

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

Deliverable D 2.4 Report on baseline assessment and stakeholder mapping in Sri Lanka

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# **1 Life cycle assessment (LCA) in Sri Lanka**

The concept of life cycle approach is fairly new to Sri Lanka but is picking up slowly but steadily. The drive towards sustainable development has acknowledged the importance of the concept, but no strong initiatives have been taken to mainstream the concept at national level. This section discusses the initiatives Sri Lanka has already taken in terms of projects, education & research, and industry applications to foster life cycle approach.

## **1.1 Introduction and Background**

The rapid increase in population and unsustainable practices of development has brought about an enormous burden on limited resources and the environment. The negative impacts of current unsustainable practices have led to new approaches towards addressing environmental issues associated with business and economic development of the country as a whole. Life cycle assessment (LCA) is a method of analyzing the environmental issues associated with a product or service of a company or of an organization throughout their life cycle or value chain.

Life cycle thinking entails adopting a holistic approach in sustainability-related decision making. It is about going beyond the traditional focus on production site and manufacturing processes to include the environmental, social, and economic impact of a product over its entire life cycle (UNEP, 2007). LCA identifies both opportunities and risks of a product or technology, all the way from raw material extraction to the final disposal of a used product and can range from a qualitative life cycle thinking to a comprehensive LCA, where overall environmental impact of a product or service is quantified. This approach prevents sub optimization and shifting of environmental burdens from one environmental medium to another and/or from one life cycle stage to another.

The promotion of life cycle thinking and LCA among the organizations in Sri Lanka is an important step to transform them from merely complying with environmental regulations to more proactive environmentally responsible entities that realize the oneness of the environment. This report presents the present level of penetration of the life cycle approach into high-level decision-making process in the public and private sector enterprises.

### **1.1.1 Capacity Building, Education and Research**

The knowledge base is the launch pad for the mainstreaming of any concept, technique or technology and capacity building is an essential first step for promoting the life cycle approach.

Several capacity building programmes have been carried out in Sri Lanka with a pioneering contribution from the National Cleaner Production Centre, Sri Lanka (NCPC-SL). This section of the report provides the details of some of the training and other capacity building programmes carried out in Sri Lanka in the areas of LCA, eco design and eco-innovations.

### **1.1.1.1 Training programmes**

#### **Life Cycle Approach**

In 2005, a national level capacity building five-day workshop on LCA was conducted for the first time in Sri Lanka by the NCPC-SL with international experts deployed by the United Nations Industrial Development Organization (UNIDO). Twenty professionals were trained including academics, consultants and industrialists and were given hands on experience on LCA software (training versions).

In 2013, again NCPC-SL conducted a national level capacity building (5 days) on LCA and eco-design. Thirty professionals including academics, researchers, industrialists and consultants were trained.

eco-innovation based on Life cycle approach training programme was organized by NCPC-SL in 2014. The event was conducted under the United Nations Environmental Programme (UNEP)-funded project on eco-innovation carried out by the NCPC-SL and participated by selected individuals from industry, academia, and government institutions. The focus of the workshop was the eco-innovation methodology and some of the trained resource persons were taken into the project at its implementation phase. During the project period (2014- 2016), NCPC-SL provided practical training to the industry representatives while eco innovation methodology was implemented in 6 companies.

In February 2015, Life Cycle Assessment for Design Sustainability Network (LCADeSNet) organised a national level capacity building on LCA & management with the support of Ministry of Mahaweli Development and Environment through Policy and Planning division in collaboration with, UNEP and Federation of Indian Chamber of Commerce & Industry. The overall objective of the series of workshop was the promotion of concepts of Life Cycle Assessment and Management as a decision making and management tool in Sri Lanka by raising the awareness and capacity building among 50 key stakeholders in the state, business, and higher education sectors. At the end of the workshop, a roadmap for promoting LCAP in the country was prepared and submitted to the Ministry of Mahaweli Development and Environment.

