National pilot programme coordinated by the Ministry for Ecological Transition, the Ministry for Food and Agriculture, the Ministry for the Economy, Finance and Recovery, and the French Agency for Ecological Transition (Ademe)

Environmental Impact Labelling for Food Products

Assessment Report by the Scientific Council

Overview

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Summary

In the opinion of the scientific council it is possible to design and implement an environmental impact labelling system for food products that fulfils the aims expressed by French lawmakers in legislation to combat food waste and support the circular economy (AGEC act, 2020) and in the Climate and Resilience Act, article 2 (2021). With these goals in mind, the council has drawn up the following proposals, on the basis of its own work, the available scientific literature, and discussions among the members of the working groups and project teams.

1. To provide incentives for changes in consumer behaviour of a nature and scope to effectively address environmental issues and challenges, environmental labelling on food products must enable consumers to compare products within food categories, based on variables related to modes of production, transformation and distribution, and between categories, with a view to encouraging changes in diet.

2. The environmental impact information to be displayed for consumers must be based on the metrics of Life Cycle Analysis (LCA), in keeping with the Product Environmental Footprint (PEF) reference framework recognized by scientific bodies and institutions in Europe. In this framework a single impact score can be calculated for food products by aggregating various impacts, including climate change, resource consumption, emission of pollutants, among others.

3. Currently available data have limitations, in particular for the integration of environmental externalities in assessment of agroecological production, and some modifications to this reference framework may be needed. The scientific council believes that such amendments should be few in number, based on scientific knowledge, and consistent with LCA metrics insofar as possible. They should be used provisionally, until the PEF terms of reference are revised. To address these questions the council suggests several corrective measures that can be rapidly implemented to better reflect impacts linked to soil carbon sequestration, biodiversity at the field scale, and toxicity factors.

4. To gather exhaustive and accurate data, and to hold down the cost of implementing environmental labelling, it is appropriate to use both generic information from public sources, furnished by the Agribalyse (AGB) database, and specific data from private sources. Companies and independent platforms must comply with a collectively accepted set of rules for the display of this information, to ensure that accurate and consistent information is supplied to consumers.

5. The AGB database is a source of reference values for environmental impacts, and as such can serve in the deployment of environmental labelling. However, all actors must recognize the capacity of this database to faithfully reflect the conditions in which food products are produced, processed and distributed. It falls to professional organizations and technical institutes to pursue work to validate the data. Environmental labelling also calls for the development of semi-specific values that users can employ to facilitate their evaluations, and the development of a platform to centralize the values to be used for display on product packaging.

6. Environmental labels must be aggregated and concise, colourful and interpretive, in order to have a significant impact on consumer purchases. The main information communicated by the label may be supplemented with, but not replaced by, analytical information referring to the

various impacts considered to obtain the final score. This additional information is intended to increase consumers' knowledge and awareness of the environmental stakes.

7. Environmental labelling must cover the full range of food products and foodstuffs. A five-level environmental impact scale, based on a single aggregated impact score, is an effective tool to guide consumers and enable them to compare products across different categories – the "dietary change" effect. This scale does not always suffice, however, to help consumers compare products within a given category, and lead them to choose production, processing and distribution modes that are better for the environment. To achieve this the five-level scale must be refined.

8. Two complementary mechanisms are feasible and effective. An environmental score expressed as a value between 0 and 100 can be given to supplement (but not replace) the product score on the five-level scale. With this more finely-grained scoring it will be easier to compare products in the same category, and the environmental outcomes that can be attained by action on the supply side will be more visible. The five-level scale can also be supplemented (but not replaced) by breaking down the aggregated score into components assessing performance according to various environmental impacts (climate, biodiversity, etc). The possibilities of supply-side leverage will be highlighted by the variations induced in component subscores. This breakdown will provide more information to consumers, without diminishing the overall effectiveness of the aggregated score. It remains to determine how all these pieces of information (five-level score, numerical value, subscores) should be displayed on product packaging – grouped in one place or at separate points (e.g. front and back) – and on dedicated websites. The actors involved must also consider how the limited space on packaging is to be allocated between different types of production information and labelling (environmental, nutritional, etc).

Introduction

The French Ministry for Ecological Transition and the French Agency for Ecological Transition (Ademe) have conducted a pilot programme to design and implement a scheme to implement environmental labelling for food products. This experimental programme was decided in application of article 15 of French legislation to combat food waste and support the circular economy (AGEC act, 2020), subsequently replaced by article 2 of the Climate and Resilience Act (2021). The programme was overseen by a cabinet-level steering committee composed of the Ministry for Ecological Transition, the Ministry for Food and Agriculture, the Ministry for the Economy, Finances and Recovery, Ademe, and the chair of the scientific council of the pilot programme.

The "pilot" programme designates all the steps taken by public authorities to choose an environmental labelling scheme, as distinct from the trial projects conducted to test various labelling formats with consumer audiences. The notion of environmental labelling scheme encompasses all the components to be taken into consideration, from construction of environmental indicators to choice of display formats and implementation mechanisms.

The scientific council for the pilot programme brought together members from public research bodies, with a broad range of specializations: agronomy and environmental sciences, industrial engineering and food processing, organizational sciences, economics of consumption, social marketing, epidemiology and evaluation of public policy.

The work of the council was to outline the scientific foundations of potential labelling mechanisms, to examine the conditions of their implementation and to evaluate the potential qualitative and quantitative impacts of environmental labelling on consumers. For this work the council relied on the expertise of its members, consulted the scientific literature, and auditioned scientific authorities on aspects outside of the domains of the council members.[1] The council's input included the work of its working groups and the results of the trial projects conducted under the pilot programme. The council also commissioned specific studies to determine the reactions of consumers to different label formats.

The overall objective of the pilot programme was to draw up a proposal for an environmental labelling scheme backed and promoted by the national government. To meet this goal the council believes that:

- The environmental labelling system must have solid scientific foundations grounded in a broad international consensus. The scientific merits of the scheme will have to be presented and defended before European institutions where the methodologies of environmental assessment and food information mechanisms are examined in light of information provided by the scientific community.

- If for operational reasons or motives linked to practical implementation in the short term the proposed system varies from common international practice these changes must be transparent, well documented, and temporary, until internationally accepted practices are put into place. The council is favourable to a progressive approach, starting with initially incomplete environmental labelling that will integrate new information, knowledge and methodologies as they are acquired and validated by the scientific community. Any environmental labelling mechanism must include processes for regular revision of its underlying parameters.

[1] The scientists consulted were Valentin Bellassen, Marc Deconchat and Philippe Roux, all affiliated with the French National Research Institute for Agriculture, Food and the Environment (INRAE).

