Development of National LCA Database Roadmaps, including further Development of the Technical Helpdesk for National LCA Databases

Deliverable D 4.5b: final roadmap report for Uganda

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EXECUTIVE SUMMARY

Many decisions concerning environmental sustainability are made on a daily basis. However, many lack real data basis and therefore end up loosely implemented with less positive impacts. Life cycle assessment (LCA) provides a comprehensive methodology that is key for evidence-based positions and decisions. This makes LCA databases to be very important in making environmental decisions. Studies based on regionalized LCA data provide results relevant for solving problems at the local level, rather than basing on the outside databases without considering the local conditions. The Uganda LCA database is there for a necessity for providing accurate data and making well-informed decisions for more sustainable development in Uganda. Decisions may include policy formulations, product development, marketing, pollution reporting.

The National LCA Database Roadmaps Development project is part of the *Resource Efficiency through Application of Life cycle thinking (REAL)* project. REAL runs from 2016-2019 and is funded by the European Commission and implemented by UN Environment. The main outcomes of the present project include roadmaps for the development of national databases for LCA in Brazil, Ecuador, India, South Africa, Sri Lanka, and Uganda. This roadmap report sets the stage of establishing the Uganda LCA database, and its establishment process has been widely supported with inputs from different stakeholders from government, industry, academia and experts. The roadmap gives the chronological order of achieving the Uganda LCA database, starting from the vision, up to the sustainability of the LCA database. Establishing the Uganda LCA database will need different resources and commitment, including capturing the ever-changing demands.

Stakeholders called for the promotion LCA that will make the LCA database more sustainable and successful. Leadership and proper management will be essential for the success of the roadmap implementation.

LCA Network Uganda together with other stakeholders are responsible for the sourcing of funds to finance the database development, and this task is immediate after the dissemination of the roadmap. For proper management, the project management institution shall establish a balanced and well experienced Steering committee that shall be well represented as per the guidelines established. The steering committee shall be responsible of establishing other committees and working groups as per the guidelines to ensure project success.

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1 INTRODUCTION

1.1 Background

There is increased need for sustainable solutions in all sectors both at national, regional and international level. As different corroborations call to implement sustainable strategies at different levels, countries must develop evidence-based strategies to a breakthrough in designing and implementing sustainable solutions. This therefore calls for country specific data will help in the adoption of policies and technologies that promote sustainable consumption and production across different sectors at national level.

One of the foundations of better sustainable solutions, is the promotion and application of life cycle assessment (LCA). Comprehensive LCAs provide environmental performance data that is used to understand and act on environmental burdens along the supply chains, thus preventing shifting burdens up or down the supply chain or between environmental impact categories. Countries need LCA data for better sustainable informed solutions that put the country on a better path of sustainable consumption and production. Uganda is no different in seeking the LCA roadmap that will lay firm steps towards the establishment of a sustainable, reliable and all-inclusive national LCA database.

1.2 Overview LCA activities in Uganda

LCA activities in Uganda have been taking shape with some researches being done at Universities, companies and individual level. The government has been participating in LCA initiatives through the promotion of LCA standards developed by the International Organization for Standardization (ISO). This has increased awareness among different stakeholders. Formal national LCA training activities started in 2013 with financial support from Swedish International Development Cooperation Agency (Sida) under the framework of "Swedish Standards Institute – East African Community" project on trade promotion through standardization. Different stakeholders were trained on the LCA standards and their implementation. This initiative together with the support from UNEP/Life Cycle Initiative in 2016 led to the formation of the LCA Network Uganda, which is legally registered under the Uganda laws.

1.2.1 LCA in industry and the private sector

Many sustainability initiatives have been on the rise both in the industry and private sector. Sustainability initiatives focused on cleaner production have been promoted in pulp and paper manufacturing, food processing industries, chemical and battery manufacturing, textile industries, metal industries, schools and hospitals, hotel industry, and the agricultural sector.

Some processors have changed their systems and operations based on LCA results and these include; juice making factories and dry fruit processors among others. Factories have been able to change their waste management, energy systems and transportation systems based on the LCA results. With increased awareness and data availability, LCA will be more helpful in determining the company sustainable strategies.

1.2.2 LCA in regulations and public policy

The participation of Uganda in different sustainability initiatives has led to its promotion of policies based on sustainable consumption and production (SCP). Uganda actively participated in the United Nations Conference on Environment and Development (UNCED) in 1992 and officially endorsed Agenda 21, the key policy output of the conference: Agenda

21, in Chapter 4, encourages countries to promote sustainable consumption and production technologies.

