Developing an LCA based consumer guide for environmental and animal welfare performance of meat/animal products

Hans Blonk[1,*], Mari Marinussen[2], Mark Goedkoop[2]
[1] Blonk Milieu Advies, Gouda, the Netherlands
[2] Pré Consultants, Amersfoort, the Netherlands

ABSTRACT

In the Netherlands experience has been gained with consumer communication on sustainability aspects of meat products and meat alternatives. The in 2009 launched meat consumer guide consists of a slightly adapted ReCiPe endpoint score for biodiversity loss and a score for animal welfare for 12 animal products and 4 "vegetarian" products. This paper focuses on the biodiversity loss calculations and the combining of both scores. The background of the welfare rating is not explained in detail. The ReCiPe based calculated biodiversity loss scores of Dutch meat products resulted in a rating of meat products that we expect to be rather robust. However, this robustness vanishes if land use conversion is included. We do not recommend to include land use conversion from theoretical as well as practical reasons. Animal welfare rating in LCA remains a challenging topic. Further research on how to convert a system based rating to a functional unit based rating is needed.

Keywords: consumer guide, meat products, ReCiPe, biodiversity, animal welfare

1. Introduction

In October 2009 two Dutch NGO's, Friends of the Earth Netherlands (FOE Netherlands) and "Pigs in Peril" (PIP) launched the "meat consumer guide" (vleeswijzer). The meat consumer guide consists of a slightly adapted ReCiPe endpoint score for biodiversity loss and a score for animal welfare for 12 animal products and 4 vegetarian products. The results are used to produce a small credit card sized table that consumers can use when buying meat and vegetarian products (Figure 1).

Animal welfare was ranked on an ordinal scale between 1 and 10, the highest score representing the highest level of animal welfare. The ranking was conducted on the basis of a questionnaire under animal welfare experts with a background in science, business or NGO's (De Jonge *et al.*,, 2008) The methodological details of the applied method can be found in (Bracke 2001, 2006) and are not further described in this paper. The welfare of living animals was ranked per animal production system, and not per individual or kg of meat.

There was a need to compute a single score for the environmental impact, as it was assumed that consumers will not be capable to interpret multiple impact category indicator results. As the focus is on animal welfare, and not on human health or resources, we decide to use the biodiversity damage category of the ReCiPe methodology that was in development at that time (Goedkoop *et al.*, 2009). The dominating inputs were land-use and climate change.

When asked to help producing a weighting between the animal welfare and the environmental impacts, in order to develop a final ranking, we had to overcome several challenges:

* Corresponding Author. e-mail: hans@blonkmilieuadvies.nl

1. In the welfare score, “more” means better, while in the environmental assessment “less” means better.
2. In the environmental assessment impacts are computed per kg meat, while in the welfare assessment, the welfare reflects the level of welfare of the animal production system.
3. The environmental score expresses a real number from zero to infinity, while the animal welfare rating is an ordinary scale between one and ten.

The initial results also posed a challenge to the stakeholders when it became clear that measures that improve welfare can have a negative impact on the environmental impacts. For instance, “free range” broilers scoring high on animal welfare have higher environmental impact scores than conventional farmed broilers, because they grow slower, consume more feed and live longer.

2. Methods

Calculating LCA scores on biodiversity loss

Calculating the LCA scores on biodiversity loss included 2 steps

Step 1. Inventory of environmental data

Step 2. Calculation ReCiPe end scores on biodiversity loss

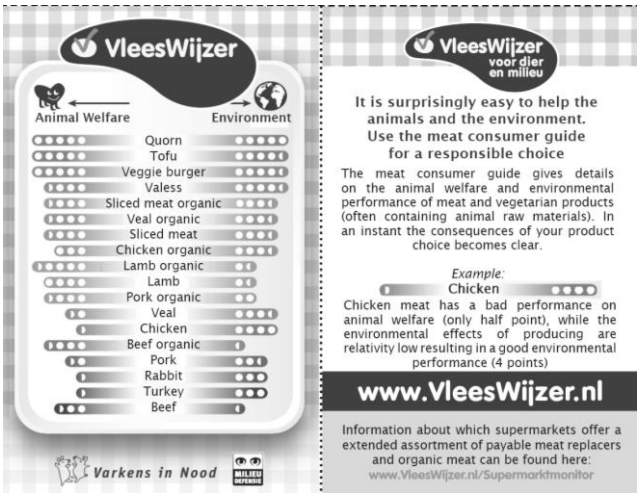

Figure 1: Meat consumer guide (vleeswijzer) of PIP (Varkens in Nood) and FOE Netherlands

<u>Step 1. Inventory of environmental data</u>

For the inventory we used the LCA inventory results from the study Environmental effects of protein-rich food products in the Netherlands (Blonk *et al.*, 2008, Marinussen *et al.*, 2010). The results are expressed per kg of meat or alternative protein rich vegetarian products. For the meat products average fresh products are defined assuming only basic processing steps (cutting, slicing, etc.). We used foremost Dutch animal production systems, which reflect most of Dutch consumption of pig, broiler and processed cattle products. However the major part of the fresh beef sold in the Netherlands is from foreign origin. Here we used Irish beef.