The ultimate choice of an environmental labelling scheme for food products will not depend on scientific arguments alone, however, as solid scientific knowledge is lacking in some areas and subject to as yet unresolved controversy in other domains. And while many environmental impacts that enter into environmental labelling are grounded in solid science, other aspects are the object of democratic debate. For these reasons the scientific council could not propose a closed labelling system or legitimately choose between the different schemes proposed by various categories of stakeholders. The council set itself the tasks of identifying feasible options, discussing their scientific merits, outlining conditions for their implementation and assessing possible impacts, in particular on consumer behaviour.

This work focused on six questions: What environmental issues should be taken into account? What objectives should be targeted? What data should be used, and how? What methods are to be preferred for evaluation of environmental impacts? What environmental scores should be selected for labels? What label formats should be proposed?

1. What environmental issues should be taken into account?

Most environmental labelling systems that have been tested to date in other countries have given precedence to climate criteria, and have focused consumers' attention on greenhouse gas (GHG) emissions. Meanwhile, other environmental issues have come into stark relief, notably the decline of biodiversity. Consequently it is logical that environmental labelling for food products should not be limited to climate impacts alone. This position is in line with the intentions of lawmakers in France, who have adopted amendments to the Environment Code (Art. L. 541-9-11) requiring environmental labelling on food products to integrate not only climate impacts, but also effects on biodiversity, impacts on consumption of water and other natural resources, and generally "all environmental externalities linked to production of the goods and services in question."

It should be noted that health effects are not explicitly included in this list. Nonetheless, the methodologies commonly used for environmental evaluation of products include aspects related to ecosystems and to human health, for example via toxicity indicators. Research work has increasingly underscored the need to integrate the dimensions of environmental and human health in environmental impact evaluation. In addition, health issues are a prime concern of consumers and the public, and could constitute a powerful lever for action that is beneficial to the environment.

Two aspects must be approached separately, however. The first of these is environmental health at the first level, referring to exposure of populations to pollutants released to the environment (particulate matter in the air, water pollution, etc). Assuming that methods and data for accurate evaluation are available, the scientific council believes it is appropriate to take this dimension into account for environmental labelling. The second area of health impacts concerns the risks associated with contaminants that may be present in food products – pesticide residues, for instance. This dimension comes under food safety regulations, and the relevant information display is stipulated in detail, in particular by EU regulation 178/2002 laying down food law and food safety procedures in the European Union. If this aspect were to be included in environmental labelling the labelling scheme could be found to conflict with national and European regulations, with significant legal risk. Environmental labelling backed by the national government must necessarily be consistent with the positions held by health agencies, and in particular with their ways of evaluating risks associated with ingredients or foods. This discussion extends beyond the framework of environmental labelling and in our view must be debated in its own right.

In addition, environmental information may be juxtaposed with other product information, such as nutritional data, and may not always converge with these analytical frameworks. In short, a product with low environmental impact may not be good in nutritional terms, and inversely. This shows that it

is desirable to make both types of information – nutritional and environmental – systematically available on packaging and at the point of sale.

2. What objectives?

Going beyond consumer demands for transparent information on the characteristics of food products, the prime objective of environmental labelling is to enable consumers to include environmental considerations in their criteria when purchasing food. With information on the environmental impacts of the products on offer consumers can reduce their environmental footprint by choosing products that have less impact on the environment than the products they have previously bought.

The environmental impacts of household and individual food consumption are determined by choices in two main categories.

- Within a given product category, environmental labelling is intended to guide consumers to choose products obtained using production, processing and distribution modes that are less harmful to the environment than others on offer. The environmental characteristics of consumer products can vary widely between products in the same category. These characteristics are determined by the ways in which products are processed and distributed throughout the value chain, from farming techniques to consumer purchase. Environmental labelling will make these characteristics and the differences between products visible, and bolster producers' effort to reduce their environmental footprint. In turn this will encourage other producers to adopt production methods, processing techniques and modes of distribution that are better for the environment.

- The combination of product characteristics and amounts consumed determine the "dietary regimen" of consumers. This regimen is changed when consumers modify the amounts (in weight) of the different foods that make up their dietary consumption. The environmental information conveyed must enable consumers to shift from one product category to another.

One of the major challenges in creating an environmental labelling system is to determine the balance between these two types of consumer choice. Should one of these levers be preferred over the other, or should the two be mobilized together, to complement one another, informing consumers on substitutions within product categories and at the same time encouraging them to replace a product in one category with a product from another category?

An overwhelming majority of scientific articles on the medium and long-term perspectives for food production and consumption suggest that producers' methods and consumers' behaviour – and above all their diet – will both have to evolve in order to achieve significant progress towards environmental objectives. This does not mean that environmental labelling on products must necessarily aim to mobilize both of these levers at once. Other public policy instruments may be used on both fronts: on the supply side, support for innovation, fees charged for environmental services, etc, and on the demand side, information campaigns, subsidies, etc. Nonetheless, the scientific council proposes environmental labelling on products that acts on both levers at once, for two reasons.

The first is that lawmakers have expressed their desire to address a broad range of environmental impacts, e.g. climate change and also preservation of biodiversity. Where climate change is concerned, action can be taken at the level of agricultural production, to encourage less use of mineral fertilizer, more legume crops, soil carbon sequestration, methanization, and more. Action can be taken at each stage of value chains. But much research work shows that change in diet, and specifically in the balance between meat products and vegetables, is a significant lever for reducing the climate impacts of food. As for preservation of biodiversity at the field level, and for reducing pollutant emissions to air and soil,

the levers for change are largely connected to production methods, e.g. fewer inputs, control of effluents, crop rotation, agroecological infrastructure, etc. To guide consumers products must be differentiated by mode of production, within each food category. In sum, to address these two environmental issues – climate and field-level biodiversity – consumers must be informed of the environmental impacts associated with each of the major food categories, and of the impacts of different production methods.

The second of our reasons involves economic and social considerations. Measures to reduce environmental impacts are often costly, both at the farm level and in food processing activities downstream, leading to higher prices for consumers, to remunerate the efforts of suppliers and companies in the value chain. Should an environmental labelling system be designed exclusively to guide consumers to substitute products within a given category, and hence to choose products that are more expensive because they are better for the environment? If the desired path is to encourage purchase of products obtained with more stringent modes of production, and therefore more expensive, the overall food bill will rise. This may be acceptable for some consumers, but not for all. To avoid an excessive increase in food costs, one solution would be to aim for a combination of the two, with both substitution of more environmentally friendly products within categories, and a shift between food categories to foods with a lower impact on the environment. The latter would depend on a change in diet for consumers. This option calls for an environmental labelling scheme that provides consumers with the information they need to make informed choices both within and between food categories.

Public authorities must nonetheless be attentive to the possible consequences of environmental labelling in terms of social equality, and complementary measures must be envisioned to avoid promoting changes that place an undue burden, of dietary change or financial costs, on the poorest segments of the population.

