Savoir faire

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Life Cycle Assessment of agri-food systems

An operational guide dedicated to developing and emerging economies

éditions Quæ

Part 1

Introduction

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LCA within developing and emerging economies

Developing and emerging economies are defined by Ghemawat and Altman (2016) as countries, regions and economies that are not fully industrialized, in socio-economic terms, generally showing an average low to middle income and high inequality of income distribution. According to various international references (UN, FAO, etc.), those countries may include least developed countries (LDC) and low and middle-income countries (LMIC[1]). The application of life cycle assessment (LCA) for environmental assessment in these contexts is still very limited (Hou *et al.* 2015), especially in Africa (Karkour *et al.* 2021). The scarce existing studies were generally commissioned by international or developed country-based institutions, or were carried out in the context of research activities financed from abroad. Recently, a growing interest is exemplified by some locally driven initiatives and emerging LCA networks (Bjørn *et al.* 2013).

Political and social conditions influence the capacity of agri-food stakeholders – i.e. in agriculture (including livestock), aquaculture, fisheries and food processing – to adopt new social or technical innovations. Such conditions may affect both the implementation of LCA and the use of final LCA results. Some specificities of developing and emerging contexts embedding potential consequences on LCA implementation and uptake are briefly presented in the following sections.

Land tenure issues

Land tenure issues have strong implications on the possibility of improving agricultural systems. Land ownership and decision-making processes on communal or private land use do not have the same implications; thus, land tenure issues should be identified before further analysis. Several governance rules were set since

1. The list of LDC and LMIC is regularly updated: https://www.oecd.org/dac/financing-sustainable-development/development-finance-standards/daclist.htm. The transition criteria across OECD country categories are described here: https://www.oecd.org/dac/transition-finance-toolkit/LMIC-to-UMIC.pdf

the end of colonialism (Focus on land in Africa (FOLA) 2018), but they are still failing to adequately consider property rights and customary land (Veit 2013). The FOLA website (https://www.wri.org/data/rights-resources-interactive-map) provides an overview of property rights issues and an interactive map of national experiences pertaining to land and natural resource rights.

In many developing countries, national land reforms have generated inequality of access, with poor land access for women under state laws and customary arrangements. Encroachment onto indigenous peoples' territories and common property resources such as protected areas are increasing due to economic and commercial pressures (UN-Habitat 2019). The Global Land Tool Network (https://gltn.net/) presents land access initiatives, while the World Database on Protected Areas (https://www.protectedplanet.net/) lists and classifies protected areas; both address these issues on the global scale.

In Asia-Pacific, around 80% of farming households are small-scale farmers. The main challenges in this region (where 13 of the world's 23 megacities are located) regarding land access include economic transformation with growing inequality (increasing level of urbanization, private large-scale land acquisitions), vulnerability of women and indigenous people, and environmental degradation (UN-Habitat 2015).

Latin America has the highest inequality of land distribution compared with the rest of the world, and this remains a key unresolved historical issue on the continent (OXFAM 2016). The concentration of land ownership and land-grabbing are strongest in Argentina, Brazil, Dominican Republic, Mexico, Chile, Colombia, Nicaragua and Uruguay (Jarroud 2016). For instance, in Dominican Republic, the agrarian revolution has not been completed, leaving a considerable part of agricultural land with no formal property titles. In 1997, about 36% of private land was used by owners with no official title. In countries where public investment is low, this lack of clear land tenure rights may prevent investments for better agricultural development (Tejada de Walter and Peralta Bidó 2000).

Other issues related to secure land access may hamper sustainable land use development. In Colombia, for instance, conflicts between the government and armed groups, which have driven refugee migrations between regions, have had a major impact on Amazonian agriculture. Raising cattle has been considered a valuable option within uncertain contexts, since livestock is a "mobile" agricultural asset. Now, improving livestock systems, e.g. with enhanced permanent pasture quality or silvo-pastoralism, could only be developed under peace conditions and with substantial support from companies, universities and research centres (Estrada and Holmann 2008).