Following her endorsement of Agenda 21 therefore, Government of Uganda advocated for the introduction of cleaner production methods across all key sectors of the economy. Sustainable initiatives include; Cleaner Production Practices, Sustainable Cities Program, Urban Transport Reforms, Biomass Co-generation, Dissemination Programs on Efficient Cooking Stoves, and Transformation of conventional agricultural production into an organic farming system.

Different sustainability policy initiatives have been put in place covering different sectors. Most of the initiatives have been realized with international organizations support, especially UNDP and UNEP. These include:

- National program on sustainable consumption and production, launched in 2011, by the Ministry of Tourism, Trade and Industry with support from UNEP. The project was coordinated by Uganda Cleaner Production Center.
- The National Development Plan (NDP) 2010/11-2014/15. It emphasizes the need for strong sustainability content in the plan and includes a comprehensive list of environmental stainability indicators in its monitoring and evaluation plan (M&E plan).
- National Development Vision (2035) also emphasizes SCP.

Other national policies in support of sustainable consumption and production include:

- The National Environment Management Policy 1994,
- The Forestry Policy 2001
- Energy Policy 2002
- The Renewable Energy Policy 2007
- The Land Use Policy 2008
- National Industrial Policy 2008
- Tourism Policy 2006
- The National Water Policy 1999
- The Fisheries Policy 2000
- The Water Policy 1995
- The National Wetlands Management Policy 1996
- The Wildlife Policy 1996.

The above national policies are indirectly linked to LCA, since they promote SCP across different sectors. This brings in strong basis for the promotion and advocating for LCA in both private and by the public sector as a way of providing evidence-based approach to policy changes, on the basis that LCA provides comprehensive life cycle perspective of environmental performance.

Other major pilot projects supported by the government and promoting SCP include:

- Demand-side Management on Energy Use,
- Demand-Side Management on Water Use and Water Harvesting,
- Integrated Solid Waste Management Program,
- Sustainable Building and Construction,
- Cleaner City-Vehicle Emissions,
- Sustainable Manufacturing,

- Sustainable Tourism,
- Sustainable Agriculture
- Education for Sustainable Consumption.

The above pilot projects were selected basing on Relevance to national needs, potential to provide synergy to existing initiatives, relevance to SCP program of the Africa region, potential to deliver quick impacts with multiplier effects, existence of capacity to implement within existing infrastructure, and more importantly being part of the global process supported by donor communities.

The government of Uganda also enacted roadmap for creating an enabling environment for delivering on UN's Sustainable Development Goals (SDGs) in Uganda. The SDGs have also been translated into some of Uganda's most spoken languages to enable everyone understand and participate. The implementation of SDGs in Uganda is coordinated through the National SDG Coordination Framework. The Framework spells out clear mandates for planning, reporting, monitoring, resource mobilization, communication, advocacy and decision-making for implementation of the SDGs anchored within existing national coordination structures. The SDGs are expected to be fully domesticated through sector and local government planning, budgeting and project implementation. The SDGs are also part of the plans by the national sectors, Ministries, Departments and Agencies, and Local Governments.

Other initiatives in corroboration with international organizations and supported by the government of Uganda include;

1. One Planet network initiatives whose projects include;
   a. Collaborative forest management,
   b. Greening supply chains,
   c. Biomass clean cook stoves and fuels.
2. SWITCH Africa green program projects that include;
   a. Promotion of Water use efficiency techniques and Practices in Micro, Small, Medium-sized Enterprises,
   b. Upscaling Generation, Commercialization and Utilization of Biomass Waste-based Green Energy Sources,
   c. Promotion of Energy Efficiency Techniques and Practices in micro, small and medium enterprises (MSMEs),
   d. Eco-Agriculture among Young Rural People, Promoting Inclusive Green Business Practices in the Tourism Sector
   e. Promoting sustainable product innovation and energy efficient practices among small scale industries in Uganda.

All the above policy initiatives and projects in support for SCP acts as the best opportunity in bringing on board the public sector and supporting partners to promote LCA initiatives including supporting LCA database roadmap.

Although circular economy is new in Uganda, one study is underway to show the importance of circularity using LCA in one min paper recycling plant. This study is under the African Circular Economy Network, a Network established to promote Circular Economy in Africa.

1.2.3 LCA in research and academia

The number of publications with LCA component has increased since 2008. The majority of the publications are from academic work at universities in collaboration with international

researchers. These mainly focus on waste management, sanitation, energy, and agriculture products. The increase indicates a growing interest in LCA, mainly from academia and to less extent independent researchers. Establishing the LCA database will therefore help in easy access to data among academia and independent researchers.

