not very apparent in the corpora studied.

Fishing

Fisheries management has long been based on knowledge produced through standardized methods of data collection and analysis at the European and international level, the main focus being the ecological status of fished species. This assessment focuses on the ecological status of populations of fished species. Ecosystem impacts on the seabed and on accidentally caught species (dolphins, turtles, birds, etc.) are increasingly documented, but are not always translated into operational indicators. Scientific work is seeking to better quantify the impact on demography and food webs. Trawling is detrimental to the seabed, while nets and lines are often responsible for more by-catches. The impact of waste and abandoned gear at sea, as well as that of practices that disrupt the carbon cycle (which has an impact on the climate and, ultimately, on ocean warming), are active research fronts. Finally, integrated multi-impact approaches on the scale of a ship or fleet are a recent development.



Key findings on the impact of voluntary standards and their the standards

Few studies on the impact of voluntary standards voluntary standards on biodiversity, except for organic farming and MSC certified

The scientific literature is generally too limited to conclude on the impact of voluntary standards on biodiversity, with the exception of organic farming and MSC certified. Organic farming offers estimated gains of around 30% in specific richness at field level, compared with conventional farming. The MSC label guarantees good management practices aimed at limiting overfishing. However, its added value for other components of biodiversity (seabed, bycatch, etc.) is poorly documented.

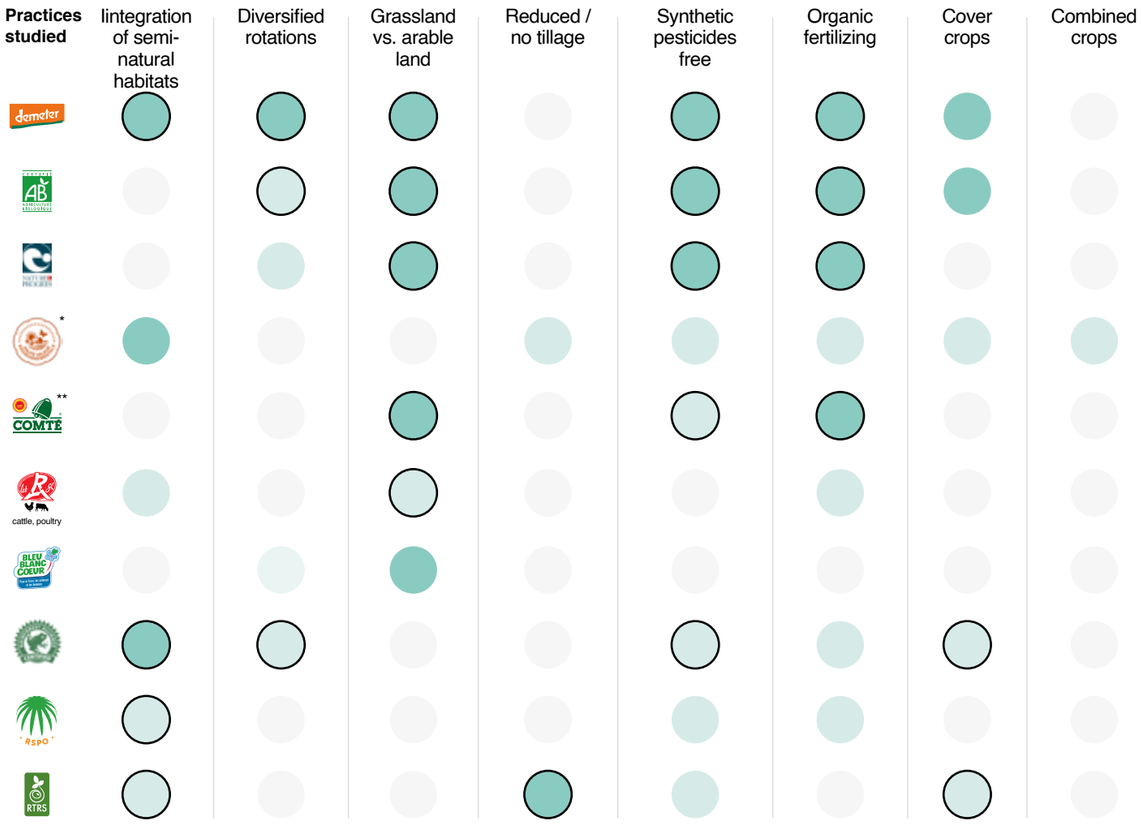
Presence, requirement and ambition of impacting practices mentioned in the standards

