



ORGANIZACIÓN INTERNACIONAL DEL CAFÉ
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**Study of the sustainability of the coffee
supply chain versus climate change
adaptation and mitigation using the life
cycle assessment (LCA)**

Background

1. This document contains a summary of the terms of reference presented by Oxford University Consulting to develop a study aimed at identifying both the positive and negative effects on the environment of all activities involved in the coffee life cycle and providing a number of guidelines and recommendations for all those involved in the coffee chain who wish to apply this method of analysis.

2. It may be noted that this study is defined within the context of the United Nations Environment Programme (UNEP) and the ICO framework of studies on coffee, environment and international trade (EB-3723/99). The preliminary guidelines for this study were funded by the UNEP and presented to the Executive Board in May 2000 (document EB-3747/00).

Action

The Projects Committee is requested to consider this proposal as well as the recommendations of the Virtual Screening Committee and, if appropriate, to recommend it for approval by the Council.

PROJECT SUMMARY

Title:	Study of the sustainability of the coffee supply chain versus climate change adaptation and mitigation using the life cycle assessment (LCA)
Duration:	Nine months
Location:	Oxford University Consulting, Oxford, UK
Nature of the project:	To contribute to understanding the impact of production, processing, distribution and consumption that trading in coffee may have upon the environment. It will be conducted using the 'life cycle' approach to identify where in the coffee chain effects take place and how they can best be addressed.
Brief description:	The proposed study will develop analytical tools and reliable data with case studies to illustrate the current situation. It will help with the planning of national agricultural coffee policies, as well as project implementation in developing and enhancing the coffee sector, identifying both the positive and negative effects on the environment of all activities involved in the coffee life cycle, and providing a number of guidelines and recommendations for all those involved in the coffee chain who wish to apply this method of analysis.
Total cost:	US\$165,000
Financing sought from CFC:	US\$120,000 (grant)
Co-financing:	US\$45,000 (in kind by Illy Caffè)
Project Executing Agency:	Oxford University Consulting (OUC)
Supervisory body:	International Coffee Organization (ICO)
Estimated starting date:	2011

Approach

1. The analysis will apply the four stages of the Life Cycle Approach to the coffee chain in accordance with Guideline 14040 of the International Organization for Standardization

- (a) Definition of goal and scope.
- (b) Inventory analysis.
- (c) Impact assessment.
- (d) Interpretation (Figure 1)

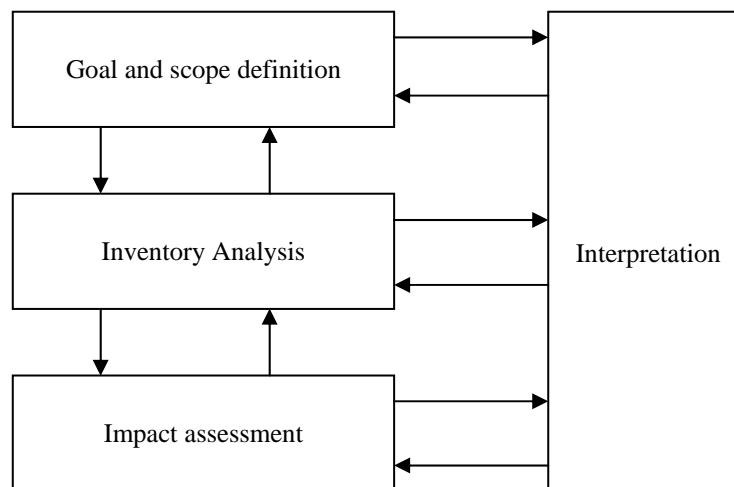


Figure 1: Phases in the life cycle assessment (Adapted from the International Organization for Standardization, Environmental Management – Life Cycle Assessment, Principles and Framework, Geneva, 1997).

2. The goal of the life cycle assessment (LCA) will be to quantify or characterize otherwise the direct and indirect material flows associated with the cultivation, processing and distribution of Arabica and Robusta coffee in the major coffee-producing countries as agreed with the International Coffee Organization. Three major final products will be considered in the life cycle assessment: roasted and ground coffee, filter coffee, and coffee machine capsules.

3. Within the first stage of the life cycle assessment, goals and scope are determined describing briefly the process under consideration. The inventory analysis comprises the establishment of a flow diagram for the life cycle of the product and recording of input-output flows at the different stages of the life cycle. These stages could comprise: (1) coffee cultivation; (2) transportation of coffee; (3) storing and cleaning; (4) roasting; (5) packaging; (6) distribution, (7) consumption; (8) waste disposal, etc. The impact assessment serves the purpose of identifying, quantifying and appraising the potential environmental effects

within different categories of damages (e.g. extensive use of fertilizers, green house effect, etc.). Within the scope of the interpretation different options are compared highlighting potentials for optimization.

4. Within the current project, three modules will be carried out that consider a basic overall analysis, the major categories of environmental impact with a particular focus on CO₂ and the creation of a model. Methodologically, the separation into modules helps to simplify the complexity of environmental impact in the case of coffee by concentrating on each module and integrating them afterwards into a more comprehensive presentation. In addition, in this way the study may be tailored to the specific focus the ICO would like to stress by exploring the different modules to varying extents.