In September 2015, LCADeSNet organized a roundtable discussion on LCA with the participation of top officials in the government agencies that could be instrumental in promoting the use of Life Cycle Approach in organizations such as Ministry of Mahaweli Development and Environment (MoMDE), Central Environmental Authority, Sri Lanka Standard Institution, Sustainable Energy Authority, National Science Foundation, National Research Council, Coordinating Secretariat for Science, Technology and Innovation (COSTI) and officials of the LCADeSNet. The main resource person for the event was Dr Llorenç Milà Canals, Programme Officer & Science Focal Point Sustainable Lifestyles, Cities and Industry, Division of Technology, Industry and Economics, UNEP, France

- A training programme on '*Lifecycle Perspectives in ISO 14001-2015*' was conducted in March 2016 for the scientific officers of the Sri Lanka Standard Institute. The Training was conducted by the NCPC-SL with the support of the local resource persons.
- A national seminar on *Life Cycle Assessment and ISO 14001, Management Systems for Sustained Success in 21st century* was organized by the Sri Lanka Standard Institution on the 14th June 2016. About fifty management level participants from public and private sector organizations attended the event. The importance of the life cycle approach, and its application in ISO 14001, was the focus of the seminar.
- In 2017, NCPC-SL together with UNEP conducted a training of trainers (ToT) for 20 participants on life cycle inventory database development. The programme was conducted under United Nations' 10 Years Framework Programme (10YFP) Consumer Information for SCP programme. Industrialists, consultants, academics and researches were trained.
- In 2018, NCPC-SL together with UNEP conducted a training of trainers (ToT) for 25 participants on Developing Eco Label for Sri Lanka. The programme was conducted under the 10YFP Consumer Information programme. Industrialists, consultants, academics and researches were trained.

### **1.1.2 Projects**

Sri Lanka has been able to receive international assistance through different projects to implement LCA related activities. Few of the key projects are elaborated below.

### **1.1.2.1 UNEP Eco-Innovation Project (2014-2016)**

*National Cleaner Production Centre, Sri Lanka* (NCPC-SL) pioneered the implementation of eco-innovation in Sri Lanka. It has also contributed to the development of the eco-innovation methodology by participating in the initial and second expert group meetings that were held to develop UNEP's eco-innovation methodology and toolkit in 2011 and 2012, respectively. In 2013, NCPC-SL has trained some of its employees through facilitating their participation in the regional training programmes on eco-innovation.

Due to its prominent position in the field of eco-innovation in the country, the NCPC-SL received financial and technical assistance from UNEP through 1st pilot application of eco-innovation (2014-2016). This pilot project on eco-innovation was implemented in agri-food sector in Sri Lanka. This pilot project on eco-innovation was implemented in agri-food sector in Sri Lanka. Companies that produce products such as desiccated coconut, dairy, cinnamon, soy and processed fruit were selected and trained to implement eco-innovation methodology in their companies. A summary of some case studies from the selected companies are presented below.

- Asian Agro, SME from Kochchikade, used to produce desiccated coconut with high levels of waste generation and energy consumptions. Through eco-innovation, the company now produces virgin coconut oil with higher profits and export potential, while minimizing wastes and diversifying to new product lines.
- Rasoda Dairies, A dairy business previously hampered by lack of technology, low supplier productivity and high waste, has used eco-innovation to move from a production-centric business model to a partnership-oriented approach. With farmer development underpinning its eco-innovations, Rasoda has increased milk yields and energized its value chain, forming multiple supplier partnerships in the process.
- Convenience Foods, producers of vegetable protein and other foods, used the eco-innovation process to address a range of "hotspots"; including low product efficiency, high import dependency and government packaging regulations. Now the company is well on the way to, a new "green-conscious" product line using locally-sourced soy, and strong partnerships with local farmers.
- Before introducing eco innovation, U10 Ceylon Commodities & Consultants which processes and exports cinnamon from Sri Lanka's Southern province were faced with a range of problems such as low product quality, high wastages, demotivated workforce and a series of environmental issues. Because of eco-innovation, the company is now introducing multiple

solutions including sustainable business practices, product diversification and eco-tourism to promote the brand.

- Jachufi Fruit-Based Industry, a specialist in fruit processing, used a range of tools including life cycle thinking to develop a new business model and became a fruit pulp supplier for bigger brands. The company plans to be a distributor of pulp and juice to customers adopting a service-oriented business model

#### **1.1.2.2 SWITCH-Asia Sustainable Consumption and Production (SCP) National Policy Support Component for Sri Lanka (2015-2019)**

The overall objective of the project is to support the Sri Lankan Government in selecting, adapting and implementing suitable economic and regulatory policy instruments to promote SCP, thereby enhancing the long-term sustainability of consumption and production patterns. The project functions under the Ministry of Mahaweli Development & Environment (MoMDE). This project is funded by the European Union.

