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Environmental food labelling: revealing visions of the future food system to build a political compromise

Laura Brimont, Mathieu Saujot (IDDRI)

The environmental labelling (EL) of food products is currently being developed in France. As part of these efforts an experiment is underway to design practical labelling systems. The value of such a tool for the transition is its ability to influence consumption and production choices and to contribute to the evolution of the agricultural model. However, the process of defining official EL requires complex methodological and scientific difficulties to be resolved, as well as compromises to be made between the different political priorities. These trade-offs require discussions to focus on the diets targeted by environmental labels, and, ultimately, on the scale of the agri-food system that underpins this diet, as food sustainability cannot be assessed only on the scale of a product.

In this context, this study proposes an original interpretative framework to identify the diets and agricultural pathways that are implicitly favoured by the various methodological options proposed in the experiment. This explanatory work provides the opportunity to take a step back in order to facilitate decisions on methodological options. In doing so, we hope to reduce the risk of a multiplication of labelling tools, or even a postponement of its implementation, as has been the case in the past, which would be contrary to the urgent need for transition and societal demand.

KEY MESSAGES

The main proposals for environmental labelling (EL) converge on encouraging a reduction in animal protein (and an increase in plant protein), which is an essential component of the ecological transition. However, there are divergences on the evolution of the consumption of different animal products, which are linked to technical and scientific limitations, but also to different visions of what constitutes a sustainable agricultural system, each having a different prioritization of environmental issues.

The methodological discussion on EL reflects one of the main debates on agricultural transition: one option is a move towards a more extensive agroecological model, which favours complementarity between animal and plant crops to avoid the use of nitrogen fertilizers; the other is a relative continuity with the current intensive system. In the first case, significant changes in the consumption of animal products make this transition to another agricultural system possible; in the second, these changes simply accompany intensification efforts in order to reduce the pressure on the environment.

In the context of EL, these alternative models can be seen in the choice of additional indicators and their weighting, but also in changes to the Life Cycle Assessment (LCA) framework, which has become the foundation of EL.

Through a systemic and comparative approach to indicators, weighting criteria and underlying visions, this study helps to take a step back on the methodological issues of LCA and thus contribute to the discussions on a convergence towards a sufficiently robust and operational EA for the transition, a perspective which seems to us to be attainable in the short term.

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1. INTRODUCTION

1.1. Political context

The idea of developing environmental labelling (EL), particularly for food products, has been under discussion in France for about ten years. A first experiment in various sectors was initiated by the Grenelle laws, concluding in 2012 with the idea that EL had environmental value, but was difficult to generalize in the short term. In recent years, the EL implementation agenda has accelerated. Firstly, EL has benefited from progress made in the nutritional labelling field, notably with the adoption in November 2017 of Nutri-Score,[1] a voluntary labelling system on food packaging. Also, checking nutritional information has now become a widespread consumer habit via the development of food scanner apps, of which Yuka is the leading example: by the end of 2019 Yuka stated that it had been downloaded 13 million times, by the start of 2021 that number had reached 20 million.[2] Finally, EL has seen significant progress triggered by the anti-waste food law for a circular economy (known as the Agec law, *loi Anti-gaspillage pour une économie circulaire*) adopted in February 2020, Article 15 of which provides for the establishment of "environmental" labelling, or "environmental and social" labelling, initially on a voluntary basis, then becoming progressively mandatory.[3] A new step in the institutionalization of EL has since been taken with the Citizens' Convention on Climate[4] and its translation into the Climate and Resilience Law, Article 1 of which stipulates that EL will be made compulsory for certain goods and services (the categories of goods and services concerned will be determined by decree), after an experimental phase of a maximum of five years,[5] and must take impacts into account "in terms of greenhouse gas emissions, biodiversity loss and the consumption of water and other natural resources" and "also take into account the environmental externalities of the production systems of the goods and services considered."[6]

The Agec law provided for an experimental phase to evaluate the various methodologies and labelling procedures. In this context, in August 2020 the Agency for Ecological Transition (Ademe) launched a call for projects in the food sector.[7] The results of this experiment, which ended in June 2021, have been published on October 20, 2021, in the scientific council's synthesis report: they should serve as a basis for drafting the decrees that will define the methodology and methods of EL.[8]

The subject of EL is also being discussed at the European level. The Farm to Fork strategy for a fair, healthy and environmentally-friendly food system, which is one of the 11 components of the European Commission's Green Deal, aims to propose an EL framework to enable consumers to make sustainable food choices by 2024 (European Commission, 2020: 22).

1 https://www.lemonde.fr/planete/article/2019/09/20/deux-ans-apres-son-lancement-le-nutri-score-a-gagne-du-terrain-dans-les-rayonnages_6012481_3244.html

2 https://www.lemonde.fr/economie/article/2019/10/14/le-nutri-score-et-yuka-bousculent-l-agroalimentaire_6015367_3234.html and https://fr.calameo.com/read/004599499225c1e00742a

3 https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000041553759/

4 See Objective A in the Consumption topic, which proposes a carbon score on products to inform consumers.

5 This article has been the subject of proposed amendments by various stakeholders (e.g. Interbev, FNSEA).

6 See the adopted text. https://www.assemblee-nationale.fr/dyn/15/textes/l15b4336_texte-adopte-commission#D_Article_1er

7 Twenty projects have been submitted as part of this experiment, supported by a variety of actors: retailers (Les Mousquetaires, Carrefour, etc.), sectors (ATLA, Interbev, ITAB, etc.), collective catering (Elior), apps (Yuka, Open Food Facts), a business association (la note globale), etc. To find out more about the experiment's governance and protocol, see https://www.ademe.fr/expertises/consommer-autrement/passer-a-laction/reconnaitre-produit-plus-respectueux-lenvironnement/dossier/laffichage-environnemental/affichage-environnemental-secteur-alimentaire-experimentation-20202021 (accessed on 22 June 2021).

8 The generic objective that the experiment should address is: how can consumers be provided with legible, reliable and objective environmental information to enable them to steer their choices towards more sustainable food consumption?

1.2. The purpose of environmental labelling

a. Raising consumer awareness and guiding consumer choice

The main objective is to raise consumer awareness of the environmental impacts of food and to potentially guide their consumption choices by providing information on the environmental impacts of products (Dubuisson-Quellier, 2016). This awareness-raising work is particularly crucial given that consumers tend to strongly underestimate the environmental impact of food, especially in relation to the consumption of animal products.[9]

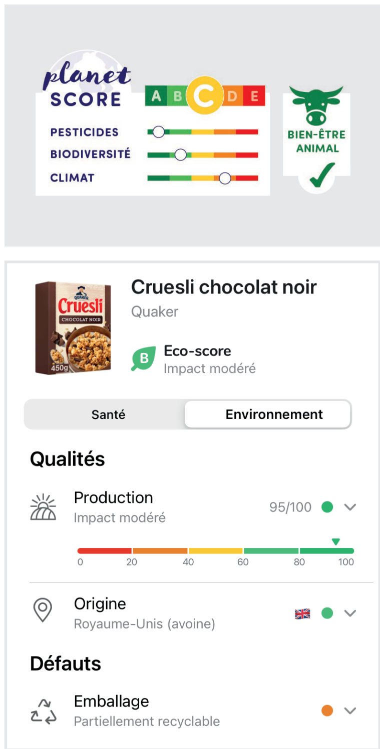
Recent scientific work shows that environmental labels can indeed be effective in guiding purchasing trends towards better environmental performance (Muller *et al.*, 2019; Feucht and Zander, 2018). The effectiveness of these informational devices in bringing about changes in consumption practices depends on several factors, ranging from consumer preferences and especially the importance attached to environmental criteria in purchasing, to the label design (Soler *et al.*, 2020). This work has enabled the identification of potential pathways (e.g. label design) that could maximize the impact of such a tool, the use of which appears necessary to bring about changes in dietary habits (Soler *et al.*, 2020). Assessments of Nutri-Score, a nutrition label, have shown the potential impact of this type of tool. A 2019 marketing study in France showed that since the advent of Nutri-Score on products, there has been a slight move towards "healthier" products (those rated A or B) at the expense of C and D-rated products.[10] An evaluation by the Ministry of Solidarity and Health in early 2021 concluded that 94% of French people were in favour of its presence on packaging, and more than one in two French people had changed at least one purchasing habit as a result (Government, 2021). The study shows that the logo is understood and used, "including by people with a low level of education or income".

Therefore, while EL has potential to raise awareness and guide consumer choices towards more sustainable food, it should not be seen as a magic bullet. It is only in conjunction with other initiatives and policies that EL will be able to contribute to building a strong and shared culture around healthy and sustainable food. Such a tool could, for example, be used to support educational activities and mobilization among a variety of actors at different levels (teachers, parents, activists, educators), as part of a broader work on food and its impacts. In the same way, an EL system could support the implementation of other types of public policies in the field of food. For example, it is possible to envisage environmental VAT policies

FIGURE 1. What does an environmental label look like?

An example of nutritional labelling: Nutri-Score

Two examples of environmental labelling:
Planet-Score and Eco-Score



indexed to the environmental impact of products (Smith *et al.*, 2018; Springmann, 2018), or commitments by retailers in terms of changes in the average consumer basket that would favour the best products in environmental terms.[11] Finally, in terms of public policies for healthy and sustainable food, while many actions are ongoing regarding collective catering (especially school catering), although this only accounts for a small proportion of total meals, as well as regarding the fight

9 Regarding meat consumption in France, see https://www.lepoint.fr/debats/les-francais-sous-estiment-largement-l-impact-climatique-de-la-viande-29-04-2021-2424270_2.php and in the UK concerning food more generally, Steentjes et al. (2021).

10 https://www.lefigaro.fr/conso/alimentation-le-nutri-score-modifie-les-habitudes-de-consommation-des-francais-20191009

11 If these commitments are monitored and evaluated by civil society actors, they can become real drivers for progress because the reputations of companies are at stake. See in this respect Pour un réveil écologique (2021). Grande distribution alimentaire: des entreprises hyper écologiques ou hyper irresponsables?

against waste,[12] not much is being done concerning food eaten at home and away from home. The introduction of a logo on packaging and apps equipped with an environmental indicator would begin to build momentum for action in terms of steering domestic consumption.

The three examples provided here all present an aggregate and prescriptive score (from A to E), with an easily identifiable colour code. Sub-indicators can also be displayed, as is the case for Planet-Score, which provides three different environmental sub-indicators and an additional animal welfare indicator.

b. Developing an environmentally-friendly approach and guiding the supply

The second commonly accepted objective of labelling schemes is to encourage more environmentally-friendly products, i.e. to encourage manufacturers to offer better quality products. Indeed, the addition of environmental information on products can endow them with a new type of marketability (in addition to price, brand awareness and practicality for example). In a context of a competitive agri-food market, EL is likely to produce a shift towards environmental issues. It is also likely to contribute to changing the expectations of industrial actors. This mechanism for driving and steering supply is also favoured by the opinions revealed in consumer surveys, according to which consumers are increasingly sensitive to food-related environmental issues (Dubuisson-Quellier and Granier, 2019). Here again, the Nutri-Score experience provides interesting facts for evaluation: although voluntary, Nutri-Score was quickly adopted by food manufacturers, with more than 400 companies involved in the initiative in July 2020, representing 50% of the market share in terms of sales volume (French Government, 2021).

It is important to note here that this environmentally-friendly approach does not follow the same terms as in the industrial sector. Indeed, unlike industrial processes, methods of agricultural production cannot be entirely standardized, insofar as they are in constant interaction with the local natural processes (soil quality, weather conditions, etc.). It is therefore more difficult to standardize the environmental impacts of different agricultural production systems. However, it is this agricultural phase, and not the subsequent processing phase, that dominates the environmental impact of food products.[13] We return to this point later in the text.

c. The requirement for a recognized vision of the agri-food system

As a tool for guiding food demand and supply, environmental labelling defines a vision of an agri-food system. While this objective is more implicit and less often discussed–it is not one of the objectives identified in the current experiment–it

FIGURE 2. The different objectives of environmental labelling

Guiding consumer choice

Guiding supply towards environmentally friendly options

Contributing to a recognized vision of the agri-food system

is no less important. The definition of a recognized vision for healthy and sustainable food and agriculture is still the subject of scientific controversy and political debate in France and throughout Europe. In a forthcoming article, Bolduc *et al.* show that there are currently different visions for a European food transition, particularly regarding protein. Advocates of these different visions are seeking to exert political influence on major programmatic texts such as the European "Farm to Fork" strategy (Bolduc *et al.* in review). In this context of confrontation between different visions of sustainable food, the definition of an EL indicator is highly strategic, given that it reflects political decisions about what matters and what should be encouraged or, on the contrary, what should be penalized. Indeed, the idea is that EL can contribute to changing the agricultural model, by defining a vision and relying on the consumer and market mechanisms to put a set of changes into motion. Thus, for example, the way in which agricultural production modes are accounted for in the calculation of the final score (e.g. how much importance to assign to the "organic" label) is an indirect way of affirming collective support for certain modes of production rather than others.

Designing an EL indicator thus implies making political trade-offs on certain aspects of the agri-food transition and defining a kind of recognized vision. In turn, by relying on consumer power and the market mechanisms in the production sphere triggered by this product rating tool, EL could help push for a reference model. The lack of clarification regarding this vision is one of the elements that complicates today's EL debate. It is also the main issue that this work aims to address.

These three objectives are compatible in principle but are not always achievable to the same degree. Indeed, the methodological choices underlying labelling may favour certain objectives over others. For example, favouring the environmentally-friendly aspect of EL requires precise data at the product level, whereas the objective of guiding consumer choice is relatively well suited to more generic data associated with product classes.[14] An imprecise signal in terms of production methods can be sufficient for the guidance tool, whereas actors who want to define a recognized vision attach great importance to the hierarchies used by EL in terms of agricultural production modes. There are

12 Notably via the 30 October 2018 law on balanced trade relations in the agricultural and food sector and healthy, sustainable food for all, commonly known as the "Food Law" or the "EGalim Law".

13 Upstream agriculture–the production phase–represents 83% of environmental impacts on average (Ademe, 2020b).

14 This brings us back to the debate on the need for specific data for life cycle assessments (LCA), an issue that we revisit below.

therefore potential issues of compromise between objectives, at least in the short term.

1.3. Designing an LCA-based environmental label: a scientific, methodological and political challenge

Life Cycle Assessment (LCA) is the most advanced method for assessing the environmental impacts of a product or service. This methodology enables the measurement of the various effects of a product or service on the environment (including global warming; soil, air and water pollution; resource use; etc.) for its entire lifespan. Moreover, at the international and European level there is a standardized method (ISO 14044), which allows an EL system to be envisaged that could be applied across several countries or regions. It is therefore logical that the Agec law makes LCA the basis of the future EL system in its Article 15. In France, the translation of this tool in terms of food is the Agribalyse database,[15] which has been under development since 2013. This database consists of 16 impact indicators[16] (climate change, water depletion, eutrophication, etc.; see Table 1) that are weighted to calculate a single score per product or product type. The Agribalyse LCA approach is based on a kilogram of product, which currently dominates the technical and political debate, notably due to the lack of consensus on an alternative unit that would better represent the functions of food (e.g. energy, by using kcal)[17]. No functional unit is neutral in terms of impact calculation, and therefore this choice, like many others, has consequences on the signal given by LCA.

However, designing an LCA-based environmental label raises three types of issues: (a) scientific issues linked to the difficulty of assessing the impact of an agricultural product without taking the overall quantities generated into account or the general production system; (b) methodological issues relating in particular to the current limitations in the representation of certain environmental issues in LCA; and (c) political issues, given that setting up a multi-criteria indicator of environmental degradation necessarily requires a hierarchy to be established between the various issues.

15 This database is itself part of a European initiative launched several years ago, called Product Environmental Footprint.

16 The European Product Environmental Footprint (PEF) framework proposes 16 indicators that are aggregated into a "single score" (PEF singlescore). However, for the food sector, the Agribalyse partners consider that the 2 human toxicity indicators are not currently robust enough to allow their use/interpretation. Thus, they are not published by ADEME (but can still be calculated in LCA software). On the other hand, they are well integrated in the final single score to respect the PEF method, but with a very low contribution (about 1 to 2%). Consistency work is planned for the next updates, according to the future recommendations of the PEF and the conclusions of the environmental labelling experimentation.

17 See in particular WG Indicators note no. 6 and note no. 5.

a. It's not about whether a product is sustainable, but whether its production system is

By design, LCA is a product-based approach. In practical terms, this means that EL will give an indication of all impacts associated with, for example, the production of one kilogram of ham. However, this assessment does not consider two systemic dimensions: 1) the overall quantity produced and its concentration in certain regions; 2) the interactions between crops in the agricultural system.

1) The overall quantity produced in each area has a strong impact on the sustainability of the production system regarding biophysical limitations: land and nutrient availability, the environment's capacity to absorb waste and preserve biodiversity, etc. To consider the example of pig farming:[18] from an environmental standpoint, the impact of this sector depends largely on the production system, and especially on the level of "intensification" undertaken to maximize production. The intensification of production has led to the concentration of large numbers of animals in certain regions, which causes significant pollution issues (nitrates, green algae) since the amount of livestock effluent produced greatly exceeds the amount that the local natural environment can absorb. Another example highlights the importance of the link between the overall quantity supplied to a food system and the production mode, for example: irrigation becomes necessary for meat-rich diets to provide a sufficient supply of maize to livestock farms. Therefore, analysing the environmental impact of *one kilogram of meat* cannot be carried out without considering *total meat production*. However, LCA provides averaged impact assessments that are assumed to be independent of total quantities.