3. What data should be used, and how?

Approaches to environmental labelling have been tested by companies in various countries since the late 2000s, but these experiments have been limited in scope, for at least two reasons. The first is the complexity of LCA when used to characterize the specific environmental impacts of products on the market. A great amount of data is required, and this is a costly process, in particular for small and medium-sized businesses. The second reason is that companies have little incentive to divulge the environmental impacts of their products if consumers do not pay them for the improvements they have made.

Three trends have changed the playing field. Consumers are demanding more information. New digital players have emerged, offering new information channels to consumers. These may spur wider implementation of environmental labelling. And measurement methods, calculation tools and data availability have all improved.

This renewal includes the creation of the AGB database that makes data on the environmental impact of foodstuffs and food products available to all stakeholders. This public database lists characteristics for 2 500 generic food products that are deemed to be representative of the diverse range of product types on the market today. An environmental impact value, called a "generic" score, is calculated for each representative product.

Using generic data reduces the cost of environmental labelling, but inversely it is not possible to give detailed descriptions to differentiate products within each product category. The AGB database comprises a limited number of representative references, in light of the hundreds of products marketed in each category. In this respect AGB does not adequately reflect the variability of impacts

depending on modes of production, processing and distribution, nor does it highlight the efforts made by companies and actors in the value chains to integrate notions of environmental design and production.

A median pathway has been identified by the Indicators working group, and is proposed by the scientific council. This approach seeks a compromise between detailed description of specific products, a costly solution, and the generic approach which is less costly, but falls short in terms of informing consumers of the variable impacts of specific products. This median pathway is based on AGB data, and consists of conducting "semi-specific" evaluations for each product on the market. The generic AGB values would be replaced by specific product values for factors with strong impacts, such as ingredients and recipes, packaging and transport. This evaluation can be carried out on the basis of publicly available data (ingredients, type of packaging, provenance), or using data supplied by companies and actors in the value chain. In both cases an impact value approaching a specific value is obtained, without having to quantify it as such. Trials carried out in the course of the pilot programme evaluated the variance between specific and semi-specific values, and these assessments show that the semi-specific values reflect the variability linked to the main impact factors.

This semi-specific framework opens up new perspectives for deployment of a high-quality environmental labelling scheme, particularly if implementation of environmental labelling remains voluntary. But there is a risk of incoherence if actors are authorized to use different values, from public sources or company information, to attribute an environmental score to products. This could lead to legal action contesting the environmental labelling scheme. In addition consumers may be confused if they have to compare products that are not evaluated in the same way or with comparable data. Furthermore, producers would have no incentive to use specific values if the generic approach generates a more favourable environmental score than that of their own products.

Several conditions must be met for successful deployment of semi-specific environmental labelling. These conditions touch upon regulation of environmental labelling, and the credibility and reliability of the data used.

- **Mutual agreement on a common methodology and shared responsibility for environmental labelling**

If actors are allowed to use data from different sources for environmental labelling, rules must be drawn up to specify which impact values are to be used and which actors calculate them. A collective agreement between stakeholders could be drawn up on the following model.

- Environmental labelling must be based on semi-specific values, based on either publicly available data or on company data.
- When a semi-specific value, produced and validated by a company or a professional organization, is available, this value and only this value is to be used for harmonized environmental labelling, including by independent platforms.
- If no producer-validated value is available, a semi-specific value can be estimated on the basis of public data and used for environmental labelling, including by independent platforms.
- Companies can use a specific value if they have the capacity to carry out evaluations at this scale. In this case, a specific value may be displayed in place of a semi-specific value.

In all cases, product assessment must be carried out in a consistent and compatible methodological framework. It must be transparent and allow traceability to support outside verification and/or institutional validation.

- **Necessary improvements to AGB to ensure consumer confidence in product evaluations**

The AGB database makes it possible to evaluate product impacts at a low cost, and to deploy environmental labelling in the near term. The trials conducted under the pilot programme show that this database is a useful resource for timely and resource-efficient evaluation of the environmental impact of food products. However, all actors must recognize the capacity of this database to faithfully reflect the conditions in which food products are produced, processed and distributed. The Indicators working group and some trial projects have identified ways in which the database can be improved. Under the pilot programme work has begun to adapt and validate the models used, and this work must be pursued and extended to all sectors of the food industry. Professional organizations and technical institutes have an important role to play here, so that AGB can become an industry reference. This work to improve the database must be carried out in collaboration with the scientific interest group Revalim (Réseau pour l'Évaluation environnementale des produits agricoles et alimentaires). Professional organizations in each branch of the food industry must:

(i) validate the nomenclature of food products and ascertain that the generic products referenced in the AGB database adequately describe the main types of products in their value chain;
(ii) characterize the main factors that contribute to variation in the impacts of the reference products;
(iii) for each factor, validate the list of factors identified and how they are taken into account to calculate the impact of each reference product;
(iv) validate calculations for each assessment mode.

- **Semi-specific value calculation tools for actors, and development of a platform to centralize data for display**

To hold down costs for producers and facilitate deployment of environmental labelling, software tools coordinated with the AGB database could be developed. These tools would be publicly available, to enable the actors involved to create semi-specific values by adjusting the AGB reference values according to the characteristics of a given product. At the farm level the INRAE-CIRAD MEANS software platform could be used to generate this data. Calculation tools for food products should also be envisioned to enable users to modulate, in a simple way, the default generic value, either on the basis of (i) lists of pre-established values, for instance different types of standard packaging, or using (ii) values produced by companies themselves, for example related to their own product packaging.

Whether they are established by companies or other actors who are not producers, the specific and semi-specific values must be centralized on a common platform, to avoid redundancies, ensure confidential transmission of certain data, encourage information exchange and build up a single reference database for environmental labelling. Information technology vendors and suppliers should be consulted for the development of these tools and the common platform. The pilot programme's trial projects have demonstrated possible options for these technological tools.

- **Clear rules of governance for the deployment of environmental labelling**

If environmental labelling for food products is to be deployed, according to a timetable to be set by public authorities, explicit targets and time frames must be set for the following phases:

- the AGB database must be revised and improved on the basis of input from professional organizations in various sectors of the food industry;
- software tools are to be developed to facilitate product evaluations;

- a platform centralizing values for labelling is to be implemented, and its mode of governance established, including evaluation methodology and measures pertaining to the confidentiality of data.

Given the uncertainties and the complexity of the procedures to be set up, governance is likely to be one of the most decisive factors in the successful deployment of environmental labelling for food products. This governance must be clearly set out, in a process involving companies and the value chain, specialists in environmental assessment and in information technology, consumer organizations and public authorities.

4. What methods are to be preferred for evaluation of environmental impacts?

Many studies using LCA methods have been conducted around the world to evaluate the environmental impacts of agricultural and food products. These initiatives assess all the life cycle stages of a product to determine its environmental impact, from extraction of raw materials and production processes, to use and final disposal or recycling. Life cycle assessment has two main phases.