The diversity of measures cited in the standards reflects the diversity of objectives set by the voluntary standards and the diversity of contexts in which they are applied. The practices cited broadly correspond to those documented by scientific studies.

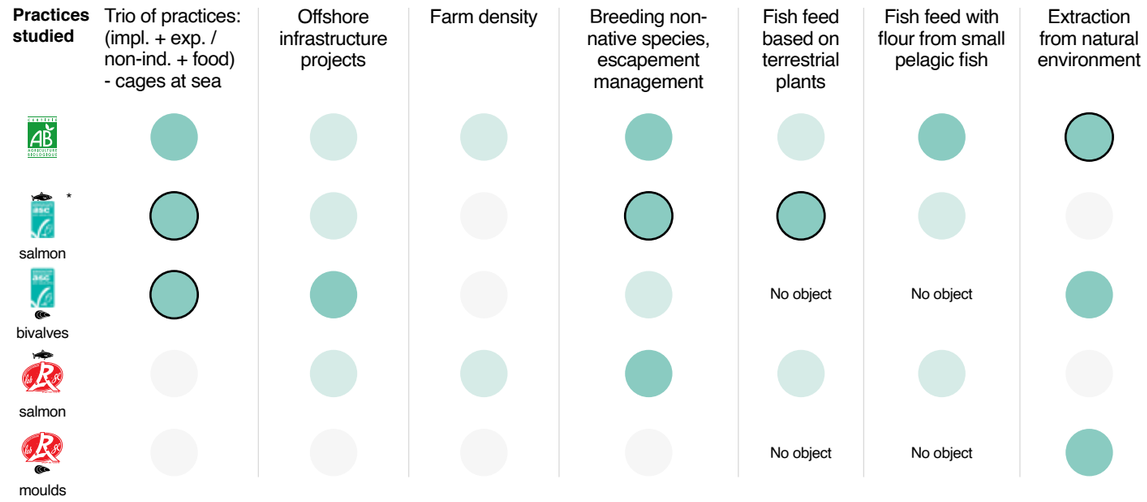
Three criteria were used to structure the analysis: 1) the presence or absence of measures designed to control or limit unfavorable practices (aquaculture, fishing) or encourage favorable practices (agriculture); 2) their mandatory or optional nature; and 3) the ambition of the measures in relation to average practices or regulatory benchmarks. This analytical approach highlights the strengths and weaknesses of each label and practice, but its fairly generic nature and the heterogeneity of the measures limit the assessment.

In agriculture, the eight PHC have been used as a basis for identifying measures with proven effects. None in our sample of standards mentions all of them. Several favourable practices are poorly covered by the labels, such as reduced tillage and intercropping. The preservation of semi-natural elements is addressed in an ambitious and mandatory way by only two of the standards. The three organic labels (Organic farming, Demeter and Nature & progrès) are the most demanding and ambitious overall. Furthermore, the absence of a PHC does not mean the absence of measures in favour of biodiversity: for example, measures to protect against imported deforestation do not appear in the meta-analyses included in our literature review.