5. Module 1 will provide a firm methodological framework that subsequently will be detailed by the following modules. The first module will provide a thorough literature review of the existing studies focused on the life cycle assessment of coffee. The major stages of the product life cycle will be firmly identified and described. Secondary Data shall be used to assess the environmental impacts of the different stages in the product chain. Within the subsequent Modules, the analysis undertaken in the first module will be extended and the various effects will be quantified in greater detail on the basis of new data. Module 4 will offer an opportunity to establish a model scheme that will enrich the final evaluation and serve as a flexible assessment tool.

6. During the preparation of the study, exchange with scientific institutions being active in coffee and alternative crop related research, including Illy Coffee, Members of the International Coffee Organization, the Association for Science and Information on Coffee will be established. The main stakeholders will be identified and involved in the assessment to get an unbiased picture.

7. The study will draw as much as possible on the experience of the leading coffee producing nations: Brazil, Colombia, Guatemala, Mexico, Costa Rica, Indonesia, India, Ethiopia and Tanzania. The study will cover both Arabica (*Coffea arabica*) and robusta coffee (*Coffea canephora*).

8. The results of the study will be formulated in terms of policy prescriptions and delivered to selected national and/or international research institutions and coffee producers. The results could then be used by them within the already existing research activities or to redirect their own activities towards a follow-up and multiplication of the approach in different regions. This would ensure that a significant impact would be reached.

Module 1: State of the art in Life Cycle Analysis research and evaluation in the context of coffee

- Key stages of the full life cycle of coffee will be identified (Figure 2).
- Existing LCA data sources on coffee will be analysed, and their relevance for the present study will be assessed.
- Scope and aims of the different studies will be characterized.
- Discussion of results on the basis of data obtained will be provided for different indicators including comparison of results from different sources (including recommendations for action).
- Identification of areas for research in the future will be carried out.

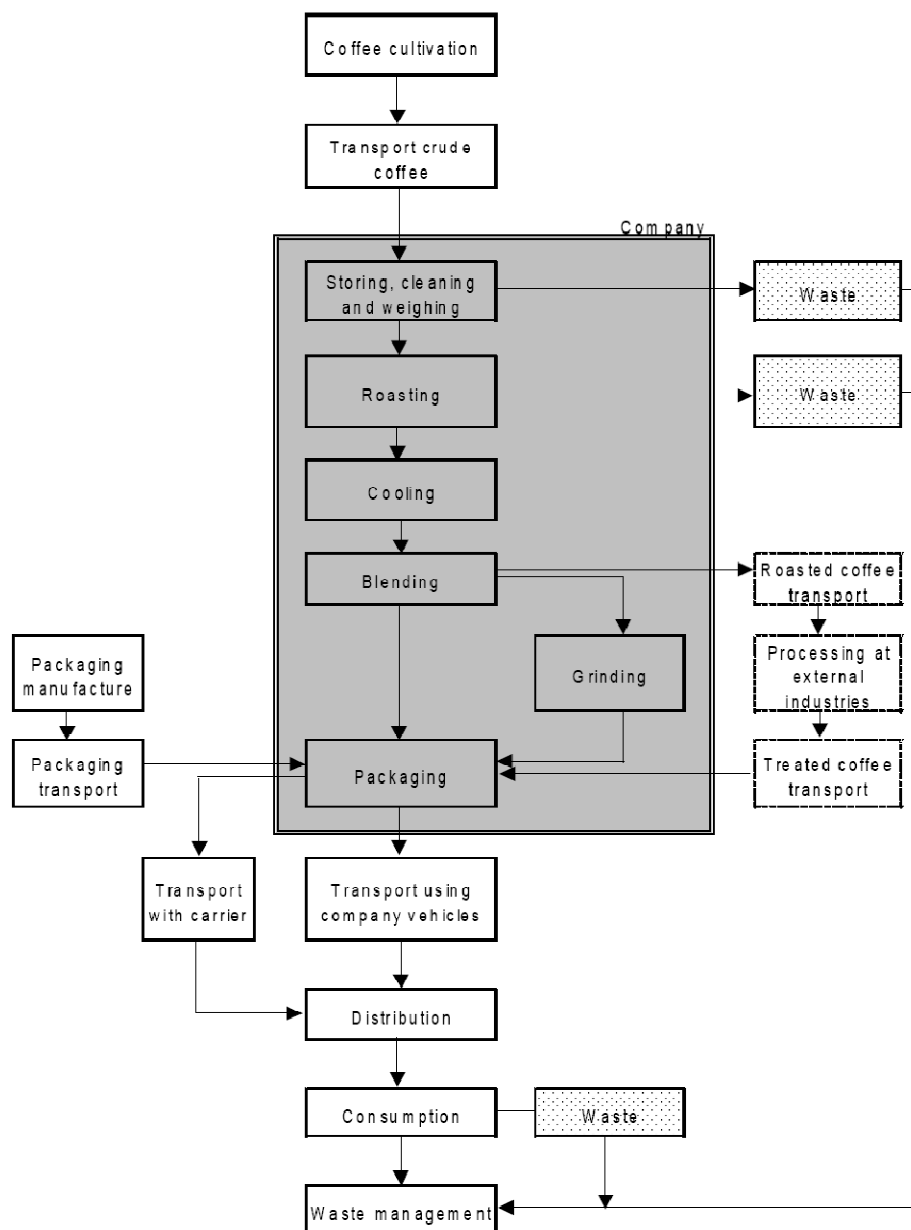


Figure 2: Simplified diagram of coffee life cycle (Simone, 2003)

