The Life Cycle Approach for Sustainable Development of the Oil Palm Industry

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INTRODUCTION

Sustaining the development of the Malaysian oil palm industry is crucial because the exports of palm oil and palm-based products bring in substantial revenue (RM 14.2 billion in 2008) to the country. The basic challenge confronting the Malaysian oil palm industry is how to sustain development and global competitiveness in the face of stagnating productivity, increasing production costs and the scarcity of environmentally suitable land for expanding oil palm cultivation. In addition, the industry now has to fulfill expectations of palm oil importing countries regarding environmental performance.

LIFE CYCLE ASSESSMENT AND SUSTAINABILITY

Sustainability

Our future generations have the right to enjoy and use the resources to which we now have access. These include clean air and water, a stable climate, varied biodiversity and habitat, pristine or virgin forests and productive natural resources. Sustainable development ensures that all these resources will still be available for use by future generations. However, sustainability is not just a matter of pollution control. There are three areas of concern in sustainability, namely, environmental, economic and social aspects. All three are man's fundamental concerns. Thus, sustainable development is what every industry must strive for and achieve as proof of their commitment to these social, economic and environmental obligations.

In order to quantify environmental performance, new tools and methods are required. Life cycle assessment (LCA) is one of the tools that can help in understanding environmental impacts associated with the oil palm/palm oil supply chain. LCA also provides the necessary information to support the implementation of policies on sustainability. Through improvement analyses based on LCA, concrete policies can be formulated for responsible use of resources so that sustainability issues are addressed accordingly.

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Life Cycle Assessment (LCA)

LCA can be defined as a step-by-step process for evaluating the environmental burdens associated with an activity, product or process. The method, based on the life cycle of an activity, product or process, identifies and quantifies the energy and materials used, and the wastes released into the environment, and thereby assesses the impact of those energy and materials used and wastes to the environment (Arnold, 1993). As a follow-up to the impact assessment, the study then determines and weighs the associated problem areas or hotspots so that improvements can be made. Such improvements can be in terms of increased efficiency, reduction of energy input or of emissions. Thus, a full LCA study also identifies and evaluates opportunities to bring about environmental improvements.

Any LCA study, especially those commissioned for legislative purposes, must be carried out according to the ISO 14040 series of standards. The ISO 14040 series (Marsmann, 2000) covers a number of environmental topics and is part of a family of standards under ISO 14000 which are standards on

environmental management. The standards had been developed to provide a practical toolbox to assist in the implementation of actions to support sustainable development. ISO 14044 is the standard outlining the requirements and guidelines for LCA. This standard clearly defines the four phases of an LCA, namely, scoping the study, life cycle inventory analysis, life cycle impact assessment (LCIA), and lastly the interpretation/improvement analysis. ISO has also established three broad categories of concern that should be tracked in any impact analysis. These impact categories are:

- resource use;
- human health; and
- ecological consequences.

THE BUSINESS CASE FOR THE LIFE CYCLE APPROACH IN THE OIL PALM INDUSTRY

Although the growth of the Malaysian palm oil industry has been phenomenal, there were many challenges that had to be overcome by the government in its efforts to nurture and develop the industry into the world's largest source of vegetable oil. In the early 1990s, claims that palm oil was detrimental to health were successfully countered with scientific evidence to the contrary provided by MPOB (then known as PORIM) and supported by scientists from other renowned institutes. Currently, the demand for renewable sources of fuel has again thrust palm oil into the limelight. Europe aims to source 10% of all vehicle fuel from biofuels by 2020, and this source of biofuel can be provided by palm oil as it can readily be used both as a food as well as a biofuel feedstock. However, pro-conservation groups are against the use of palm oil, claiming that oil palm cultivation drives the destruction of biologically-rich rainforests and may produce more greenhouse gas (GHG) emissions than conventional fossil fuels. LCA has been proposed as a decision support tool to mitigate these ecological concerns because environmental impact can be quantified through an audit of the inputs and outputs into the system delineated in the study. LCA enables the oil palm industry to carry out eco-efficiency analyses which is a harmonization of economic and ecological considerations. Besides compliance to regulations, LCA gives a market advantage for environmentally preferred products. A sector which has carried out an LCA study goes into the global market with increased competitiveness because its sustainability claims are backed by the LCA study.