2) The issue of crop interactions is another aspect. Indeed, an important component of the sustainability of an agricultural system is its capacity to ensure the retention of soil fertility, particularly nitrogen, without resorting to synthetic fertilizers. This can be achieved through crop complementarity (particularly the introduction of leguminous rotation crops capable of nitrogen fixation from the air), as well as through complementarity between livestock farming and plant crops, which allows the transfer of nutrients between legume-rich permanent grasslands, which fix nitrogen, and cultivated fields.[19] This illustrates the complementary relationships between the production of different agricultural crops, as well as between crop and livestock production: an agricultural product becomes sustainable when it is "co-produced" with other elements of the farming system. Another example of interaction in agricultural production is between milk and meat production, which mostly come from the same farming systems, as described in section 3 which highlights the difference between product-based and system-based assessment approaches.

18 See also the recent example from the Netherlands on this issue of environmental saturation linked to intensive livestock farming.

19 We envisage here a situation where synthetic nitrogen fertilizers made by chemical processes are no longer used. This point is discussed below.

Thus, although the product approach is valuable in several respects, LCA does not fully assess the sustainability of the overall production of a given commodity. This is where scenario-based approaches can be valuable, which start from agricultural systems and their biophysical limitations to determine the place that each commodity chain can potentially occupy and, ultimately, the form that a sustainable diet can take. Agronomic and biophysical limitations are generally combined with nutritional considerations: scenario-based approaches–such as Afterres (Solagro) on the French scale, TYFA on a European scale, EAT-Lancet on a global scale–will thus seek the point of balance between a strategy to reduce the environmental impacts of agricultural production and the need to provide a quality diet for all. This provides information, returning to our earlier example, such as the identification of the total quantity of pork that can be sustainably produced and consumed, which is complementary to the information provided by LCA.

b. Current methodological boundaries of LCA

Creating an LCA-based label raises a series of technical and methodological issues: defining environmental impact indicators, defining the weight given to each, ensuring they can be measured using robust data, translating this complex information into a simple and readable indicator, etc. Although scientists and public authorities have been making major efforts in this regard for over ten years, it is easy to see why the methods used for these purposes are still imperfect and undergoing constant improvement.[20] Without trying to provide an exhaustive list, we highlight here two current LCA limitations that we believe are particularly relevant to the environmental labelling debate:

- **Some environmental issues are poorly represented:** van der Werf *et al.* (2020) showed that certain environmental issues, such as land degradation, biodiversity loss and the impact of pesticides on human health and ecosystems, are currently poorly or not at all represented in LCA. For example, the European LCA framework contains a human toxicity indicator (which in theory favours less pesticide-dependent agricultural practices), but the associated robustness factor is very poor,[21] due to the limited number of scientific publications on the link between pesticides and human health.
- **Agriculture's ecosystem functions are poorly valued:** There are two ways of understanding the links between agriculture and the environment (van der Werf *et al.*, 2020). The first approach considers the agricultural system as independent of the natural environment, i.e. it does not support ecosystem services. The functions of agriculture are limited to the production of biomass/food, which must be optimized to have the least possible impact on the rest of the "environment". The aim is therefore to minimize the resources used to produce a unit of agricultural produce, including inputs (and their related pollutant emissions) and soil. The second approach considers that the agricultural system is part of the natural environment and therefore provides ecosystem services (biodiversity conservation, maintenance of soil quality, water regulation, etc.). According to this approach, environmental assessment should take the ecosystem services of agricultural production into account. At present, LCA methodology is based more on the first perspective.

These two limitations have political implications since, as it stands, LCA "tends to favour intensive agricultural systems" and does not value agroecological methods (van der Werf *et al.* 2020), because such agroecological methods differ particularly on aspects that are currently not considered by LCA (human toxicity, ecosystem services provided by agriculture). This situation has attracted criticism, particularly from the organic and extensive livestock farming sectors.[22] These limitations also restrict the ability of LCA to discriminate between products according to their production modes: in practice, and importantly, only averaged generic data from the Agribalyse LCA database are used per product class, which makes it impossible to differentiate environmental impacts according to different production modes in the framework of an LCA-based EL system. To overcome these limitations, many experiments propose the use of additional indicators (i.e. on top of LCA) to consider certain production modes. The recommendations of the cross-cutting "Indicators" working group[23] are also along these lines.

c. The need for trade-offs between different environmental issues

The environmental impact of our food–or rather that of agriculture–has multiple dimensions: greenhouse gas emissions,

20 See for example these press releases from several organizations calling for the original timetable to be adhered to and for more time to be given to experimentation and development of the method: https://grenoble.ufcquechoisir.fr/wp-content/uploads/sites/59/2021/04/210407_CP-Affichage-environnemental.pdf and https://www.interbev.fr/wp-content/uploads/2021/07/cp-interbev-resultats-experiences-affichage-environnemental.pdf

21 In the LCA method, the robustness factor is a weighting coefficient applied to each indicator according to the level of scientific consensus on each indicator; it should be assessed mainly in light of the available scientific publications.

22 ITAB (2020). Questions have been raised on the relevance of Agribalyse 3.0 data for the environmental assessment of agricultural products and the environmental labelling of food products (see also the webinar organized by ITAB on 08/07). Regarding criticism of extensive livestock farming stakeholders, see https://www.interbev.fr/wp-content/uploads/2021/04/cp-interbev-experimentation-07042021_vdef.pdf and https://www.interbev.fr/wp-content/uploads/2021/07/cp-interbev-resultats-experiences-affichage-environnemental.pdf See also the response from Ademe and Inrae: Ademe, Inrae (2021). Éléments d'information à propos de la base de données Agribalyse 3.0 et de son utilisation pour l'affichage environnemental, 8 January 2021.

23 Different bodies make up the governance of the experiment currently underway: 1) the steering committee, composed of the Ministry of Ecological Transition, the Ministry of Agriculture and Food, the Ministry of the Economy, Finance and Recovery, Ademe and the president of the scientific council; 2) the scientific council, composed of researchers; 3) the cross-cutting "Indicators" working group, composed of a restricted group of stakeholders; 4) the partners' committee, composed of an extended group of stakeholders.

TABLE 1. Weighting applied to calculate average scores, recommended by the European Commission and used by Agribalyse

	Aggregated weighting set	Robustness factors	Intermediate Coefficients	Final weighting factors (incl. robustness)
	A	B	C = A*B	C scale to 100
Climate change	12.9	0.87	11.18	21.06
Ozone depletion	5.58	0.60	3.35	6.31
Human toxicity, cancer effects	6.8	0.17	1.13	2.13
Human toxicity, non-cancer effects	5.88	0.17	0.98	1.84
Particulate matter	5.49	0.87	4.76	8.96
Ionizing radiation, human health	5.70	0.47	2.66	5.01
Photochemical ozone formation, human health	4.76	0.53	2.54	4.78
Acidification	4.94	0.67	3.29	6.2
Eutrophication terrestrial	2.95	0.67	1.97	3.71
Eutrophication, freshwater	3.19	0.47	1.49	2.80
Eutrophication, marine	2.94	0.53	1.57	2.96
Ecotoxicty freshwater	6.12	0.17	1.02	1.92
Land use	9.04	0.47	4.22	7.94
Water use	9.69	0.47	4.52	8.51
Resource use, minerals and metals	6.68	0.60	4.01	7.55
Resource use, fossils	7.37	0.60	4.42	8.32

Source: Agribalyse website, https://doc.agribalyse.fr/documentation/methodologie-acv

pollutant emissions into marine and terrestrial ecosystems, land use to the detriment of natural habitats, freshwater consumption, disruption of the nitrogen and phosphorus cycles, etc. The design of an indicator of environmental impact for a food product therefore requires an evaluation of the impacts on each of these components, weighting their importance, with a view to obtaining an aggregate score. The LCA methodology, for example, is based on this rationale (see Table 1).

This weighting exercise requires trade-offs between the different environmental issues: what relative importance should be assigned to each? Table 1 presents the process implemented by the Joint Research Centre (JRC, 2018) to determine a suitable weighting. It illustrates the difficulty of the exercise and the fact that it cannot be based solely on an analysis of scientific evidence. The weighting applied is based on a variety of methods: expert and general public consultation, expert judgement and the analysis of scientific evidence (JRC, 2018). Alternative methods could have been used that would have generated different results, including: the Planetary Boundaries framework as defined by Rockström *et al.* (2009), the monetization of impacts, and weighting calculated on the basis of the gap between public objectives and the environmental status according to each aspect (JRC, 2018). This assessment therefore has an arbitrary element. Moving beyond methodological issues, we can consider a practical example based on the different environmental impacts of agriculture. Section 2 examines the place given to extensive cattle farming, which is very different depending on whether one prioritizes the objective of combating greenhouse gases almost exclusively–from this perspective, the objective is to reduce the herd as much as possible to limit methane emissions; or whether other planetary boundaries are considered, such as management of the nitrogen cycle (extensive livestock farming allows the transfer of nutrients to cultivated fields via animal excrement), biodiversity preservation (extensive livestock farming maintains permanent grasslands with a high level of biodiversity) or the regulation of water bodies (here again, through the existence of permanent grasslands).

The design of EL, although based on factual scientific data, therefore necessarily implies an element of political compromise[24] between different environmental issues. The framework proposed by the JRC is relevant but could certainly be discussed again. The question then arises of the political and scientific processes that could allow these trade-offs to be reviewed.

1.4. A recognized vision to facilitate the design of an environmental label

The issues described above show that LCA is a vital tool, but one that has certain limitations. In the view of the authors, any consideration of EL cannot avoid a discussion on the recognized vision of a sustainable agricultural system. Why should this be the case? Firstly, it is important to acknowledge that LCA, which is the foundation of EL, implicitly defines a vision of a sustainable agri-food system by giving a score to all food products, particularly through the translation of EL into consumer guidance. However, this vision is not yet very explicit in the debate on EL. Secondly, given the limitations described above, a recognized vision would be useful to: 1) give direction to the

24 "Any weighting scheme is not mainly natural science based but inherently involves value choices that will depend on policy, cultural and other preferences and value systems. No 'consensus' on weighting seems to be achievable." (JRC, 2018) https://ec.europa.eu/environment/eussd/smgp/documents/2018_JRC_Weighting_EF.pdf

agricultural production system, to ensure that signals on the consumption of a given product are compatible with a global level of production; 2) help make judgements about different environmental issues, and therefore ultimately between different models of agri-food transition; and 3) finally, integrate other important political issues, such as social or nutritional questions.

The lack of a recognized vision makes EL more complicated. However, it is important to note that this vision of a long-term French agricultural and food model, which could guide the EL, is the subject of heated debate between stakeholders and is therefore not forthcoming. The EL project crystallises the tensions between those with different visions for the food system. In practical terms, while the National Low-Carbon Strategy (*Stratégie nationale bas-carbone*, SNBC)[25] offers a relatively accomplished vision of the agricultural production component, simultaneously giving consideration to climate issues (efficiency drivers, increase in carbon capture, biomass production and evolution of the product mix towards less animal production), biodiversity (development of organic farming, general decrease in pesticides, diversification of production systems) and natural resources (particularly water and soil), this indicative pathway however remains unknown, or is even deliberately ignored, by a large number of actors, and was not included in the Ministry of Agriculture and Food's (MAA) climate action plan published in June 2021. Moreover, the food component has not yet been directly addressed. Thus, the SNBC does not propose a reference diet[26] for 2030 or 2050, and the indicators provided remain very general.[27] It does at least refer to the dietary recommendations of the French National Nutrition and Health Programme (*Programme national nutrition-santé*, PNNS). Although the PNNS guidelines are clear, their implementation has also been difficult. Moreover, they were constructed based on nutritional rather than environmental objectives, which means that they do not address all food choice aspects, but only those that pose a problem from a health perspective. For example, poultry consumption is not covered by PNNS recommendations, even though it is certainly an issue from an environmental position. The convergence between nutritional and environmental recommendations has therefore yet to be accomplished (Saujot and Brimont, 2021).[28]

An implicit vision underlying EL. In addition to the lack of a recognized vision, it is difficult to visualize which agri-food transition system is implicitly supported by the various EL proposals, which is complicating the discussion among actors. Indeed, the discussion focuses on very specific technical and methodological issues, without allowing the various alternatives to be considered on a broader political level: what environmental issues should be prioritized in the building of tomorrow's agri-food system? What should be produced and consumed more? What should be reduced? What modes of production should be used? What are the social and economic implications of these approaches? However, some of the trade-offs must be made on these broader issues, and not only on the methodological ones.

Structuring the dialogue to achieve EL that attracts widespread support. In this context, it seems difficult to set up constructive collective discussion on EL systems. The chances are high that the political debate on EL planned for this autumn will lead to further entrenchment on methodology, with each actor supporting technical choices based on the economic and reputational stakes of their own sector. Indeed, organic farming actors have already voiced strong criticism of the Agribalyse database,[29] because of its limitations in representing all benefits of this production method. However, the risk of not having EL seems relatively low, given the strong public demand[30] and the fact that certain actors (notably Yuka and its partners) are already capable of implementing such tools and could potentially do so independently, without waiting for a public decision. The absence of a collective decision on EL would mean leaving it up to these actors–and others, running the risk of allowing multiple systems to develop–to make decisions on what form EL should take, and thus to ultimately steer the future of a sustainable agri-food system. For consumers, such a development could be confusing, which might limit the effectiveness of the introduction of EL.

25 This document describes the French roadmap for conducting climate change mitigation policy in all activity sectors. It defines short and medium-term greenhouse gas emission reduction targets for France–carbon budgets–and has two ambitions: to achieve carbon neutrality, i.e. zero net emissions, by 2050; and to reduce the carbon footprint of the French population. The SNBC sets out guidelines for agriculture and has focused on the production aspect, without however completely mapping out the transition path. See the January 2020 version put online by MTES https://www.ecologie.gouv.fr/sites/default/files/2020-01-20_MTES_SNBC2.pdf and the Climate Action Plan of the Ministry of Agriculture and Food published in June 2021, which follows the same logic regarding food demand (see Axis 3).

26 As part of the development of the specific emissions pathways for French agriculture, hypotheses for change were formulated as part of the technical work, but cannot constitute an official "diet".

27 For example, "quantities of meat other than poultry consumed per week and per capita" or "number of meals with the consumption of pulses per week and per capita".

28 The Climate and Resilience Act introduces a new document that is intended to create coherence between nutrition and food policies (National Strategy for Food, Nutrition and Climate). EL could then complement Nutri-Score and together they could constitute one of the pillars of this future strategy.

29 We return to these methodological issues in more detail in section 3 of this study. See the summary of the ITAB study: http://itab.asso.fr/downloads/amenites/communique_itab-rapport_agribalyse_20201214_v.pdf, and the response from Ademe and Inrae (2021). Éléments d'information à propos de la base de données Agribalyse 3.0 et de son utilisation pour l'affichage environnemental, 8 January 2021.

30 The Citizens' Convention on Climate (CCC) had indeed expressed the wish to have information available to enable more environmentally responsible consumption. This demand from citizens has also been expressed at the European level through a recent European Citizens' Initiative for a European Eco-Score (see https://europa.eu/citizens-initiative/initiatives/details/2021/000005_en).

This study aims to address this gap: we closely examine the agri-food models that the different EL proposals would support–which requires an analysis of the vision implicit in LCA as it is currently constructed–in order to facilitate policy debate on EL, particularly to identify key points of agreement and critical divergences. This work is complementary to the essential work carried out by the scientific council to identify methodological and scientific avenues for improving the LCA framework.

With this in mind, we compared two EL systems with agri-food transition scenarios that outline models of sustainable agri-food systems.

These scenarios, however, prioritize environmental issues differently (see section 2, for an overview of possible agri-food transition alternatives). This decision to compare the EL schemes with scenarios rather than public policy objectives in terms of agri-food transition in France is due to the currently partial nature of these strategies.

These scenarios are also valuable for reconnecting the discussions on food policies with those on agricultural policies. Food demand and agricultural supply are closely linked: changes in food preferences require changes to the food supply and therefore agricultural production; conversely, food supply is largely built on anticipated consumer demand (Dubuisson-Quellier, 2013). The methodological trade-offs in EL therefore have consequences for agricultural production. From a public policy perspective, it is therefore necessary to visualize these implications to measure the coherence between diet and agricultural systems promoted through EL, as well as agricultural public policies. However, one of the problems in EL debates stems from the fact that it is difficult to connect these two areas: what is the implicit vision of the agri-food system in an EL scheme?

In summary, the development of environmental labelling (EL) requires the solving of methodological problems and making political decisions on the priority of environmental issues, particularly climate and biodiversity issues.[31] Also at stake is the choice of a recognized vision of the future agri-food system that includes all levels and not only environmental ones.

The establishment of political, scientific and methodological guidelines takes time. However, pressure to act more quickly to develop official EL is being exerted by demands from civil society and citizens, embodied into law, as well as by the ability of independent actors to develop EL mechanisms, outside of any official or organized processes. This issue is one reason for carrying out this study, which aims to clarify the policy implications of these methodological points and to identify which debates are important to have.

