

Using the CLEANED approach to assess the environmental impacts of livestock production

An Notenbaert (CIAT), Mats Lannerstad (ILRI), Jennie Barron (IWMI), Birthe Paul (CIAT), Ylva Ran (SEI), Joanne Morris (SEI), Simon Fraval (ILRI), Simon Mugatha (ILRI) and Mario Herrero (CSIRO)

Key features

- CLEANED is an approach to carry out a Comprehensive Livestock Environment Assessment for Improved Nutrition, Secured Environment and Sustainable Development.
- CLEANED assessments are envisioned to be rapid, *ex-ante* assessments that quantify potential environmental impacts of planned livestock development interventions at multiple spatial scales.
- CLEANED assessments have a particular focus on developing countries. They use a participatory approach to ensure relevant assessments based on often fragmented data on agro-ecological landscapes and production systems.
- CLEANED assessments can support stakeholders choose interventions that manage both production opportunities and environmental co-benefits.

The challenge

Globally, livestock production generates more than 40% of agricultural GDP and is among the fastest growing agricultural sectors. Livestock production provide livelihoods for more than 1 billion people and are major contributors to food and nutrition security (World Bank, 2009). In developing countries, the sectors make large contributions to increasing livelihood resilience for many smallholders and offer ways to lift people out of poverty. However, livestock production and associated fodder production impact land, water and biodiversity resources, and in different ways contribute to global warming and pollution.

As demand for livestock products continues to grow due to rising population and dietary shifts, there is an urgent need to develop strategies to reduce the environmental footprints from livestock production. The first step in such a process is to develop tools to measure and model potential impacts of such strategies. It is thus important to assess impacts in four key impact categories: (i) water, (ii) soil health, (iii) greenhouse gas emissions, and (iv) biodiversity.

A review of existing tools and approaches for assessing environmental impacts of crop and livestock value chains (Ran et al. 2015) showed that most existing frameworks focus on the livestock production stage and mainly take short-term impacts at field and farm scales into account. A review of lifecycle assessments of livestock production (Fraval et al. 2015) found that only 7 out of 57 studies covered the entire value chain, from production on the farm to consumption. Existing tools and frameworks are generally knowledge-intensive and require significant time and data input.

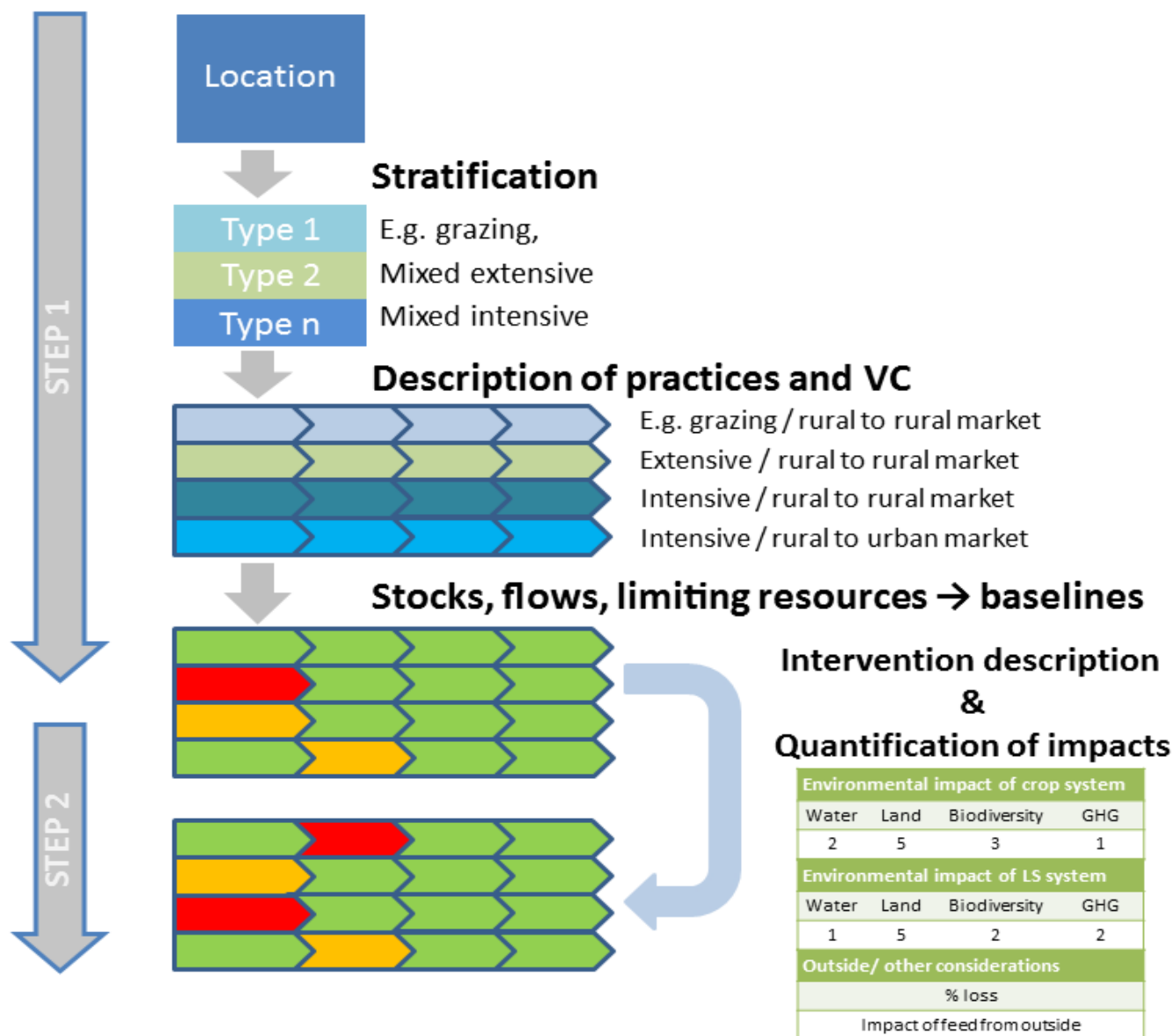
In response to this, the CLEANED framework was envisioned to produce rapid multi-dimensional environmental impact assessments following expected livestock rearing transformation in mixed crop-livestock smallholder systems in developing countries.