1.2.4 Other LCA activities

Uganda has been participating at ISO in the development and reviewing of the LCA standards. This has led to increased appreciation of the importance of LCA and created awareness among different stakeholders through engagements in technical committees and workshops. This work is led by Uganda National Bureau of Standards, a government agency responsible for the formulation, promotion of the use of, and the enforcement of standards in protection of the environment, public health and safety.

2 TOWARDS A NATIONAL LCA DATABASE

In Uganda, formal national LCA capacity building started in 2013 due to increased awareness of the importance of environmental protection, and the possible impacts associated with products among different stakeholders. This resulted in increased interest to understand and address these impacts. Uganda National Bureau of Standards (UNBS), a standards agency responsible for the formulation, promotion of the use of, and the enforcement of standards in protection of the environment, public health and safety sought support to implement international standards for life cycle assessment (LCA) (ISO 14040 and ISO 14044). This was for capacity building of industry, government and the academia in implementation of these standards, different capacity building programs on LCA were done with support from the Swedish Standards Institute (SIS), drawing participants from industry, government, Non-Governmental Organizations (NGOs, the academia and independent researchers. During capacity building programs, lack of national LCA database was identified as a major challenge.

2.1 LCA capacity building and database development achievements

Over the period of four years, thirty-five experts were trained in the application of LCA standards in the period 2013 to 2017. In partnership with Kyambogo University and Makerere University, twenty-five trainees participated in LCA pilot studies on pineapple, hot pepper, coffee, sugar, papaya, and briquettes. The LCA trainees further participated in the implementation of the 2014 UNEP funded pilot case study on "Life Cycle Management Capability Maturity Model (LCM-CMM)" In addition six people were trained as LCA trainers under the Training of Trainers (TOT) program (2013-2017).

For database development, seventeen people were trained in LCA database development with the objective of facilitating the establishment of Uganda LCA database. The training covered data acquisition and documentation (including calculation and modeling), data quality review, and strategic continuous improvement in quality and quantity. The participants were from academia, government, NGOs and practitioners.

These achievements will therefor serve as a starting point and contribute greatly to the development of the LCA database.

2.2 Target audience and intended use of roadmap report

The roadmap is a step-by-step guide for developing the Uganda LCA database. It is intended to be used by the database development project team in achieving the different assignments as required. It includes activities, responsibilities, timelines and the needed resources, in addition to the quality of work expected. This will further act as a checklist for assessment after database development. The roadmap therefore strives to cover all needs required in developing the LCA database.

2.3 The roadmap establishment process

The development of the present roadmap report has gone through different stages leading to different activities being undertaken. These include;

- Baseline assessment and stakeholder mapping and engagement
- Establish working group
- Plan the road mapping process
- Develop the roadmap - vision and goals
- Develop the roadmap - action plans

- Draft the roadmap
- Review the roadmap and obtain stakeholder support
- Revise and finalize the roadmap
- Disseminate the roadmap and execute first steps

2.3.1 Baseline assessment and stakeholder mapping

The baseline assessment and stakeholder mapping was carried out with a view of understanding the status of LCA activities and different stakeholders' potential role in developing the LCA database.

As part of project activities, LCA Network Uganda held one-on-one meetings, virtual meetings, and group consultations with key stakeholders. This was followed by email and phone call consultations. The objective was to provide the background information to each stakeholder in line with their mandate and priorities, the relevance of LCA to their work, and their potential role in contributing to LCA database development and usage.

Five broad categories of stakeholders were identified: public sector, Industry and private sector, academia and research, civil society and independent experts. Specific organizations and individuals within the five categories were identified and selected based on their previous interest, participation and support to LCA activities in Uganda. Other stakeholders were also selected based on their previous support and participation in sustainability projects like policy formulation and startups.

Overall, stakeholders' engagement showed support and commitment for the need of the LCA database development roadmap and subsequently the LCA database. However, more concern was put on the benefits associated with LCA and the financing of the database and other LCA activities like capacity building.

2.3.2 National Database Working Group (NDWG)

The major task for the NDWG was to develop the LCA database roadmap in consultation with other stakeholders. The composition of the NDWG was based on the baseline assessment and stakeholders' engagement results. The selection of the NDWG members depended on;

- Sector representation private, government, academia, LCA expert groups)
- Engagement in LCA activities
- Commitment to participation
- Previous interest and support

More details of the NDWG composition are presented in Appendix A – NDWG composition.

2.4 Roadmap report writing process

This intermediate report was compiled with the contribution from the whole NDWG. Mr. Paul Walakira and Mr. Dean Tashobya of the LCA Network Uganda provided a leading role in compiling the report. Full NDWG members are presented in Table 1 below.