General objective: contribute to the necessary trade-offs to define operational and effective EL for the transition to healthy and sustainable food.

To this end we aim to:

— identify the implicit system that we would be led towards by the LCA signal and that of two EL proposals, through a method of translation and comparison with scenarios that are well established in the debate;
— make tangible the implications of methodological decisions on EL and reconnect food issues with those of agricultural models;
— identify any common ground between the different proposals, which would enable an acceptable, if still imperfect, pathway to be envisaged;
— identify any divergences and key points to be discussed in the short term or put onto the scientific agenda.

31 See note no. 4 of the "Indicators" WG. For example, the weight of the climate indicator currently represents 21% in the European LCA framework. This figure is the result of the multiplication between the primary weight of the climate indicator and its robustness factor. These factors play an important role: they are high for climate, but very low for human toxicity indicators for example.

2. THE AGRI-FOOD VISIONS BEHIND ENVIRONMENTAL LABELLING

To contribute to the political debate on EL, we have carried out "translations" between the methodological choices of EL and the different visions of the agri-food transition present in the public debate. In the absence of clearly identified food targets in public sustainable food policies in France (see below), as reference scenarios we chose to use those produced by scientists, which also reflect political visions of the European debate. We analogized these scenarios to navigation compasses that point the way towards a sustainable food and agricultural system. As we see in section 3, these scenarios prioritize environmental issues differently, leading to different agronomic transition paths. The value of using them as reference scenarios is to provide a clearer visualization of policy alternatives in terms of the agri-food transition, and to discuss them with respect to the methodological options in terms of EL.

To use our analogy, if we can consider the EL information, supported by LCA, as a kind of map, i.e. a very detailed set of data about the food landscape, to guide ourselves along this map we'd need a compass–which are the agri-food transition scenarios–to correctly reach our targeted destination, the sustainability of food and agricultural systems. This is the objective of this work: to compare the EL signal with the signal contained in the diets proposed by these scenarios.

2.1. Two policy visions of a sustainable food and agriculture system

The environmental impacts of the current agricultural production system are now well documented in terms of its contribution to global warming, soil and water pollution and also the destruction of biodiversity. Many studies show that radical transformation, of agricultural systems and dietary trends, is the solution to these problems, particularly a reduction in the consumption of animal products[32] (Bryngelsson *et al.*, 2016; Buckwell and Nadeu, 2018; Poux and Aubert, 2018; Willett *et al.*, 2019; Clark *et al.*, 2020). In 2010, the French and other Europeans consumed almost twice as much protein as recommended by nutritional guidelines.[33] Approximately two thirds of this amount is derived from animal products (Poux and Aubert, 2018: 23). A rebalancing in favour of plant proteins would be beneficial from an environmental point of view, but also in terms of health: the challenge is therefore to reduce animal protein consumption by almost half.[34]

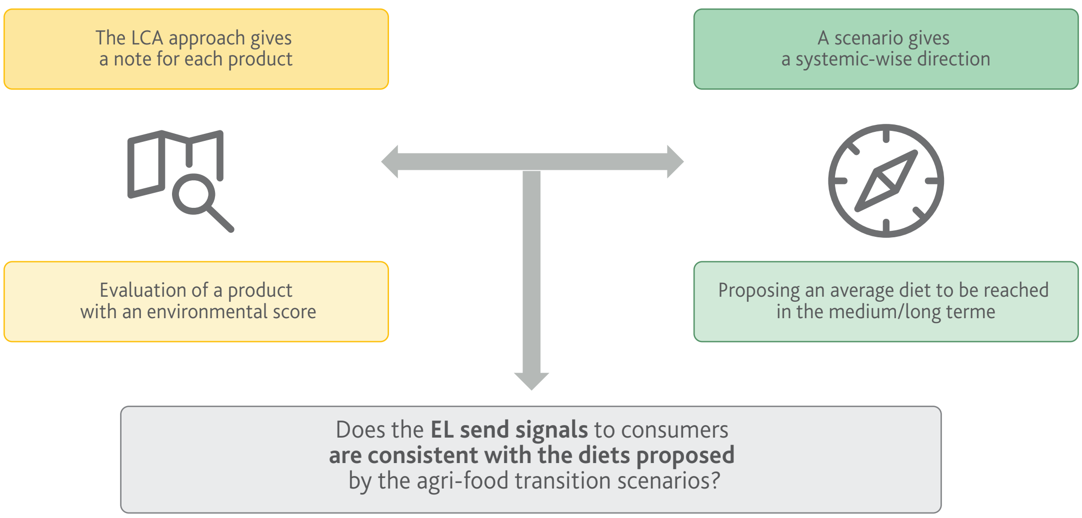
However, the nature and scope of this "protein transition"–i.e. the switch to a diet that is lower in animal proteins in favour of plant proteins and/or proteins derived from new alternatives such as cultured meat–overlap with rather different visions of what is meant by "less but better" meat (Sahlin *et al.*, 2020).

32 It should be remembered that approximately 63% of European arable land is dedicated to the production of animal feed. https://storage.googleapis.com/planet4-eu-unit-stateless/2019/02/83254ee1-190212-feeding-the-problem-dangerous-intensification-of-animal-farming-in-europe.pdf

33 The reasoning is as follows: the reference consumption recommendation of EFSA and ANSES is 0.83 g of protein per day and per kg of body mass. In France, consumption is around 83 g/day according to the INCA3 study by Anses, while the recommendation for a person weighing 65 kg is around 43-54 g/day. Consumption is therefore almost double the recommended level. EFSA recommendations: https://efsa.onlinelibrary.wiley.com/doi/pdf/10.2903/sp.efsa.2017.e15121

34 With a 50:50 ratio between animal and plant protein, which would provide the necessary micronutrients for an average person, the reference requirement for animal protein is therefore around 25-30 g/day compared to 55-60 g/day consumed today in Europe. See the nutritional recommendations of the Netherlands, which lead to this ratio of about 50:50 https://mobiel.voedingscentrum.nl/Assets/Uploads/voedingscentrum/Documents/Professionals/Overig/White%20paper%20-%20Towards%20a%20more%20plant-based%20diet%20-%20Dutch%20Nutrition%20Centre.pdf

FIGURE 3. Reconnecting EL with visions of the sustainable agri-food transition



A study conducted by IDDRI shows that at least three visions of the protein transition can be distinguished in the European debate (Huber *et al.*, 2020; Bolduc *et al.* in review, see methodology in Box 1). Here we have focused on the two most ambitious visions for changing diets–particularly for reducing the consumption of animal products–namely the so-called "Agroecological" vision and the "Sustainable Intensification" vision.

While these scenarios share the aim of significantly reducing the consumption of animal products, they differ in the farming methods used, and especially in their dependence on synthetic nitrogen fertilizers. This difference has important implications, particularly regarding the way in which biodiversity and the ecosystem services of agroecosystems are managed. Nitrogen fertilizers, invented at the beginning of the 20th century, released farming from the need to rely on "natural" nitrogen supply mechanisms for agricultural production, particularly fodder (use of animal excrement and legumes).[35] This "opening of the nitrogen cycle" via synthetic nitrogen has led to a significant increase in agricultural production, especially the production (and consumption) of animal products (Grigg, 1995), but at the same time has led to significant environmental degradation, particularly in terms of biodiversity (Sutton *et al.*, 2011). In addition, the use of synthetic nitrogen fertilizers is now associated with high levels of pesticide use to manage weeds and diseases that are favoured by the application of high levels of nitrogen fertilizer (Huber *et al.*, 2020). These pesticides also have an impact on ecosystems and their biodiversity, while their impacts on health also cannot be ignored (Poux and Aubert, 2018).

One of the main aims of the agroecological vision is therefore to free ourselves as much as possible from synthetic nitrogen fertilizers, via an agricultural system based on complementarity between crops (particularly the introduction of leguminous rotation crops capable of fixing nitrogen from the air into the soil), as well as on complementarity between livestock and plant crops, which notably allows nutrient transfer between legume-rich permanent grasslands, which fix nitrogen, and cultivated land (Garnier *et al.*, 2016). This last point leads advocates of this vision to maintain a relatively large share of extensive grass-fed cattle breeding in this scenario, insofar as ruminants have the capacity to valorize the nitrogen fixed in the grasslands in a "natural" way, via digestion/excretion. In other words, they transfer nitrogen from grassland to the cropping system, unlike monogastric animals, which at best only recycle the nitrogen they receive in their diet via plant proteins from intensive agriculture. In short, the diet proposed in the Agroecological vision is therefore designed and adjusted so that the consumption of meat and milk provides the necessary quantity of these environmental benefits in terms of nitrogen but also through maintaining the management of natural agro-pastoral habitats with a high biodiversity.

This objective to reduce nitrogen fertilizer dependency is not accomplished in the same way via the Sustainable Intensification scenario. It reduces dependence on fertilizers by developing precision agriculture, which would increase the efficiency of using synthetic mineral nitrogen, rather than making use of legumes and crop-livestock complementarity. This leads this scenario to be even more ambitious in terms of reducing animal protein consumption. The central aim here is to reduce total protein consumption, and as much as possible to substitute proteins of animal origin, particularly beef, with those of plant origin. This is accompanied by the "sustainable" intensification of production processes to reduce the amount of nitrogen used and, more generally, to increase agricultural efficiency (plant and animal). Indeed, ruminants emit methane during digestion (via burping and flatulence), a gas that potentially has a major impact on the greenhouse effect (see more detail on this subject in Box 2).

Finally, these two visions have a different understanding of the link between the agricultural and natural systems, and therefore different strategies for maintaining biodiversity. The Sustainable Intensification scenario considers the agricultural system to be independent of the natural environment, i.e. it does not support ecosystem services. As a result, the biodiversity conservation strategy is to use as little land as possible for agricultural purposes, to preserve as much land as possible in its "natural" state: i.e. the so-called land sparing strategy (Green *et al.*, 2005). The Agroecological vision considers that the agricultural system is part of the natural environment and provides ecosystem services (preservation of biodiversity, soil quality, water regulation, etc.). This concept of preserving biodiversity within the agricultural space is also called land sharing.

2.2. Climate implications of the scenarios

a. Comparison of the climate impacts of the two vision types

The main greenhouse gases (GHGs) emitted by the agricultural sector are nitrous oxide (N_2O) and methane (CH_4). N_2O is linked to the application of nitrogenous inputs, animal manure and biological processes in cultivated soils. Methane arises from the farming of ruminants, via their digestion and/or excreta.

The two visions described above have quite different emission profiles for these two gases. Through the avoidance of synthetic nitrogen fertilizers, the Agroecological vision greatly reduces nitrous oxide emissions (48% decrease in the TYFA-GES scenario) but has less impact on methane emissions (18% decrease in emissions linked to digestion). The Sustainable Intensification vision would achieve the opposite: a major reduction in the role of ruminants would considerably reduce methane emissions, but the model's retention of synthetic nitrogen (even if its usage is optimized) thus translates into associated nitrous oxide emissions.[36] In terms of direct emission reductions therefore, the

35 Nitrogen (N2) is indeed a central component of agricultural production in general and protein production in particular. For example, to produce meat, livestock must be fed with fodder plants rich in nitrogen compounds.

36 Knowing that there is a significant difference in the climate impact of inorganic and organic nitrogen, the latter having a much lower impact, is an advantage for a scenario where inorganic nitrogen from synthetic fertilizers is not used.

BOX 1. WHAT IS MEANT BY "LESS BUT BETTER" IN THE EUROPEAN DEBATE?

The work of Huber *et al.* (2020) and Bolduc *et al.* (2021) builds on the work of Kim and Jasanoff (2009), who define the term "sociotechnical imaginaries" as "collectively imagined forms of social life and social order reflected in the design and fulfilment of nation-specific scientific and/or technological projects." To identify different visions, the authors conducted around sixty interviews between June and October 2020 with various stakeholders: companies, NGOs, think tanks, farmers' representatives, civil servants, etc. These interviews were supplemented by grey literature from the organizations represented by the interviewees.

This work has identified three visions, which differentiate around two key issues: 1) the extent to which animal protein consumption should be reduced, and 2) the management of the nitrogen cycle (see above). In the food transition debate, a more conservative vision than the others exists with regard to the reduction of animal protein consumption, in the sense that this vision is based on smaller changes to the diet. This vision, described as "technofix", is based on the assumption that technical innovations can reduce the environmental footprint of agriculture (particularly livestock farming), thus enabling a potentially smaller reduction in animal protein consumption than the other two visions.[1] These innovations range from the development of anti-methane masks for cows[2] to the production of protein through fermentation or bioengineering techniques (cultured meat). This work does not include an analysis of this vision.

For clarity on what these visions represent in terms of diet, Huber *et al.* reconstructed diet archetypes for each, based on the diets of two scenarios: the TYFA (Ten Years for Agroecology)[3] for the "Agroecological" vision (Poux and Aubert, 2018; Aubert, Schwoob, Poux, 2019), and the scenario developed by the EAT-Lancet Commission for the "Sustainable Intensification" vision (Willett *et al.*, 2019). The figure below presents these two diets in comparison to the typical current diet (2010).

Source: adapted from Huber *et al.* (2020).

1 At least with a very slow decrease, and possibly a substitution between the consumption of products from cattle farming and those from the farming of monogastric livestock (insofar as monogastric animals do not emit methane during digestion).

2 https://www.lesechos.fr/finance-marches/marches-financiers/le-geant-cargill-sapprete-a-commercialiser-des-masques-anti-methane-pour-vaches-1321061

3 For the purposes of this work, the assumptions used are those of the 2019 version (TYFA-GHG), which sought to examine further the emission reduction potential.

FIGURE E1. Focus on animal protein intake/day for 2 contrasting visions (European scale)

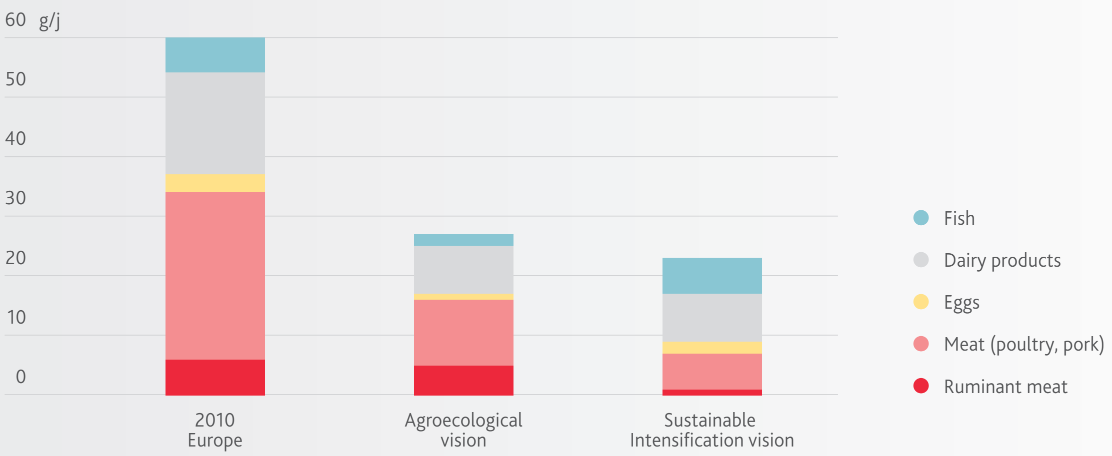
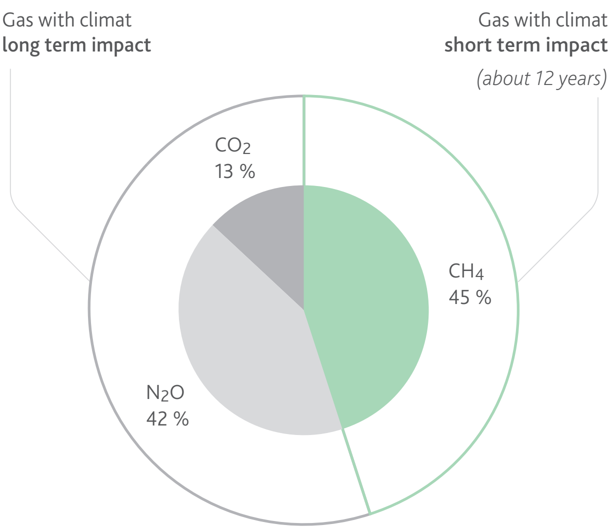


FIGURE 4. Distribution of GHG emissions from agriculture and forestry in France (2019)



Source: https://ree.developpement-durable.gouv.fr/themes/defis-environnementaux/changement-climatique/emissions-de-gaz-a-effet-de-serre/article/les-emissions-de-gaz-a-effet-de-serre-de-l-agriculture

TYFA-GES scenario is aligned with the objectives of scenarios based on a sustainable intensification approach that is discussed and designed at the European level (Aubert, Schwoob and Poux, 2019). The differences, which do not make it easy to establish a single hierarchy, are: 1) at the level of environmental co-benefits (biodiversity, cessation of pesticide use, etc.), where the TYFA scenario offers more gains and guarantees; and 2) at the level of bioenergy production (and potentially carbon capture/reforestation), where the various sustainable intensification scenarios offer greater potential (Aubert, Schwoob and Poux, 2019).

b. Climate impact: the limitations of aggregation metrics and LCA

In the context of decision-making tools, for example a strategy to combat climate change or an LCA, there is a need for a common metric to compare the impact of different GHGs, each having different atmospheric lifetimes and different radiative efficiencies. The GWP (Global Warming Potential) [37] method is thus used to compare the warming potential of each gas to that of carbon dioxide (CO_2), over a given period. The GWP 100 system, for example, enables the comparison of the warming power of an additional methane molecule (CH_4), which has a shorter lifetime (about 12 years) and a greater radiative efficiency than a CO_2 molecule, with other GHGs, such as nitrous oxide (N_2O), which has an average lifetime in the atmosphere of over 100 years.