Environmental vs. economic development concerns

In contexts where the economy is becoming increasingly industrialized, and sometimes quickly, another key aspect relates to the potential trade-offs between economic development and environmental protection[2]. Growth-oriented strategies usually focus first on increasing production, often through conventional systems rather than more environmental-friendly practices. A related aspect may be the low environmental awareness of local populations, due to low levels of education and knowledge about the environmental pressures of socio-economic activities. Additionally, sometimes the lack of proper law enforcement may lead to misappropriation of funds allocated to development priorities due to corruption or insufficient field control when dealing with environmental protection laws (e.g. legislation protecting natural reserves). The environmental Kuznets curve highlights that environmental degradation increases with economic development until a difficult-to-predict (Bernard *et al.* 2015) tipping point is reached, and then starts to decrease (Du and Xie 2020). However, this model has been challenged based on evidence that some developing economies are also addressing environmental issues, and that the prevalence of conflicts and the quality of institutions are more important drivers (Stern 2004; Kinda 2015; Sarkodie and Strezov 2018).

Most developing and emerging countries are located in the tropical zone

Most developing and emerging countries are located in the tropical zone (in-between the two tropics), although not exclusively. The tropical zone can host extreme climate conditions, from humid to very arid climates. The history of those very contrasted climates has led to highly contrasted pedoclimatic conditions, with sometimes heavily weathered soils, very arid areas or areas facing regular floods, etc. In most extreme contexts, the development of agricultural activities has long been hampered by extreme events and the lack of proper infrastructure to enable resilient development. Nonetheless in some humid tropical zones, soil and climate conditions may also provide optimal conditions for faster crop rotations and even more frequent harvests per year on the same field compared to temperate climates (Table 1.1). Such diversity in natural conditions has obviously led to a unique range of adaptation strategies and broad diversification of practices. In such optimal conditions, where the soil has been protected by the natural vegetation, there is also critical competition for land between agri-food systems and still pristine environments with a high biodiversity (e.g. the agricultural and livestock frontier expands in the South American Amazonia at the

2. In Africa and Asia, for instance, the increase in cocoa production for export is based on expanding surfaces, whereas in Latin America it is based on increasing yields driven by management improvements (Arvelo Sánchez *et al.* 2017).

expense of rainforest and Pantanal biomes; the cotton-growing frontier expands in Sahel areas at the expense of savannah systems). Such competition has led to land conflicts, imbalances in ecosystems and support for the development of more resilient agricultural development pathways.

Table 1.1. Pedoclimatic factors influencing temperate and tropical agriculture.

Factors	Temperate agriculture systems	Tropical agriculture systems
Climate	Four seasons with winter rains Lower humidity Lower temperature	Dry vs. wet season(s) with heavy rainfall events Higher humidity Higher temperature
Soil	Higher natural fertility Higher organic matter Lower decomposition rate Lower leaching	Lower natural fertility Lower organic matter Higher decomposition rate Higher leaching

Sources: Hartemink (2002); Six *et al.* (2002).

The specific soil and climate conditions, combined with the diverging long-term evolution of socio-technical agricultural systems, have led to a wide range of agri-food systems, both in terms of practices in fields (as well as in ponds and seas for fish and seafood products i.e. "blue foods", Gephart *et al.* 2021) and in terms of food processing and value chain organization. The evolving socio-technical systems have been influenced by many factors, including colonialism, governmental instability, development funds, population growth rates, etc. Compared to more industrialized contexts, the combination of complex tropical conditions and precarious socio-economic contexts – with no safety net such as mutualized risk management within Europe – has led to a lack of standardization of agri-food systems such as that observed today in many countries (e.g. among European countries). From past shifting cultivation to sedentary intensive systems, very diversified agri-food systems co-exist still today in tropical and emerging countries, which will have implications for the application of LCA.