High-confidence practices present in the 10 agricultural specifications studied



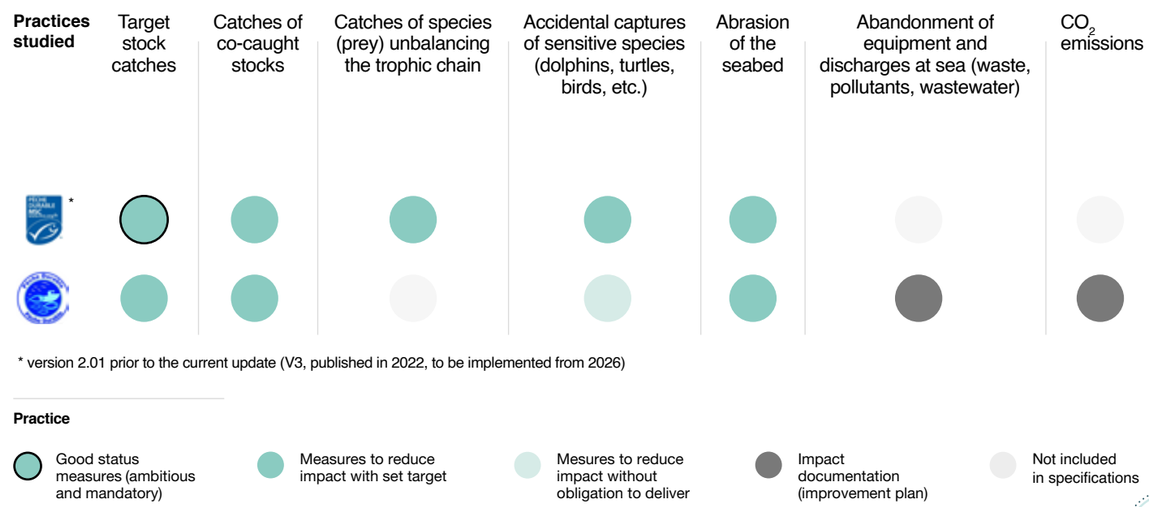
Practices present in the 5 aquaculture specifications studied



In aquaculture, the requirements for organic aquaculture, and those for ASC and Label Rouge (targeted products: salmon and bivalves or mussels) identify the main risks for biodiversity. Measures vary considerably between types of production and between standards. The stringent obligations in terms of requirements or performance mainly concern food and the risks of escape of non-native species (Organic, ASC). The threshold values appear to be motivated more by animal welfare than by the protection of biodiversity (density, behaviour).

The two **fishing** voluntary standards examined, MSC and Ecolabel Pêche Durable, are very different: the former is private, global, long-established and widely distributed, while the latter is public, national, recent and little used. Despite these differences, their the standards are largely similar, reflecting the global state of knowledge on the impact of practices on biodiversity. Neither label has any exclusion criteria for fishing gear. The MSC is mainly deployed in large-scale fisheries (tuna and trawlers in particular) supplying the world market.

Practices present in the 2 fishing specifications studied



Methodological guidelines for qualifying and quantifying impacts on biodiversity

Quantifying impacts on biodiversity remains a challenge, given the lack of observational data and operational methods available today. Drawing on scientific knowledge, the experts have designed, adapted or applied three pilot methods for aggregating biodiversity variables to labelled products. They have the advantage of being based on public data, and of shedding light on the role of practices. These are original approaches, with various levels of consolidation and validation.

Three ways of constructing aggregated biodiversity scores were explored

The « CONTRA-BiodivLabel » indicator is based on multi-criteria aggregation using the principle of fuzzy decision trees. It predicts a level of biodiversity per unit area, depending on land use and the practices contained in the standards. Explored on a single taxonomic group (plants) and a single EBV (specific richness), the model evaluates, for example, a higher level of biodiversity for organic voluntary standards in field crops compared to other voluntary standards and conventional; and higher and more homogeneous levels between voluntary standards, in the case of grasslands.

The BVIAS method (*Biodiversity Value Increment from Agricultural Statistics*) adapts a pre-existing method designed to take better account of biodiversity in LCA. Applied to accounting and mapping data from over 5,500 farms, the BVIAS method makes it possible to estimate actual practices and compare the impacts of labelled and non-labelled products. The voluntary standards, including those for organic farming, do not differ in terms of landscape variables and, with a few exceptions, only mandatory practices are found in actual practices. Lastly, biodiversity impact scores vary according to whether they are related to a unit of area (hectare) or product (kcal, ton, etc.).

