Food and Agriculture Organization of the United Nations

DRAFT FOR PUBLIC REVIEW

Developing sound tools for transition to sustainable food and agriculture

LEAP Partnership Life Cycle Assessment Guidelines on Livestock supply chains: Methodological notes

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Why this Partnership

"You can manage what you can measure" is a motto that nicely reflects the philosophy underpinning all technical activities of the Livestock Environmental Assessment and Performance (LEAP) Partnership. The LEAP Partnership aims at developing both globally-accepted assessment methodologies and reference databases to support better environmental management of livestock production systems via environmental benchmarking.

Consensus building was deemed necessary in this field due to the significant role played by livestock relative to climate change and the environment as a whole, and the mistrust of decision makers on all environmental disclosures caused by the proliferation of heterogeneous environmental assessment technical documents over the last years. Various organizations, in fact, conducted a number of environmental assessment studies and, due to differences in methodology and data, their results were often contradictory and heavily criticized by scientists and livestock supply chain stakeholders. To build up trust and help policy makers, businesses and other stakeholders make informed choices on livestock environmental sustainability, LEAP founders embraced Sacrates philosophy according to whom "The only true wisdom is in knowing you know nothing" and established the LEAP Partnership in 2012. Joining forces and engaging in technical discussions in a humble and collaborative manner was found as the only way to analyse methodological issues from all different angles possible and to effectively and efficiently solve them.

Consensus achieved

The LEAP Partnership is a global, multi-stakeholder initiative co-chaired by FAO and composed of governments, private sector, NGOs and CSOs. LEAP works in collaboration with the Global Agenda for Sustainable Livestock, and pursues its objectives under the auspices of many stakeholders, including UNEP, OIE, ISO and the European Commission.

LEAP technical outputs are living deliverables, which are subject to changes and improvement as soon as new science becomes available, testing highlights methodological gaps, and new partners join LEAP bringing new perspectives.

The LEAP life cycle assessment (LCA) guidelines represent the latest agreement found by the LEAP Partnership on methodology and indicators for quantifying and interpreting the environmental

performance of livestock production systems[1]. All LEAP guidelines are freely available for download on the Partnership website[2].

These technical documents were shaped by technical advisory groups made up of world-leading researchers and technical officers in environmental assessment and in feed and livestock production systems. All LEAP guidelines are the result of a multi-level structured participatory technical development process open to all LEAP partners that also involves several review steps, stretching from several internal consultation rounds with the LEAP Steering Committee, to an external review conducted by three technical experts, up to a public consultation.

Even if LEAP technical documents are acknowledged as the reference environmental assessment frameworks at the time of their release, science is evolving fast in this field and hence LEAP partners and stakeholders can build on LEAP technical outputs and go beyond them. For this reason, formal endorsement is not necessarily assumed by LEAP partners at this point in time and complying with LEAP guidelines is not legally binding. Nevertheless, should LEAP members deviate from these guidelines, a justification with reasoning should however be provided and approved by the LEAP Steering Committee in order to still claim alignment with LEAP recommendations.

LEAP guidelines key features

LEAP LCA methodologies are, voluntary, collectively-agreed, and science-based. Designed to be environmental measurement tools, the LCA methodologies in the LEAP guidelines allow for increased consistency across environmental assessments of feed and livestock production at various scales, from the product level, to the organisation, up to sectorial at both regional and global scale. To date, LEAP has delivered guidelines on feed, poultry, as well as on small and large ruminants. These guidelines are global reference assessment tools because they are:

- Aligned as far as possible with ISO 14040:2006 and ISO 14044:2006, the international standards on LCA;
- Built on and often go beyond many other standards, technical specifications and other guidelines such as e.g. ISO TS 14067:2013; FAO's Sustainability Assessment of Food and Agriculture systems (SAFA) guidelines:2014; Greenhouse Gas (GHG) Protocol:2011 by World Resources Institute and World Business Council on Sustainable Development; ENVIFOOD Protocol; ILCD Handbook; the European Commission's Product Environmental Footprint guide; PAS 2050:2011; PAS 2050-1:2012; BPX 30-323-0 and BPX 30-323-20, the International Dairy Federation (IDF) guide to standard lifecycle assessment for the dairy sector;
- Built on latest cutting-edge science also produced in the context of the Global Research Alliance – Livestock Research Group and of the UNEP SETAC Life Cycle Initiative.