Inadequate input issues

The environmental impacts of agri-food systems in developing and emerging contexts are often influenced by underperforming or inadequate inputs (e.g. homemade aquafeed, over-fertilization, pesticides designed for another crop, highly polluting fuels, etc.). In many cases, producers use these inputs because there are no suitable or economically interesting alternatives, or because they do not have enough knowledge on available and feasible alternatives. For instance, African small-scale horticulture farmers often use pesticides designed for cotton or other cash crops (Avadí *et al.* 2020b). Many Peruvian fishmeal producers use heavy residual fuels instead of natural gas, because the gas pipelines simply do not reach them or are overloaded (Fréon *et al.* 2017). Many Zambian and Peruvian small-scale fish producers cannot afford commercial aquafeed, or its transportation to remote locations, and thus rely on homemade feed (Avadí *et al.* 2015, 2021). Most market vegetable producers in Benin over-fertilize their plots with manure and compost, mainly due to ignorance on the nutrient content of these organic inputs (Avadí *et al.* 2021a).

Moreover, benefiting from economies of scale is less widespread, especially in developing contexts, due to gaps in infrastructure (e.g. poor roads impede efficient transport, sparse irrigation infrastructure hinders controlled irrigation, and poor landing facilities increase vessels' fuel consumption and generate product losses).

Research and development priorities and capacities

Finally, in developing and emerging contexts, research and development priorities vary regionally depending on the development levels and invested resources, while globally, agri-food systems face new or tougher challenges related to worldwide trends and changes (Table 1.2).

Table 1.2. Trends and challenges in food and agriculture in developing contexts.

Trends	**Challenges**
– Population growth, urbanization and ageing – Global economic growth, investment, trade and food prices – Competition for natural resources – Climate change – Agricultural productivity and innovation – Transboundary pests and diseases – Conflicts, crises and natural disasters – Poverty, inequality and food insecurity – Nutrition and health, including the connections among environment, agriculture and infectious diseases of poverty – Structural change and employment – Migration and agriculture – Changing food systems – Food losses and waste – Governance for food and nutrition security – Development finance	– Sustainably improving agricultural productivity to meet increasing demand – Ensuring a sustainable natural resource base – Addressing climate change and intensification of natural hazards – Eradicating extreme poverty and reducing inequality – Ending hunger and all forms of malnutrition – Making food systems more efficient, inclusive and resilient – Improving income earning opportunities in rural areas and addressing the root causes of migration – Building resilience to protracted crises, disasters and conflicts – Preventing transboundary and emerging agriculture and food system threats – Addressing the need for coherent and effective national and international governance

Sources: WHO 2013; FAO 2017a.

National agricultural research systems in developing countries in particular are usually understaffed and underfunded, thus a large proportion of agri-food research is carried out in cooperation with, or directly by, international institutions. For instance, the main global agricultural development research institution, the Consultative Group on International Agricultural Research (CGIAR), devoted 11% of its expenditure in 2008 to strengthening national agricultural research centres across the world, 8% to environmental protection, and under 50% to increasing productivity, plant enhancement and breeding, and research on production systems (Lele *et al.* 2010). Public agricultural research and development investment has increased worldwide in the last 40 years, notably in Latin America, Asia-Pacific and China. However, West Asian and African public investment has remained relatively low. The relevance of extension services (i.e. agri-food advisory) proved valuable in improving both agronomic performances and environmental protection (Lele *et al.* 2010). Unfortunately, these services show uneven coverage and efficiency, and often farmers remain isolated with no access to technical advice or capacity-building support.

2

The purpose of this operational guide

This operational guide focuses on applying LCA to agri-food systems in a range of socio-economic contexts, from least developed to emerging economies, mainly within the tropics. Agri-food systems are defined as all systems providing food, fibre and bioenergy products based on agriculture, livestock, aquaculture and fisheries. This guide aims to provide solutions to overcome the specific issues found by LCA practitioners in developing and emerging contexts, by consolidating the knowledge from the literature and formalizing LCA practitioners' experience in these contexts. Feasible and practical solutions are preferred, namely those that are useful under severe resource constraints, but more sophisticated and resource-intensive solutions are also discussed.