The STECF method Scientific, Technical and Economic Committee for Fisheries of the European Commission) establishes three scores on the risks of overfishing, seabed abrasion and unwanted catches of sensitive species. It is based on average public data, which can be refined if voluntary standards or fisheries provide their actual data. The BiodivLabel study compared the STECF scores obtained by French fisheries bearing the MSC and Ecolabel Pêche durable voluntary standards with their own assessments. The ratings are consistent for stock management, but may differ for other environmental impacts.

The results were discussed, highlighting several points of tension. In particular, it highlighted the importance of spatial and temporal ecological processes for biodiversity. These processes are insufficiently taken into account in existing quantification methods, as are the socio-economic dynamics associated with land use. Moreover, whatever the method, the impact must relate to a unit (area or product), the choice of which proves all the more difficult as biodiversity does not refer to a consensual unit of measurement.

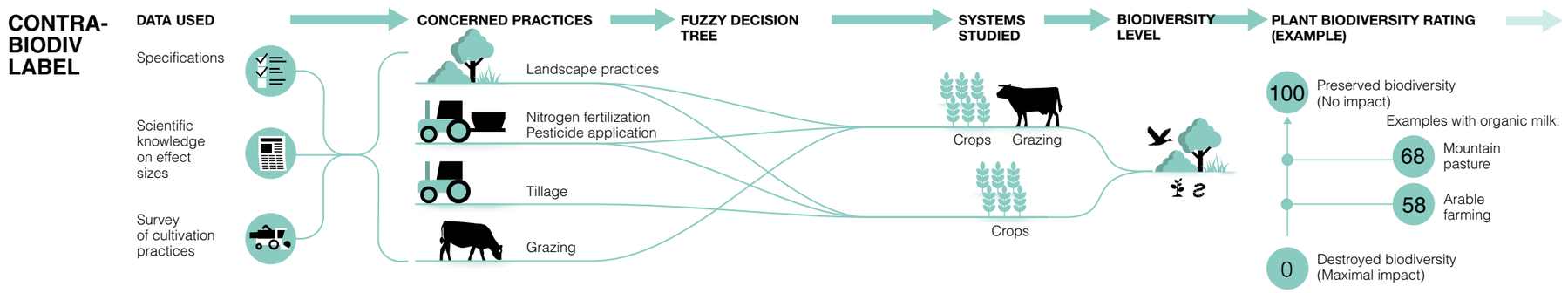
Understanding the effectiveness of promises