[1] The LEAP Steering Committee cleared these guidelines for release on a consensus basis. For the release of the LEAP technical documents, agreement is not sought amongst those LEAP partners that are not represented in the LEAP Steering Committee as members. Involvement in the external technical review does not necessarily represent endorsement neither by the experts nor the organizations these individuals are affiliated with.

[2] www.fao.org/partnerships/leap/livestock-partnership

Experts in environmental assessment and in feed and livestock production systems are the targeted audience of LEAP technical documents.

As science is getting mature on carbon footprinting and climate change, LEAP recommendations on GHG emission accounting, climate change impact assessment and reporting are more structured and detailed on this issue.

LEAP guidelines on livestock supply chains strive to be specific and applicable to the wider range of production systems established worldwide. These also include, but are not limited to, pastoralism, family farming and other forms of community-based agriculture.

In order to come up with tools enabling to identify cleaner livestock production systems, the scope of the LEAP guidelines on livestock supply chains was tailored according to a partial LCA approach stretching from feed production, if any, to the farm gate, up to the off-farm activities up to the primary processor gate (e.g. the scope of the large ruminant guidelines stretches up dairy product processing, slaughtering). Packaging life cycle was left out of the scope.

Relying on the modular approach, LEAP guidelines on poultry, small ruminants and large ruminants shall be used in conjunction with LEAP guidelines on feed.

The adoption of a commodity-based perspective, according to which production technical outputs such as products[3], residues and waste streams are clearly distinguished from a technical perspective on the basis of their individual economic value, is a major strength of these guidelines. This feature allows in fact for indisputable definition of the assessment scope in terms of system boundary thus opening the doors to increased consistency across assessments. This feature not only paves the way towards assessment result comparability, but is also seen as a fundamental prerequisite for broader livestock commodity value chain sustainability assessments.

Moving from the evidence that methodological inconsistencies are likely to produce misleading results, provided that more than a single data modelling approach exists in LCA and that a number of these approaches sound equally legitimate from a scientific perspective, it was conveyed that mixing data modelling approaches should be avoided. The scrupulousness in pursuing alignment with the principles underpinning the LCA attributional data modelling approach described in the UNEP SETAC Life Cycle Initiative's Principles for LCA databases makes these LEAP guidelines unique in the soundness achieved. It was found that this is the only way to make sure that all inflows and outflows are correctly accounted for and to also comply with the internationally-agreed rules on allocation set in the context of the Guidance for Product Category Rule Development developed by The Product Category Rule Guidance Development Initiative.

As far as LEAP accounting requirements are concerned, it was consensually-agreed that allocation of emissions, releases and resource use among the products concerned should be avoided as much as possible. Should allocation be necessary because of the assessment goal, then practitioners are

[3] Going beyond the mainstream definition of commodity, these guidelines refer to products as both goods and services. Large ruminants, for example, not only provide a number of products, but may also deliver draught power and wealth security services.

recommended to make use of the diagram in the guidelines providing a principled basis to move along the ISO 14044:2006 stepwise procedure for allocation. On top of that, recommendations on default allocation keys have been provided.

LEAP guidelines are aligned with and go beyond the 2006 IPCC Guidelines for National Greenhouse Gas Inventories providing detailed guidance on how to account in different situations for enteric fermentation, methane emissions, and GHG emissions from land use change. It is however recommended reporting separately land use change impacts. As land use change impacts may not be directly caused by the specific product system investigated and default values on the GHG emissions from land use change often lack in depth peer-review, it was agreed that the land use impacts change should be reported separately.

The role of the interpretation phase is particularly emphasised in these guidelines especially when it comes to reporting assessment results. Even if uncertainty is minimised through epistemological adherence to the reference principles set for the attributional approach by the UNEP SETAC Life Cycle Initiative, other sources of uncertainty remain. For transparency sake, reporting crisp numbers without uncertainty ranges should be avoided because prevents stakeholders to correctly interpret results.

Some open issues

Even if all technical advisory groups have extensively discussed how to handle multi-functional processes, allocation remains an open issue for the LEAP guidelines released in April 2015. A major step forward was however made over the last year because epistemological adherence to the reference principles underpinning the chosen modelling approach is now ensured.