Over the last two decades, LCA has become an essential framework for the environmental assessment of agri-food systems at various scales, from the cropping system to the rest of the value chain and even entire agricultural regions. Applying LCA to agri-food systems, is supported by a number of methodological developments and resources. These include dedicated guidelines for direct emission models, life cycle inventory (LCI) databases, life cycle impact assessment (LCIA) methods, sets of characterization and normalization factors, and multiple research initiatives aimed at overcoming unresolved issues[3]. Existing LCA resources, such as background inventory databases on technologies and practices or emissions models, are generally tailored to developed and temperate contexts, where LCA was first developed. Hence, the vast majority of LCA resources available nowadays represent production systems operating mostly in temperate and developed contexts, where large statistical and field measurement datasets were available to develop various models.

Putting LCA into practice for agri-food systems in developing and emerging economies is more recent and faces specific challenges, related to both the socio-economic and biophysical specificities of these contexts. As already mentioned, tropical agricultural systems can be highly diversified and complex (e.g. tropical

3. See a list of unresolved issues in LCA in Reap *et al.* (2008a,b). Some of these issues have been successfully addressed to date, but not all.

agroforestry systems), while data is often missing to characterize this diversity and calibrate existing models, which have been calibrated for temperate conditions. Moreover, in the tropics some environmental issues may be particularly severe such as water deprivation, salinization, soil quality and biodiversity losses. They may require specific parameters in LCA (e.g. regional characterization factors (CFs) that are thus far mostly lacking for tropical zones).

3

Standards, guidelines and tools

The international organization for standardization (ISO) 14040 and 14044 standards (ISO 2006a, b) describe the LCA methodology procedure. All subsequent standards, guidelines, databases and tools are ultimately based upon the ISO 14040/44 standard. ISO 14040/44 determine the four phases of LCA, namely goal and scope, inventory analysis, impact assessment, and interpretation; they also include the mandatory and optional elements of LCA. Appendix A (p. 121) presents an overview of the ISO norms 14040 and 14044.

The goal and scope phase demands particular attention as it determines the rules for the rest of the study (see study design in Chapter 8 "Co-designing the study with stakeholders"). See Table 3.1 for the exhaustive list of items that should be included in a goal and scope definition.

Table 3.1 Elements of the goal and scope definition according to ISO 14040 (verbatim from ISO 2006a).

Goal	Scope
– the intended application – the reasons for carrying out the study – the intended audience, i.e. to whom the results of the study are intended to be communicated – whether the results are intended to be used in comparative assertions intended to be disclosed to the public	– the product system to be studied – the functions of the product system or, in the case of comparative studies, the systems – the functional unit (FU) – the system boundary – allocation procedures – impact categories selected and methodology of impact assessment, and subsequent interpretation to be used – data requirements – assumptions – limitations – initial data quality requirements – type of critical review (CR), if any – type and format of the report required for the study

Beyond ISO 14040/44, and the ISO 14020/25 standard describing the rules for LCA-informed environmental labels and declarations, several general guidelines were developed by various institutions to help practitioners implement the LCA framework according to best available practices and methods. Harmonization of LCA practices is a challenging endeavour given the flexibility in the LCA framework as described in the ISO standards, but also given the need to regularly update emission and impact modelling according to continuous scientific advances. A summary of existing guidelines, tools and databases is presented in Figure 3.1.