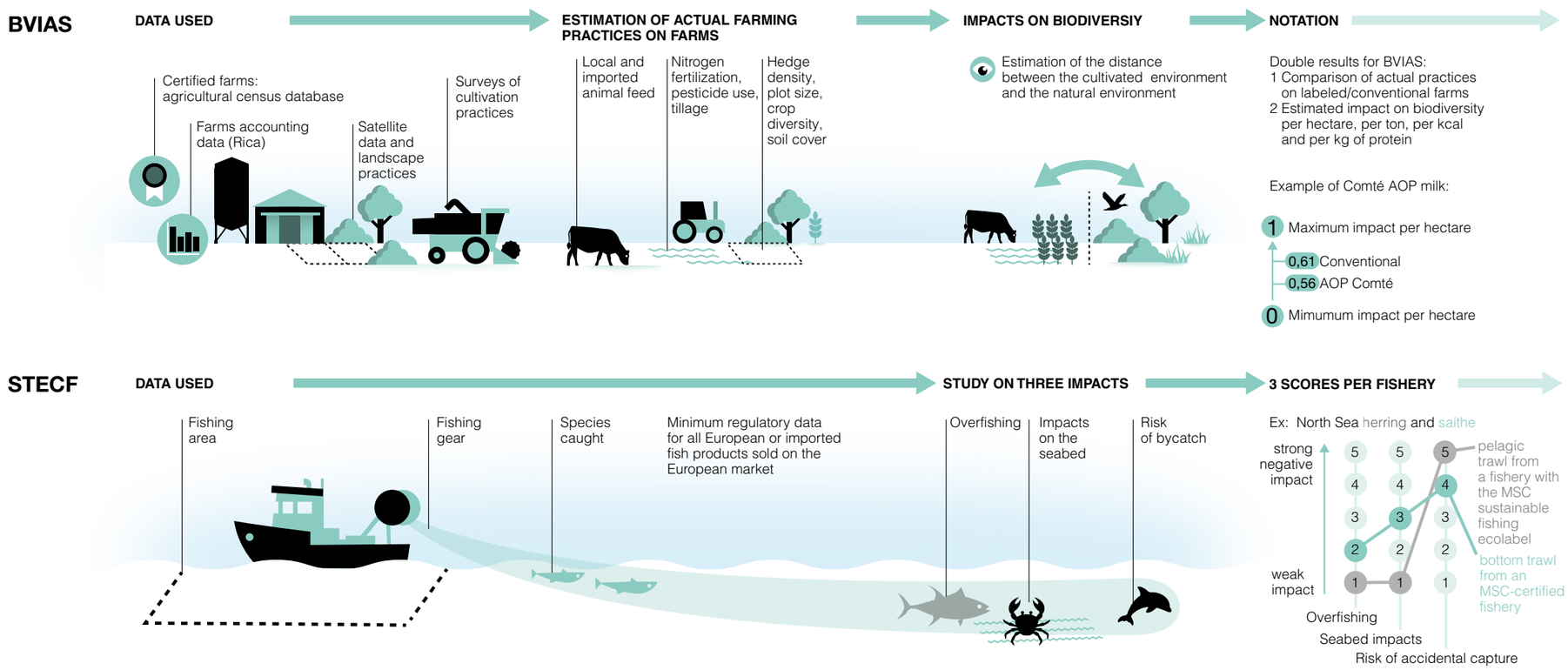
How voluntary standards work: for a standard to be effective, consumers must be able to trust that the standard delivers what it promises. In other words, that the production and trade practices used by operators are really those that the voluntary standard claims that they are. Each voluntary standards develops their own unique «institutional design» which determines whether or not the practices written in the standards' criteria are applied in practice. The creation of the standard, the control procedures, the management of non-compliance, the renewal of certification and, finally, the traceability of claims throughout the chain to the consumer are embodied in procedures and relationships between stakeholders: label holders, legislators, producers, certification bodies, processors and consumers. Numerous operating modes coexist. They include hybrid formats combining the requirement of organizational independence with participatory guarantee systems. Through this institutional design, voluntary standards manage the tension between adherence to a standardized criteria and the integration of rules into actual practices, according to local conditions.

The economic appeal of voluntary standards: for a label to have a significant impact, it must be used by producers, and therefore be attractive and economically viable. Analysis of organic farming and the MSC illustrates two avenues of support: consumers' willingness to pay, and guaranteed access to certain markets. In addition, public support in the form of subsidies or supervision of practices is crucial encouraging the adoption and maintenance of biodiversity-friendly practices.

Strengthening the legal framework: since 2020, French and European regulations have sought to strengthen environmental information for consumers and better protect them against abusive claims. At the European level, the draft Green Claims Directive aims to combat greenwashing and stipulates that environmental commitments must be objective and verifiable. In doing so, the Commission's proposal reverses the burden of proof, which would rest ex ante with the marketer.

Finally, the study raised a series of points to watch out for in terms of rebound effects and risks of inconsistency between biodiversity protection policies, agricultural and fisheries policies, and nutrition policies.