#### **1.1.2.3 UN 10 Years Framework Programme (10YFP) Consumer Information for Sustainable Consumption and Production ( SCP ) (2017-2019)**

With the successful completion of the aforementioned UNEP-funded eco-innovation project, NCPCL-SL managed to secure funding from the UN 10YFP's Consumer Information Programme to implement a project on "*Promoting SCP in Sri Lanka through facilitating accessibility to information*". The project focuses on creating synergies among eco-innovation, life cycle thinking, green public procurement (GPP) and other SCP concepts. Major activities of the project are;

- Developing a **national Life Cycle Inventory (LCI) database** for agri-food (rice, tea, and dairy processing industries)
- Developing a **green product certification scheme for a selected dairy product category and assisting two companies to adopt eco-innovation** (potential/eventual replication)
- Assessing and increasing consumer awareness on sustainability issues, use of information and available green product certification.

## **1.2 LCA in industry and the private sector**

There is a considerable increase in the usage of LCA-related tools in industries, especially the LCA for evaluating environmental performance of their products (i.e., product LCAs). Full scale LCA of products such as tea, fabric dye and rubber gloves have been carried out by several companies in Sri Lanka. These assessments have been either carried out by private sector service providing organizations or academics.

In addition, single impact category LCAs have been carried out to assess impact of these products on global warming or water usage. Table 1 summarizes key organizations which have carried out LCA of some of their products and the service providing organizations that have conducted the LCA. It is noteworthy that all the industries given in the table produce the products for export market. Three Sri Lankan tea producing companies have been certified as carbon neutral companies. However, the organizational carbon footprint calculation methodology does not take a life cycle perspective and only Sri Lankan product that has been certified as a carbon neutral is a bra manufactured by MAS Intimate. This, in fact, is world's first carbon neutral bra and has been given a huge publicity by the product retailer M&S.

Apart from the carbon footprint, the other impact assessment widely done is the water footprint of products or organizations. The Sri Lanka products for which the water footprint have been calculated include tea sachet, desiccated coconut, fabrics and some rubber products.

**Table 1: Some of the LCA studies carried out in Sri Lanka**

Service provider	Industry	LCA approach
NCPC-SL	Fabric dye	LCA
	Textile	Water Footprint calculation, Product Carbon Footprint
	Tea	Product Carbon Footprint
	Food Processing	Water Footprint Carbon Footprint Calculation
	Rubber	Water Footprint Carbon Footprint Calculation
	Tourism sector (Hotels)	Carbon Footprint Calculation Water Footprint
Carbon Consultancy Company	Tea	Product Carbon Footprint
	Apparel	Product Carbon Footprint
	Rubber	Product Carbon Footprint
	Bottling (water)	Product Carbon Footprint
Leiden University	Rubber Gloves	Social Life Cycle Assessment

### 1.3 LCA in regulations and public policy

The EU-funded project on Switch Asia National Policy Support Component has developed a National SCP Policy for the country. An overarching national policy in Sri Lanka on SCP, which is coherent and integrated with related sectoral policies, is the need of the hour for achieving the desired goal of economic and sustainable development. (<http://mmde.gov.lk:National Policy on Sustainable Consumption & Production for Sri Lanka>)

The policies related to a life cycle approach are summarized in the sections below.

#### 1.3.1 Science and Technology Policy

##### Policy Principle

Science & Technology (S&T; and Research and Development, R&D) based on Life-Cycle Thinking recognised as precondition for sustainable development

## **Policy Statements**

1. Create an enabling innovation culture on SCP among all sectors
2. Develop and promote appropriate resource efficient technologies (eco-innovation / environmentally sound technologies) relevant for different sectors ensuring sustainable consumption & production of goods & services
3. Ensure S&T achievements on SCP readily accessible to industries and the public
4. Encourage technology transfer, application of resource efficient technologies for commercialization through Public Private Partnerships (PPP)
5. Document, publish and promote science based-evidence to foster indigenous knowledge on SCP in all sectors
6. Develop knowledge base for Life Cycling Thinking and apply LCA to promote clean and safer products over the value and supply chains
7. Provide technical guidance for retailers, consumers and producers for behavioural and life style changes ensuring improvements in use efficiency
8. Ensure quality assurance of green products and services
9. Provide technical evidence, education and awareness on SCP best practices to motivate consumers to make attitudinal, behavioural and life style changes towards sustainability
10. Apply ICT for technology banks, awareness, promotion and networking of all sectors