- The first step is to quantify resource use and pollutant emissions for all stages in the product's life cycle. This assessment aims to be as exhaustive as possible, and spans acquisition and manufacture of all the commodities, materials and intermediate products required to produce the product. In this step databases such as the AGB database are indispensable to properly represent the complexity of the systems being studied.
- The values obtained for resource use and pollutant emissions are then aggregated to obtain a limited number of environmental impact indicators, such as climate change, land use, particulate pollution and ecotoxicity. For the purposes of this aggregation the values are multiplied by "characterization factors". Each characterization factor associates a substance with an impact. A given substance may have several characterization factors if it has a role in distinct impacts.

By using multiple indicators the products are subject to a multi-criteria environmental assessment. In this way LCA reveals any transfers of pollution. For instance, when assessing pork production, it can be observed that shifting from slatted floors to straw bedding for animals reduces eutrophication impacts due to nitrate and ammonia emissions, but augments the climate change impact due to higher nitrogen oxide emissions.

LCA methodology is based primarily on scientific knowledge and approaches to (i) choose or create models of resource use and pollutant emissions, and (ii) generate the characterization factors used to calculate impacts. LCA is constantly improving, driven by the work of a large international scientific community. The accepted methodological techniques are often informed by the broad consensus attained in other scientific bodies such as the International Panel on Climate Change (IPCC) and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES).

Under the PEF programme the European Union has issued its Recommendations 2013/179/EU for a set of reference methods to measure the environmental performance of products, in particular food products.[2] These methods are based on LCA and continue to evolve with the advances of international scientific consensus.
One option would be to use this methodological framework for environmental labelling, as it is the fruit of work at the European level and is supported by scientific consensus.

[2] https://eplca.jrc.ec.europa.eu/EnvironmentalFootprint.html

The PEF framework, however, like any approach based on ongoing acquisition of knowledge, has certain limitations. These limitations are well-known, and researchers have studied ways to overcome them. Certain points are still in debate: weighting of impacts according to the accuracy of knowledge; allocation of impacts associated with coproducts; choice of a functional unit based on product mass or linked to product nutritional value, etc. The LCA framework is sometimes contested on the grounds that it penalizes extensive productive systems because it fails to take into account certain environmental benefits procured by these systems.

Limitations to the PEF framework related to available data or methodologies have been discussed in the scientific literature. As a result of these limitations some environmental impacts are inadequately covered. Although the PEF approach includes several factors that affect biodiversity, such as climate change and eutrophication, biodiversity changes at the field level that are directly tied to agricultural practices are not estimated. It is legitimate to point out this drawback of the PEF method in relation to environmental labelling for food products, for which specific production factors are significant levers for action to reduce environmental harm and provide arguments in favour of certain products. Likewise, problems have been identified with quantification of toxicity and ecotoxicity impacts, threats to certain species and the proliferation of invasive species. These issues should be addressed to improve the PEF assessment.

It is vain to think that valid and consensual responses to these methodological questions can be found in the short term. Nonetheless the scientific council feels that is possible to suggest improvements to the PEF reference framework on the points outlined in Table 1.

- **Soil carbon storage**

LCA methods provide a way to observe variations in soil carbon (C) stored in the agroecosystems that produce foodstuffs; these variations may be the result of long-term trends, shifts to farming practices that sequester more carbon than previously used techniques, or changes in land use. Soil carbon stocks are associated with CO_2 emissions, positive or negative, and it is therefore legitimate and desirable to take these variations into account for environmental labelling. Numerical data have been summarized and published recently, enabling users to integrate these emissions (the "4 per 1000" initiative).

Soil carbon change trends can be readily taken into account, because it is relatively easy to associate a product with land use, e.g. permanent grassland or arable land. Following through on these remarks, the AGB database should be updated to include the results of the 4 per 1000 initiative.

It is more difficult to quantify additional carbon sequestration linked to adoption of specific farming practices, because this requires tracing and verification that the practices have indeed been implemented in the farming systems where the products are produced. Two possible solutions can be envisioned. If calculations are based on company data (or semi-specific values from professional groups) information exists on the practices associated with a given product and can be used for calculations. If calculations are based on public data, it is necessary to use quality labels, seals or certifications backed by publicly available terms of reference to link a given product to specific production practices. This involves using data from the literature to calculate default values for quality labels.

Even though it is legitimate to consider variations in soil carbon linked to changes in land use for the purposes of environmental labelling, this is hard to implement in practice. It would be a significant first step to take into account observed trends in carbon stocks and the additional carbon sequestered when specific farming practices are adopted. This would underscore the value of grass feeding for livestock and of cultivation techniques that enhance carbon sequestration.

The service rendered when existing carbon is conserved in the soil varies from one agrosystem to another, (e.g. permanent grassland or arable land). To take this "conservation" into account a supplementary indicator is needed, posing the problem of weighting coefficients, with the risk of over-rating conservation of soil carbon compared to other indicators used for environmental labelling.

- **Toxicity and ecotoxicity**

Proposals for toxicity and ecotoxicity indicators were formulated in the course of various trial projects. These proposals related to the data to be used. A revised distribution of substances in environmental compartments is suggested, to include air, water, soil and plant matter, and not just soil. The amounts of trace metals found in organic fertilizer were also discussed, as certain molecules in use at the time the AGB database was created have since been banned and are in principle no longer used. Updating the AGB data should be a high priority, and this work has already begun.

Other proposals relate to calculation of impacts, in particular the choice of a 100-year horizon for metals used as pesticides. The scientific council approves this choice, and feels that ideally the same horizon should be applied to all substances, for all uses. If this revision is adopted, characterization factors would have to be recalculated and made available to users.

One of the trials also suggested that indicators for terrestrial and marine ecotoxicity be added. This seems premature, at this stage. These new impacts are indeed a relevant concern, but are topics to be studied for future revisions of the environmental labelling scheme rather than for immediate action.

Another proposed change is to eliminate the human toxicity impact, because it is deemed to be incomplete and biased, due to data gaps in AGB. This impact could be replaced by corrective measures outside of LCA. In our view it is preferable to use proxies to compensate for the lack of data, rather than to introduce exceptions to the LCA framework. Generic values or the value of a structurally similar molecule can be inserted for missing values, or a specific value obtained automatically using machine learning tools.

- **Biodiversity**

Understanding the relationships between agricultural practices, food products and impacts on biodiversity is a complex task, given the multiple dimensions and scales involved. A great deal of research has been devoted to this subject, both within and outside of the LCA framework. A number of ways to better take biodiversity into account in life cycle assessments have been described in the literature. Some of these pathways were tested in trials carried out during the pilot programme. They have promise as ways to address this issue, but require further development.