The leaders of the technical advisory groups agreed that more emphasis should be given in future editions of the LEAP attributional guidelines to system expansion over subdivision, whereas reporting at multiple product level fits with the assessment goal. This issue is a low hanging fruit for LEAP. This issue looks in fact easy address over 2015 also in the context of the newly-formed technical advisory group on pig supply chains.

While there was general agreement on the preference for a sound biophysical approach enabling to effectively relating inflows of outflows of livestock production systems, it was pointed out that it should be improved the consistency between current recommendations on allocation and the principled basis set in the general diagram for handling multifunctional processes. More specifically, the proposed preference of physical allocation over economic allocation poses a consistency issue for the recommendations on e.g. feed ingredients. In addition, it was also acknowledged that the rationale underpinning the recommendations on allocation relative to livestock production downstream processes should also be consistent (cfr. slaughtering products with processed milk products). Assessment fairness was also raised a principle to bear in mind when discussing rules on allocation.

Despite these inconsistencies, the general figure on handling multifunctional processes was kept in the guidelines. LEAP technical advisory group leaders acknowledged allocation as a complex issue to solve and hence requiring a detailed procedure for practitioners.

While sound solutions are necessary, it was acknowledged that, irrespective of the allocation approach adopted in attributional guidelines, the overall amount of resources used and of emissions will not change.

The leaders of the technical advisory groups also agreed that, amongst others, more discussion is needed to advance guidance on data quality assessment, environmental accounting of manure management, and on Life Cycle Impact Assessment Framework. While the technical advisory group on pigs is already expected to better address over 2015 issues such as data quality and manure management environmental accounting, a new life cycle impact assessment framework is proposed below for review of the Partnership and the public.

The leaders of the technical advisory groups conveyed that LEAP biodiversity principles should translated into practical guidance for inclusion in the LEAP LCA guidelines. As soon as the LEAP guidelines are comprehensive in scope and also possibly validated through road tests, LEAP should better concentrate efforts and resources to discuss the effectiveness of environmental improvement measures identified through actual assessments conducted according to LEAP guidelines. To this end, complementary guidance on consequential modelling and future-oriented scenario assessment should also be discussed.

Unlocking the potential of Life Cycle Assessment for a transition to Sustainable Food and Agriculture: a new life cycle impact assessment framework

LEAP LCA methodologies have the potential to become sound environmental measurement tools for an effective transition towards sustainable food and agriculture systems. More specifically, LEAP LCA guidelines aims at providing a comprehensive overview of the potential environmental pressures, impacts and resource use associated to the interventions on the environment made by livestock production systems over a determined time frame.

At this stage, the scope of the LEAP LCA guidelines is limited to climate change and energy use from fossil sources. LEAP guidelines on feed and large ruminants are actually broader in scope and also capture additional issues. Nevertheless, all LEAP LCA guidelines are expected to become broader and broader in scope in order to prevent any shift of burden from an environmental area of concern to another.

While impact assessment methods already exist for several environmental impacts currently out of the scope of the LEAP guidelines, some other environmental areas required more scoping for inclusion in a LCIA that is meaningful for livestock and other agricultural products.

To this end, a new life cycle impact assessment (LCIA) framework is proposed in this document. Figure 1 is the updated version of the framework originally incorporated in the LEAP draft LCA guidelines on large ruminant supply chains as well as on the LEAP draft principles on biodiversity assessment, which already passed a technical review round.

Unlike the vast majority of the currently-available LCIA frameworks, the proposed framework is not only damage oriented. LEAP acknowledges, in fact, the evidence that the interventions on the environment undertaken by livestock production systems can not only lead to negative effects on various sustainability facets, but also to significant positive ones. For example, livestock production systems, mostly depending on the farming practice and environmental management solutions adopted by the various actors involved in the supply chain, can lead to both benefits and negative impacts on biodiversity and food security. Capturing the also possible benefits of manure relative to soil quality (e.g. building organic matter) is also

deemed essential by LEAP in order to get more balanced figures of the impacts of manure especially in those regions where desertification is a major issue or just a threat.