Table 1: NDWG composition

No	Name	Institution	Status
1	Mr. Paul Walakira (Chairperson)	LCA Network	Project coordinator
2	Mr. Stephen Wekoye	Kyambogo University	Member
3	Mr. Herbert Murungi	NGO	Member
4	Mr. Richard Nyenje	Ministry of Agriculture	Member
5	Mr. Joseph Mary Tumanyane	Private Sector	Member
6	Mr. Edson Twinomujuni	UCPC	Chair
7	Mr. Dean Tashobya	LCA Network	IWG-representative
8	Mr. Moses Nabasa	NGO	Member
9	Ms. HawahNambasa	Makerere University	Member
10	Mr. Richard Okot	Private Sector	Member
11	Ms. ProssyNabaggala (Secretariat)	UNBS	Member

2.5   Dissemination activities

The Roadmap report dissemination will be at the face to face stakeholders meeting at the end of the project. More discussions will be directed towards how best the LCA database can be achieved, as well as creating awareness to the new stakeholders.

3 ROADMAP FOR DEVELOPING A NATIONAL LCA DATABASE

3.1 Vision and goals

3.1.1 Vision

The Uganda LCA Database will be the recognized source of Uganda based life cycle inventory data and will be relied on in carrying out life cycle assessment studies to support decision-making.

3.1.2 Goals of the Database Project

The goals of the database project are to:

- Generate transparent LCI quality data.
- Cover mostly used materials, products, and processes in Uganda
- Support the increased use and application of LCA for decision making.
- Maintain compatibility with other established international LCI databases.

3.2 Governance and management

The inclusiveness of different stakeholders from different sectors together with the different levels of interests' calls for balanced representation and participation in developing the Uganda LCA database. The management shall have three levels which include the steering committee, technical committee and working groups.

3.2.1 Steering committee and its roles

The project management institution (s) shall be responsible for the establishment of the steering committee. It is recommended that the steering committee shall be composed of representatives from different stakeholders, sectors and with relevant LCA knowledge and experience. Steering committee members shall be from government, industry, expert groups, academia and the Uganda LCA network. LCA experts from Uganda Cleaner Production Center (UCPC), Kyambogo University and Makerere University are recommended to be among the members of the steering committee since they have deep experience in LCA activities in Uganda. Serving on the steering committee will be on a voluntary basis and by commitment.

The steering committee will be the overall overseer as it carries the mandate to make sure the database is developed.

The steering committee shall further be responsible for advancing the business case (why a national LCA database and its benefits), prepare work plans, budgets and funding requirements; Identify user needs, conduct gap analysis and seek funding from different sources.

3.2.2 Technical committee and its roles

The technical committee is responsible for the technical work of the database. The technical committee shall be composed of LCA professionals that have demonstrated expertise in LCA database development including IT professionals with knowledge and experience in database development and management.

The technical committee shall be responsible for establishing the different working groups involved in actual data collection and the database setup.

The technical committee shall further ensure the development of LCI data case studies, operationalization of the website with data from case studies and sample data downloads; selection of internal and international experts to guide the database development when required and to ensure data quality and quality assurance.

3.2.3 Working groups

Different working groups shall be set up according to the required mandate and these will include experts with experience in the relevant tasks. The working groups shall be composed of experienced professionals in executing relevant tasks. These shall be responsible for carrying out different mandates as assigned by the technical committee.

3.2.4 Data manager

The steering committee shall appoint a data manager that will be responsible for the day to day operations of the database. The data manager shall consistently evaluate the performance of the database, data availability, data needs and monitor the data usage. This will periodically be submitted to the steering committee to enable continual improvement of the database.

3.3 Data needs priorities

The NDWG working selected the following broad categories to begin with in the order of priorities.

1. Power, fuels, energy, and transportation
2. Products and materials
    a. Food and agriculture
    b. Building and construction
    c. Commodity chemicals and materials
    d. Packaging
3. Basic manufacturing processes
4. End-of-Life (Recycling, Landfill, etc.)

Although the priority list covers a large number of separate processes, only the highest priorities will first be considered due to the likely funding and time limits as well as the management implications of undertaking too many data collections at the same time.

Fuels, energy and transportation are considered a priority area since they are crucial in all other processes. Within the sub-groups of the products and materials category, priority is also set at high, medium, and low priorities. In the case of the transformation and end-of-life categories, a smaller number of priority areas will be selected. During the implementation, lists will further be evaluated based on priority considering the probable limited funding.

3.3.1 Power, fuel, energy and transportation

Nearly every LCA study involves the use of some kind of energy, whether for any transportation, movement or stationary purposes. This means fuels, energy, and transportation database must be maintained as a top priority from the start database development. Energy and transportation are the most important common database requirement. During the development, other database modules can be linked to the data sets for the production and consumption of fuels used for process and transportation energy.