Step 2. Calculation ReCiPe end scores on biodiversity loss

The ReCiPe method (Goedkoop *et al.*, 2009) distinguishes 3 endpoint impact scores: human health, ecosystems and resources. For the impact on ecosystems the indicator potential loss of biodiversity (expressed in potential species loss per year) is used. When no land conversion takes place, land use and greenhouse gas emissions are by far the main contributors for the loss of biodiversity by animal products. With regard to land use the current method of calculating species loss distinguishes only between a limited set of agricultural land use types. For instance grass land is deemed to be managed properly, while the major part of grasslands in developing countries is grazed beyond the carrying capacity. Moreover, differences in natural background biodiversity are not accounted for. We did not add new land use types but with regard to background biodiversity we made a sensitivity analysis in which we assumed a 3 times higher background biodiversity for South America and South East Asia versus Europe and North America. The factor 3 is derived from a review of plant species biodiversity of ecosystems in the world (Kier *et al*., 2005) and must be considered as an estimation on the upper side of the range. A comparison of typical European and Brazilian biomes showed a difference of a factor 2 in plant species diversity per hectare (Blonk and Goedkoop, 2009). Because of the fact that plant species diversity is not the single indicator for species diversity we used a factor 3 as a proxy for investigating the effects on the results.

We excluded land use conversion because of several reasons. First, it is hard to determine how much land conversion and on which location must be allocated to existing land use. Methods for this so-called indirect land use conversion are still under development. In Ponsioen and Blonk (2010) for instance a method of how land use change can be allocated to lands use of crops based on statistical trends per crop per country is described. Applying this method, land use change is mainly allocated to soy beans and palm fruit because of trends in growing crop areas in South America and South East Asia. It remains however questionable whether this land use change must be treated likewise as other interventions in LCA. Ponsioen and Blonk (2010) argue therefore that these results must be reported separately from other results.

Second, a more practical reason for not including land use change is the huge variability in the origin of raw materials in feed concentrates and vegetarian products. The use of soy and palm products would completely dominate the ReCiPe scores while the use of these raw materials fluctuates in animal feed in relation to market prices. For instance the amount of soybean meal used in pig concentrates varies strongly over the years. The soy used per kg pig meat could either be much higher or much lower than per kg vegetarian product with the effect that the ReCiPe score of pig meat can either be lower or higher then a vegetarian product, which is very confusing for consumers.

Combining biodiversity loss scores with the animal welfare rating

The University of Utrecht (De Jonge *et al.*, 2008) derived a welfare rating of farming production systems of different animals based on a query under animal welfare experts in the Netherlands (Table 1).

To be able to make a combined presentation of the welfare rating and biodiversity loss, the results of the welfare rating were converted into a rating on animal welfare loss (Table 1, 3rd column). In this way we created an impact category which is conceptual more or less consistent with other impact scores within LCA. We assumed that farming of organic lamb is a situation with no welfare loss and the conventional farming of turkey, broilers and rabbit in the Netherlands is a situation with 90% welfare loss. The calculated ReCiPe biodiversity loss scores were also converted to a 0-100% scale where 100% was set equal to the highest animal production system.

Table 1 Welfare rating of Dutch animal production systems

Meat from:	**Welfare Rating according to the De Jonge *et al.* (2008)**	**Welfare loss scores used to combine with biodiversity loss scores**
Turkey, Broiler, Rabbit	1	90%
Calf, Pig	2,5	75%
Broiler (Volwaard), Beef cattle	5	50%
Broiler (Label Rouge), Broiler (Organic)	6,5	35%
Dairy cow, Calf (organic), Pig (organic)	7	30%
Beef cow (organic), Dairy cow (organic)	8	20%
Lamb	9	10%
Lamb (organic)	10	0%

The method of combining the biodiversity loss score with animal welfare loss described above has some conceptual flaws within the scope LCA. The most important is that the amount of welfare loss is rated on a system level without dimensions in time or space. So in fact welfare loss can not be linked to a certain amount of production and thus not to a weight based functional unit. An interesting idea that emerged during the discussions was to create an equivalent DALY (Disability adjusted life years) for Animals. We could multiply the disability (loss of welfare) with the number of days that an animal needs to gain an additional kilo of meat. This concept was rejected as it was thought to be too difficult to explain for instance because of the fact that how much individuals needed for production is not deemed relevant in this approach.