However, much literature has highlighted the fact that GWP misrepresents the impact of short-lived gases, such as methane (Costa *et al.*, 2021). Based on recent research (Cain *et al.*, 2019), which led to the proposal of a new GWP* method, Costa *et al.* (2021) sought to assess the real impact of methane emissions from the agricultural sector between 2020 and 2040. This analysis shows that:

— an annual decrease of about 0.35% is sufficient to halt any further increase in global temperatures due to agricultural CH_4 emissions. This is analogous to the impact of zero net CO_2 emissions;
— an annual decline of about 5% could offset the additional warming caused by agricultural CH_4 since the 1980s;
  • faster reductions in CH_4 emissions have a similar impact to removing CO_2 from the atmosphere;
  • however, a 1.5% annual increase in CH_4 emissions would result in climate impacts that are around 40% greater than those indicated by GWP 100.

c. Implications for comparisons between LCA and the scenarios

According to the LCA approach, a product that leads to the emission of an additional methane molecule is associated with an additional climate impact, translated via GWP into an equivalent that enables the calculation of the various GHGs associated with its production, processing, transport, etc.

According to the rationale of the scenario, it is total methane emissions that determine the climate impact: either a rise if there is an increase, or no warming if the emissions remain stable, or a cooling if the decrease is drastic.[38] It is possible to analyse climate impacts without GWPs, by the direct use of a climate model, which uses the quantities of various GHGs as an input and then mobilizes the physical and chemical equations that make it possible to assess the global warming power, from these various gases, at a given time horizon.

In the first instance, the "product" approach means that the total quantity of methane emitted by agriculture is a blind spot. To approximate a figure requires the use of GWP. In the second case, it is not possible to distinguish the climate impact of a particular product, but only that of the whole scenario. These issues do not lead to an underestimation of methane's significance, quite the opposite in fact, but they do indicate that it is above all the comparison between several agricultural systems as a whole that is relevant for thinking about environmental and climatic impacts, and that the product-by-product comparison (e.g. "chicken" or "beef") is only an approximation that has limitations.

37 https://www.bilans-ges.ademe.fr/documentation/UPLOAD_DOC_FR/index.htm?prg.htm

38 The methane that is currently in the atmosphere and exerting its radiative power will be gone in a decade or so; if it is not replaced, this is equivalent to cooling, in the sense that the radiative power is reduced.

d. What are the consequences for environmental labelling methodology?

The IPCC's view: The recent Working Group 1 report[39] provides an account of the different metrics used (such as GWP* or CGTP) and their implications for the results, pending more detailed analysis by the Working Group 3. It is important to note that the IPCC does not recommend any particular metric: "*As pointed out in AR5, ultimately, it is a matter for policymakers to decide which emission metric is most applicable to their needs. This Report does not recommend the use of any specific emission metric as the most appropriate metric depends on the policy goal and context*". Furthermore, it has been noted that the literature has identified this metrics issue in life cycle assessment and emphasizes that LCA users should be aware of the challenges and value judgements inherent in the aggregation exercise of different GHGs, and recommends aligning the choice of metric with policy objectives, as well as conducting sensitivity tests.[40]

In line with IPCC proposals, it would appear useful to carry out sensitivity analyses with the GWP* as part of the experiment, which is partly what the Planet-Score does. The analysis of the scientific council will also be interesting in this regard. Finally, in the view of the authors, the best way to ensure relevant EL is through a dialogue with the scenario approaches and the choice of a recognized vision, which would take all associated environmental issues into account (emission reductions, potential for bioenergy production, carbon sinks, biodiversity, etc.).

2.3. Comparing environmental labelling schemes with scenarios

To discuss EL schemes alongside the agri-food transition scenarios described above, we compared the consumer signals generated by LCA and two EL schemes with those of the changes to diets and farming systems envisaged in the above-mentioned agri-food transition scenarios. This work was conducted at two levels. First, we looked at the signal sent by the Agribalyse LCA database,[41] which forms the basis of the work on EL, to compare the signals on diets (what proportion of which product). We then focused on the signals generated by the two EL proposals included in the experiment (Eco-Score and Planet-Score) when taking the production modes into account.[42] Eco-Score was chosen for several reasons:

— The methodology behind the label is transparent and accessible;[43] it is also easy to test using the Yuka app, which already offers Eco-Score for certain products.
— The design of Eco-Score was based on the Agribalyse LCA, with additional indicators (see **Figure 5-6**). This architecture (LCA + additional indicators) appears to be an interesting way of building an indicator, the main issue being the choice of these indicators and their weighting. The comparison we make in this study could therefore easily be replicated for other EL indicators and not only Eco-Score.
— This architecture of the indicator enables the separate observation of the signal in terms of dietary changes (i.e. to make a comparison between the environmental impact of different food products) and the signal sent on the promotion of different agricultural systems (i.e. to make a comparison between different production modes for the same product).

Planet-Score was chosen for several reasons:

— The design of Planet-Score was also based on the Agribalyse LCA. It proposes a very ambitious set of modifications, by assuming the complementary indicators approach, but also through corrections directly in the LCA.
— Planet-Score has explored methods to better account for the specificities of agroecological production modes in EL, which is a key issue in the debate on future pathways for agriculture and the food system.
— While the method, which is more complex and has been developed within the very short time of the experiment, is not yet totally transparent at this stage, methodological elements will be progressively made available and, as for the other experiments, will be analysed by the scientific council.
— Planet-Score, through its objectives in terms of the changes implemented, facilitates the discussion of not only the short-term choices for EL, but also the medium-term changes in the LCA and the calculation methods.

As shown in **Figure 6**, Planet-Score proposes two levels of changes: corrections are made to the LCA for three of the four main categories, and additional indicators are added to the LCA score. The changes that have the greatest impact on the results are summarized below (for more details see the ITAB experiment report).

The key principle guiding Planet-Score is to distinguish between the different production modes (conventional, organic, extensive, etc.), and thus to give better consideration

39 https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Full_Report_smaller.pdf ; Technical summary p. 66. Considering the new metrics built to better account for gases such as methane (GWP* and CGTP), it is noted that "Using either these new approaches (...) can improve the quantification of the contribution of emissions to global warming within a cumulative emission framework, compared to approaches that aggregate emissions of GHGs using standard CO_2 equivalent emission metrics." Chapter 7, p. 124.

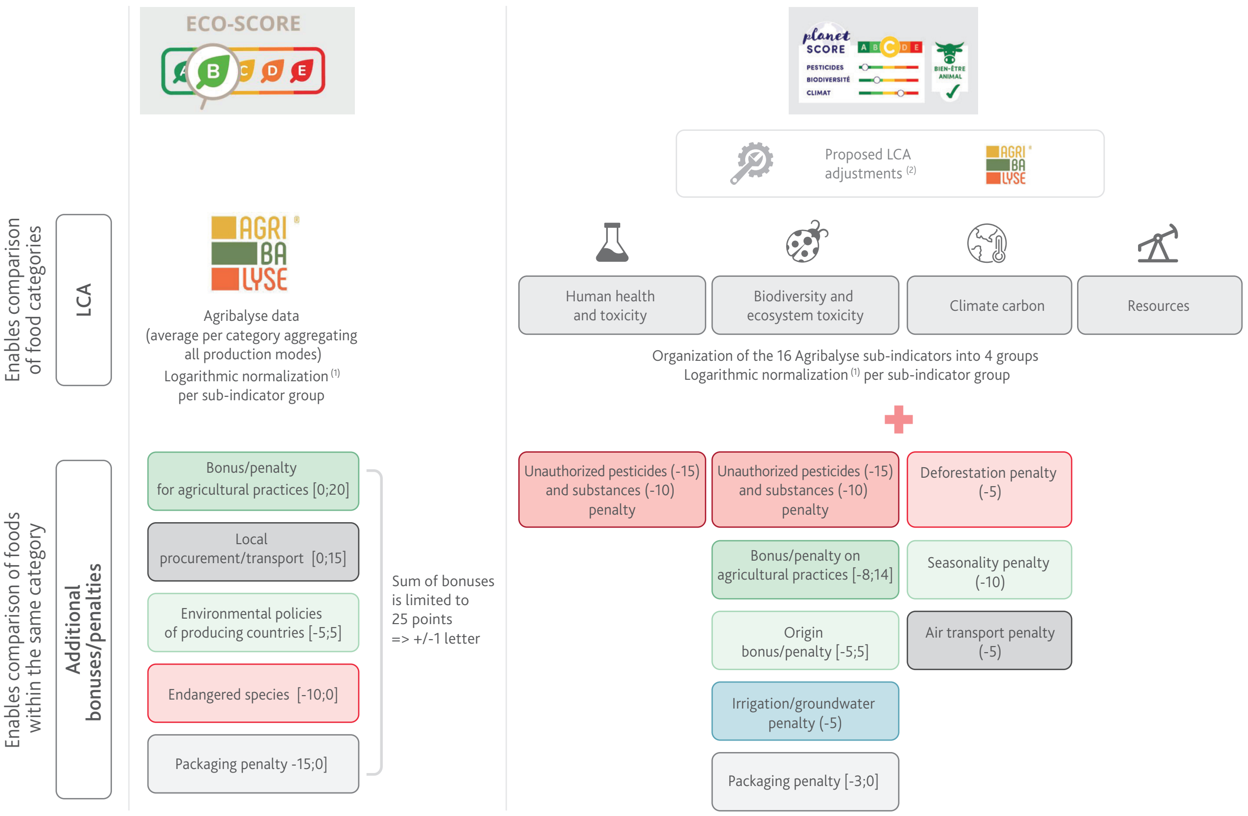
40 Chapter 7, p. 127. See also table SM - p. 24.

41 The LCA score is translated into a score out of 100 with the standardization of Eco-Score.

42 At the end of the experiment, among the 20 projects, 4 main types of directly operational methodologies emerged: LCA-FEP, Global Score, Eco-Score, Planet-Score. We focused on the last two methodologies, as well as on LCA-Agribalyse (coming from FEP framework), because the proposal of Global Score did not at that time allow the consideration of the entire diet because of its overly restrictive scope.

43 https://docs.score-environnemental.com/

FIGURE 5-6. **Design of the environmental label according to the Eco-Score and Planet-Score ***



(1) Logarithmic normalization allows products with very different environmental impacts to be represented on a simplified scale [0;100]. This reduces the gaps: thus, the gap between two letter grades represents a multiplication of the environmental impact by a factor of between 1.6 and 2 (e.g. an E classified product has twice the environmental impact of a D classified product). In this context, giving a 20-point bonus after standardization amounts to reducing the environmental impact considered by a factor of (1.6; 2), which is very significant.

(2) For more details on LCA adjustments, see ITAB, Sayari and VGF, 2021

** The European LCA framework includes 16 indicators but, due to robustness issues on the three toxicity indicators, two have already been removed from the simplified base (see https://doc.agribalyse.fr/documentation/acces-donnees) and the third is being removed*

to the differences between them: pesticide use, ammonia (and nitrogen) management, land use.

— **Avoidance of the use of standard robustness factors** that assign weightings to the 16 environmental indicators that make up LCA: according to ITAB, even indicators that are considered reliable have limitations or need improvement or updating. Planet-Score therefore reverts to the original weighting of environmental issues by removing the robustness filter (see Section 1, Table 1 on weighting). This has the effect of reducing the weighting of climate change (from 21% to 12.9%) while bringing pesticide issues back to the fore (robustness factor 0.17).

— **Biodiversity.** Accounting for the impacts of pesticides and synthetic nitrogen fertilizers on biodiversity is a challenge for LCA, and few methods are currently available (see note no. 3 of the Indicators WG). To improve this aspect, Planet-Score uses a tool developed at INRAE that allows labels to be rated on the basis of their specifications, and thus to associate a bonus/penalty with agricultural practices. Other bonuses/penalties are integrated to account for origin, irrigation and packaging.

— **Biodiversity and human health**
- Pesticides: a pesticide penalty is also applied according to the production method, to account for its impact on biodiversity but also on human health. Corrective measures are proposed for certain products to take better account of human toxicity and ecotoxicity.
- Ammonia: this nitrogen-based pollutant has an important influence on the final LCA result, as its impact is expressed through three indicators (acidification, fine particles, eutrophication). Planet-Score differentiates the impact of ammonia according to the farming method, integrating the fact that extensive farming methods allow a significant reduction of these impacts.

— **Land resources.** LCAs consider land as an environmental resource and account for its usage. As a result, production systems such as extensive livestock farming can be penalized for using a lot of land. Planet-Score accounts for the fact that some areas used by extensive livestock farming are unsuitable for cultivation (slopes, climate, rocky areas or swamps...) and should not be regarded as a resource for cultivation.

— **Climate.** GWP* is used instead of GWP to account for methane (CH_4) emissions; the emission factor for nitrous oxide (N_2O) is updated, and soil carbon storage is accounted for and added to the LCA, which was not previously the case due to a lack of scientific consensus (see note no. 5 of the Indicators WG). It should be noted that these changes, particularly GWP*, do not have a very significant impact on the final score, due to the low weighting given to the climate and the prevalence of other impacts, such as ammonia.

2.4. Comparison methodology

For the agri-food transition scenarios, we began with the dietary information taken from the two agricultural transition scenarios mentioned in section 2.1. The protein element of these diets is presented in Box 1. To compare the signal generated by LCA and EL with these target diets, for the purpose of the analysis we reconstructed some scores that were associated with each scenario, reflecting the signal that should be sent to consumers to reach these target diets. More specifically, to create these Vision-Scores, for each protein category we calculated the percentage decrease or increase between current consumption and the scenario's target consumption. This percentage difference was then normalized to a base of 100:0 so that it could be compared with EL scores. The interpretive system is thus identical: the consumption of products with a score of 100 should increase significantly; conversely, the consumption of products with a score close to 0 should decrease significantly (Table 2; see also Appendix 1 for a more detailed description of the methodology).

Two-step comparison of scenarios with LCA and the two environmental labels:

Step 1: We firstly assessed the consistency of the dietary change signal generated by Agribalyse LCA. It is important to note that we used Eco-Score to provide a score out of 100 obtained from the normalization of the single score taken from LCA, which does not account for the bonuses and penalties resulting from the additional indicators. We compared this score with the scenario scores.

Step 2: Comparison with Planet-Score and Eco-Score.

— We then evaluated Eco-Score's signal by including the additional indicators, i.e. the bonuses associated with production methods, by observing the effect of the bonus granted by labels that are associated with agroecological practices (particularly the "organic" label).

— We also evaluated Planet-Score's signal for two very contrasting production types: intensive conventional production and extensive, organic grassland production.

The results of this comparison are presented in section 3. We also discuss the methodological modifications that enable the signal from EL to connect with the changes in diet and agricultural production modes envisaged in the agri-food transition scenarios. It should be noted, however, that this comparison exercise is based on a major assumption: we consider that a signal from EL will have an impact on consumption choices, without accounting for the other elements that influence such decisions. For example, we do not assess the extent to which EL can interact with price.[44] However, we refer to these issues in some of the discussion points.

This work is also based on the technical and scientific literature on EL, for example the reports and notes produced by the experiment's pilots and the "Indicators" working group, as well as several reports produced by consortia involved in the experiment, such as that of ITAB (ITAB, Sayari and VGF, 2021). We also conducted interviews with several stakeholders (see list in Appendix 5). Finally, we participated in the EL working group initiated by the Institute of Trade, in which around 10 distributors and food manufacturers participated,[45] as well as in two steering committees (COPIL) of the experiment. Finally, it should be noted that this work is intended to be complementary to the report of the scientific council, whose contribution to the process will be essential. The synthesis of this report was published on October 20, 2021, and is therefore not taken into account in our analysis; it is simply mentioned where necessary.