Output

9. a report providing the overview of the existing life cycle studies of coffee, including a conceptual diagram, covering all major stages in the life cycle of coffee cultivation, processing and distribution up to final disposal of packaging wastes.

Indicative Costs: US\$25,000

Module 2: A Carbon Balance

10. This module will be carried out with the help of the state of the art Life Cycle Analysis software and will focus on obtaining detailed specific estimates of how much CO₂ is emitted and locked up at all important stages of the coffee life cycle. This analysis will be carried out for the three main types of coffee products, discussed in the introduction, including ground and roasted coffee, filter coffee and coffee machine capsules. As much attention as possible will be devoted to the cross-country differences, depending on the coffee-producing region.

CO₂ absorption is going to be analysed in the context of:

- Arabica (traditional and intensive)
- Robusta
- Shade trees
- Other main crops associated with coffee
- Other elements of coffee systems vegetation (forest remnants, soil cover, etc.)

CO₂ emissions and release is going to be discussed from the point of view of:

- Agricultural practices (fertilizer, fuel, soil clearance, soil, tillage, etc.)
- Post harvest processing
- Transport
- Roasting and packaging
- Consumption

11. For decision makers, we need a better understanding of how much difference it would make to CO₂ levels if, for instance, more shade trees were grown (see Module 4 on modelling below).

12. Close liaison will take place with Illy caffè who will be contributing technical input to this Module. In particular this will cover field work, case studies and data collection through questionnaires applying the sustainable coffee farming framework.

Output

13. A report detailing the existing data on coffee systems as carbon sinks and sources and how this is likely to change if, for instance, soluble coffee consumption rises and coffee shade declines.

Indicative Costs: US\$35,000
Including US\$12,000 software + data
Illy caffè US\$45,000 provided as in kind funding

Module 3: Global warming effects

14. In consultation with the UK Met Office, Brazil, the leading coffee-producing country, together with another country to be agreed with the ICO, will be explored from the point of view of likely climatic changes to occur in their territories within the next several decades. Because there is increasing evidence of climatic change, any comprehensive study on coffee and the environment must include consideration of the global processes underway that are outside the coffee system. Thus over the next 30 years temperatures may well rise by 2°C, and rainfall patterns will alter, which will change distribution of coffee growing and with it quality, yields and farming practices. This will lead to changes in the variables mentioned in the rest of this document.

15. For this module, as a first step a major coffee-producing country (e.g. Brazil) will be studied as a case history. The climate of the current coffee areas in that country will be defined based on existing data. Using the Global Climate Model of the Hadley Centre¹, projections will be made for the 2020s, 2050s and 2080s for variables such as temperature, rainfall, evaporation, solar radiation, etc. Using available coffee agronomic and physiological data, the impact of the projected change in climate variables on coffee production will be calculated. General biomass predictions for these regions will also be made.

Output

16. a report projecting the effects of global warming on coffee production in a major coffee-producing country. It is likely that the required data is going to be available in July 2011.

Indicative Costs: US\$30,000

¹ Part of the UK Meteorological Office, the module will be carried out in collaboration with them.

Module 4: A Model

17. An analytical simulations model focusing on the coffee production, transportation and environmental effects from these processes is going to be constructed in this module. The model is going to assume that it is possible to substitute some existing processes by more environmentally advanced technologies and will track what the overall effect of these changes could be. The model will be capable of answering questions such as:

- Consumption trends may increase CO₂ emissions (steaming and soluble coffee) but could these be offset by changes in coffee growing practice? Or would it be more cost effective, say, to improve efficiency in coffee brewing?

18. Accurate answers to these questions will take much detailed study to elaborate, as outlined in the modules above, but it is important to start making approximations very soon. The reason is that there may already be sufficient data available to make educated guesses about effects and the very action of trying to answer the questions would reveal gaps in knowledge, which need to be filled.

19. Such a model is going to be formulated through consultations using a brainstorming workshop of experts. Once constructed it could then be 'run' for a range of values and parameters (e.g. to carry out a sensitivity analysis). If credible 'ball-park' outputs are obtained, this will allow us to make predictions which could then be tested through further data gathering and experimentation to feed back into the above modules. If improbable scenarios emerge it would force us to reconsider both the quality of the data used and the assumptions and concepts we have employed.

Output

20. A brainstorming workshop, a report and a simple model that can be operated from any Pentium PC.

Indicative cost: US\$30,000
Inclusive of: US\$5,000 for a Senior Oxford University member's time to review the final report.