In addition, resource use and environmental impacts are seen as distinguished yet strongly-interlinked concepts. Their correct framing in LCIA frameworks is an indispensable step to be able to track eco-efficiency of any production systems over time as also pointed out in the guidelines of the UNEP's International Resource Panel on decoupling natural resource use and environmental impacts from economic growth. Distinguishing renewable from non-renewable resources is seen as crucial to also take planet carrying capacity into account.

Resource wastage is also captured in the proposed LCIA framework as natural resource value loss. This issue can be captured thanks to the commodity science-based approach currently recommended for environmental accounting in the current edition of LEAP LCA guidelines. Resource wastage includes but is not limited to food loss and food wastage.

Food wastage along with climate change, preservation of biodiversity and use of phosphorus, water, land and other resources were found, amongst others, as key elements to be accommodated in an ad hoc LCIA framework for food and agriculture in order to sufficiently address food security.

Finally, it is acknowledged the evidence that impacts can be generated both from input and output flows.

While the proposed LCIA framework goes already beyond the boundaries of a classic environmental assessment, LEAP LCA guidelines are expected to go even beyond such LCIA framework to embrace additional social and economic dimensions that can be captured through an LCA. Coupled with complementary non-life cycle oriented tools (e.g. lab tests) enabling to investigate the supply chain performance relative to additional sustainability dimensions (e.g. food safety), LEAP LCA guidelines are expected to be part of integrated assessment tools enabling to drive transition to more sustainable, region-specific livestock production and consumption systems.

Due to the narrow scope of the current LEAP LCA guidelines in terms of both life cycle stages and environmental areas of concern captured, by applying the current version of the LEAP guidelines, no conclusion can be drawn on the overall environmental superiority of any production practice over another, of a product over another, of an organisation over another, of a region over another.

In order to prevent shift of burden from environmental issue to another, no environmental improvement option should be recommended without having at least assessed in a qualitative manner and according to a life cycle perspective the effects on resource use and those other environmental impacts targeted as relevant for livestock supply chains by international governmental bodies and governments. Such qualitative assessment should be reviewed by relevant stakeholders and competition between sectors for land, water and other resources shall be taken into account through consequential considerations.

The same holds true stems when it comes to sustainability assessments. Should all relevant environmental dimensions be reflected in a tool box for sustainability integrated assessment, it was equally agreed that it is misleading concluding that one livestock value chain is more sustainable than another in general terms unless all relevant facets of sustainability are captured in the integrated assessment and their assumptions and conclusions are sufficiently reviewed at relevant scales.