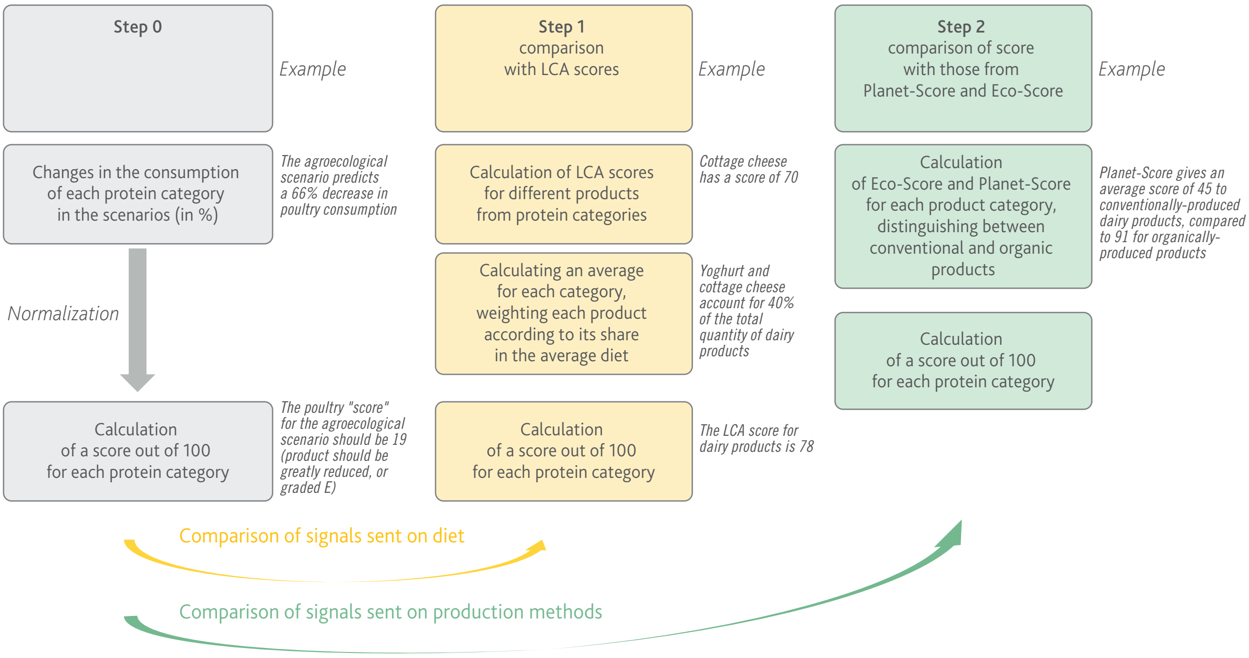
44 These issues will be addressed in the scientific council's report.

45 https://institutducommerce.org/articles/529/principes-communs-du-score-environnemental

TABLE 2. Protein sources corresponding to each vision and changes compared to the 2010 diet

	Consumption 2010 (g/day)	Consumption in Agroecological diet* (g/day)	Expected development compared to 2010	Consumption in Sustainable Intensification diet** (g/day)	Expected development compared to 2010
Pulses	5	30	500%	75	1,400%
Cereals	355	300	-15%	232	-35%
Beef	32	26	-19%	5	-84%
Dairy products	505	250	-50%	250	-50%
Poultry	58	20	-66%	29	-50%
Pork	88	36	-59%	7	-92%
Fish	27	10	-63%	28	+4%
Eggs	20	10	-50%	13	-35%

FIGURE 7. Diagram of methodology



3. RESULTS

This section describes the results of the comparison between the LCA, the two selected environmental labels (Eco-Score and Planet-Score) an9d the two selected agri-food transition scenarios (Agroecological and Sustainable Intensification visions). More specifically, we aim to address the following questions:

— What is the direction and magnitude of the signal to consumers on the consumption of animal products, compared to the current dietary situation?
— What are the differences between the signals sent to consumers by the different EL schemes and the developments proposed by the agri-food transition scenarios? What do these differences reveal and how can they be interpreted?
— What are the major points of consensus and disagreement between the two main EL proposals?

3.1. What signals does LCA send on diet?

Figure 8 shows the comparison of the LCA signal strength and our two visions. This figure allows us to analyse the signal on diet–which in the technical debate is also known as the inter-category comparison, without considering product quality.

Dietary comparison: the implicit diet behind LCA. The comparison between the LCA signal (blue line in Figure 8) and the status quo diet[46] (grey line) shows that the protein component of the LCA includes very little meat and fish, but more poultry, eggs, lightly processed or unprocessed dairy products, and more pulses. To be more specific:

— Regarding animal products, the LCA signal **points towards a significant decrease in consumption**, except for dairy products and, in a limited way, eggs.
— **There is a clear hierarchy of animal products:** beef is strongly advised against; pork and, to a lesser extent, poultry are discouraged; eggs are slightly discouraged; while dairy products are rated very positively, even going slightly beyond the status quo dietary levels.[47]
— The signal on pulses is for a major increase.
— Fish receives a fairly low score which in fact covers two contrasting situations: "large fish" (salmon, tuna, cod, etc.) receive very poor LCA scores (between 14 and 28/100) and their consumption is therefore not recommended, while "small fish" (sardines, mackerel, herring) receive average to very good scores (between 45 and 92) and their consumption is therefore maintained or encouraged.

The comparison between LCA and the Agroecological vision reveals that the evolution of animal products is seen differently: beef must decrease but not very strongly, which explains why it is relatively better rated than in the LCA. On the other hand, dairy products are encouraged to decrease very

46 The status quo diet refers to a situation where the label shows the consumer an "average grade", for example between B and C, which would suggest that they should neither decrease or increase consumption. This is equivalent to a 0% change in a diet proposed by one of our two visions.

47 As explained in Appendix 2, the score for milk, one of the dairy products considered in our average, was recalculated with the food normalization formula and not the beverage one (95 instead of 54). This does not call into question the score given by Eco-Score, in terms of the signal to the consumer regarding their choice of "milk" as a beverage, but it seemed more logical in our comparison exercise with scenarios based on a whole milk equivalent. Ultimately, this does not considerably change the analysis: the products are even better rated and the gap with the Vision-Score is even greater.

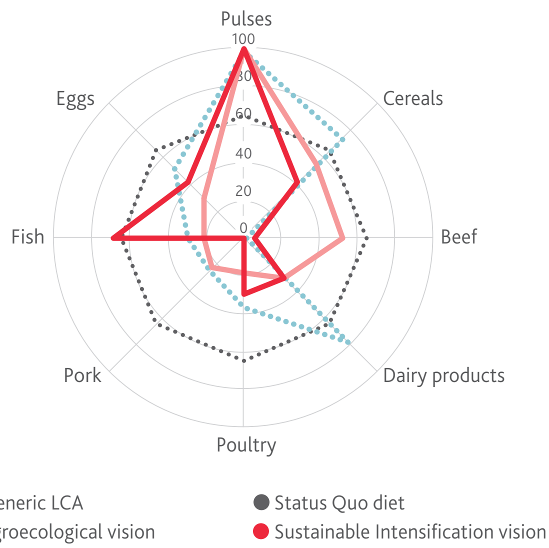
strongly, which implies a lower rating. Similarly, the consumption of poultry and eggs is expected to decline sharply. In summary:

- LCA is almost in line with the Agroecological vision for pork, farmed fish and pulses.
- LCA encourages the consumption of poultry, eggs and especially dairy products more than an Agroecological model, the same is true for cereals.
- LCA discourages beef consumption much more than the Agroecological scenario.

Finally, **the comparison between LCA and Sustainable Intensification** shows a difference in the evolution of animal products, especially for dairy products and pork.

- LCA is nearly aligned with the Sustainable Intensification vision for pulses and beef, and they are very similar for eggs and poultry.
- LCA encourages much greater consumption of dairy products and significantly more pork consumption than Sustainable Intensification. This is also true for cereals.
- LCA discourages fish consumption much more than the Sustainable Intensification vision.

FIGURE 8. Comparison of LCA and visions *



** Note that the generic LCA score (average per product of all production modes) is generated with the Eco-Score normalization formula.*

3.2. Detailed analysis of animal products in the Agroecological vision

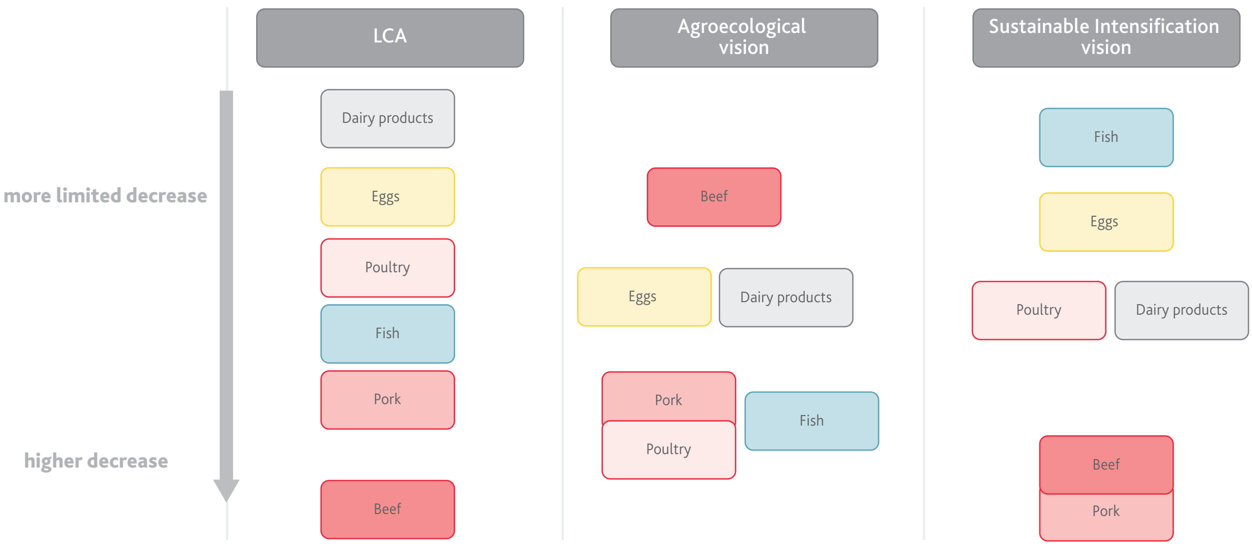
a. Beef

This gap highlights the difference between LCA that steers consumers away from beef protein, and the Agroecological scenario that shows, if production methods evolve towards an agroecological model (extensification, mixed farming, etc.), that the consumption of this protein type does not need to be drastically reduced. The Agroecological vision values the positive environmental externalities of extensive cattle farming (particularly biodiversity protection via grasslands) as well as the capacity of ruminants to valorize fodder resources (grass) that are unsuitable for human consumption (Poux and Aubert, 2018).[48] As a result, there is less competition between land used for livestock and land used for human food. From a climate

48 This is not the case for monogastric animals (pigs and poultry), which consume cereals and protein crops, the production of which not only competes with human food production but is also potentially spatially decoupled from livestock areas.

FIGURE 9. Evolution of the consumption of different animal products according to LCA, Agroecological and Sustainable Intensification visions

This comparison makes it possible to visualize simply which animal products should be reduced the most or the most moderately.



BOX 2. DO DAIRY PRODUCTS SCORE RELATIVELY TOO WELL IN LCA?

In an LCA, milk and meat sectors are assessed separately, which corresponds to the current organization of cattle production.[1] However, the dairy sector is the main supplier of meat, accounting for more than half of our consumption, through so-called "cull cows" and all cattle, calves and heifers not intended to replace dairy cows. For this sector, LCA therefore deals separately with the environmental impacts of meat and milk co-products.[2]

Is this separation too favourable to the milk co-product? A standard allocation method is used which, to our knowledge, has not been called into question. However, from this comparison between LCA and the scenarios, it seems clear that the LCA's rationale for allocating impacts differs greatly from that of the scenarios.

This divergence is linked to the systemic nature of the scenarios, which consider all the environmental impacts of livestock farming and take the agronomic interaction between milk and beef production into account. Conversely, LCA is not designed to consider this systemic aspect of agricultural production, nor to go beyond the evaluation at a time t (LCA does not project into the future). As a result, the allocation rule selected may give consumers the impression that they can continue to consume dairy products, even though meat production (and therefore the livestock population) would decrease very sharply in a system where meat production would have been drastically reduced (which corresponds to the very negative signal for meat in LCA). Other inconsistencies concerning dairy products can be noted, such as for Camembert and semi-skimmed milk. It takes about 8 litres of whole milk to make one kilogramme of Camembert, whereas it takes only 0.74 litres of whole milk for one litre of semi-skimmed milk, i.e. around ten times less.[3] However, the Agribalyse score is 0.5 mPt/kg versus 0.13 mPt/kg respectively, i.e. about 5 times less. Eco-Score, due to a different normalization formula for drinks,[4] gives the same score for these two products (54/100, whereas the formula for foods would give milk a score of 95/100). While this logic is justified by the need to show the consumer that plant milk tends to have a lower environmental impact than animal milk, this discrepancy may nevertheless be surprising in an approach of comparison between product categories. In a context of this comparison work with two visions, it would seem relevant to use scores based on the same normalization formula, and we therefore use the 95 score for milk in the dairy products category.

1 For a brief overview of the two types of farming, see https://www.la-viande.fr/animal-elevage/boeuf/organisation-elevage-bovin-france and Idele, CNE, Les chiffres clés du GEB, Bovins 2020: productions lait et viande.

2 A biophysical allocation is made between the milk and meat production of the cull cow. Specifically, all environmental impacts related to the life phase where the cow produces milk are attributed to milk and calf; all other life phases are attributed to meat production. Then, the allocation of impacts between milk and veal is "carried out in proportion to the energy needed to produce these two products". See Agricultural Methodo Report V3.0, May 2020 https://doc.agribalyse.fr/documentation/documentation-complete

3 The experiment conducted by Atla and Cniel specifically addressed the issue of dairy products, including these technical parameters.

4 The idea is to make liquids comparable by taking their volume into account.

perspective, this vision favours the objective of reducing nitrous oxide rather than methane (see section 2). Finally, extensive cattle rearing makes it possible to consider the reuse of nitrogen from a herd's manure to fertilize plant crops, in an approach towards the avoidance of nitrogenous fertilizers.

b. Dairy products

The Agroecological vision favours extensive grass-fed cattle systems. This development implies changing herd profiles by favouring breeds that have the capacity to make the most of grassland resources for as long as possible during the year, and that can supply both meat and milk.[49] This goes against the European trend in recent decades, which has moved towards physical productivity (quantities of meat or milk produced by the animal), and the specialization of animals to produce a co-product. Therefore, herd changes according to the Agroecological scenario means lower milk yields, an increase in the meat/milk production ratio, and consequently a decrease in production and consumption.[50] This also explains why the expected decrease in dairy products is even greater than the decrease in beef consumption (decrease of 50% compared to one of 19%). As a result, the Agroecological vision is more severe than the LCA, which does not consider these agronomic constraints.

c. Poultry meat

The Agroecological vision envisages a significant reduction in the production of poultry, the feed of which (cereals, protein

49 In the TYFA scenario, more than 75% of meat comes from the dairy sector. There is therefore a relationship between the two productions. Today in France, it is also a little more than half.

50 This change accounts for the nutritional recommendations. Indeed, the Esteban study estimates that about 40% of French people consume too many dairy products compared to the PNNS recommendations (2 portions per day). https://www.santepubliquefrance.fr/content/download/186844/2320242

crops) competes with the production of human food, which accentuates the competition for agricultural land and is a cause of deforestation in certain countries, particularly Brazil. Moreover, this type of farming does not allow the organic nitrogen in grasslands to be used and is therefore of only secondary interest in an approach to minimize the use of mineral nitrogen fertilisers. This scenario therefore aims to reduce livestock numbers and to make livestock farming less intensive and productive.[51] In contrast to the Agroecological scenario, LCA sends a significantly more positive signal to the consumer regarding this type of meat (+18 points), which may conflict with the issues of animal welfare, biodiversity management and natural resource conservation.

d. Eggs

Eggs score rather well in LCA, and significantly better than poultry meat (51/100 vs 37/100).[52] In the Agroecological scenario, egg consumption follows the same trend as that of poultry meat, since it is motivated by the same objective to reduce the poultry population in order to reduce the land pressure linked to the cultivation of cereals and protein crops for their feed. As a result, the gap between the LCA signal and the Agroecological one is slightly greater for eggs than for poultry meat (+21 points compared to +18 points).

e. Pork

The Agroecological scenario significantly reduces pork production for the same reasons as for poultry. At this stage, LCA sends a consistent signal regarding the volume of consumption.

f. Fish

The signal on fish consumption seems to be consistent with LCA: in both cases, consumption is discouraged, although, as described above, there is a big difference between the scores for "large" and "small" fish. The Agroecological scenario aims for a decrease in wild fish consumption because it threatens the renewal of certain species, without however relying on a significant increase in aquaculture, which causes several environmental problems (see Box 3).

3.3. Detailed analysis of animal products under Sustainable Intensification

a. Beef

The LCA signal on these foods is convergent with that of the Sustainable Intensification vision, a model that prioritizes climate and health issues. The methane emitted by ruminant livestock is a powerful greenhouse gas, and red meat consumption[53] is associated with an increased risk of several pathologies (Willet *et al.*, 2019). Furthermore, the environmental and agronomic externalities valued in the Agroecological model (see section 3.2) are not considered here, leading the Sustainable Intensification scenario to point towards a very large reduction in beef consumption.

b. Dairy products

While this vision and the LCA converge for beef, the signal for dairy products differs strongly: the Sustainable Intensification scenario envisages a significant decrease in the consumption of dairy products, in line with the envisaged decrease in the cattle herd (see previous point). This raises real questions about the allocation issues, as discussed in Box 2.

c. Poultry meat

Poultry has the greatest efficiency in terms of the conversion from plant to animal protein, and therefore has potential from an environmental perspective in a scenario emphasising production efficiency. Moreover, the Sustainable Intensification vision gives an important emphasis to the health issue. The overconsumption of poultry meat does not pose a nutritional problem, unlike pork (especially processed pork) or beef, the overconsumption of which is responsible for several illnesses (Willet *et al.*, 2019).[54] As a result, the envisaged reduction in poultry consumption is

FOCUS ON PLANT PRODUCTS

Cereals

Both the Agroecological and Sustainable Intensification scenarios propose a reduction in cereal consumption, with respective decreases of 15% and 35%. As cereal consumption is currently at a sufficiently high level in terms of nutrition, reducing its consumption would enable a reduction in the environmental impact of this crop without any nutritional impact (remembering that, in terms of nutrition, the challenge is to reduce the consumption of refined cereals to allow an increase in the intake of dietary fibre). The Sustainable Intensification scenario envisages reducing cereal consumption to 60% of total energy. A similar approach is used in TYFA but with less intensity, resulting in a less favourable score than that of LCA.