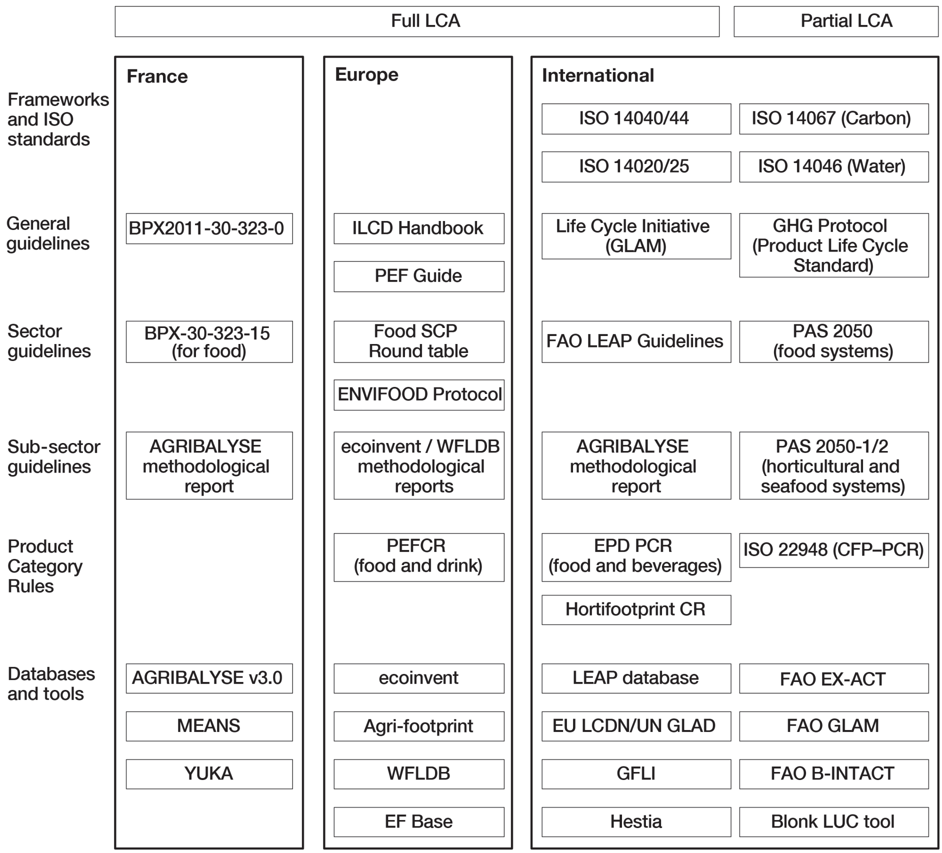

Figure 3.1. Non-exhaustive overview of LCA standards, general and sector-specific guidelines, and related tools around the world.

In this figure, one can measure the number of existing guidelines, tools and database. Partial LCA applies a life cycle approach but focusses only on one or a few environmental indicator(s) such as global warming potential (carbon footprint) or water deprivation (water footprint). BPX2011-30-323-0 is a French standard describing the general requirements for the implementation of the LCA approach for the French eco-labelling program, for all products. BPX2011-30-323-15 is a French standard describing the specific requirements for the implementation of the LCA approach for the French eco-labelling program, for food products. AGRIBALYSE corresponds to the French reference environmental database for agricultural and food products. The MEANS (MulticritEria AssessmeNt of Sustainability) platform is the result of the decision of the French National Institute of Agricultural Research (INRAE), and since 2018 of the French agricultural research and international cooperation organization for development (CIRAD), to provide the scientific community with comprehensive and modular software for multi-criteria assessment of agricultural and agri-food systems. YUKA is an application for smartphones that allows scanning the labels of food and cosmetic products and provides a detailed information on their quality (nutritional for food) and attached health risks. The ecoinvent database provides well documented LCI process data for thousands of products, across product categories, helping LCA practitioners inform their background modelling. Agri-footprint is a LCI database, focused on the agriculture and food sector. HESTIA (Harmonized Environmental Storage and Tracking of the Impacts of Agriculture) is an online platform to enable the sharing of food sustainability data in a structured, open source and standardised way. The FAO EX-ACT: Ex-Ante Carbon-balance Tool accounts for GHG emissions covering the entire "Agriculture, Forestry and Other Land Use" (AFOLU) sector, including agricultural inputs, energy, infrastructure, management of organic soils, coastal wetlands, fisheries and aquaculture. The FAO B-INTACT makes use of various geo-referenced maps and tools to increase accuracy and account for the ecological value and biodiversity sensitivity of project sites. Blonk LUC tool: Direct Land Use Change Assessment Tool, allows calculating the GHG emissions associated to direct land use change.