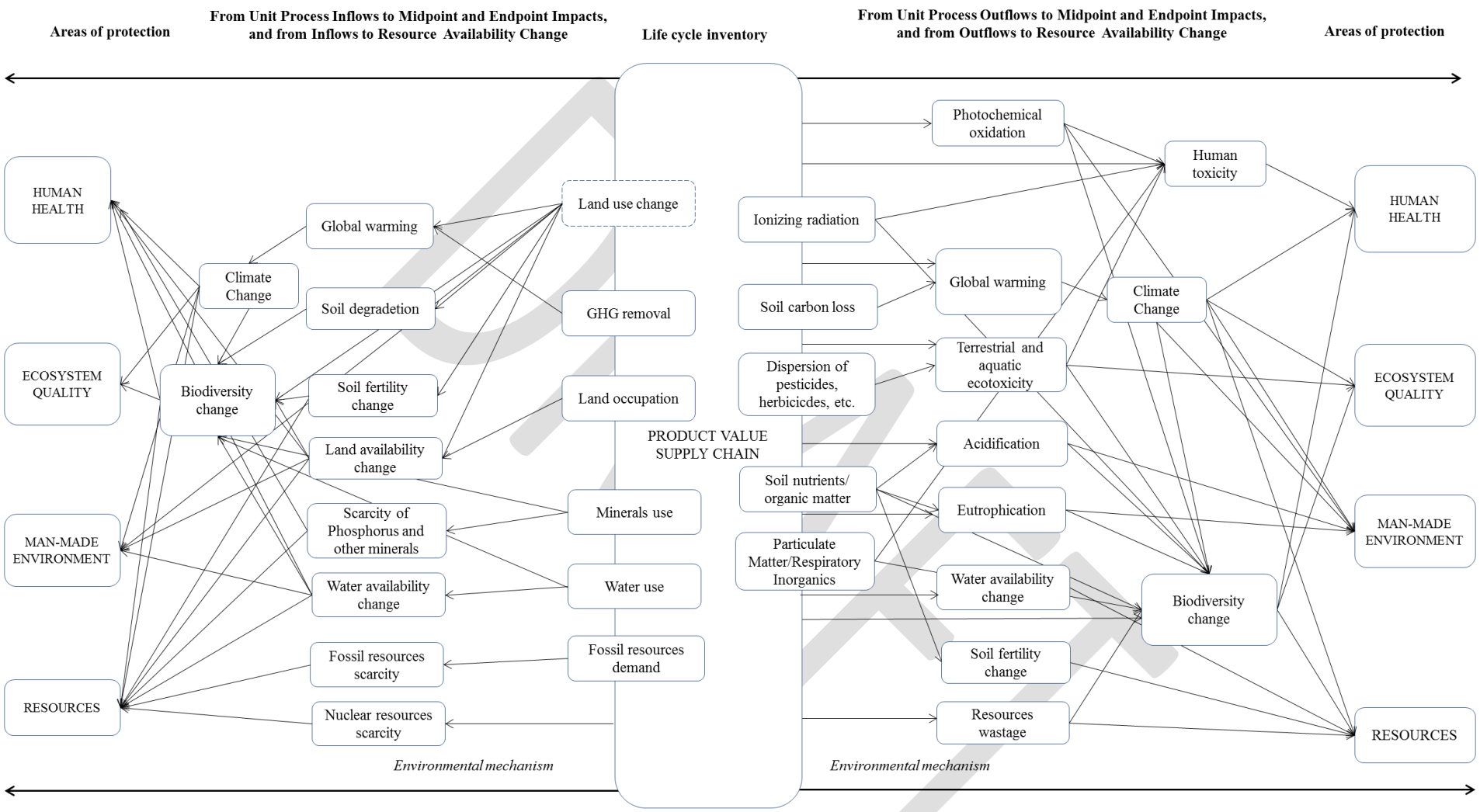

Figure 1: Proposal for a LEAP Life Cycle Impact Assessment Framework

LEAP guidelines: application contexts

LEAP guidelines should only be used as pre-competitive basis. The general aim of the LEAP LCA guidelines is, in fact, to set a level-playing field among stakeholders to boosting better environmental management at the level of farms and other organizations involved in livestock product supply chains. This was deemed doable by designing guidelines that, relying on the LCA attributional modelling approach, would make possible driving environmental improvement by monitoring and benchmarking the environmental performance of the involved production systems over time[4].

In addition, these guidelines can also be used in many other application contexts. The attributional modelling is, in fact, widely used in support of environmental monitoring, which is often deemed necessary to demonstrate progress towards specific environmental targets. A few examples of these application contexts are the following:

- National GHG Emissions Inventories according to the United Nations Framework Convention on Climate Change (UNPCC) and Kyoto Protocol;
- National GHG mitigation schemes;
- The FAO Global Livestock Environment Assessment Model (GLEAM);
- National energy plans instrumental to the promotion of the use of energy from renewable sources;
- Life-cycle based environmental indicators for monitoring the performance of sectors on the basis of a basket of products.

In combination with economic input-output tables, the attributional approach has also been used as backbone of Environmentally-Extended Input Output Analyses to e.g. rank the environmental criticality of economic sectors.

The attributional approach is extensively used in the context of business-to-business environmental reporting; product environmental communication; product-oriented environmental management systems; as well as to conduct hot spot analyses enabling to identify suitable criteria for eco-design, green-public procurement, or to detect environmental key performance indicators in support of green purchasing.

Even if LEAP guidelines can be used in all abovementioned contexts, the LEAP Partnership has not concluded on which LCA data modelling suit the most for application in specific contexts different from the one indicated as general aim of these guidelines and those others whose focus is on environmental monitoring and business-to-business reporting. Future-oriented scenarios can also be assessed in a static manner through an attributional approach.