MPOB LCA Study

In 2006, MPOB embarked on a full LCA study of the oil palm/palm oil supply chain to provide generic data for the Malaysian oil palm industry as well as to endorse the sustainability of the oil palm industry. The life cycle inventory (LCI) data for the palm oil supply chain were first collected based on sub-systems, *i.e.* gate-to-gate, by different researchers. The required data included energy and raw materials, air emissions, waterborne effluents, solid wastes, co-products and other environmental releases incurred in all the sub-systems investigated. The sub-systems included activities/processes in oil palm nurseries (Halimah *et al*., 2009) and plantations (Zulkifli *et al.*, 2009), mills (Vijaya *et al*., 2006; 2008a, b), kernel crushers (Vijaya *et al.*, 2009) refineries, fractionation plants (Tan *et al.*, 2009), biodiesel plants (Puah *et al.*, 2009), and the manufacture of palm-based products and oleochemicals.

Figure 1 shows the cradle-to-grave life cycle of the palm oil supply chain where the four sub-systems, enclosed within dotted boundaries, are the systems which have been evaluated by MPOB. A solid line encloses the system boundary for the whole oil palm supply chain. LCI data were collected from these sub-systems through questionnaires disseminated to stakeholders and palm-related agencies such as PORAM (Palm Oil Refiners' Association of Malaysia), POMA (Palm Oil Millers' Association), MPOA (Malaysian Palm Oil Association) and MBA (Malaysian Biodiesel Association). On-site visits were then carried out to verify the data extracted from the questionnaires. Background data for resource exploitation and production of supporting feed materials such as fertilizers, pesticides, bleaching earth and other chemicals were obtained through available databases in various LCA software (*e.g.* SimaPro), literature and public database searches (*e.g.* LCAccess EPA-sponsored website), as well as the National LCA database project under SIRIM Berhad.

The information for the MPOB LCA study was evaluated using the software SimaPro Version 7.1 (2007) (**S**ystem for **I**ntegrated environ**M**ental **A**ssessment of **PRO**ducts), an internationally established and validated tool used by LCA practitioners. The LCA methodology used was Eco-Indicator 99.