One potential approach is to characterize agricultural practices that are associated with positive impacts on biodiversity. This approach raises two problems for environmental labelling regarding food products. (i) A given practice does not necessarily have the same effects in all circumstances, depending on the territory in which it is implemented, and it is difficult to quantify these impacts. (ii) In order to associate a biodiversity impact with a food product it is necessary to know what agricultural practices were used in cultivation. This requires traceability of this information, from the field to the final product. One way to address these two requirements is to focus on quality labels and certification applicable to food products, at least at the start. Some studies of the relationships between quality labels and biodiversity are already available. More broadly, a scientific review of these relationships should be carried out to assess the labels' terms of reference and criteria in the light of biodiversity impacts. On the basis of such an assessment it should be possible to pinpoint the values to be considered to evaluate the amplitude of impacts on biodiversity linked to agricultural practices under different quality labels and certification processes.

In this case a rapidly operational solution would be to add a new impact category of "biodiversity at field level" to the LCA framework This category would rely on two parameters. Firstly, a coefficient expressing biodiversity benefits associated with various labels and seals, compared to conventional practices. And secondly, a weighting factor for this impact category, in relation to all the other categories (climate, etc) that would necessitate weighting of societal concerns, according to an arbitration process to be established. The scientific council has drawn up a calculation process to integrate this additional indicator.

Regarding endangered species, LCA takes many impacts of fishery practices into account, but the direct pressure on marine species is not represented in the PEF method or in other methods that are currently operational. Methodological proposals have been circulated, and adding a new impact category would be one way to include impacts on endangered species in environmental information for food products. For the time being the only feasible way to do this is to use semi-specific values based on company data. At present the requisite information is not available in the AGB database. In addition to values, the weight of this impact relative to other impacts must be determined.

Other factors could possibly be integrated in the future, but before this can be done more extensive knowledge is required and an international scientific consensus must be obtained.

5. ***What environmental scores should be selected for display?***

Current tools for assessment of the environmental impact of food products can be enhanced by improving databases (in particular AGB) and amending the PEF framework on the points specified above. In this way the range of impacts associated with different production systems would be better taken into account.

Some actors have proposed in their trial projects to add bonus/penalty points as a corrective measure to refine the PEF scores obtained for products. The list of additional indicators is long and diverse. These proposals can be classed according to three types of objectives.

- **Compensate for lack of data**

In some projects, when a generic value from AGB is used to evaluate a product impact, it may be appropriate to correct this value, because product transport distance is lower than the average, or because it comes from a country that uses more farm inputs than for the average value. Bonus points or penalties would be used here to make the AGB value more "specific".

In our view the prime objective of this type of correction should be to improve the database rather than to introduce additional indicators intended to correct the data. Furthermore, the goal of the proposals outlined above for data and data use is to base environmental labelling on semi-specific values. This would largely address the issue of available data. In our view there is an alternative to external corrective measures in the form of bonus/penalty points. A more robust way to correct average values would be to apply a coefficient to the impact and to the life cycle phase that enter into the calculation of the semi-specific value in the LCA process. These coefficients would have to be calculated and backed by supporting arguments, of course. Seasonal products can be differentiated by modulation of the agricultural production phase, for instance a coefficient to correct for the absence of a heated greenhouse. A corrective coefficient can be used to account for recyclable packaging materials used instead of generic packaging, and so on. In some trials a detailed calculation chart was proposed for automatic calculation of these coefficients.

- **Integrate environmental issues that are insufficiently or not at all covered by LCA**

Some trials propose to introduce correctives outside of the LCA framework to measure field-scale biodiversity. These additional criteria are based on agricultural practices or the presence of agroecological infrastructure. The final LCA score is modified by application of bonus or penalty points. This solution is in some cases implemented without distinguishing between different life cycle stages (production, transformation, distribution) or the relevant indicators. In our view this approach is less rigorous than the one we propose above. While waiting for a consensus on indicators, within or outside of the LCA process, to quantify the relationship between food products and biodiversity, there are several advantages to the proposal to introduce a new impact category for LCA. (i) This solution is transparent, in that it explicitly expresses the scope of benefits attributed to different production systems or labels compared to conventional practices, on the basis of the scientific literature. (ii) This solution transparently ascribes a weighting factor to this indicator, directly comparable to the factors applied to all other indicators. (iii) This system can be easily revised to reflect new knowledge, and modes of calculation can be readily replaced with new methods as they become available.

Following the proposals for toxicity and ecotoxicity outlined above it would be possible to rapidly address certain limitations of LCA, with respect to data and updating of the AGB database or modelling approaches. Additional indicators have been suggested in trial projects. These new issues are indeed a relevant concern, but in our view they are topics to be studied for future revisions of the product environmental labelling scheme. One objective is to move on from qualitative considerations to quantification of impacts.

One major aspect that is not covered by current LCA methodology concerns the health consequences of contaminants found in food products. As mentioned above this subject must be addressed separately, given the specific regulatory framework in place for food safety labelling.

- **Amplify the variation between products**

Actors have also proposed additional indicators and associated weighting factors as a way to amplify the differences between LCA scores assigned to products, or even to change their ranking.

Sensitivity analyses of impact evaluations such as those characterized by an aggregated environmental footprint score show that some levers for action in the value chain and measures taken by companies have effects that have low visibility on the five-level scale of assessment. In light of this low sensitivity of product rankings to certain types of action on the supply side, some producers want to amplify the differences between scores, either to increase their appeal to consumers (e.g. amplifying the impact of packaging because consumers believe this factor has a strong impact on product environment impact) or to support companies' efforts (e.g. taking corporate commitments into account, and not only product characteristics). But introduction of bonus or penalty points would distort the previously established relationship between a product and the environment, for reasons unrelated to existing environmental impacts. In our view it is preferable to address the low sensitivity of calculations to some forms of action by adjusting label formats, for example increasing the number of levels in the scale, or introducing a numerical value, rather than changing the environmental score (see section 6 below).

Additional indicators, outside of the LCA framework, can be considered for strategic reasons or to further other public policy objectives. It may be desirable to support activities and production systems that provide environmental services other than those quantified in the current models, or services beyond the domain of the environment. These options are determined by political decisions.

Generally speaking we feel that it is important to exercise restraint when introducing non-LCA indicators, to include as few as possible and carefully control their impact on the final aggregated score,

as these effects may be considerable. If government authorities want to include non-LCA indicators for operational or strategic reasons, a set of rules must be in place to ensure these indicators are rigorously constructed.

- Any corrective factor applied must address an explicit environmental objective and the scope of the correction must be substantiated. The process for applying the additional indicator to the initial score must be transparent and clearly explained.
- Additional indicators must not be redundant with other items already included in the LCA or with other corrective measures. The same effect must not be corrected twice.
- Corrective measures applied to one stage of the product life cycle (production, transformation, transport, etc) must be implemented only for this stage and not others.
- Measures applied to one impact category (climate change, toxicity, etc) must be implemented only for this category and not for others.