Conclusions

Main findings of the study

The study clarifies the state of knowledge on the impact of voluntary standards on biodiversity:

- The impacts of production practices were identified using the framework of Essential Biodiversity Variables.
- Direct observation and analysis of the standards attest to the positive effect of organic farming on biodiversity, compared with conventional farming, at field level. In the fishing sector, the MSC label provides a guarantee of no over-fishing, while the assessment of impacts on ecosystems remains under debate. The literature on biodiversité impact of aquaculture is limited. The measures vary widely between standards and are not often ambitious when it comes to unfavourable practices.
- Information on other food voluntary standards is fragmentary.
- Mandatory measures generally structure the coherence and ambition of a specification, and are the only practices that the label certifies.
- The irreversibility of damage is rarely mentioned; fishing voluntary standards, for example, address this issue in relation to the seabed.
- The effectiveness of a label depends not only on its standards, but also on its institutional design and economic appeal. The multiplicity of ways to ensure compliance illustrates the dynamics in this area.

The study made a number of methodological contributions:

- It proposes a typology of practices according to their effects on ecological processes, and classifies practices according to the level of confidence of their impact on several dimensions of biodiversity. These confidence levels will be raised and extended to other practices, as knowledge progresses.
- It provides original methodological avenues for estimating the impact of production methods on biodiversity, helping to shed light on the construction of environmental labelling.
- It shows the value of public databases on agricultural and fishing practices for providing tools for quantifying impacts. These databases should be better documented, including at wider ecosystem, spatial and temporal scales, which currently lack sufficient data.
- It lays the methodological foundations for including the institutional design features of standards in the criteria for assessing the impacts of labelled products.

he study provides elements to encourage the inclusion of biodiversity in voluntary standards and public policies:

- A comparison of approaches in the marine and terrestrial sectors suggests that, in terms of impacts on biodiversity, voluntary standards would benefit from the joint use of means and results indicators, and from considering two levels of management: individual management at the level of the producer or fishery, and collective management at the level of the territory, ecoregion or maritime zone.
- The standards could be expanded to include measures identified as favourable to biodiversity but rarely taken into account.
- In terms of traceability, the segregation of certified supply chains should be encouraged, as this is the only way to ensure that consumers actually eat certified products. Credit markets that decouple the physical traceability of products and the certification of producers run the risk of drift.
- Lastly, the inclusion of biodiversity in the conditions for public support for production methods would be a logical consequence of the knowledge and thinking generated by the study.

The main gaps, limitations and uncertainties highlighted

- There is a lack of *in situ* biodiversity monitoring data, which is essential for assessing the quality of impact prediction models.
- There are also gaps in knowledge of the impact of practices on biodiversity, particularly in the case of aquaculture. In agriculture and fisheries, there are large-scale studies, meta-analyses or synthetic reports, but in these bodies of work, the coverage of EBVs remains partial and that of taxa uneven.
- What's more, these syntheses do not allow to analyze interactions between practices, which are crucial for dealing with the assembly of practices in production modes. These observations call for a return to primary articles to go further, and for new research.
- Examination of the standards revealed the fairly generic nature of the basic documents, the heterogeneous nature of the commitments and the lack of explicit coherence between the metrics. This limits a full assessment of the voluntary standards' impact on biodiversity based on the standards alone. A more detailed analysis of the documentation as a whole could modulate the «global» assessment of the standards.
- Assessing impact at farm field level, as discussed in the BiodivLabel study, provides only partial information. Indeed, several ecological processes beyond the field scale have major effects on biodiversity and are insufficiently taken into account in existing quantification methods.
- The BiodivLabel study does not allow to decide what is most appropriate functional unit for assessing the impact of labelled products on biodiversity. However, the complexity of the assessment and the blind spots of existing methods can in no way justify inaction in the face of the collapse of biodiversity.

