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TOWARDS A PRACTICAL APPLICATION OF LIFE CYCLE SUSTAINABILITY ANALYSIS (LCSA)

Henriksson PJG, Guinée JB*

**Institute of Environmental Sciences (CML), Leiden University
Einsteinweg 2, 2333 CC Leiden, Netherlands
henriksson@cml.leidenuniv.nl*

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ABSTRACT

As part of the on-going SEAT (Sustaining Ethical Aquaculture Trade) project, an integrated approach was developed for collecting life cycle costing (LCC) and life cycle assessment (LCA) data for several actors throughout Asian aquaculture value chains. Parallel to this effort, also socio-economic data were collected, but only for grow-out farms. Because of differences in the analytical approach for socio-economic impacts, a larger sample of 35 farmers per farming system was selected for livelihood surveys. Meanwhile, a wider vertical approach was taken for LCA and LCC data at sample sizes between five and ten. Several challenges were encountered with regards to sensitive topics, from economic information on farms, to the number of children in China, to the use of controversial chemicals. However, the overall outcome was an extensive database of - what could be called - aquaculture LCSA data.

INTRODUCTION

Quantifying the economic, environmental and social sustainability of production chains is desirable in order to evaluate the overall sustainability of products. As a result of this, life cycle assessment (LCA), life cycle costing (LCC) and social life cycle assessment (SLCA) have evolved alongside each other. When implemented alongside each other, at least one dimension of life cycle sustainability assessment (LCSA) is performed (Guinée et al., 2011).

Of these three methods, LCC has the longest history while LCA has the most elaborated methodology and also a supporting ISO standard (14040-14044, 2006). SLCA, on the contrary, is the youngest and least evolved of the methods, probably because of its more qualitative nature. Each method also has its own set of challenges with regards to choice of indicators, data requirements and data evaluation. While several theoretical advancements have been made towards harmonizing the LCSA methodology (Zamagni 2012), few practical cases of its application exist (Traverso *et al.* 2012). According to the UNEP-SETAC guidelines (Valdivia et al. 2011): “The availability of data is another aspect that must be considered; this may be a critical issue in developing countries and in small and medium enterprises when conducting”.

Data collection is often one of the most time and resource consuming stages when building life cycle inventories (LCIs). Maximising efficiency by implementing a cross-

The present research is part of the EU FP7 funded Sustaining Ethical Aquaculture Trade (SEAT) project. The SEAT project aims to evaluate the sustainability and ethical aspects related to increasing imports of tilapia (*Tilapia spp.*), Pangasius catfish (*Pangasius spp.*), shrimp (*P. monodon* and *P. vannamei*), and freshwater prawns (*Machrobrachium spp.*) from China, Thailand, Vietnam, and Bangladesh (www.seatglobal.eu). The SEAT project involves twelve work packages (WPs), which include LCA, LCC, and livelihood surveys. Beyond this, the SEAT project includes WPs focusing on food safety and public health, global value chain analysis, ethical frameworks, risk assessment and environmental modelling, all which can provide underlying data for the LCSA.

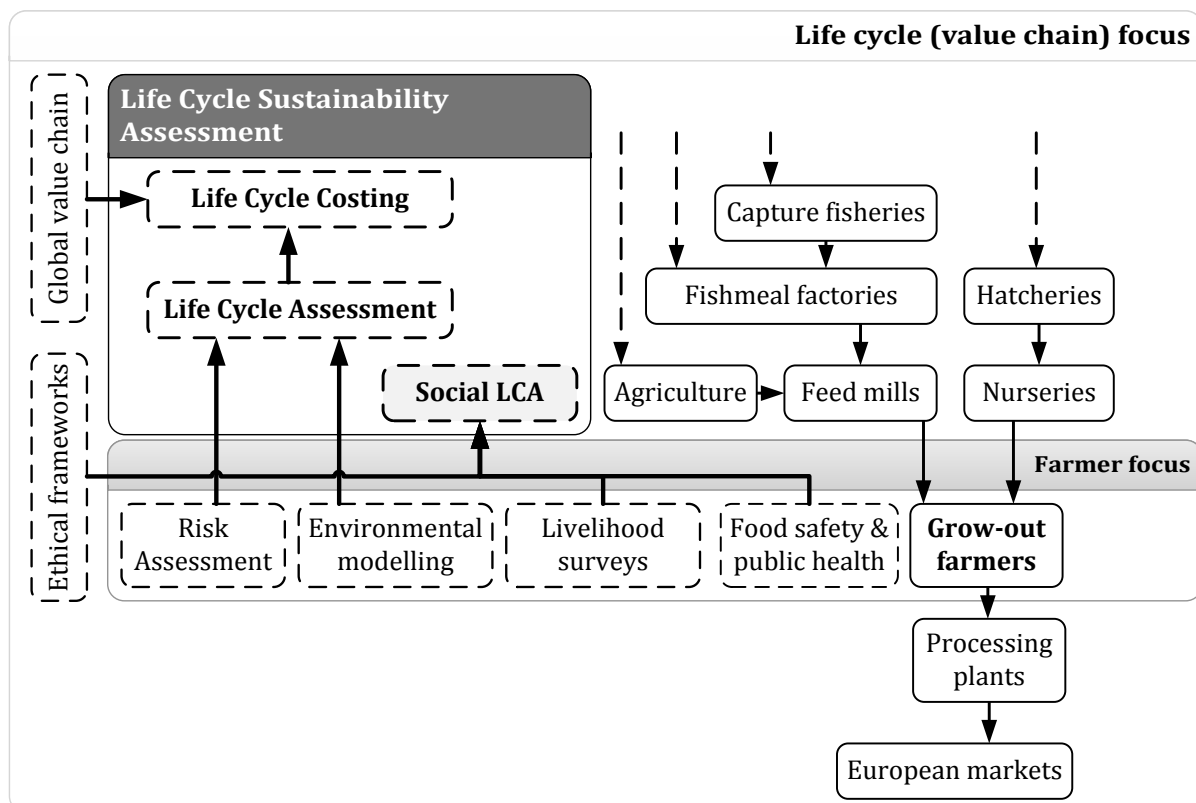


Figure 1: Structure and information flows within the SEAT project. Work packages are indicated by dashed lines and actors in the value chain by solid lines. While most WPs focus on aquaculture farmers, several work-packages have a lifecycle approach.