Non-LCA indicators must also be examined in light of the changes they induce in weighting factors. If additional indicators associated with various bonus and/or penalty points are taken into consideration the relationship established between a product and environmental impacts by LCA (even when corrected by the proposals listed above) may be considerably modified. This is particularly true if bonus/penalty points are attributed after a change of scale used to express the score (application of a logarithmic scale). If this is applied, as suggested in several trials, a 20-point bonus attributed on the basis of a non-LCA indictor would reduce the LCA environmental score by up to 50% (depending on the mode of calculation). This is a very strong correction, that weighs much more on the final score than the weighting of indicators in the LCA calculation. For example, if a bonus of 15 points is attributed to a given production mode for its beneficial impact on field-scale biodiversity, and estimating that these benefits are twice those of conventional production techniques, the ultimate outcome will be to consider that biodiversity is 20 times more important than climate change. Certain additional indicators have the effect of strongly reducing the weight of climate change in the final environmental score, and may even result in decorrelation of the final aggregated score and the climate change indicator. The end result would be an environmental labelling system that would be ineffective in terms of reducing climate change impacts.

6. What display formats should be used?

Assuming that quantitative environmental impact values for food products, such as PEF scores, have been determined in the ways outlined above, the next step is to decide how these environmental scores are to be used to inform consumers of the impacts of food purchases.

The label format is the visual presentation of information made available to the customer at the time of purchase. This format is described in detail by a set of objective criteria. The information is meant to be displayed on packaging surfaces that are visible to consumers for in-store purchases or displayed onscreen for online purchases or in digital consumer information applications. The choice of label format is guided by two main considerations:

1. The **graphic design** per se, including analytic or aggregated information, use of letters, numerical values, symbols, colours, etc, and the level of interpretation presented in the display.
2. The **calibration** of the score, i.e. the stages used to transcribe the environmental score in a display format. This refers to the scales used, the number of classes or levels, the ranking of products by food category or across all categories.

Several projects propose that the PEF value be converted to a score on a scale from 0 to 100. This is justified when the aim is to use a numerical value in environmental labelling. But this change of scale

must be rigorously executed, because the choice of calibration method will have an effect on the ranking of products.

The calculated environmental impacts must also be correlated to a functional unit. Various studies reveal significant differences in product ranking according to the functional unit used. The scientific council proposes that the classic approach be followed, and impacts correlated to kilogram of product weight (functional unit of mass), for all product types. Other systems have been proposed, notably to take the nutritional value of different foods into account (functional unit of nutritional value). The nutritional contribution of products is important, but there are problems and questions associated with the use of nutritional value as the functional unit.

First of all, nutritional information is already displayed on products. In our view the combination of nutritional and environmental information should be coordinated to enable consumers to perceive the convergence or divergence between nutritional and environmental impacts for a given product. This would be more transparent and easier to understand than information based on different functional units for different food categories – protein for meat products, calcium for dairy products, fibre for fruit and vegetables, etc.

Furthermore, it would be necessary to create different environmental information formats for each food category if nutritional units are adopted. As a consequence the system would no longer present comparisons allowing consumers to consider substitute foods across categories, and this would deprive it of one of the levers to reduce the environmental impact of food consumption.

Environmental labelling must be assessed according to specific criteria to determine how consumers react to packaging display or onscreen information, when purchasing or consuming food products. Information on consumers' reactions can be gathered all along the pathway from purchase to final disposal: does the display catch their attention, are they inclined to read it, are they motivated to seek out information, are they able to find it, how do they perceive, understand and interpret information, what are the impacts on their intentions, their purchases, and ultimately on the environment? The performance indicator to be adopted is the impact on food choices at the time of purchase. All the prior stages that inform and motivate this choice should be consistent with the desired goal. It should be noted that the surveys carried out in trials under the pilot programme focused on intermediate performance indicators such as perception and comprehension, rather than on indicators of capacity to effectively inflect the final choices.

- **General findings on product labelling**

In recent years much research has studied food information, particularly nutritional labelling. This work has furnished a list of variables linked to differences between display formats that result in different behaviours. This research also explores various methods that introduce these variables, and their consequences for the behaviours they induce. These findings show that the effects obtained vary widely with label format, confirming that this aspect is of significant importance.

An effective format is one that stands out and draws attention. To achieve this the label should be standardized, in a single and immediately recognizable format placed where consumers expect to find it on product packaging. For enhanced visibility it is preferable that the label be in colour. The most effective labels draw upon empiric processes that are familiar to consumers, leading to implicit associations that make them easy to use. One example is the Nutri-Score format that follows the format of energy consumption labelling. The colours red and green are rapidly translated into a decision. To be effective, the practical utility of the information displayed will be readily anticipated by consumers. To this end the label should directly signal an interpretation of product quality that can be immediately transposed into a decision and choice among products. Other degrees of information, on

a scale of several levels for instance, should be explicitly given on a spectrum that stands out on each product, e.g. a colour scale. Through this label consumers are made aware of the full range of possible values and of the product's ranking on the proposed scale.

If a format is to effectively change consumer behaviour it must synthesize information. A label that includes separate analyses of several components is less effective, because it obliges the consumer to arbitrate between factors. A label that is both analytic and interpretive may lead to dilemmas that must be resolved by the consumer, who may not have the knowledge needed to assess the stakes. Furthermore, this arbitration is generally too complex to be carried out in the setting of food purchases, where consumers make decisions in a hurry. An aggregated interpretive ranking may nonetheless be supplemented by analytic information. If consumers easily grasp the signal given by the aggregated indicator, the format will not be less effective if it includes analytic information to supplement, explain or substantiate the overall message. The availability of detailed data is important from the consumer point of view. The presence of this data makes the aggregated information format more credible and enhances users' ability to discern and judge information.

Calibration factors do not necessarily modify the amplitude of the average effects observed. Calibration does, however, result in the specific variations that lead to the observed effects, even if these changes are of equal effectiveness. A cross-category ranking leads to more shifts between categories (changes in diet); labelling by category leads to more changes within categories. In an experiment with nutrition information it was found that different levels of graduation lead primarily to changes in consumer behaviour at the extremities of the assessment scale (levels A and E in a lettered five-level scale).

Overall, the consensus of studies of nutritional information labelling is that colourful and interpretive aggregated label formats are the most effective in encouraging consumers to buy foods of higher nutritional quality.

- **Specific features of environmental issues**

While these findings are clearly established for nutritional information, they may not be directly transposable to environmental information, which differs from nutritional information in several key ways.