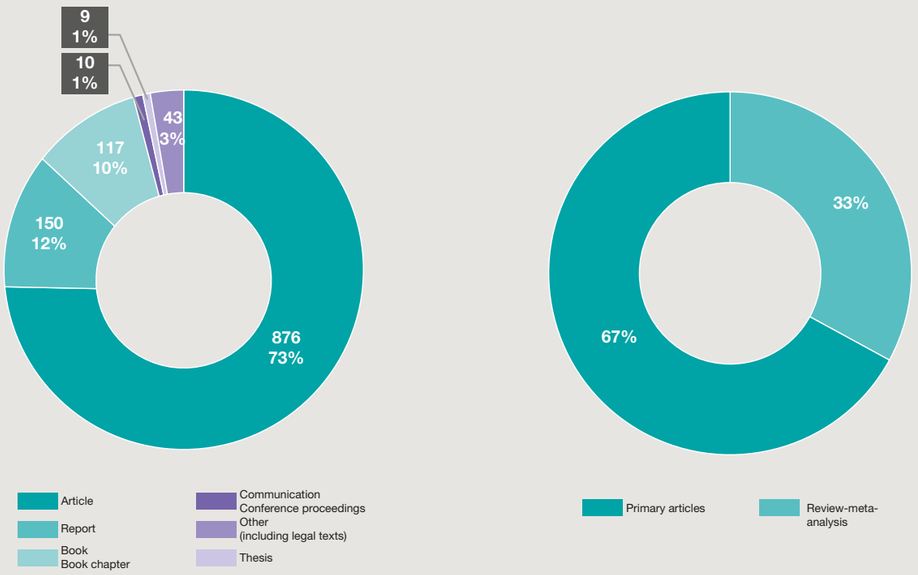
Thus, the BiodivLabel study is not a buying guide and does not aim to compare voluntary standards but it provides keys for analysing and understanding their overall impact on biodiversity. It is up to public authorities, scientists, standards development organisations and other stakeholders to take up its findings.

Expert panel and documentary sources

The multidisciplinary committee gathered some 29 scientific experts belonging to 9 public research and higher education organisms: AgroParisTech, Anses, Cirad, CNRS, Ifremer, Institut Agro, INRAE, MNHN, Pisa University.

Their qualification profiles cover the diversity of the subject areas relevant to the study: agronomy, fish sector, ecology, biology, hydrology, economics, management, sociology and law.

The quality of the analysis is based on the state of the art of the scientific literature. The Web of Science and Scopus databases were used as the main bibliographical sources. Other resources were consulted, such as the Evidensia platform (on labels), Google Scholar and legal databases. Literature searches focused on biodiversity, fishing practices, agriculture, aquaculture and labels. The report is based on 1,205 references, including 876 scientific articles published in peer-reviewed journals. 1/3 of these articles are synthesis, reviews or meta-analysis (compilation of independent studies). Most part of these publications were published after 2010 (83%). The main journals publishing the articles cited are multidisciplinary or specialize in environmental sciences, agronomy and sustainability sciences. In the grey literature, reports from national and international public institutions account for about half of the documents. Among private sources, reports by NGOs (15%) and standart holders (11%) are the most cited.



Distribution of scientific literature by type of publication

Document reference:
Clara U lrich (coord.), Françoise Lescourret (coord.), Olivier Le Gall (coord.), Valentin Bellassen, Claire Bernard-Mongin, Christian Bockstaller, Luc Bodiguel, Claire Cerdan, Cécile Chéron-Bessou, Fabienne Daurès, Alexandra Di Lauro, Anne Farruggia, Colin Fontaine, Marine Friant-Perrot, Guillaume Fried, Didier Gascuel, Sarah Huet, Thierry Laugier, Morgane Le Gall, Sophie Le Perchec, Harold Levrel, Allison Loconto, Sterenn Lucas, Pierre-Alain Maron, Clémence Morant, Anne Mérot, Emmanuelle Porcher, Mégan Quimbre, Adrien Rusch, Marie Savina-Rolland, Clélia Sirami, Fabrice Vinatier, José Luis Zambonino Infante, Catherine Donnars (2025). *Agriculture, aquaculture et pêche : impacts des modes de production labellisés sur la biodiversité.* Summary of the study report , INRAE -Ifremer (France). 12 pages.

Version 2 - July 2025 incorporating changes to the infographics and data for some voluntary standards.

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