Pulses

Both visions strongly recommend the consumption of pulses, due to their agronomic and nutritional (fibre, protein) value. The LCA also gives pulses an excellent rating, so there is no real issue around the rating of this commodity.

51 For more details, see for example Poux and Aubert (2018: 43). Assumptions are based on Breton organic pork farming, and organic farming data for poultry.

52 Here again, LCA assesses the two sectors separately. It should be noted that the egg sector is largely independent of the poultry meat sector. The meat of laying hens, known as spent hens, thus represents only a small part of total poultry meat production. https://agreste.agriculture.gouv.fr/agreste-web/download/publication/publie/SynAvi21373/consyn373202106Aviculture.pdf

53 In the international literature, "red meat" includes ruminants and pigs.

54 The PNNS recommends giving preference to poultry and limiting the consumption of other types of meat: https://solidarites-sante.gouv.fr/IMG/pdf/pnns4_2019-2023.pdf

BOX 3. THE CHALLENGE OF ASSESSING THE ENVIRONMENTAL IMPACT OF FISH CONSUMPTION

Assessing the environmental impact of fish consumption is different for wild and farmed fish. For farmed fish, the environmental issue is to reduce the pressure on ecosystems–pollution, especially that linked to inputs such as drugs, and to the waste produced; genetic impact on wild species; destruction of natural ecosystems to install aquaculture infrastructure, etc. (Martinez-Porchas and Martinez-Cordova, 2012) –and to ensure that the source of protein used to feed farmed fish are sustainable, particularly in the case of carnivorous species.

For wild fish, the main problem is that of stock renewal, which has been undermined by overfishing. It is therefore this stock renewal threshold–which is different for each fish species and must be assessed according to each fishing area–that determines whether the consumption of a species is sustainable. However, knowledge of various fish stocks is currently incomplete, which limits the scientific robustness of existing labels.[1] Eco-Score was based on three sources[2] to assess the status of stocks according to geographical areas. If the fishery is not sustainable, the product is graded E. If there is no indication of the origin and if there is at least one area where the species is under excessive fishing pressure, the grading is also an E.

Eco-Score awards bonuses according to different labels.[3] The ASC label is applied for farmed fish, which receives 10 points. The Eco-Score approach transparently displays the references used to select the labels. Since seafood products are generally less studied (for example, these labels are not included in the ADEME database),[4] the analysis of the ASC label is based on only one assessment taken from a Swiss study.[5]

The environmental impact of fish consumption is therefore very heterogeneous, which is reflected in the scores given by Eco-Score based on LCA, which vary greatly depending on the species: 24/100 for farmed fish such as trout and salmon, and scores ranging from 14/100 for cod to 92/100 for herring (see Appendix 2).

1 The origin of the fish is also often missing from labelling. For example, in the Yuka app, some products do not indicate the origin of the fish.

2 Ethic Ocean (http://guidedesespeces.org/fr) WWF (http://www.consoguidepoisson.fr/wwf-recommendations/) IFREMER (https://wwz.ifremer.fr/)

3 10 points for MSC (fishing) and ASC (aquaculture), 15 points for sustainable fishing techniques (line, hook, etc.). For further explanation, see https://docs.score-environnemental.com/methodologie/produit/especes-menacee

4 See the platform dedicated to environmental labels https://agirpourlatransition.ademe.fr/particuliers/labels-environnementaux

5 https://www.labelinfo.ch/fr/projets-devaluation/-evaluation-des-labels-alimentaires

smaller than that of pork and beef (a 50% reduction, compared to 92% and 84% respectively, see Appendix 1). The gap with LCA is therefore smaller than the one between the Agroecological vision and LCA (7 points).

d. Eggs

In this vision the decrease in egg consumption is less significant, because the poultry population is maintained for the above-mentioned reasons. As a result, the gap between the signal from this scenario and that of the LCA is relatively small (10-point difference).

e. Pork

This scenario leads towards a major reduction in pork consumption (92% decrease), particularly for health reasons (the overconsumption of processed pork products is associated with an increased risk of cancer and cardiovascular disease). As a result, the gap between the signal from this scenario and that of the LCA is significant (more than 25 points).

f. Fish

In the Sustainable Intensification vision, the consumption of fish and seafood is encouraged, not least for nutritional reasons. There is no decrease compared to the current situation.[55] In France, for example, the National Health Nutrition Programme (PNNS) recommends eating fish twice a week because of the protein quality, including oily fish (sardines, mackerel, herring, salmon) for its omega-3 content.[56] Furthermore, this vision considers that fish farming can be developed without excessive environmental impacts.[57]

55 See for example this analysis of the diets of G20 countries in the Eat-Lancet report (p. 19): fish consumption may increase to reach their "planetary health diet" https://eatforum.org/content/uploads/2020/07/Diets-for-a-Better-Future_G20_National-Dietary-Guidelines.pdf

56 For the intake of fatty acids, see https://www.anses.fr/fr/content/les-acides-gras-om%C3%A9ga-3

57 "Aquaculture will not solve the challenges posed by feeding about 10 billion people healthy diets but could help steer production of animal source proteins towards reduced environmental effects and enhanced health benefits" (Willett et al., 2019: 476). The authors also make recommendations for sustainable fish farming.

3.4. Considering production methods in Eco-Score

The question of how to account for different production methods, particularly the valuation of agroecological practices compared to so-called "conventional" practices, is a central element of the EL debate. Indeed, as mentioned in section 1, LCA imperfectly reflects the benefits of the ecosystem services provided by organic farming and other agroecological practices due firstly to its evaluation logic, but also because of methodological limitations. These limitations are reflected in the use of the "average" data for a commodity in the database, i.e. data that represents the average of the different production methods for the same commodity type (e.g. wheat) (Soler *et al.*, 2020).

This situation is problematic, especially from an Agroecological perspective, which considers the development of agricultural practices as a central component in its approach, and that communicating these issues to consumers is essential. This situation justifies the medium-term need to improve LCA methods so that they reflect, as well as possible, the impacts of various agricultural practices, which is a crucial issue addressed by several actors participating in the experiment and the scientific council. In the short term, and with a view to developing a first, admittedly imperfect but operational, version of EL, the preferred approach within the experiment consisted in adding additional indicators to the LCA results in the form of bonuses/penalties, to reflect "organic" labels or "official signs indicating quality and origin" (SIQO) in general, to differentiate between production methods. Note that the Scientific Council, in its synthesis report (Soler *et al.*, 2021), proposes to reintegrate these corrections directly into the LCA framework.

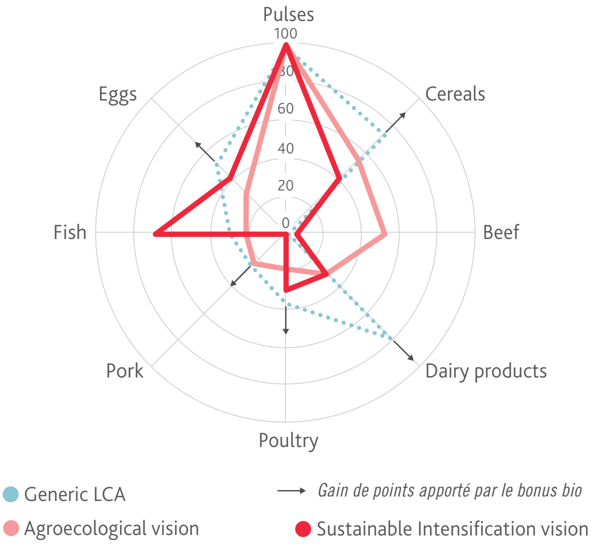
In this section, we analyse the impact of choices of additional indicators and the weightings given by Eco-Score by comparing signals from this EL, when production methods are accounted for, with those of the Agroecological vision:[58] do they enable certain products to move from one category to another and to change the signal to consumers?

a. Assigning bonus/penalty weightings linked to production methods

Figure 10 shows the shift in the Eco-Score signal when a bonus is added for organic farming practices (which amounts to the systematic addition of 15 points to the final score of products labelled as organic, and 10 points for Label Rouge products).

Figure 10 shows that the addition of the "organic bonus" does not bring the Eco-Score signal closer to the Agroecological scenario. Indeed, for the consumption of products that LCA relatively "over-encourages" (such as dairy products, pork, poultry, etc.), the addition of an "organic bonus" widens the gap with the Agroecological scenario. The opposite is true for beef, where the

FIGURE 10. Effect of Eco-Score's 15 point "organic bonus" (FR or EU)



simple LCA signal is too "weak" compared to that of the Agroecological scenario: the additional "organic" bonus reduces the gap–slightly–for this product.

This raises the question: could the "organic" label encourage greater animal product consumption, particularly in relation to the targets envisaged in the agri-food transition scenarios, and particularly in the Agroecological transition scenario?

Organic agriculture intrinsically induces physical production limits (lower yields, stricter animal welfare criteria, grassland area): the generalization of organic consumption would induce a supply deficit in relation to demand and would therefore have no environmental impact, provided that its standards are maintained. In other words, the total production limit can be seen as a low consumption logic. Furthermore, the EL's signal to the consumer must be considered within the parameters that influence consumer choice, particularly price. Organic livestock products are indeed more expensive than conventional equivalents, and this additional cost can be very high (especially for pork).[59] As a result, this price difference can be expected to moderate the EL signal. Finally, several studies show that organic consumers have a more plant-based diet with less animal products (Baudry *et al.*, 2019), which also reduces the risk of overconsumption.

b. Does Eco-Score sufficiently value organic farming? A comparison with other additional indicators

In the context of EL that combines LCA and additional indicators, the level of weighting of an indicator (and therefore

58 We focus only on this vision because in the Sustainable Intensification vision, the issue of production methods is much less central (the Sustainable Intensification vision does not imply an evolution of production methods towards agroecological practices).

59 For example, there is a doubling of the price per kg of cooked ham: https://www.carrefour.fr/p/jambon-a-l-etouffee-sans-nitrite-bio-herta-7613036624909 and https://www.carrefour.fr/p/jambon-le-bon-paris-a-l-etouffee-sans-nitrite-herta-7613035989535

its influence on the final score) can only be assessed in relation to the other weightings. Thus, as well as production method labels such as "organic", Eco-Score integrates other additional indicators, for example the environmental policies of the producer country (an adjustment of -5 to +5 points on the final score) or local sourcing (maximum 15 bonus points). For example, a product made in France receives 4 bonus points due to French environmental policies and 15 bonus points for transport;[60] in total, a French conventional product can gain 19 bonus points. An organic product made outside France can receive a bonus of the same magnitude; for example, an Italian organic product receives 24.9 bonus points.[61] The signal to the consumer on conventionally produced French products will be roughly the same as for organically produced products from another European country.

The same is true for French organic products, as there is a maximum of 25 points that can be accumulated through the additional indicators. Thus, a French organic product will receive 25 bonus points, even though the sum of the bonuses (4 for environmental policies, 19 for transport, and 15 for the "organic" label) is actually 36 points.[62]

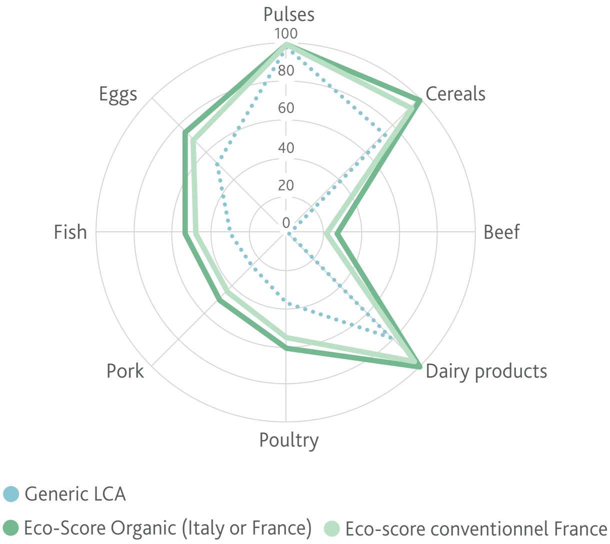
Figure 11 shows that the mode of production is put on an equal footing with the issue of local supply, i.e. transport. There is room for debate on this weighting as transport represents only a small part of the environmental impact, around 5% (Indicators Group, 2021b: 5), while upstream agriculture–the production phase–represents 83% of environmental impacts on average (ADEME, 2020b). Eco-Score allocates a bonus of up to 15 points for local sourcing, which is in line with consumer understanding on food-related environmental issues: i.e. the perceived impact of transport and the links between local sourcing and respect for the environment. However, it is important to note that, as it stands, this indicator is not refined at the sub-national level, as the notion of "local" implies: an approximation based on the distance between the producer country and the country of consumption, and on the mode of transport. The practical consequences of which are that "made in France" products get bonus points, the relevance of which is debatable.

Moreover, this reduction of environmental concerns to the issue of local production is the result of a political construction. Michel *et al.* (2020) use the term "local trap" to refer to this phenomenon of retranslating criticism of food sustainability, where local production has been made synonymous with being environmentally friendly, thus enabling the political discourse to steer clear of addressing other (more crucial) aspects of the agri-food system, such as dietary composition or production methods. However, it can be argued that if we take the local approach literally, i.e. "local production for local markets", this implies a radical change in the agri-food system: the current model is based on territorial specialization for certain products (pork in Brittany, wheat in Beauce, sugar beet in northern France), which does not allow for a diversified local food supply.

Beyond specific questions on what constitutes local production, the important thing to take from the consideration of this issue is that consumption concerns are not "natural". They result from awareness-raising, political framing, and also from making certain issues more visible than others. The implementation of an EL tool therefore offers an opportunity to raise consumer awareness of new issues and to create new expectations.

The choice of highlighting certain environmental issues over others via the system of additional indicators and weighting should be based both on scientific and technical facts–for example, the fact that LCA does not correctly represent the environmental and health benefits associated with organic farming, or issues related to plastic pollution–but also on political trade-offs. In this perspective it may be useful to compare the choices made in terms of additional indicators and weighting with existing public policies. For example, the fact that Eco-Score allows packaging to have a relatively high influence on the overall score[63] is justified by the objective to reach 100% recycled plastics by 2025, as set out in the Environmental Code, and also because LCA does not account for all pollution issues linked to packaging, particularly plastic (Indicators Group, 2021b).

FIGURE 11. Comparison of the organic label weighting in relation to the producer country



60 This is therefore an initial approximation which means that products from France are assigned with the minimum transport distance, which is obviously not accurate when considering areas near the border.

61 An Italian organic product receives a bonus of 15 points for the European organic label, 8 points for transport and about 2 points for the country's environmental score (54 x 0.15 pts for transport and 68/10 -5 for the country's environmental score), giving a total of 24.9 points.

62 Note that granting a bonus of 36 points would mean considering an environmental impact of a factor of 3-3.6 for this product, which would be huge and not in line with reality.

63 The packaging score is integrated into the overall product score in the form of a penalty of up to -15 points. In addition, products packaged in non-recyclable plastic are not eligible for an A grade, they are at best graded B.

Finally, a last element to be considered in the selection of additional indicators and their weighting is the adequacy between the environmental issue to be represented and the relevance of an indicator to reflect it. At present, quality indicators for agricultural practices are represented by labels and other certifications, which are intended to signify the producer's commitment to agricultural sustainability. For example, Eco-Score gives bonus points to 14 different labels–from +10, +15 to +20 points depending on "the level of commitment and the estimated environmental benefits".[64] However, numerous labels exist, each with very different levels of ambition, sometimes even within the same label (e.g. within Label Rouge) (Alliot *et al.*, 2021). Moreover, some labels that Eco-Score, and public authorities more generally, currently rate highly, such as the High Environmental Value label (HEV, which earns 10 bonus Eco-Score points), suffer from a significant lack of environmental ambition due to the indicators, thresholds and criteria used (Aubert and Poux, 2021). This work of selecting and weighting additional indicators therefore requires a systemic evaluation of the environmental, economic and social impacts of the labels, an evaluation that has not yet been conducted. However, a recent study by BASIC, Greenpeace and the WWF offers a promising approach to this area (see Box 4).

BOX 4. ASSESSING SUSTAINABILITY APPROACHES IN THE FOOD SECTOR: THE BASIC/GREENPEACE/WWF STUDY[1]

This work evaluated fifteen sustainability approaches from both social and environmental perspectives. The methodology is based on three components: 1) the development of a non-sustainability grid listing environmental and social issues; 2) an analysis of the theory of change of each approach; 3) an assessment of the potential impact. The potential impact was analysed in detail. This impact is especially important because: a) the links between the actions carried out and each issue are as direct as possible, b) the approach has a positive influence on a sufficient number of known causes of each issue, and c) the actions carried out by the approach have sufficiently proven influences (degree of certainty). This study thus shows that it is possible to rely on robust methodology to rank sustainability approaches and set associated bonuses in the context of EL. Such an approach, extended to other indicators, would thus be very valuable in informing indicator choice and their weightings.