First of all, consumers have little knowledge of the environmental impacts of the food products they consume. Furthermore, consumers have a murky vision of the scope of environmental impacts, perceived as both vast and indeterminate. This scope is often associated with a number of other dimensions – social, "alternative", political, ethical, economic, cultural. The environmental criteria most often cited by consumers reflect concrete and immediate concerns, such as locally produced foods, recyclable packaging and quality seals. These criteria are imperfect indicators, and may even give a false impression of the environmental impacts of products. Research has shown that "false beliefs" often lead consumers to give low weight to factors with high impacts, and inversely.

This highlights that environmental labelling should include criteria tied to an intermediate goal, that of promoting better comprehension of environmental impacts. To this end it is important to underscore that the goal is to achieve long-term changes in consumer behaviour, and not merely unconscious changes driven by *nudge* display formats. On the contrary, the format chosen should augment consumers' knowledge and understanding of environmental stakes, so that they make an informed and informed commitment to change. Additional measures such as information campaigns on environmental issues, among other vectors, will be needed to improve the didactic value of environmental labelling.

Another question is the sensitivity of environmental scores to action by producers on the supply side and ways to make the impacts of different food categories more visible to consumers, in addition to the different impacts of various products within the same category.

- **Research findings on environmental labelling**

The scientific council has not sought to compare graphic formats (on this aspect we refer readers to the ESA study, the work done by the working group on formats, and surveys conducted for specific trial projects). Our goal has been to examine the possible impacts of different modes of implementation, i.e. calibration, for graphic displays that are considered to be effective in light of experience with nutritional information labelling. Two tests were conducted with consumers to assess the effects of environmental labelling on their intentions and real purchases.

The first experiment measured the impact on consumers' criteria for choices and their purchase intentions in two cases: presence or absence of a coloured five-level scale lettered A to E (similar to the Nutri-Score display) referring to an aggregated and transversal (across all food categories) environmental score such as PEF.[3] This experiment yielded the following findings:

- When presented with this label the environmental quality of food items selected by consumers increased significantly compared to their purchases in the absence of the label.
- Consumers' purchasing criteria were modified by the presence of the label. In the absence of the label, consumers were guided primarily by packaging, provenance or a quality seal in their selection of environmentally friendly items. With display of the environmental label, this information became the principal criterion used by consumers to gauge the environmental impact of products.

This second finding suggests that in the presence of environmental impact information consumers are less likely to use "short-cuts" such as packaging or provenance to evaluate the environmental quality of products. This leads to greater reduction of environmental impacts. This leads us to think that the environmental label replaces "false beliefs" with information to guide purchases.

The second experiment measured the effects of different label formats on consumer purchases.[4] A panel of 620 consumers were asked to choose items from among a selection of just under 300 products available on the market. The environmental impact of the products in the selection were calculated to obtain a semi-specific value that integrated corrective measures (ingredients, transport, field-scale biodiversity, toxicity, etc) applied to AGB data. The label formats for comparison were:

(i) a coloured five-level scale lettered A to E (similar to the Nutri-Score label) applied across all food categories;
(ii) a format similar to (i) applied to separate food categories; the aggregated five-level score (A to E) was determined on scale that is specific to four major food categories;
(iii) a transversal format similar to (i) based on an aggregated score (A to E) established across all food categories, supplemented by a number value from 0 to 100;
(iv) a transversal format similar to (i) based on an aggregated score (A to E) established across all food categories, in this case broken down into subscores by type of environmental impact (climate, biodiversity, etc).

[3] Study carried out at the Centre des Sciences du Goût et de l'Alimentation (Dijon) by L. Arrazat, S. Chambaron, G. Arvisenet, S. Nicklaus and L. Marty. September 2021.
[4] Study carried out at the GAEL laboratory (UMR CNRS 5313 / UMR INRAE 1215) by Philippine de Lattre and Laurent Muller. September 2021.

These trials show that:

- All four formats tested had an influence on purchases of environmentally friendly products and resulted in total purchases of significantly higher quality in environmental terms, as measured by the aggregated environmental score for all the products bought by individual consumers. There was little difference between the formats in terms of performance.
- The cost per kilogram of purchases was lower when environmental information was displayed, compared to a situation without environmental labelling. This change is due to substitutions between product categories. The cost reduction was slightly greater for the label plus subscores, and slightly lesser for labelling by category.
- The participants were receptive to the information given in the labels. All of the label formats generated a significant increase in purchases of products labelled A and B, and a significant drop in purchases of products labelled D and E. Labelling by category generated the most changes in product purchases, probably because this label format highlights differences between products within a given category, and it is easier for consumers to change to another product in the same category than to substitute products between categories.
- The display of a label plus subscores resulted in significant shifts to fruit, vegetables and legumes and to organic foods and "red label" quality certifications. This option led to the greatest shift favouring products with a quality seal that are presumably more expensive than standard products, and to a lower average price for products purchased. This observation is explained by substitutions of products between categories (changes in diet) that offset the higher cost of quality-certified products.

Overall these trials confirm the general findings reported in the literature for environmental labelling: (i) significant impacts for colourful and interpretive aggregated information label formats; (ii) distinct effects for transversal information formats *versus* display by category. Labelling by category encourages substitutions within the food categories. This option does more to highlight action on the supply side, compared to a transversal format, but has limited impact on dietary practices.

These trials also illustrate that the impact of an aggregated label is not reduced by the presence of additional information, and on the contrary may even be enhanced. The presence of a numerical value in addition to an aggregated ranking is conducive to both types of substitution, within and between categories. The additional information highlights incremental improvements on the supply side. This fine-grained information may seem excessive, however, in light of the uncertainties that underly environmental impact assessment.

Likewise the combination of an aggregated score with a breakdown into subscores helps consumers make substitutions within categories on the basis of different modes of production, and shifts between categories. The subscores make producers' action on the supply side more visible to consumers. This breakdown provides more information to consumers, without diminishing the overall effectiveness of the aggregated score.

Introducing a numerical value and/or the breakdown into subscores are effective ways to supplement the five-level ranking based on an aggregated score, in line with the fundamental objectives outlined above, i.e. providing consumers with information that is pertinent for changes both within and between food categories. All of this information must be made available to consumers on product packaging and on all other dedicated media (applications, websites, etc). Environmental labelling must also take into account that both nutritional information and the environmental label will have to coexist on packaging, and the two must appear on surfaces of limited dimensions visible to consumers.

7. Conclusion

The conclusion of the scientific council is that it is possible to design and implement an environmental impact labelling scheme that fulfils the goals expressed by French lawmakers. The components of this display are shown in Diagram 1. The selection and weighting of options will depend on decisions by public authorities. On the basis of its study of the literature, discussions in the working groups and the findings of trial projects, the scientific council makes eight proposals, as follows:

1. To provide incentives for changes in consumer behaviour of a nature and scope to address environmental issues and challenges, environmental labelling on food products must enable consumers to compare products within food categories, based on variables related to modes of production, processing and distribution, and between categories, with a view to encouraging changes in diet.