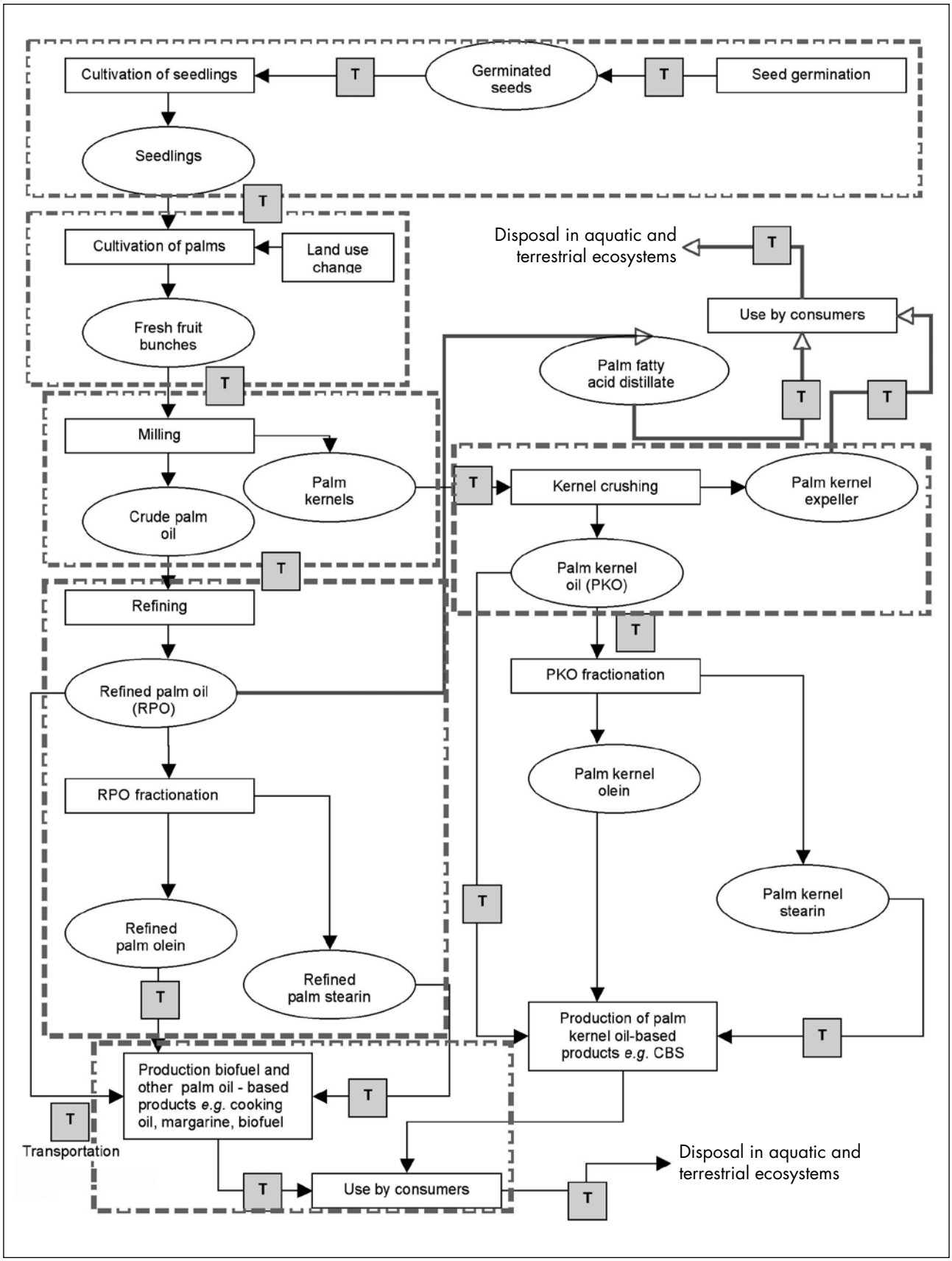

Figure 1. System boundary of the LCA study.

LCA Deliverables

The long-term deliverables from using the life cycle approach in the oil palm industry can be summarized by the following:

- integration of LCA of all palm oil sectors into a full LCA for palm oil and palm oil products for decision-making to develop sustainable products and processes;
- identification of best practices in the various palm oil sectors;
- guidance for bench-marking against other vegetable oils;
- building an environmentally sound technology system for palm oil production;
- effective integration of environmental consideration into the product design process, *e.g*. an eco-efficient design can be derived from the life cycle profile of a product;
- identification of a set of significant environmental parameters for monitoring environmental performance of the industry; and
- product life cycle information for marketing (*e.g.* carbon footprint).

It must also be emphasized that LCA is iterative in nature. As such, it is important that stakeholders participate in dialogues for continual improvement and decision-making regarding inventory updates and new technology.

Current Status of LCA Knowledge

Currently, technical expertise in LCA is still lacking in Malaysia although it is slowly growing with the help of established practitioners such as in Japan, the Netherlands and Denmark. On its part, MPOB has supported the growth of a critical mass of LCA practitioners through training of researchers in the use of various LCA software, participation in LCA/environmental-related programmes and in-house seminars on the theory and practice of LCA.

CONCLUSION

In order to move towards sustainability, the oil palm industry has to address the issues of pollution prevention, product stewardship and clean technology. The oil palm sustainability vision should include a concerted effort by the industry to shift from pollution control to that of pollution prevention, minimization of pollution from palm oil production and all environmental impacts associated with the full life cycle of oil palm, and investment in as well as the adoption of new environmentally sustainable technologies.

Despite the fact that LCA methodologies are controversial and still evolving, the principles behind the life cycle approach have been adopted by the manufacturing and service industries as a reference point for measuring their environmental performance. It is of utmost importance to note that the goal of LCA is not to arrive at *the answer* but rather to provide information for improvements. Engaging in LCA is a key element for gaining credibility for the environmental performance of the palm oil industry. Through improvement analyses based on LCA, a concrete policy can be drawn up for responsible use of resources so that sustainability issues regarding oil palm cultivation and palm oil production are accordingly addressed.

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