The international reference life cycle data system (ILCD) handbook (EC-JRC 2010) was developed by the Institute for Environment and Sustainability in the European Commission Joint Research Centre (EC-JRC). The ILCD handbook provides guidance for good LCA practices in policy and business. This handbook comprises a set of documents that are in line with ISO 14040 and 14044, based on existing best practices – not on new methodological developments – and provides recommendations established through a series of extensive public and stakeholder consultations. In parallel, the European Council invited the Commission to "develop a common methodology on the quantitative assessment of environmental impacts of products, throughout their life-cycle, in order to support the assessment and labelling of products". Building on the analysis of seven product-specific methodologies of environmental footprinting (including the ILCD handbook), the EC-JRC developed guidelines for this common European environmental footprint (EF) methodology (EC-JRC 2013) regarding products (Product EF – PEF) and organizations (Organisation EF – OEF). Since its first release in 2013, the PEF/OEF guidelines have gone through a pilot phase (2013–18) and a transitional phase since 2019 (https://eplca.jrc.ec.europa.eu/EnvironmentalFootprint.html), resulting in the continuous publication of (sector) PEF Category Rules (PEFCR). PEFCR compete with the ISO-compliant product category rules/type III environmental declarations (ISO 14025) produced by the international Environmental Product Declaration – EPD system (https://www.environdec.com/home).

More specific and strict prescriptions are easier to draw up at the sector and product category level in close consultation with all stakeholders. As a follow-up of the PEF initiative and with inputs from JRC, the Food Sustainable Production and Consumption Roundtables co-supervised by the European Commission and food companies finalized in 2012 and tested in 2013 the ENVIFOOD protocol (Food SCP RT 2013), i.e., harmonized guidelines for evaluating environmental impacts of food products. The food sector was thus the first sector with specific rules to apply the PEF guidelines. In May 2018, an accepted draft of PEFCR guidelines applying to more sectors was published (EC 2018). In this document, LCA practitioners can find clear technical specifications for an LCA applied to particular sectors such as agriculture and which address specific issues such as biodiversity. At the French level, a similar initiative was launched as part of the government's Grenelle law no. 2009-967 involving representatives of all stakeholders to harmonize requirements to implement LCA for all products. Requirements were further specified for the food sector in a dedicated report called BPX-30-323-15 (AFNOR 2012). Application to the agri-food sector was carried out within the AGRIBALYSE project (Koch and Salou 2014, 2016) and provided the backbone to the current French Agence de l'environnement et de la maîtrise de l'énergie (ADEME) AGRIBALYSE LCI database. Revisions of the LCA-based EF requirements are underway in France. The smartphone application YUKA, which originally presented detailed nutritional information on foods, has begun presenting environmental information partially based on LCA studies (AGRIBALYSE 3) via an eco-score and as part of an environmental labelling experiment (https://yuka.io/eco-score/).

In complement to these initiatives, in 2014, the EC-JRC launched the Life Cycle Data Network (LCDN) to provide "a globally usable infrastructure for the publication of quality assured LCA datasets from different organizations" (https://eplca.jrc.ec.europa.eu/LCDN/). It also aims to host and share data packages in line with the PEF/OEF framework. The European LCDN somewhat overlaps with the UN GLAD initiative (see Chapter 7 "Established and emerging initiatives").

For the LCA of livestock products, FAO has been leading the consensus-building process. Launched in 2012, the FAO Livestock Environmental Assessment and Performance (LEAP) partnership programme established ten Technical Advisory Groups on the application of LCA in the following sectors: animal feeds, poultry, small ruminants, large ruminants and pigs, as well as on the following focus topics: nutrient cycling, water, soil carbon sequestration, biodiversity and ecosystem services. The LEAP programme involves over 300 experts from academia, governments, industries and non-governmental organizations and has so far produced a series of background and guidance documents that are available on its website (http://www.fao.org/partnerships/leap/en/). Although the LEAP reports propose some case study-based illustrations and occasionally a tiered approach to apply more or less complex methods depending on data availability, the guidelines remain general and mostly theoretical. They do not provide practical methods based on field experiences in developing countries or cover other important aspects such as partnership or ethics.