Design and implementation

The CLEANED conceptual framework was developed during 2013 and 2014 as an easily adaptable and transferable indicator framework that takes the full value chain into account. It was envisioned to estimate biomass, water and nutrient flows and assess four dimensions of environmental impacts across different spatial and temporal scales (Notenbaert et al. 2014; Morris et al. 2014).

The process flow of the assessments was designed as a step-wise procedure (Figure 1) that can be adapted to the local context, users' requirements and to available data. The assessments can be applied to a district, watershed, or any other spatially defined unit. The background calculations that relate the livestock production and value chain data with the environmental impacts are performed for discrete unit(s) within the overall study site, such as livestock production zones or pixels. It is assumed that conditions and activities are homogenous within these units and thus result in homogenous impacts. The input data are collected for the discrete units. Users are able to use as much detail in the input data as is available.

Figure 1: Process flow of the CLEANED ex-ante environmental assessment framework



The applicability of these generic concepts and the implementation process was first tested for the dairy value chain in Tanzania (Notenbaert et al. 2016). The design of the actual assessment tools and underlying calculations was thereby guided by three principles: i) the tools should be suitable for general use, requiring little time investment and technological know-how; ii) data should be available mostly from public sources, and it should be possible to be complemented through rapid assessments, participatory community approaches and expert consultations; and iii) the results should include a first set of indicators on whether developments in livestock production and consumption may result in adverse, positive, or static environmental impacts in terms of water, soil health, GHG emissions and biodiversity.

In 2016 the framework and associated tools were further developed and tested for a dual-purpose dairy value chain in Nicaragua (Hoek et al. 2016) and a pig value chain in Uganda.

Environmental impacts and indicators at different scales

The main environmental impact categories and indicators included in the framework are:

- **WATER** availability and quality – indicated by the total water requirement for production of feed, i.e. total evapotranspiration for feed production as a proportion of total precipitation over the area of production and change in water quality as a result of chemical use and manure management.
- **SOIL** and land health – indicated by soil erosion in terms of sediment loss; the potential change in soil organic matter; and change in nutrient balances.
- **BIODIVERSITY** – indicated by species richness index and the number of species that become critically threatened as a result of the value chain development.
- **GREENHOUSE GAS** emissions – indicated by three subcomponents; enteric fermentation, emissions from manure management and emissions from feed and fodder production, assessed according to Intergovernmental Panel on Climate Change (IPCC) guidelines.

Different existing methods can be used to quantify these indicators in terms of total use as well as efficiencies, e.g. per hectare. Specific impacts and impact indicators are linked to one or several spatial scales and to specific temporal scales.

Potential application of the framework

The framework is designed to help ensure that actions aiming to improve incomes and food security in livestock and fish value chains have a minimum environmental footprint, while at the same time lifting people out of poverty. It focuses on environmental impacts and is meant to complement other more commonly applied assessments such as cost-benefit analyses and feasibility studies.

As it employs locally relevant and up-to-date information and knowledge on production systems, the framework should help to identify the likely impacts of implementing specific technologies. It could also be used to rapidly screen sets of interventions in farming systems when these are in the early stages of development as a basis for further discussion. A third application would be to use the framework to quickly evaluate the impacts of a wide range of interventions, then to identify subsets of promising interventions to be evaluated using more detailed quantitative information to estimate aggregated impacts in certain regions, or to link these interventions to global and regional change models.

The target audiences for CLEANED assessments include decision-makers at different levels, such as donors, government agencies and NGOs. For these groups, CLEANED can provide a rapid ex-ante assessment as an alternative to monitoring and evaluating interventions already taking place at farm scale. The framework further seeks to highlight positive and negative trade-offs between resource use and productivity in order to identify and capture environmental impacts at multiple spatial and temporal scales.

Implementing the framework

The framework can be implemented through two tools (Birnholz et al. 2016; Pfeifer et al. 2016): CLEANED(R) is a spatially explicit tool that draws extensively on secondary GIS layers. It uses pixels as discrete unit and produces outputs in the form of raster maps. CLEANED(X) is an excel version that uses livestock production systems as the discrete, homogeneous unit. It visualizes the results in the form of graphs and tables. Both tools can be downloaded from <http://data.ilri.org/tools>.

The assessment tools are currently designed for 'livestock enterprises'. They were initially developed with data from East Africa and for dairy applications. They have also been tested for dual-purpose cattle systems in Nicaragua and, partially, for smallholder pigs in Uganda. CIAT has developed an extended 'whole farm' variant to accommodate crops as well as livestock with pilot studies in several African countries.

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Credits and more information

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Patron: Professor Peter C Doherty AC, FAA, FRS

Animal scientist, Nobel Prize Laureate for Physiology or Medicine—1996

Box 30709, Nairobi 00100 Kenya
Phone +254 20 422 3000
Fax +254 20 422 3001
Email ilri-kenya@cgiar.org

ilri.org
better lives through livestock

ILRI is a CGIAR research centre

Box 5689, Addis Ababa, Ethiopia
Phone +251 11 617 2000
Fax +251 11 667 6923
Email ilri-ethiopia@cgiar.org

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