3. Results

Biodiversity loss

Beef from beef cattle in the Netherlands has the highest biodiversity loss and is set to 100%, meaning a 1,294 E-9 species lost per year/kg. Chicken meat from broilers has the lowest biodiversity loss score in the baseline: 120 E -9. However, the high content of soy bean meal in the broiler feed and applying a 3 times higher background biodiversity in South America and South East Asia almost doubled this score to 249 E-9 species lost per year/kg. The average is used to calculate the relative biodiversity loss score (Table 2).

Table 2: Combination of biodiversity loss and animal welfare loss

	Relative Biodiversity loss score	**Animal welfare loss (system based)**	**Environment points**	**Animal welfare points**
Beef	100%	50%	C	OOC
Lamb	52%	10%	OC	OOOO
Pork (organic)	26%	30%	OO	OOOC
Pork (conventional)	21%	75%	OOC	OC
Turkey	19%	90%	OOO	C
Rabbit	18%	90%	OOO	C
Sliced meat from dairy cow	16%	20%	OOOC	OOO(
Chicken	15%	90%	OOOO	C
Chicken organic	14%	35%	OOOC	OOO
Sliced meat from dairy cow organic	14%	20%	OOOC	OOOC

Combining the Biodiversity loss scores with animal welfare loss

The consumer meat guide as published by Pigs in Peril combined the biodiversity loss scores with the system rating based on De Jonge *et al.* (2008) (Table 2). The results are scaled from relatively bad to good performance (inverse of calculated scores) and visualised the results in "points".

4. Discussion

Environmental scores

The biodiversity loss scores are highly dependent on two midpoint impact categories in the ReCiPe method: land occupation and greenhouse gas emissions. The applied data for greenhouse gas emissions related to land use and equivalency factors related to land use occupation and background biodiversity are therefore major determinants. We expect that in particular more detailed data of biodiversity loss related to land occupation in countries will have significant effects on the results and on the ranking of products.

Including the two other ReCiPe scores for resources and human health would alter the results slightly in favour of the products which have a relatively low input of fossil energy. This leads to some changes in the relative distance of the products and also in some changes in the rating of the products. Applying the aggregated ReCiPe indicator scores from Broekema and Blonk (2009) for pigs, chickens, valess and tofu would result in 21%, 15%, 16% and 9% respectively instead of 21%, 13, 8% and 7% as published in the meat consumer guide. Some "vegetarian" products would end up higher on the rating due to the relatively high inputs of fossil energy.

Applying the ReCiPe method for rating the environmental effects of animal products result in a low impact of local important themes (in the Netherlands) like emissions of heavy metals, eutrophication, acidification or the quality of farming nature (contribution in local biodiversity). This automatically leads to less favorite scores of less productive farming than average conventional farming as is in the case of organic farming.

The current meat consumer guide actually involves 16 product categories which in itself can have a rather high range in PDF scores of approximately plus or minus 25% depending on the specific product type. In Broekema and Blonk (2009) the variation in PDF scores in between the different vegetarian alternatives was plus or minus 20%. Therefore it is important to use a limited amount of scoring classes; the current Consumer guide uses 10 classes, which might be too many considering the variability per product.

Welfare scores

The applied welfare rating on system level used as baseline is a first attempt of making a rating of the welfare conditions of different animal species farmed in Dutch production systems. In this paper we do not discuss the methodology issues of the welfare rating any further. The most important question for LCA is how to link the system level scores to a functional unit. There are basically two options a time (productivity) based or an individual based welfare loss score. Both methods indicate that in case of similar welfare conditions it is far better to use big animals instead of small animals, because big animals gain more weight per day and fewer individuals are harmed for the production of each 1,000 kg meat.

Another issue is the scaling of the welfare scores. We assumed the welfare rating to be a linear scale while in fact the scaling is based on an expert judgement and not on measurements or a model. However, this is also the case with the DALY method, where the actual estimation of the extent of disability depends on expert judgement (Goedkoop *et al.*, 2009). So it seems acceptable to include a subjective interpretation within the impact model.

Consumer empowerment

The publication of the meat consumer guide led to much rumour. Some people argued that science is not capable yet to give unambiguous ratings on welfare or environment. Other welcomed the initiative as an important mean to give information on animal production systems and the trade off between welfare and environment. This latter aspect can be regarded as a form of consumer empowerment. They become more informed about two important sustainability aspects and they can choose which aspect they would prevail.

Conclusions and recommendations

The current consumer guide of pigs in peril is far from perfect, but it is an informative tool which gives insight in how environmental and welfare loss are interrelated and that they are often not pointing in the same direction.

With regard to the sequence of environmental scores per type of meat we expect to be rather robust. Applying more specific ReCiPe based calculations will not give great shifts in sequence. The robustness of the rating could be enhanced applying fewer classes, for instance 5 instead of 10. The inclusion of land use change, which we do not recommend, would give a considerable shift in outcome. The animal welfare rating needs to be further developed in LCA from a system based rating to a functional unit based rating.

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