2. The environmental information provided to consumers via environmental labelling must be based on the metrics of life cycle assessment (LCA) in the Product Environmental Footprint (PEF) framework that is recognized by the scientific community and at the institutional level in Europe. In this framework a single impact score can be calculated for food products by aggregating various impact impacts, including climate change, resource consumption, emission of pollutants, among others.

3. Currently available data have limitations, in particular for the integration of environmental externalities in assessment of agroecological production, and this reference framework can be refined in the future. The scientific council believes that such amendments should be few in number, based on scientific knowledge, and consistent with LCA metrics insofar as possible. They should be used on a provisional basis, until the PEF terms of reference are revised. To address these questions the council suggests several corrective measures that can be rapidly implemented to better reflect impacts linked to soil carbon sequestration, biodiversity at the field scale, and toxicity factors.

4. To gather exhaustive and accurate data, and to hold down the cost of implementing environmental labelling it is appropriate to use both generic information from public entities, furnished by the Agribalyse (AGB) database, and specific data from private sources. Companies and independent platforms must comply with a collectively accepted set of rules for the display of this information, to ensure that accurate and consistent information is supplied to consumers.

5. The AGB database is a source of reference values for environmental impacts, and as such can serve in the deployment of environmental labelling. However, all actors must recognize the capacity of this database to faithfully reflect the conditions in which food products are produced, processed and distributed. It falls to professional organizations and technical institutes to pursue work to validate the data. Environmental labelling also calls for the development of semi-specific values that users can employ to facilitate their evaluations, and the development of a platform to centralize the values to be used for labels on product packaging.

6. Environmental labels must be concise, colourful and interpretive, in order to have a significant impact of consumer purchases. The label may be supplemented with, but not replaced by, analytical information referring to the various impacts considered to obtain the final score, information intended to increase consumers' knowledge and awareness of the environmental stakes.

7. Environmental labelling must cover the full range of food products and foodstuffs. A five-level environmental impact scale, based on a single aggregated impact score, is an effective tool to guide consumers and enable them to compare products across different categories – the "dietary change" effect. This scale does not always suffice, however, to help consumers compare products within a given category, and lead them to choose production, processing and distribution modes that are better for the environment. To achieve this the five-level scale must be refined.

8. Two complementary mechanisms are feasible and effective. An environmental score expressed as a value between 0 and 100 can be given to supplement (but not replace) the product ranking on the five-level scale. With this more finely-grained scoring it will be easier to compare products in the same category, and the environmental outcomes that can be attained by action on the supply side will be more visible. The five-level scale can also be supplemented (but not replaced) by breaking down the aggregated score into components assessing performance according to various environmental impacts (climate, biodiversity, etc). The possibilities of supply-side leverage will be highlighted by the variations induced in component subscores. This breakdown will provide more information to consumers, without diminishing the overall effectiveness of the aggregated score. It remains to determine how all these pieces of information (five-level score, numerical value, subscores) should be displayed on product packaging – grouped in one place or at separate points (e.g. front and back) – and on dedicated websites. The actors involved must also consider how the limited space on packaging is to be allocated between different types of production information and logos (environmental, nutritional, etc).

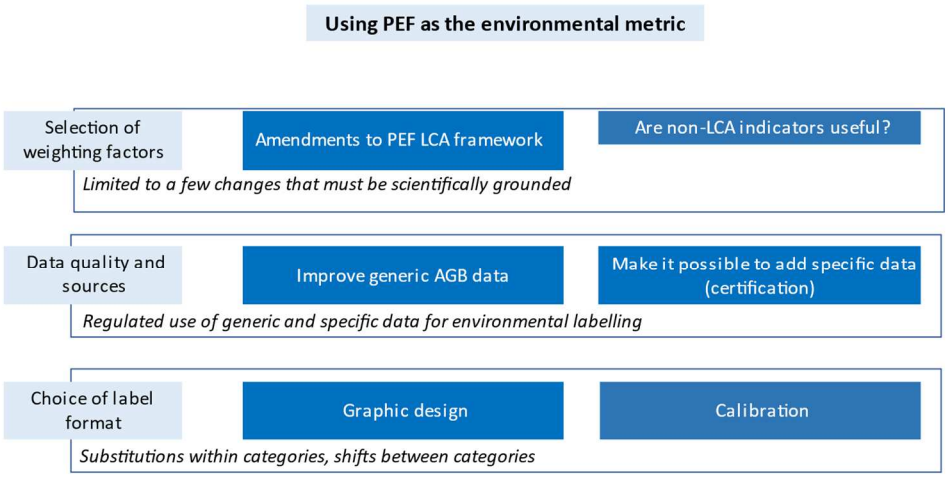

Diagram 1. Options to be arbitrated by public authorities

Impact indicators		Issues	Solutions	Projected implementation
Climate	Soil carbon storage	**Carbon storage trends**	Update AGB databases from "4 per 1000" findings	Short term
		Additional carbon sequestration due to new practices	Adjust the impact of climate change in light of farm practices (quality seals and certification data for semi-specific values)	Short term
		Soil carbon variation due to changes in land use	Modify data on a local scale (e.g. *département* , county or group of counties)	Medium term
		Serviced obtained by keeping carbon in grassland soil	Construct and weight a new indicator to reflect a variable that is not an actual flux	To be studied
	N2O	**Old AGB data**	Update AGB data from 2019 IPCC data	Short term
	Biogenic methane	**Modification of global warming potential for methane**	Follow IPCC recommendations	Medium term
Biodiversity	Plot biodiversity	**Option 1: Effects of practices on field-scale biodiversity**	Add and weight a new impact category. Set coefficients for quality labels and certification in light of scientific analysis of the relationship between labels and biodiversity.	Short term
		Option 2: Effects of practices on biodiversity	Change the land use impact category	Medium term
	Endangered species	**Threats to marine species**	Add and weight an impact category. Evaluate fish stocks. Semi-generic values are possible using company data.	Short term
Toxicity–Ecotoxicity		**Update and supplement AGB inventories**	Break down substances between compartments water-air-soil-plants; trace metals in organic fertilizer; update molecules in use and those banned	Short/medium term
		Toxicity–Ecotoxicity. Molecules with no data	Use approximate data: similar molecules and artificial intelligence tools	Short term
		Human toxicity, residues in foodstuffs	Technically possible to add an indicator. Study compatibility with regulations. Communication via labels	Medium term
		Ecotoxicity at field scale	Take biodiversity indicator into account at the field scale	Short term
		Metals	Set impact to 100 years for metals used as pesticides. Apply this timeframe to all substances	Short term
Resources	Water	**Water use**	Include water use data for all AGB data	Short term
LCA weighting factors		**EF weighting**	Compare EF weighting with other options (planetary limits), revise if necessary	Medium term

Table 1. LCA data and methodologies