Care should be taken to ensure that major problems in comparing results from different LCI sources do not arise. For example, the energy and emissions profile for the use of 100 kWh of electricity may differ widely depending on the fuel used, the data for the production and

consumption of each type of fuel, the generating efficiency, and the transmission and distribution losses. All stages must be considered for energy and transportation and these include; energy and emissions to extract, process, and deliver each type of fuel or energy in addition to combustion energy and emissions for each type of fuel used for process or transportation energy. The data categories shall include electricity generation from hydro, biomass (natural sources-trees etc.), biomass (solid waste) and photovoltaics. Transmission and distribution line losses must also be included.

3.3.2 Products and materials

Four detailed lists of products and materials are prioritized. Food, livestock and agriculture production including unit process data for crop production and livestock are of high priority. All in puts in agriculture and livestock production must be considered.

In additions, packaging materials, building and construction and basic commodity chemicals and materials. Priority under products and materials will be given to the ones that are most important and mostly used. Sub-groupings in each list may be prioritized into three categories: highest priority, medium priority, and lowest priority, based mostly needed and used.

These detailed, priority-ranked lists shall be developed at the time of implementation and as deemed necessary by the steering committee.

3.3.3 Basic manufacturing processes

Uganda being a developing country, there are many basic manufacturing processes relevant to other different industries and they are therefore necessary at the beginning of database development. Mostly applied transformation process shall be considered. These may include transformation of plastics (injection molding, blow molding, compression molding) and metals (casting, welding, extruding). Priority should be given to the mostly used, and this will be decided at the implementation stage by the steering committee.

3.3.4 End-of-Life

Although some focus may be on cradle- to-gate, it is important to include common end of life units that can enable user to do full LCA studies of cradle-to-grave. Priority of end-of-life process should be given to landfill (with and without energy recovery), composting, recycling (plastics, metals, paper) and combustion (paper, wood etc.)

3.4 Human resources and capacity development

The purpose of any LCA database is its use in decision support by providing accurate data and in the right format. This requires expertise in developing the database, maintaining the database, collecting the data, performing the LCA. It is therefore crucial to build up LCA database development expertise in the country. These experts will be chosen carefully from different sectors and their experience in LCA will be considered. This is to avoid depending on foreign experts all the time. If foreign experts are contracted to technically lead the database project and knowledge transfer is not effective, the resulting database will be of little use. Any trainings are therefore to mitigate any eventualities and enhance the national capacity and lay strategies for database sustainability.

For the first phase, the following number of experts will be trained;

- Ten experts in database development
- Ten experts in data analysis
- Five experts in IT for LCA database
- Ten experts in performing thorough LCA
- Twenty experts in data collection
- Five experts in data quality management

The chosen trainees to be experts should have strong engineering or natural sciences background and be able to learn and implement fast and then train others to increase the expertise in the country.

Commitment of chosen experts will be highly emphasized to be ably volunteer in performing their duties assigned after the project even when there is limited funding. Since funding can always be limited at the start, an expert can only be trained in two areas and this is to cater for having as many deferent trained people as possible to reduce on the workload of one expert and increase on the number of participants in the project.

Since efficient LCA database establishment requires prior experience in addition to the new experts, partnering with experienced experts from other countries is necessary and inevitable. The project team will therefore identify different external experts to help in the development of the Uganda LCA database.

The steering committee in coordination with the technical committee must ensure that the database being established is representative and does not serve only one sector.

3.5 Data and database

3.5.1 Database hosting

In choosing the database host, organizations impartiality, susceptible to changes due to different reasons for example political situations need to be avoided. Avoiding these changes will act as a firm foundation for the LCA database sustainability. It is from this perspective that Kyambogo University was selected to host the LCA database. Being a public university and considering the support it has greatly offered in developing the LCA activities in Uganda. Also, its support for the LCA roadmap development is good commitment and indicator to promote LCA database in Uganda. The University has committed to host the LCA database.

3.5.2 Database access

The LCA database shall be freely accessible to the users after authorization by the data manager. The users shall have to first register on the website before accessing the data. This is to facilitate continual improvement and understanding of the data usage analytics as deemed by the steering committee and the data manager.

When individual entities decide to sell their LCA data through the Uganda LCA database, such data will be in the compatible format and a percent of the cost shall be retained for the sustainability of the database.

3.5.3 Data quality requirements and review

The availability of high-quality background Life Cycle Inventory (LCI) data is key to the success of the LCA database. This is because life cycle-based policies and instruments and industry applications need the correct methodological guidance and LCA data to have reliable decision making. The database will therefore consider data from across industry

sectors and of high quality. Below are the different data quality parameters that will be used to assess its quality.