1 In addition to the report, the results of this evaluation can be seen on the dedicated website: http://bit.ly/durabilit%C3%A9-alimentaire

3.5. Considering production methods in Planet-Score

Comparison of LCA and conventional Planet-Score

The aim here was to examine the impact of the modifications proposed by Planet-Score, both in terms of LCA adjustments and bonuses/penalties, for an intensive conventional product, in comparison with the average considered in LCA (see **Figure 12**). This comparison is important because, by default, this is the LCA figure that could be used for an intensive conventional product.

The data used corresponds to a very intensive production mode: it is a "minimum" marker as explained in Appendix 4 and is not therefore an average of conventional production. However, it should be noted that in the case of pork production, this "minimum" threshold represents most of the current French production.

The changes suggested by the Planet-Score's environmental assessment make the scores for poultry and pork considerably lower. It should be noted that it is primarily the penalties related to the additional indicators, and not the corrections made to LCA, that account for most of the changes. Moreover, in this framework, the score for intensive beef corresponds to the LCA score for an average production method. Therefore Planet-Score gives the same minimum score to animal products (poultry, pork, beef). The decrease is also important for eggs. Only dairy products retain a score that is close to the average, but which is nevertheless significantly lower than that derived from LCA: it should be noted here that we compared highly intensive dairy production with a score derived from LCA, which is an average score of production methods.

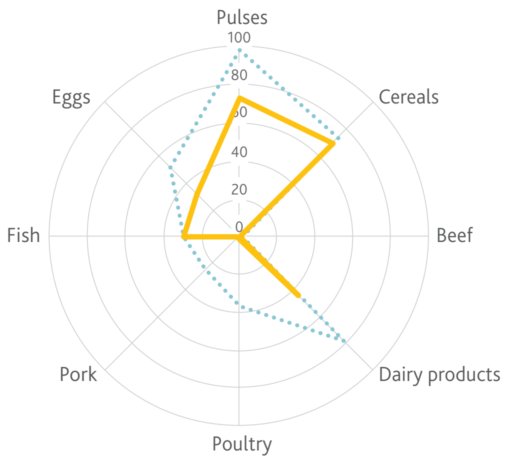
Comparison of Agroecological vision and extensive/organic Planet-Score

This comparison is important because the aim of Planet-Score is to provide a better reflection of the Agroecological vision. The data used here (see **Figure 13**) correspond to an environmentally highly ambitious production system: it is a "maximum" threshold, as explained in Appendix 4. For poultry, eggs and pork, in the absence of a benchmark for very beneficial practices, the practices considered here are "normal organic".

The most important deviation concerns dairy products: there is an amplification of the differences between the LCA approach and the scenario approach that we analysed earlier, notably because the production method considered is very beneficial but also very rare–a more common standard organic method would receive a score of 75/100 (instead of 91 in this case). For other animal products, Planet-Score tends to send a more positive signal than the Vision-Score of the Agroecological scenario. Here again, there is a difference between a scenario approach that considers the total amount that can be produced sustainably, and which must therefore significantly decrease, and an EL approach which is built to send a signal on the production method according to a rationale of changing consumption, but without considering the total volume.

64 https://docs.score-environnemental.com/methodologie/produit/label

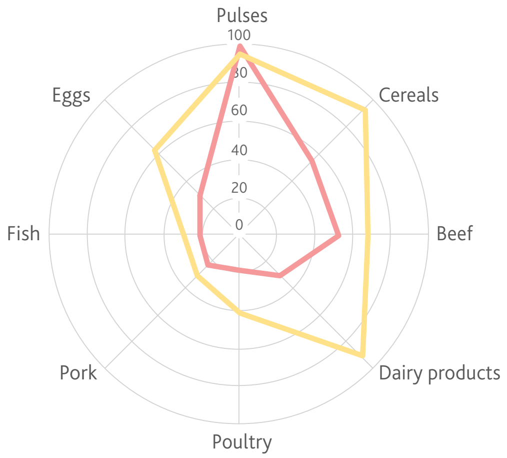
FIGURE 12. Comparison between LCA and Planet-Score for conventional products *



Generic LCA
Conventional intensive Planet-Score

** For fish, the Planet-Score currently uses the LCA score as it is.*

FIGURE 13. Comparison of the Agroecological scenario and Planet-Score for organic/extensive products*



Agroecological vision
Planet-Score extensive/organic

** For fish, the Planet-Score currently uses the LCA score as it is.*

3.6. Comparison between Planet-Score and Eco-Score for an organic product

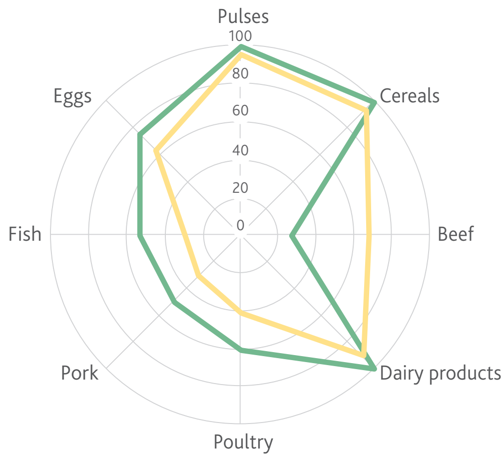
Figure 14 shows that the two signals are fairly consistent, with Eco-Score being slightly higher overall.

— The most notable difference concerns beef, where Planet-Score's adjustments lead to a significant increase in the score (a B on the label), which is not the case with the Eco-Score bonus. More specifically, Planet-Score's adjustment of the LCA adds around 45 points to the basic LCA score, and the bonuses add around 20 points.

— There is a one grade difference (about 20 points) for poultry and pork because, in both cases, the Planet-Score adjustments add 5 points to the LCA score, while Eco-Score adds 25 points. This can be explained as follows: for poultry, the Planet-Score's LCA adjustment reduces the standard LCA score slightly (by about 5 points) while the "organic" bonus adds about 10 points, resulting in a 5-point addition overall; for pork, the Planet-Score adjustment has little impact, while the bonus accounts for about 5 points.

In general, Eco-Score gives a higher score to an organic product than Planet-Score. However, Planet-Score enables a better differentiation between production methods, as it values agroecological practices while penalizing the scores of conventional products, especially the most intensive ones. Indeed, this EL system provides not only bonuses but also significant penalties depending on the production method (e.g. a pesticide penalty of up to a 15-point reduction) as well as LCA adjustments. Eco-Score mainly relies on production method bonuses (except for a 5-point penalty if the producer country has only

FIGURE 14. Comparison between Eco-Score and Planet-Score for an organically produced product*



Eco-Score Italian/French organic
Planet-Score extensive/organic

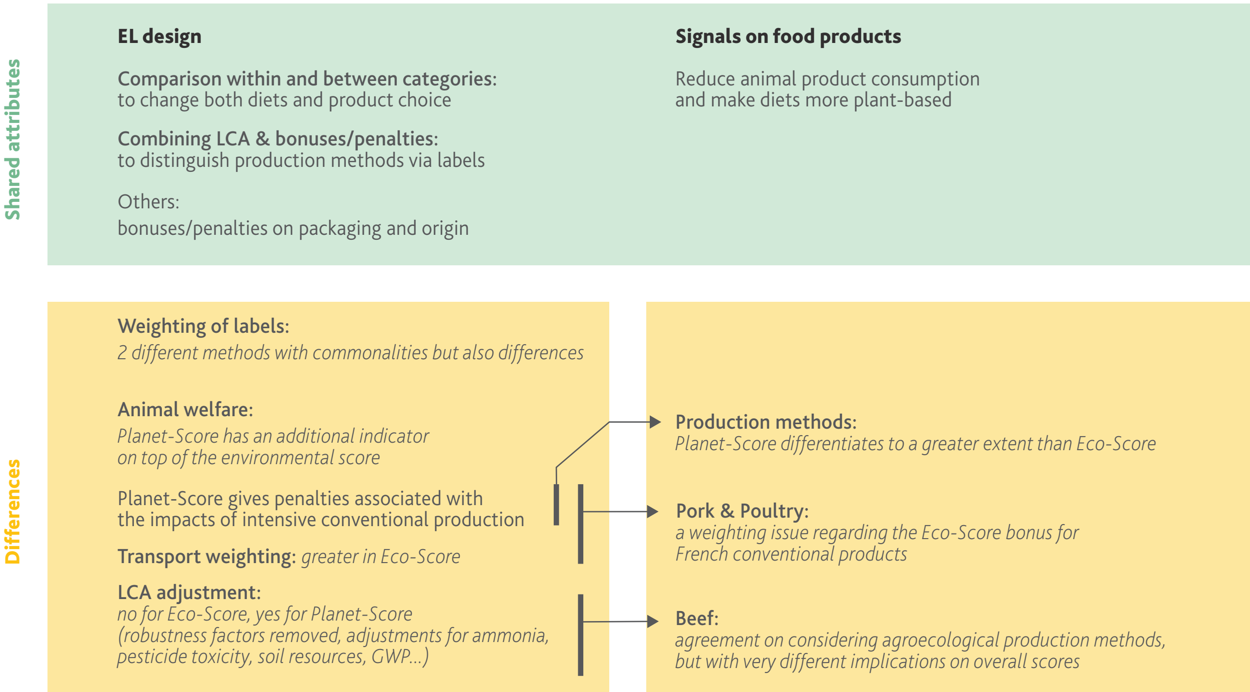
** More precisely, the Eco-Score compares products that combine an organic bonus (15 points), a transport bonus and a bonus for the "environmental policies of the producer country", making a total of 25 points for an Italian organic product, for example, and 36 points for a French organic product, which is then reduced to 25 points. As for the previous graphs, it should be noted that for fish, the Planet-Score uses the LCA score as it is now.*

a very limited environmental policy). Moreover, labels such as HEV attract a 10-point bonus, even though their environmental benefits are questionable, and they are not really distinguished from conventional production (see below). In comparison, this leads Eco-Score to under appreciate the real benefits of organic farming. It should be noted that this weighting is likely to change, due to the ongoing work of the Eco-Score developers. Finally, it is striking to note that Planet-Score's ratings for beef vary considerably according to the production method (between 0 and 68/100), which is not the case with Eco-Score.

Figure 15 summarizes the differences and similarities between these two EL systems, both in terms of design and results.

Arrows indicate where a methodological change contributes to a change of signal for a food product.

FIGURE 15. General comparison of Eco-Score and Planet-Score



Arrows indicate where a methodological change contributes to a change of signal for a food product.

BOX 5. A DIFFERENT APPROACH TO ACCOUNT FOR PRODUCTION DIFFERENCES: SPECIFIC DATA

In the Sustainable Intensification vision, the question of the differentiation of production methods is raised in a different way. The objective is to encourage the most efficient intensive methods so that production uses the lowest possible amounts of inputs and causes the least impacts. The aim is not to enhance the links between agricultural production and ecosystems, but to ensure that agricultural systems have the least possible impact on them. In practical terms, Sustainable Intensification's signal is: "in 2050, with poultry farms at a high level of efficiency, this is what your consumption should be," i.e. a large amount of plant-based food and a proportion of animal protein consisting mainly of poultry meat. To analyse the efforts made to develop intensive agricultural practices that are less input-intensive and have less impact on ecosystems, it is necessary to develop specific data that go beyond generic figures that don't distinguish between different production methods. The idea would involve giving producers the capacity to valorize, within the EL framework, the improvements made to production methods as part of an environmentally-friendly approach. The "Indicators" working group notes that carrying out product-specific LCAs is costly and therefore not accessible to all manufacturers and producers (Indicators Group, 2021a).[1] Intermediate options are also under consideration, such as the collection of semi-specific data–i.e. replacing some generic data with specific data, focusing the specification effort on the structural parameters (e.g. raw material origin, farming system, packaging type, manufacturing process, etc.) that are responsible for the majority of the environmental impacts of products. However, this option requires a choice to be made on which structural parameters would be covered by the specification, and to determine their value for a variety of situations. The question arises as to the short-term availability of this material. As a minimum, the working group therefore recommends specifying at least the list of ingredients and their quantities in order to refine the calculation, based on generic data.

1 The development of such specific data also raises legal issues. For example, in May 2021, the Council of State ruled in favour of Lactalis, which considers that making milk origin information mandatory for dairy products is illegal. See https://www.lemonde.fr/economie/article/2021/07/09/dans-l-agroalimentaire-la-bataille-pour-l-etiquetage-fait-toujours-rage_6087664_3234.html

4. CONCLUSION

4.1. Our ambition: to facilitate a political compromise

The experiment on food EL in France is an important step forward in the construction of a public policy on sustainable food. Its implementation on a French–or even European–scale would indeed provide consumers with guidance on the environmental impact of their food, an area where there is currently a lack of understanding (Hartmann and Siegrist, 2017; Huber and Aubert, 2019). Beyond the potential of a tool, the experimental approach launched by the government crystallizes several political issues: what is the average diet we want to move towards? Which farming systems are best suited to address environmental challenges? These questions have not always been properly addressed at the political level. For example, the National Low-Carbon Strategy (SNBC), the French roadmap for tackling climate change, has not reached a conclusion on the content of a sustainable diet, and the direction it gives to the agricultural system is still far from serving as a reference point. The creation of an EL indicator requires a decision to be made between different strategic orientations–insofar as the methodological choices will implicitly favour certain options over others–and therefore ultimately reveal a sustainable agri-food model. It is this aspect that complicates the EL debate: beyond the technical and methodological difficulties, it is important to know which transition path we want to take, but this path has not been defined. In this context, there is a risk of ending up with a multiplication of labelling tools, or even a postponement of its implementation, as has occurred in the past.

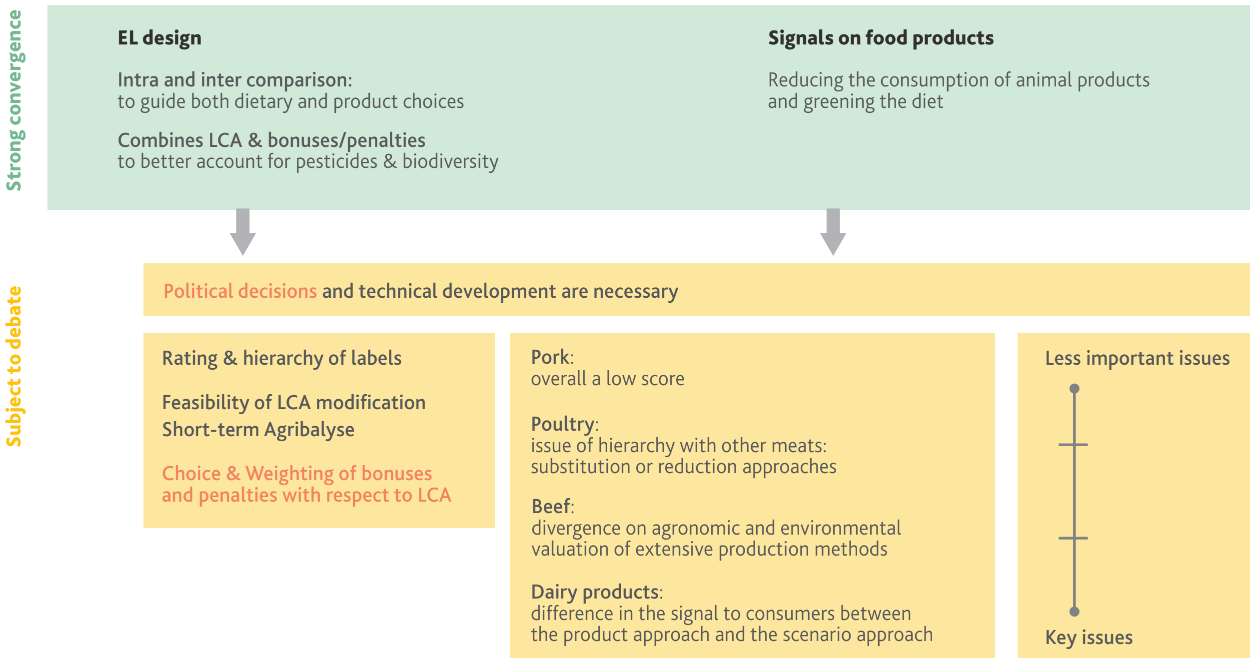
This study aims to address this issue: to maximize the chances that this experiment will actually lead to the implementation of EL, it is essential to reach a political compromise on the agri-food vision supported by this tool. However, until now it has been very difficult to reconnect the methodological debates about labelling with political visions. We aimed to respond to this issue by comparing the signals sent to consumers through labelling with the signals that would be expected from two agri-food transition scenarios. The ultimate objective is to answer the following question: do we have the foundation to develop an operational EL system in the short term, a system that would be in line with an ambitious vision of the agri-food transition?

4.2. Summary of results

This work of comparing the EL proposals with the two main visions of the agri-food transition has enabled us to identify the most significant commonalities, which make it possible to move forward, but also the elements that require trade-offs, sometimes with needs in terms of methodological progress. These results are summarized in **Figure 16**.