Over the last few years, the number of guidelines, tools and databases for agri-food LCA studies and data has increased dramatically (see, for example, the World Food LCA Database – WFLDB (Nemecek *et al.* 2014, 2020) or the Agri-footprint LCI database (Blonk Consultants 2014, 2019)). All these databases provide very detailed methodological reports describing precise choices, methods and data for LCA studies for a wide range of agricultural products. The WFLDB has a global coverage with the objective of representing at least 50% of the global market in mass for each product from the main exporting countries. However, many of these inventories rely heavily on assumptions and secondary data. The Agri-footprint database has also a global coverage but it is predominantly built on statistical/top-down rather than on system-level bottom-up data. Input data and yields for cropping and animal systems are based on pre-existing primary or secondary data and rarely rely on dedicated field studies.

All these general or sector-specific guidelines constitute key reference documents for all LCA practitioners including those working in developing or emerging contexts. However, they are either very general, or tailored to developed contexts and certain specifications are not applicable in developing contexts. For instance, the recommended sampling procedure from PEFCR implies that statistical data exist on the studied systems to define homogeneous sub-populations, whereas this is generally not the case in tropical developing contexts. Furthermore, for guidelines including products from developing countries (e.g. the WFLDB), data are largely based on existing literature references and do not guide LCA practitioners with respect to practical aspects such as field data collection, stakeholder participation, partnership or ethics. The present guide intends to be very specific in terms of both the specificities of the contexts explored and the practical solutions for LCA practitioners.

4

Preparation process and intended audience

This operational guide is the result of combining an array of feedback from LCA experts who have carried out comprehensive studies in developing countries. Experts from CIRAD, King Mongkut's University of Technology, INRAE, Indonesian Institute of Sciences, Stockholm University, WorldFish, Pontificia Universidad Católica del Perú, University of Oxford, Wageningen University, UNEP, FAO, and independent experts with recognized expertise in LCA studies in developing contexts have been involved. All these LCA experts have expertise on agri-food systems in Africa, Asia, Latin America and the Caribbean, including crops (such as citrus, mango, strawberries, banana, sugar cane, pineapple, market vegetables, green beans, coffee, cocoa, rice, cassava, cotton, palm oil), livestock (beef, fish, milk) and bioenergy products.

First, all identified experts (around 40) were invited to complete an online questionnaire to consistently formalize their experience on key aspects of implementing LCA in agri-food systems in developing contexts (29 answers received).

Second, all experts were invited to a series of four workshops to share their experiences and develop consensual recommendations. The four workshops were held between May and June 2019 with the following topics:

- **Workshop 1: Building and communicating with stakeholders:** Expectations, partnerships, confidentiality, ethical aspects and restitution
- **Workshop 2: Inventory:** Sampling and representativeness issues, data collection, field emissions
- **Workshop 3: Impacts:** LCIA methods depending on the study and certain important and complex impact categories such as land use, water, toxicity and ecotoxicity, biodiversity, eutrophication
- **Workshop 4: Validation and interpretation:** Data quality system, critical review (CR), sensitivity and uncertainty analyses

The guide covers the main aspects of conducting LCA studies in these contexts, considering not only scientific and methodological bottlenecks, but also organizational, legal, partnership and ethical constraints. This guide seeks to provide practitioners with advice and tools to understand and anticipate the pitfalls linked with these specific contexts, which will ultimately help improve the quality of their studies. In terms of study objects, this operational guide is broadly centred on LCA of agri-food systems in developing contexts, as previously defined, including different system boundaries depending on the goal and scope of each study. In a non-exhaustive way, the feedback collected from experts specifically dealt with LCA studies on crop production, animal husbandry, fisheries, aquaculture and food processing.

This operational guide is primarily intended for practitioners carrying out LCA studies with on-site data collection in developing and emerging contexts. It aims to enable practitioners to:

- understand the specificities of conducting a comprehensive LCA study in these areas;
- identify the most appropriate existing LCA methodological recommendations, considering up-to-date scientific results;
- prepare for frequently encountered field constraints to develop adapted and/or fall-back strategies;
- improve the quality and reliability of the final results;
- ensure the completion of the LCA study when facing constraints external to the study itself; and
- optimize the impact of the study by improving communication on its objectives, data collection and results according to the audience.

This guide is more specifically aimed at experienced LCA practitioners who are new to the implementation of LCA in developing/emerging countries, or who need to become familiar with the specificities of applying the conceptual framework to such areas and agricultural productions.