- Technical Representation- Representation shall address the technology mix or existing technology being used. This will be qualitative and will reflect the extent to which the dataset represents the reality of a certain process or process units, it will be assessed as either completely, partly or not representative.
- Geographical representativeness-the data shall be representing the real Ugandan situation including technology, energy and materials.
- Time-related representativeness shall be included. This will focus on the validity of the datasets as the year of data collection is taken as the reference.
- Completeness- the percentage of flows that are measured, estimated or recorded shall be determined. The unreported emissions shall be noted and documented.
- Consistency requirements shall be determined, and this will encompass uniformity of the data, methodology and procedure used, database maintenance and any additions. This shall also apply to data quality assessment and documentation, documentation format, data exchange format, and nomenclature.
- Uncertainties in the quality of the dataset shall be documented. This shall include data uncertainty within each unit process.

Overall data quality shall therefore be determined on the basis of accuracy (representativeness and methodological appropriateness and consistency), compatibility, uncertainty, model assumptions, data uncertainty and completeness of the inventory.

An independent external expert shall be used for critical review since taking in consideration that automatic calculation of data quality cannot capture a number of relevant aspects, such as data gaps, model assumptions, cross-correlation of data uncertainty among others. The achieved quality will be well documented including recording the less precise data.

3.5.4 Data formats

The data documentation shall follow at minimum the ISO 14048 data documentation format as specified in the Guidelines. The use of the 14048 data documentation format will ensure that the data documentation information is imported and preserved alongside the data elements in all the major LCI software tools. However, the technical team can determine with reasons for the use of other formats as deemed necessary, e.g. because of compatibility and adaptability.

A point to note is that by publishing unit-process details and documenting the data according to the ISO 14048 documentation format, is advantageous since the data will be usable in a variety of software tools and by many users.

3.5.5 Interoperability over the Global LCA Data Access (GLAD) network

In developing the LCA database, international interoperability of the data sets shall be considered. The developed data base shall be able to be accessible in the agreed formats at the Global LCA Data Access" network (GLAD). This will consider methodological, technical, and IT level including review and documentation. Data set converters that convert one data set format into another shall be considered where and when necessary, and these will include elementary flow, flow property, and unit mappings intended to yield compatible data sets inventories.

4 ROADMAP IMPLEMENTATION PLAN

4.1 Roles, responsibilities, activities and timeline for roadmap implementation

This kind of project should not be contracted to one person or organization since they cannot have a sufficiently broad range of skills and a large enough staff to develop all of the data modules required within a reasonable time frame. This is also to avoid the high-risk approach of assigning the entire project, including all of the data collection and analysis functions, to one entity or group.

With the steering committee taking the oversight role, the fundamental approach shall be taken in line with the following guidelines.

1. The data collection and analysis shall be undertaken on a contract basis and by various organizations, individuals and working groups that are experienced in and knowledgeable about LCA database development and the relevant industry sectors. The working groups will be evaluated for competence by the technical committee.
2. The technical committee shall have the responsibility of developing terms of reference, accepting proposals from prospective contractors, letting and monitoring contracts, managing private sector contributions to the project, this will be reporting to the steering committee of all steps and work being undertaken.
3. The steering committee shall be responsible for ensuring that funds are utilized appropriately. This shall include funding from any core budget, funding from private and public sources. Any funding shall be independent of ownership rights to specific process or data (e.g., a company cannot specifically fund and own a certain study, although it may provide the funding specifying that a certain module be developed as part of the project)
4. The steering committee shall endeavor to encourage the different sector stakeholders to be involved in data provision and review of final data reports. All the roles are in addition to any other roles assigned in the different clauses of this roadmap. Details of action items, timelines and responsibilities are presented in Table 2.

4.2 Timeline for roadmap implementation

Table 2 - Summary of the activities, timelines and responsibilities.