[4] LEAP guidelines are specific to livestock production systems. In order to benchmark the environmental performance of integrated multi-outputs farming systems and conclude that environmental improvement was actually made overall, the other farming technical outputs delivered by the production system (e.g. crops, silkworms, timber, honey, mushrooms) shall be assessed through complementary LCA guidance documents. These technical documents shall be consistent with LEAP LCA guidelines in order to come up with the overall environmental footprint of the farm concerned or of the agriculture sector as a whole and be able to track the overall environmental performance over time.

Complementarity LCA data modelling approaches

While developing guidance according to the attributional perspective, it was acknowledged that, as maintained by W. Edward Deming, “management by use only of visible figures, with little or no consideration of figures that are unknown or unknowable” is one of the seven deadly diseases of management.

The attributional approach was flagged as the only one enabling to provide “visible figures” in the sense that no emission can be hidden through its application.

The LEAP Partnership technical members conveyed that, depending on the application context concerned, there should also be room for application of complementary modelling approaches attempting to also capture those “figures that are unknown”. “Unknowable figures” such as those e.g. from environmental disasters and accidents are instead out of the scope of any classic LCA. For completeness sake, other tools such as e.g. environmental risk assessment methods can be used to capture these “Unknowable figures” and provide additional, complementary information.

When it comes to strategic decision making both in policy and in business, the LEAP Partnership acknowledges the necessity to also systematically explore the “figures that are unknown”. Such figures are indeed sometimes visible straight away the intervention on the environment but their modelling follows a different epistemological root than the one the attributional assessment adhere to. For strategic decision making, it is hence recommended conducting in parallel LCAs according to attributional and consequential approaches before unambiguously concluding on the soundness of any environmental improvement measures, including but not limited to GHG mitigation options. This is deemed necessary to prevent perverse effects on the environment and on society. In particular, consequential assessments are recommended to complement attributional assessment results with and to provide environmental information on:

- Displaced productions (e.g. avoided production of mineral fertilizer due to manure deposition). As livestock products value chains produce valuable materials that are likely to replace products manufactured from non-renewable resources, strategic decision-making should account for environmental credits due to displaced productions.
- Knock-on effects on other product systems and other sectors (e.g. indirect land use change also due to land grabbing) due to changes in demand or offer of livestock products or their production inputs.

Capturing and assessing knock-on effects allows accounting for possible perverse effects and benefits determined by a change in strategy. This modelling feature is particularly important for agriculture as a whole because food security is often threatened by the existing competition between food, feed, fibre, timber and fuel.

LCA consequential modelling is a scenario-dependent approach, and hence its results cannot be precise by definition. The assumptions set by LCA practitioners shall be reviewed by relevant stakeholders at regional and global level (e.g. Global Agenda for Sustainable Livestock).

Those data modelling approaches relying on the accounting of rebound effects through econometric models shall include an in-depth description of the uncertainty of results by also flagging the assumptions underpinning those econometric models.

About this document

The LEAP Partnership uses its best efforts to deliver high quality results and to verify that its reports and databases are underpinned by knowledge based on the best available science.

However, some pieces of information in this document may, of necessity, be preliminary in nature because they are presented prior to review and approval of the LEAP Partnership. This document was in fact written by a single author, Camillo De Camillis (current LEAP manager) who built on scientific literature as well as on technical discussions within the LEAP secretariat and with the leaders of the technical advisory groups on feed, poultry, small ruminants and large ruminants. LEAP secretariat members and technical advisory group leaders are expected to further contribute to this document and eventually co-author its final version 1.

This technical report is published as draft version 1.0 and is released in April 2015 for review of both the LEAP Partnership participants and the public. External experts on Life Cycle Assessment and on environmental assessment of food and agriculture will be invited, amongst others, to provide feedback during the public consultation period. The contents of the post-print of these methodological notes are expected to be reflected in the next edition of the LEAP LCA guidelines.

Readers are cautioned to consider carefully the provisional nature of this document. This document will be revised and released as version 1.0 by December 2015.

Recommended citation: LEAP, 2015. *Developing Sound Tools for Transition to Sustainable Food and Agriculture LEAP Partnership Life Cycle Assessment Guidelines on Livestock supply chains: Methodological notes*. Draft version 1 for public review. Livestock Environmental Assessment and Performance (LEAP) Partnership. © FAO, Rome, Italy.

http://www.fao.org/partnerships/leap

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