Editorial: Special Issue of IJoLCAS Vol 3 No 1

Cécile Bessou

CIRAD, UPR Systèmes de pérennes, pôle ELSA, F-34398 Montpellier, France
Tel.: +33-467-614-487; Fax: +33-467-616-590
E-mail address: cecile.bessou@cirad.fr

Agriculture is a key sector for rural development globally. In several emerging economies in Asia and Latin America, agricultural growth has played an important role in *jumpstarting* overall economic development and has been associated with high rates of poverty reduction. Agriculture also remains high on the agenda in other lower-income countries as a promoted engine to boost economic growth, e.g. in sub-Saharan Africa or some South Asian countries. Many of the Sustainable Development Goals focus on themes in which agricultural progress plays an important role [1]. Agriculture progress notably implies agriculture expansion, which is still needed given the projected world population over 11 billion people by the end of this century. This expansion is taking place mostly in tropical countries due to mainly two combined parameters. First, the population growth and the increase in living standards are the most important in the tropics. Second, tropical conditions allow for year-round growth of crops in areas where production factors (e.g. land, manpower) are generally more easily affordable than in temperate countries [2].

Concomitantly, agriculture also is a key driver of negative environmental impacts. Nowadays, Agriculture, Forestry, and associated Land use and Land use changes (LULUC) are responsible for 19–24% of global anthropogenic greenhouse gas (GHG) emissions [3],[4]. Beyond GHG emissions, land use change also is among the main drivers of biodiversity losses. Nowadays, over half of the tropical and sub-tropical forests are substantially altered. Those ecosystems represent more than half of the 35 terrestrial biogeographic regions that are considered as biodiversity hotspots and as such world's most biologically important real estate [2]. Agriculture may affect natural land and water resources through both land use and land use change (LULUC). Agricultural practices may lead to pollution and depletion of resources, such as showed the limits of the Green Revolution [5]. Indeed, agrochemical inputs promoted within the Green Revolution, e.g., nitrogen fertilisers or pesticides, have impacted not only soil management and agricultural practices but also natural biogeochemical cycles [6]. Nitrogen or pesticides losses to the environment contribute to various impact categories, such as climate change, acidification or ecotoxicity.

Given the critical global role of agriculture and associated risks, it is paramount to quantify negative environmental impacts of agricultural production systems and to identify ways and practices to reduce those impacts. Improved production systems that do not jeopardize resource availability for future generations are needed to reach sustainability. Life Cycle Assessment (LCA) is unavoidable when assessing the environmental impacts of agricultural value chains. It is a standardised methodology – with ISO norms (14040 series 2000) – recommended worldwide notably within public regulations for food and fuel, e.g. European Directive on Renewable Energy or Product Environmental Footprints in various countries such as Thailand or Japan. The LCA holistic approach enables the quantification of various impacts along the value chain, highlighting impact hotspots but also potential trade-offs and rooms for practice improvements. It provides significant information on pathways towards more environmental-friendly agricultural systems. Together with other assessment approaches and indicators, it can help to design sustainable agricultural systems. However, agricultural systems are very diverse; some can be very complex and current impact assessment methods do not capture all potential impacts. There is a need to invest in fieldwork and scientific analysis to increment knowledge on agricultural systems.

This special issue of IJoLCAS Vol 3 No 1 (2019) offers a panel of LCA studies that explore contrasted situations of agricultural impacts on the environment and ways to reduce those. In the first article, **Thoumazeau et al. (2019)** recall the critical impacts of LULUC due to agriculture and examine one of the methods available in LCA to account for such impacts. Focusing on the specificities of the tropical contexts, the study shows that research work is still needed to account better for the local context and practices in the assessment of agricultural impact on soil quality. **Basset-Mens et al. (2019)** investigate the impacts of French bean production in Kenya. The study aims to provide information for decision-makers at the national level. Authors hence needed to assess various production systems and various markets. Their study shows the great diversity of production systems and how it influences their environmental performances. While LCA results are meant to support decision-making process, the study also highlights that stakeholders should be involved early in the process to guide LCA practitioner across the diversity of systems and situations. The final user of LCA results should also be aware of intrinsic methodological limitations, such as when assessing the impact of pesticides that is still only partial and very uncertain. When assessing the multi-criteria impact of an agricultural value chain at the landscape scale, **Vayssières et al. (2019)** also emphasises the crucial need to involve the stakeholders throughout the process. Multi-criteria assessment consists of many indicators to assess the impacts on the three dimensions of sustainability, i.e. social, economic and environmental impacts. All indicators cannot be measured with the same approach or method. It is hence particularly relevant that stakeholders are involved at all stages, from identifying key local challenges to interpreting the results, in order to make sure that data collection and analysis are consistent with local choices and embedded uncertainties. Finally, the two last articles explore tracks for identifying best agricultural practices in LCA of transformed agricultural products. **Baron et al. (2019)** explore the potential impacts of composting palm oil mill residues in order to reduce the environmental impacts of palm oil. Oil palm fruit processing leads to the production of many co-products, such as empty fruit bunches and palm oil mill effluents. Those co-products represent large biomass amounts that can bring added value when used in the field. The study highlights the importance to gather site-specific data to characterise the quality of compost and the potential reduction of negative environmental impacts taking into local factors. **Meneghel Fonseca et al. (2019)** analyse the impacts of electricity generation from *Jatropha* oil in a short chain in Mali. Biofuels have been widely studied in the LCA literature, since LCA makes it possible to compare their impacts with substitute fossil fuels while accounting for potential impact along the whole chain. The better performances of biofuels compared to fossil ones are highly depending on the context. In remote areas, such as in a Malian village, the access to electricity grid may be problematic and the use of mobile generators is very common. Biofuels produced locally from non-edible crops such as *Jatropha* can be an interesting alternative to diesel. To do so, the study highlights the need to manage fertilisers efficiently as to limit the environmental impacts. The use of oilcake co-product, either as organic amendment, fuel, or simply as waste, could be also determinant in improving the overall environmental performances.

REFERENCES

Journal Article

[1] Pingali P, Feder G. Agriculture and rural development in a globalizing world. London: Routledge; 2017.

[2] Laurance W, Sayer J, Cassman K. Agricultural expansion and its impacts on tropical nature. Trends in Ecology & Evolution. 2014;29(2):107-116.

[3] FAO. Agriculture, forestry and other land use emissions by sources and removals by sinks: 1990-2011 analysis. Ed. F.N. Tubiello, M. Salvatore, R.D. Cóndor Golec, A. Ferrara, S. Rossi, R. Biancalani, S. Federici, H. Jacobs, A. Flammini. Rome. 2014. (ESS Working Paper). Report No. 2

[4] IPCC. Summary for policymakers. In: climate change 2014: impacts, adaptation, and vulnerability. Part a: global and sectoral aspects. Contribution of working group ii to the fifth assessment report of the intergovernmental panel on climate change. Ed. Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, L.L. White. Cambridge, United Kingdom and New York, NY, USA. 2014. (pp. 1-32). Cambridge University Press.

[5] Altieri MA. The ecological role of biodiversity in agroecosystems. Agriculture, Ecosystems & Environment. 1999;74(1-3):19-31.

[6] Martín WS. Nitrogen, science, and environmental change: the politics of the Green Revolution in Chile and the global nitrogen challenge. Journal of Political Ecology. 2017;24(1):777.