Action Items	Timeline	Responsibility
Sourcing for database development funds	**1-6 months**	LCA Network Uganda & other stakeholders
Project Management		
Establish the steering committee.	1–6 months	Project management institution (s)
Establish the technical committee	1-6	Steering committee
Develop LCA database business model	1-3 months	Steering committee
Establish the terms, guidelines and implementation plan	1–9 months	Steering committee
Request for proposals	1–9 months	Steering committee
Hire subcontractors.		Steering committee
Assess the subcontractors' implementation plans and signing the contracts.	3–12 months	Technical committee
Corroborate with the national, regional and international LCA database efforts.	1–24 months	Technical committee
Formation of working groups	1-12 months	Technical committee
Data collection		
Collection of data for different sectors (starting with Power, Fuel, Energy, Transportation and agriculture)	1-24 months	Working groups
Analyzing the data and quality control	1-24 months	Technical committee
Review the datasets (quality, gap analysis)	1-24 months	External expert
Update or correct the data as necessary	1-24 months	Technical committee
Check data for completeness and into the required selected format and templates	1-36 months	External expert
data entry and initial database	1-36 months	Working groups
Test database internally	1-36 months	Technical committee
Database use guidelines development	1-12 months	Technical committee
Database rollout	1-36 months	
Dissemination	1-36 months	Steering committee
Establish a communication system	1-24 months	Technical committee
Feedback compilation and analysis	1-24 months	Technical committee
Database corrections	1-24 months	Technical committee
Database revision/ updating		
Analysis of more database needs for expansion or revision	1-24 months	Data manager
Filling the data needs	3–24 months	Data manager
Review, update or replace data sets in the database.	3–36 months	Data manager
Provide change details.	3–36 months	Data manager

5 FUNDS AND FINANCING

First and foremost is the fact that the building of the LCA database will only start a process that must be continuous.

LCA Network Uganda together with other stakeholders shall identify potential funders and source for funding for database development after the dissemination of the roadmap. Potential funding organizations and companies shall be approached in a manner that will not compromise the quality of the intended database.

The focus is on a three-year program with the objective of developing and making available selected critical LCA data that will be valuable in its own right and demonstrate the value of the database project. This further involves the continued expansion of the database. The expansion of the database should incorporate more data from more unit processes as well as continuous reviews, modification and improvement of the data that is already in place.

Availability of funding and time are critical in implanting this project and for its success. It is therefore important to take reasonable approach in selecting critical necessary data instead of looking at all area and detail of even less valuable unit process. Prioritizing is therefore important in the quest for collecting original data.

Confidentiality must be taken into account where stakeholders feel it is important not to disclose confidential data and cases where data is missing or in aggregated form should be properly noted. Illustrations of the proper use of cradle-to-gate and gate-to-gate data modules in constructing full cradle-to-grave LCIs must be well documented. This includes sample calculations, process trees, metadata and any other examples that will help ensure awareness among the users of all contributing unit processes when they build their own process trees. This will be essential in avoiding careless calculations.

In the short term, funds for the database development shall be sourced from donors, private sectors and government. Mobilization of different stakeholders locally and internationally shall be done to ensure initial funding and establishment of the database.

For the long-term, sustainable business model hinged on revenue generation shall be worked out to ensure continual and sustainable revenue generation of the database. This will be coupled with the promotion of the database among different stakeholders and collaboration with different international stakeholders on different projects.

5.1 Estimated cost

Data collection and modelling is regarded as the main challenge and also the largest cost factor for LCA database development.

LCA studies and applications. Being the first time such a database is set to be developed, there still significant unknowns with regard to such a project. However, preliminary costs based on review of different existing databases in other countries have been provided.

A preliminary cost estimate range is shown in Table 3 for each of the data categories in total, with specific remarks.

For the different categories, the cost estimates shown include research, data collection, data quality documentation, and modeling. Since this budget is an estimate, more conclusions on the actual costs shall be made in the final budget towards the implementation stage.

Table 3 - Estimated Cost of the Uganda LCI Database

Item	Assumptions	Estimated cost (US$)
Training of experts	Initial experts to support data collection and data development (refer to 3.4)	100,000
Website development		20,000
Guidelines for use of database		50,000
Contingency		50,000
Expert reviews		60,000
Sub total		**180,000**
Data collection and database development		
Power, fuel and transport	Includes all types of electricity generation	150,000
Food and Agriculture	Includes the most priority areas	200,000
Building & construction	Considering different materials	100,000
Commodity chemicals & materials	Priority areas to be considered	130,000
Transformation processes		100,000
End-of-life	Includes all major waste streams and options	150,000
Sub total		**830,000**
Total		**1,010,000**

6 CONCLUSIONS AND RECOMMENDATIONS

This roadmap report provides the detailed strategy for achieving the Uganda LCA database. It highlights the importance of a broader inclusion and participation of different stakeholders as well as the quality of the database envisaged.

During the implementation of the projects, the project team shall ensure the vision, goals and objectives of the roadmap are met.

It is recommended that the project team ensures transparency in establishing the database and seek guidance for the success and sustainability of the project.