With most LCSA research being made on a theoretical level, the present research explores the practical hurdles that need to be overcome for efficient data collection. In this study we will focus on data collection for Asian aquaculture value chains, involving mainly small and medium enterprises. Whilst originally not intended as an LCSA exercise, the outcomes of the present research provides practical recommendations, useful when collecting and evaluating data from a lifecycle perspective.

METHODS

During late 2010 and early 2011, a project wide integrated survey was carried out, collecting basic data on 1 600 randomly selected aquaculture farms in Bangladesh, China, Thailand and



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Vietnam, describing farming practices of two different species in each country (Murray et al. *in prep.*). Following this, in-depth data collection activities were started. For this, a questionnaire detailing inventory and cost data for the most relevant inputs and outputs of aquaculture farmers was developed. Information on social well-being was included in the form of a livelihood survey, detailing household structure, private possessions, family balance, social interactions with the community, as well as access to natural resources, food, and infrastructure (Kruijssen et al. *in prep.*). In addition, a joint LCA and LCC questionnaire was developed for farmers and other actors in the value chain (Figure 1), while focus group discussions (FGDs) were conducted to capture socially relevant indicators beyond the farm. Trials with the questionnaires were carried out in 2011 with the ambition of reducing each interview to less than one hour and revise any questions which could be misinterpreted or inappropriate. The final questionnaires and checklists were summarised in the guidelines for data collection (Kruijssen et al. *in prep.*).

The in-depth data collection, using the guidelines, was carried out for a sub-sample of farmers from the integrated survey. The sub-sample was selected from groups of farmers, which each represented the most prominent farming practices (e.g. extensive and intensive) identified from the integrated survey. Within each group, a random sample of farms was generated and data was collected between 2011 and early 2012. The sample sizes needed for the quantitative livelihood analysis were bigger than those needed for the LCA and LCC. A minimum sample size of 35 farmers per group was determined for the livelihood surveys, in order for it to be normally distributed. Meanwhile, a minimum sample size of only 5 farms per group was deemed sufficient for LCA and LCC data. The owner of each farm/factory was targeted for the interview. However, in many cases other employees were the only persons available. Certain cut-off points needed to be implemented with regards to unique practices with negligible contributions to country-wide production, and geographically remote areas.

Beyond stating that the system boundaries should remain identical for all three assessments, the UNEP-SETAC guideline (Valdivia et al., 2011) gives little guidance on data collection. In the present study, resource limitations restricted the extent of the livelihood surveys to the aquaculture farm level. Other actors in the value chain were evaluated using key informant interviews and focus group discussions were facilitated (Kruijssen et al. *in prep.*).

RESULTS AND DISCUSSION

The most relevant data needed for the three methods were possible to collect in less than one hour. In cases where the interviews for various reasons exceeded one hour, a noticeable decline in data quality was often noticeable. The guidelines were generally applicable to all four countries without any modification. Certain questions were, however, found to be sensitive in some countries, e.g. number of children in China given the one-child policy. Some farmers also overestimated or underestimated certain variables, in order to seem more successful or to avoid risk of theft. Livelihood data proved to be the most resource demanding to collect, and also most difficult to quantify. SLCA data is also most scarce and inconsistent amongst secondary data sources, while several secondary databases are available for LCA and LCC data.

China displayed the large diversity in farming practices, and was therefore also the country where most in-depth surveys were conducted. Bangladesh, in the meantime, exhibited the



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longest value chains with several value additions between producers, middlemen and consumers. In Vietnam, vertically integrated companies were common, where one company owns e.g. both the farm and the processing factory. Thailand, being the most developed of the four countries, housed two distinctly different production chains, that for the domestic market, and that for the international market.

Small and medium enterprises were often more accessible than large enterprises. While most grow-out farmers were welcoming us, most large companies needed long correspondence or introductions before any physical appointment could be set up. The position in the company hierarchy of the interviewed could also influence accessibility and results. For example, a technician would be able to provide far more accurate data on more technical LCA related questions, while an office clerk could have more information on monetary LCC related data. Farm/company owners generally possessed the widest range of information, and were also most willing to share their knowledge. Employees were more reluctant to talk about company practices and policies, as they feared to give away sensitive information. The position of the person interviewed also had a strong influence on the livelihood results.

CONCLUSIONS

Inventory data collection is generally the most time and resource demanding stage of any LCSA study, especially for small and medium enterprises in less developed countries. Building upon an interdisciplinary data collection therefore optimises the inventory data collection and assures consistency amongst the three methods of LCSA. The present study showed how such a data collection could be setup, even for small and medium sized enterprises in developing countries. However, of the three methods, SLCA (livelihood) data proved to require the largest sample sizes and also proved most difficult to quantify. Culturally diverse characteristics also highlighted the importance of conducting fieldwork in order to understand and identify production practices.

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