In general, the debates and the experimental results show convergence among stakeholders on major principles. Thus, there is consensus on the fact that the future system must allow

FIGURE 16. Summary of the main similarities and differences between the LCA results, the two EL proposals and the two visions



for the differentiation of environmental impacts according to different product categories, and in this context it must lead consumers towards greener diets and a reduction in animal product consumption. In addition, there is also a consensus on the need for the system to discriminate between products within the same categories, which has led experiments to propose "patches" (i.e. additional indicators) to measure issues that are poorly accounted for by LCA.

However, differences become apparent at a more detailed methodological level of the analysis. Concerning the signals on food products, divergences appear on the hierarchy given to different animal products, particularly regarding beef and dairy products. These divergences are partly linked to different visions of what constitutes a sustainable agricultural system: the Agroecological vision gives a more important place to cattle breeding than the Sustainable Intensification one, according to a rationale of avoiding synthetic nitrogen fertilizer and preserving permanent grasslands. The Sustainable Intensification vision, which is more focused on climate and health issues, envisages limiting the cattle herd population as much as possible to reduce methane emissions to a maximum extent. From this perspective, it is in line with LCA which, under the current methodology, gives a very poor rating to cattle farming. As a result, the two scenarios assign a different ranking to poultry meat. The Agroecological vision targets a major reduction in poultry numbers because maintaining a certain cattle population reduces the dietary need for protein from poultry, and also because the production of poultry feed is very demanding in terms of agricultural area. The Sustainable Intensification scenario also calls for a significant decrease in poultry numbers, but there is still a little more poultry meat than in the Agroecological vision, because it is considered to be better than pork and beef from a nutritional perspective, and is thus the meat that generates the more positive signal, as in LCA. Concerning dairy products, a divergence of signals was observed between LCA and that of the scenarios. Here we see the value of considering the scale of the agri-food system, rather than focusing on the product scale as the LCA does: indeed, it is impossible to envisage a simultaneous drastic reduction in cattle numbers, as recommended by LCA, while maintaining a similar level of dairy product consumption (which is implied by the good score that LCA gives to this product category).

Concerning the design of EL, particularly the choice and weighting of labels that give additional points to the LCA score, the comparison between Eco-Score and Planet-Score has shown that there are common points but also divergences. Nevertheless, it seems to us that these divergences could be resolved through ongoing work and discussions (see the BASIC/Greenpeace/WWF report cited in this study) and from future collective expertise from INRAE. In this perspective, the development of EL has created a very positive dynamic because it encourages the systemic analysis of the impacts of labels on the environment and other social issues. It also allows for the possibility of spillover effects on sectors, which would be encouraged to improve their specifications in order to be "better rated" in the EL framework. However, such a process of the continuous improvement of agricultural practices requires a governance mechanism that would allow the specifications to be re-evaluated according to their evolution, and the weightings within EL to evolve accordingly, a mechanism that does not exist at present. In the short to medium term, it is certainly possible to agree collectively on a label hierarchy and thus their valuation within an EL scheme. In this debate, a key point could be whether to give bonuses to conventional production, as Eco-Score does through the bonuses associated with French production (including the environmental score of France, the transport bonus and the bonus for HEV type labels).

The weighting of bonuses and penalties is a real debate. These weightings are crucial because of their significant effect on the final score. For example, a 20-point bonus to the LCA score means dividing the environmental impact by 1.6 or even 2 (due to the effect of normalization). In its recent synthesis, the Scientific Council underlines this difficulty, which justifies its proposal to take it into account directly via corrections in the LCA framework, before normalization. Given the current limitations of LCA, but also the consideration of labels, what weighting would be reasonable? While there is no definitive answer to this question yet, a comparison with the scenarios may be useful in defining it.

Beyond the question of how to better represent production modes and associated benefits within EL, our study has also shown the necessary compromise between the desire to be as systemic as possible in considering the various environmental issues (pollution linked to packaging, limitation of goods transport, animal welfare, etc.) and the weakening of the relative weight of each one when we multiply the complementary indicators.[65] The construction of such a compromise also comes up against very different levels of justification: should EL be constructed in a way that is consistent with consumer comprehension of the issues at stake, or should a compromise based on scientific knowledge be favoured? This is a difficult question because the first option increases the likelihood of understanding–and therefore of acceptance–by consumers, which is important in a context of mistrust[66] in the agri-food sector. However, it is unsatisfactory from a scientific and political point of view, as it does not necessarily address the most crucial issues. In the view of the authors, the best approach could be a middle way that would refer to the orientations of public policies and strategies to make these trade-offs. For example, on the issue of packaging,[67] the argument that "since consumers are sensitive to the issue of plastic, it should be given a prominent position" is often contrasted with the argument that "packaging only represents a small part of the environmental impacts of

65 The LCA itself has been designed to be as comprehensive as possible in considering the different environmental impacts. However, it has in practice established a hierarchy among the issues, which is open to debate.

66 About mistrust, see Brimont, L. and Saujot, M. (2020). "Ecological transition and inequalities, a democratic challenge. Part Two: Conducting the transition in a society of distrust", Blog post, IDDRI, https://www.iddri.org/en/publications-and-events/blog-post/ecological-transition-and-inequality-democratic-challenge-part-0

67 The same question could be asked about the importance of local transport/production in the calculation of the final score.

food production". This discussion is made even more difficult to resolve given that scientific knowledge on (micro)plastic pollution is still very incomplete (Indicators Group, 2021b). In the face of these uncertainties, it may be useful to refer to public policy objectives regarding plastic recyclability.[68] Another element to be considered in this compromise is the value of the EL tool in achieving a target compared to other public policy tools. On the issue of packaging, it is also worth considering that this issue could be addressed through regulation (i.e. mandating the use of recycled plastic) or through other incentive tools. The trade-offs on the preferred environmental objectives in the context of EL must therefore account for all existing public policies on each of the issues.

Finally, regarding the changes to be made to the LCA methodology, the possibilities of success seem less obvious in the short term, insofar as it is an internationally standardized methodology and therefore requires broader scientific and political consensus. Nevertheless, the work carried out in this experiment, the proposals made by stakeholders, and the work of the scientific council will be valuable in launching and feeding the debate at the European level, particularly on improving the consideration of toxicity issues for human health and ecosystems, biodiversity indicators, or carbon storage according to different types of land use (ITAB, 2021).

4.3. The agricultural model, a key issue in the debate

The methodological discussion on environmental labelling reflects alternatives in terms of the agricultural transition model: either a shift towards a more extensive agroecological model, which favours complementarity between animal and plant crops in order to avoid the use of nitrogenous fertilizers; or a relative continuity with the current intensive system, but with a notable reduction in the consumption of animal products. There is thus an alternative between a vision where the change in consumption driven by EL accompanies a systemic change in production methods, and a vision where the two dynamics are largely disconnected (each is optimized separately). Methodologically, this issue is reflected in the choice of complementary indicators and their weightings. Indeed, LCA does not currently take the question of production methods into account in its assessment (ITAB, 2021); the differentiation of the various production methods therefore mainly involves the addition of complementary indicators, some of which are proxies for certain agricultural practices (e.g. the "organic" label). However, our study has shown that the choice of weightings, particularly those assigned to other policy issues (e.g. transport or national production), can considerably modify the importance given to this parameter, and thus in other words the vision of the agricultural system promoted by EL.

The question of the agricultural transition model that is implicitly encouraged by EL will be the focus of most of the political debate. Indeed, as mentioned in the introduction, defining an EL indicator implicitly amounts to defining a "standard" of sustainable food, and thus ultimately a vision of a sustainable agricultural system. If we fully grasp the potential of EL as a tool for influencing consumption choices, then EL can contribute to changing the agricultural model, by defining a vision and relying on consumer and market mechanisms to put a set of changes in motion. From this point of view, it is likely that the issue of the differentiation of production methods will be the centre of the political debate. Indeed, it is on this aspect that the main criticisms of the experiment have emerged.[69] Moreover, the debates within the EL working group led by the Institute of Trade show that this aspect attracts the most dissent in the industry: "The question of modulation by complementary indicators before or after standardization, for its part, did not lead to a consensus within the think tank because it depends on a political vision of the food system that is not yet known" (Institut du commerce, 2021 : 8).

4.4. The future for environmental food labelling in France and Europe

At the end of this 18-month experiment, what follow-up can be envisaged for the development of EL in the food sector? Firstly, the implementation of this tool is clearly relatively well supported, or at least does not meet with significant opposition. The issue at stake in the debate is on the form that this EL will take: we have shown to what extent methodological choices have an impact on the signals sent to consumers, and have considered different visions of the agri-food transition. This experiment has also given rise to a significant collective effort to advance EL methodology, with several proposals. While this effort is to be welcomed, it is now important to assess the proposals on the table with the limitations of their implementation–this is the objective of this study. In the search for a compromise on the form that EL should take, it will be necessary to judge the options according to their political relevance (what public policy objectives do they serve?), but also their technical and methodological feasibility (what costs in terms of time and human and financial resources do they entail?).

In this context, it is also necessary to consider the position of the European Commission and other Member States on EL. It should be noted that Action 23 of the Farm to Fork strategy for a fair, healthy and environmentally-friendly food system, which is one of the 11 components of the European Commission's Green Deal, proposes an EL framework to enable consumers to make sustainable food choices by 2024 (European Commission, 2020: 22). At this stage, it is unrealistic to expect that a common position on EL can be developed in the short to medium term. In

68 Article L. 541-1 4°bis of the Environmental Code thus requires the aim to be 100% recycled plastic by 2025.

69 See for example the press releases of ITAB and its partners quoted in the study.

this respect, it is worth noting the Nutri-Score example: six years after its launch, Nutri-Score has still not been adopted by the European Commission, notably in the face of opposition from certain countries, including Italy.[70] It is therefore highly unlikely that EL will become mandatory in France, as such a provision could be challenged by other Member States as an obstacle to the free movement of goods. The most realistic option for France would therefore be to propose an official EL methodology, so that companies can develop it on a voluntary basis. Companies would have a strong incentive to use it, as a player such as Yuka would be able to offer it, even without a dedicated logo on packaging. And we can see that the momentum is really building: many retailers are testing the deployment of the Eco-score or Planet-score, especially in France. These initiatives will be very useful to generate knowledge to feed the process of defining an AE in France, but also in Europe.

70 https://www.lemonde.fr/planete/article/2021/03/16/l-appel-de-270-scientifiques-pour-l-adoption-du-logo-nutri-score-en-europe_6073326_3244.html

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APPENDICES

Appendix 1. Data and methodology for "Vision-Score" calculations

Normalisation* of expected "Visio-Score" evolutions

	Agroecology (in %)	Vision-Score	Signal	Sustainable intensification (in %)	Vision-score	Signal
Pulses	+500	100	to promote	+1,400	100	to promote
Cereals	-15	54	to limit	-35	41	to reduce
Beef	-19	52	to limit	-84	5	to be greatly reduced
Dairy products	-50	30	to reduce	-50	30	to reduce
Poultry	-66	19	to be greatly reduced	-50	30	to reduce
Pork	-59	23	to reduce	-92	0	to be greatly reduced
Fish	-63	21	to reduce	+4	68	to be favoured under certain limits
Eggs	-50	30	to reduce	-35	41	to limit

* Normalization formula used: 0.68*[100 + 100*(x-xmax)/(xmax-xmin)] where x is change in diet

Data on pulses were excluded from normalization because they are extreme; a Vision-Score of 100 was assigned to pulses.

Example of calculation for beef in the agroecological diet:

0.68*(100+100*(-13-4)/(4-(-92)) = 56

Appendix 2. List of products used to calculate the LCA and Eco-Score for each category

Protein category	Product name	Normalized LCA score according to Eco-Score	Average per category
Beef	Rump steak	3	2
Beef	Pure minced beef	0	
Bee	Entrecote	3	
Dairy products	Cottage cheese	70	78*
Dairy products	Plain yoghurt	85	
Dairy products	Yoghurt with fruit	69	
Dairy products	Semi-skimmed milk	95 (54)	
Dairy products	Cream (single or double)	70	
Dairy products	President butter	27	
Dairy products	Carrefour Mozzarella	54	
Dairy products	Camembert	54	
Dairy products	Comté	49	
Poultry	Roast chicken breast fillets	37	37
Poultry	Loué chicken thighs	37	
Poultry	Chicken drumsticks	35	
Poultry	Maître Coq chicken fillets	37	
Pork	Pork chop/pork loin	21	
Pork	Frankfurter	17	25**
Pork	Bacon	36	
Pork	Good quality ham	33	
Pork	Saucisson	36	
Pork	Carrefour Aoste cured ham	7	
Fish	Salmon steak	24	29***
Fish	Trout steak	23	
Fish	Canned yellowfin tuna	28	
Fish	Canned sardines in oil	50	
Fish	Canned mackerel	45	
Fish	Smoked herring in brine	92	
Frozen fish	Alaskan pollock	14	
Frozen fish	Frozen raw cod	14	
Pulses	Lentils	99	98
Pulses	Baked beans in tomato sauce	96	
Pulses	Cooked green lentils	99	
Eggs	Organic eggs (œufs de Rey)	51	51

* Average obtained by weighting each dairy product sub-category by their respective share of the average consumption, as defined in INCA3 (p. 160). Milk: 39% (75 g); yoghurt and cottage cheese: 40% (77 g); cheese: 16% (31 g); animal fat: 5% (9 g).

For milk, Eco-Score uses a weighting formula for beverages, which leads to a score of 54. If the food formula were used, which may make more sense from an environmental point of view as explained in Box 2 on dairy products, the score would be 95 and the score for the dairy category would be 78 instead of 62. As part of our comparison of environmental impacts, we use this value of 78.

** Average obtained by weighting charcuterie and pork equally.

*** To calculate the average LCA score for fish, we follow PNNS recommendations which advise one portion of oily fish (average of all common oily fish) and one portion of white fish (average of all common white fish).

Appendix 3. Comparison of the LCA and "Vision-Score" signals

	Normalization							
	Agroecology (in %)	Vision-Score	Signal	Sustainable intensification (in %)	Vision-Score	Signal	LCA Score	Signal
Pulses	+500	100	*to promote*	+1,400	100	to promote	98	*Very low impact*
Cereals	-15	54	*to limit*	-35	41	to reduce	74	*low impact*
Beef	-19	52	*to limit*	-84	5	to greatly reduce	2	*very high impact*
Dairy products	-50	30	*to reduce*	-50	30	to reduce	78	*low impact*
Poultry	-66	19	*to greatly reduce*	-50	30	to reduce	37	*high impact*
Pork	-59	23	*to reduce*	-92	0	to greatly reduce	25	*high impact*
Fish	-63	21	*to reduce*	+4	68	to promote with certain limits.	29	*hight impact*
Eggs	-50	30	*to reduce*	-35	41	to limit	51	*moderate impact*

Appendix 4. List of product scores in Planet-Score

	Planet-Score	
	Most intensive conventional	Extensive/grassland/ organic systems
Pulses	73	95
Cereals	70	93
Beef	0	68
Dairy products	45	91
Poultry	2	41
Pork	1	31
Fish	29	29
Eggs	31	63

A representative product, with an LCA score very close to the average per category calculated in Appendix 2, was used to give the Planet-Score value. The two production mode categories correspond to extremes: the "minimum" and "maximum" thresholds. These production modes may represent a very small proportion of French production (e.g. high threshold, a 100% grassland dairy production on permanent grassland), or a large proportion (e.g. low threshold, a very intensive pig production system, which is almost the dominant model). At this stage, this comparison is a sensitivity test, and further work on this EL will allow the refinement of the scoring of average/representative products.

Appendix 5. List of people interviewed for this study

- Benoît Granier, Food manager, RAC
- Didier Moreau (Director of Sustainable Development), Agnès Martin (Health and Diet Advocacy Director) and Alice Lesmesle (CSR Project Manager), Danone
- Valérie To, Project manager for the carbon impact of agriculture and environmental labelling, Commissariat Général au Développement Durable (CGDD)
- Catherine Conil, Head of the Food and Sustainable Agriculture Office, French Ministry of Ecological Transition
- Xavier Poux, senior project manager, AScA, Associate researcher, IDDRI
- Florence du Buit, CSR manager, Carrefour Île-de-France
- Louis Georges Soler, Deputy Scientific Director, INRAE
- Suzanne Dalle, agriculture campaigner, Greenpeace
- Caroline Guinot, Head of CSR Livestock and Meat Sector, INTERBEV
- François Martin, co-founder, Yuka
- Natacha Sautereau (project manager, in charge of sustainability assessment, responsible for the Sustainability-Transitions cluster) and Sabine Bonnot (administrator, professional referent of the Sustainability-Transition cluster), ITAB,
- Emilie Chalvignac, Director of Operations, Institut du commerce
- Sharon Bligh, Health and Wellness Director, The Consumer Good Forum
- Christophe Alliot, co-founder, BASIC
- Sylvain Doublet, responsible for the bio resources activity, SOLAGRO

Environmental food labelling: revealing visions of the future food system to build a political compromise

Laura Brimont, Mathieu Saujot (IDDRI)

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CONTACT
laura.brimont@iddri.org
mathieu.saujot@iddri.org

Institut du développement durable et des relations internationales 41, rue du Four – 75006 Paris – France

www.iddri.org
@IDDRI