Appendix A – NDWG composition

No	Name	Institution	STATUS
1	Mr. Paul Walakira **(**Chairperson**)**	LCA Network	Project coordinator
2	Mr. Stephen Wekoye	Kyambogo University	Member
3	Mr. Herbert Murungi	NGO	Member
4	Mr. Richard Nyenje	Ministry of Agriculture	Member
5	Mr. Joseph Mary Tumanyane	Private Sector	Member
6	Mr. Edson Twinomujuni	UCPC	Chair
7	Mr. Dean Tashobya	LCA Network	IWG-representative
8	Mr. Moses Nabasa	NGO	Member
9	Ms. HawahNambasa	Makerere University	Member
10	Mr. Richard Okot	Private Sector	Member
11	Ms. Prossy Nabaggala (Secretariat)	UNBS	Member

Appendix B - NDWG meetings

1. Face-to-face NDWG meeting held on 25th January 2019
   - Discussed the Guidelines for the establishment of the Roadmap and assigned roles and responsibilities
2. Online meeting of NDWG held on 25th February 2019.
   - Discussed the progress of the roadmap establishment process in relation to the different assigned responsibilities and the project expectations.
3. Online meeting of NDWG held on 7th March 2019.
   - Discussed the intermediate report and the progress towards the targets of the final roadmap report.
4. Face-to-face meeting of NDWG held on 10th June 2019
   - The discussion was centered on the final roadmap report and the dissemination activity.

Appendix C - Stakeholder consultations

Consultations were made with the following stakeholders:

Sector	Stakeholder	Involvement	Contact established
Public	Ministry for Agriculture, Animal Industry, & Fisheries	direct	Yes, Mr. Muzira Fred, Senior Inspector
	Ministry for Water & Environment	direct	Mr. Magara Nicholas, Regional Wetlands Coordinator
	Ministry for Trade, Industry and Cooperatives	direct	Mr. Prime Blessed, Ag. Senior Industrial Officer
	Uganda industrial research institute	direct	Mr. Asuman Ratib, Senior Analyst
	National environmental management authority	direct	Ms. Nereko Patience, Principal Environment Officer
	Uganda National Bureau of Standards	direct	Ms. Nabaggala Prossy, Senior Standards Officer
	Ministry of Energy and Mineral Development	direct	Ms. Akum Justine, Energy Officer
	Ministry for Works & Transport	indirect	
	Uganda Coffee Development Authority	direct	Mr. Kiwanuka David, Manager Quality Assurance
	Kampala Capital City Authority	direct	Mr.Byangire Paul, Physical Planning Engineer
	Ministry of Finance, Planning and Economic Development	direct	Ms. Kibenge Sarah, Policy Analyst
	Uganda Cleaner Production Center	direct	Silver Sebaggala Director
Industry/private	Uganda manufactures association	direct	Mr. Ssali Godfrey, Senior Policy Analyst
	Uganda Small Scale Industries Association	indirect	
	Jabba Engineering Ltd	direct	Mr. Ernest Namanya, Environmental Officer
	Technical Committee of Environment Practitioners	indirect	
	Private Sector Foundation Uganda	direct	Ms. Ekanya Eva, Senior Projects Officer
	Uganda Institution of Professional Engineers	direct	Eng. Lameck Kajubi,
	Atacama Consulting	direct	Mr. Richard Okot,

Sector	Stakeholder	Involvement	Contact established
			Sustainability Officer
	Luwero Industries	direct	Mr. Joseph Mary Tumanyane, Projects Officer
Academia and research	Makerere university	direct	Dr. Mfitumukiza David, Senior Lecturer
	Kyambogo university	direct	Mr. Wekoye Stephen, Lecturer
	Uganda Martyrs university	direct	
	Mbarara University of Science and Technology	direct	Dr. Twongyire Ronald, Senior Lecturer
	Gulu University	direct	Dr. Opio Alfonso, Senior Lecturer
	Kabale University	indirect	
	International University of East Africa	indirect	
	Kampala International University	direct	Mr. Ssendawula Charles, Lecturer
	Management Training and Advisory Centre (MTAC)	direct	Mr. Godfrey Atuheire, Lecturer
Civil society	Uganda consumers protection association	indirect	
	National Association of Professional Environmentalists	indirect	
	Pro-biodiversity conservationists in Uganda	indirect	
	Uganda Environmental Education Foundation	indirect	
	Uganda National NGO Forum	indirect	
	Environmental Alert	indirect	
	Environmental Management for Livelihood Improvement	indirect	
	Rural Environmental Sustainability Initiative	direct	Mr. Herbert Murungi, Director
	African Institute for Energy Governance	direct	Mr. Moses Nabasa, Senior Energy Officer
	Advocates Coalition for Development and Environment (ACODE)	direct	Mr. James Muhindo, Manager Environment