## **Policy Goals**

1. Streamlining of life cycle approach to industries facilitated
2. SCP principles incorporated into product design processes
3. Mechanism to share science & technology achievements with industries established
4. Green label standards introduced to industries, retailers and consumers
5. Methodologies introduced for resource pricing
6. Methodologies introduced to value biodiversity and eco-system services
7. ICT enabled technology banks established and networking introduced
8. Key Performance Indicators (KPI) established to evaluate progress achieving SCP
9. National scheme to value and recognize SCP achievements, with progressing levels (bronze-silver-gold)

### **1.3.2 Public Procurement Policy**

#### **Policy Principles**

Sustainable Public Procurement properly understood and applied

### **Policy Statements**

1. Build capacity and empower public sector establishments on Sustainable Public Procurement (SPP)
2. Apply Sustainable Public Procurement Practices (SPP) in all relevant sectors and for each product that have a significant impact

### **Policy Goals**

1. Administrative and legislative framework established for the promotion of Sustainable Public Procurement (SPP) in relevant sectors before 2020.
2. Life cycle databases for key product categories with significant environmental impact either created or updated by 2025.
3. Implementation of SPP ensured at least in 5 major product categories, in relevant sectors that have a significant impact, before 2020, at least 50% of product categories by 2030.

## **1.4 LCA in research and academia**

### **1.4.1 Life Cycle Approach in University Curricula**

Majority of universities in Sri Lanka teaches sustainability related subjects and life cycle approach/assessment related topics are covered to a varying degree of extent in some degree programmes. While some takes the subject as a part of the course, some programmes sensitize the students on these concepts so that they can best contribute in a multi-disciplinary team. Table 2 indicates some of the Undergraduate programmes that have LCA in the curriculum.

**Table 2: Degree Programmes related to Life Cycle Approach**

University	Degree Programme	Level	Nr of credits	Coverage	Average number of students per batch	Lecturers	Software being used
University of Colombo	Bachelor of Business Administration	3 <sup>rd</sup> year	2 Optional Course	Provide an introduction to LCA concept under the subject "Environment Management"	200	Ms. Sashya Herath	No technical aspects are covered.
		4 <sup>th</sup> Year	2 Optional Course	Provide an introduction to LCT concept under the subject "Supply chain Management"	100		No technical aspects are covered.
			3	An introduction to the concept of LCT under the subject Operational Management	50	Mr. Chandana Wijekoon	No technical aspects are covered.
	Masters of Environment Management	2 <sup>nd</sup> Year	3	Under the subject Environment and Industry Resources, technical aspects of LCA, LCT is discussed.	40	Dr. Sampath Wahala	Until now no software is being used.
University of Sri Jayawardenapura	Postgraduate certificate in Corporate Environment			An introduction, why LCA?, few applications,	5	Chalaka Fernando Dr. Randika Jayasinghe	No software is used
University of Kelaniya	B. Sc in Environment Conservation and Management	3 <sup>rd</sup> Year	3	Under the subject Env. Management Systems and Green Technologies	50	Dr. Priyantha Epa Dr. Rangika Bandara	Till now no software is being used due to unavailability
University of Moratuwa	Chemical and Process Engineering	4 <sup>th</sup> year	4	Under the module Clean Technology	80	Dr Manisha Gunasekara	No software is used
	Masters of Environmental Engineering and Management			Course component – Env. Management: an introduction, why LCA, wider applications,	~40	Mr. Chalaka Fernando	Few examples being explained through GaBi, no modelling done.

University	Degree Programme	Level	Nr of credits	Coverage	Average number of students per batch	Lecturers	Software being used
University of Peradeniya	Chemical and Process Engineering M. Sc in Sustainable Built Environment	3 <sup>rd</sup> year		Under the module Environmental Management	25		
	BSc. Production Engineering		3	Under the subject sustainable manufacturing, LCA concept is discussed	40	Mr. Jagathdeva Vidanagama	Until now no software is being used.
University of Ruhuna	Bachelor of Science in Green Technology	4 <sup>th</sup> year	2	Life Cycle Assessment	50		
University of Sabaragamuwa	BSc. Honours in Eco-business Management	3 <sup>rd</sup> year	3	Industrial Ecology	60	Dr. Sampath Wahala	Open LCA, SimaPro faculty version
		4 <sup>th</sup> year	2	Creativity and innovations management			
		4 <sup>th</sup> year	3	Modelling eco business			
	B.Sc in Environmental Sciences and Natural Resource Management	3 <sup>rd</sup> year	2	Cleaner Production and Green Productivity	60	Ms. Upendra Arjeewani Weerathunga	Do not use software.
Open University of Sri Lanka	M. Sc in Environment Science	2 <sup>nd</sup> year	Optional course	Under the subject Cleaner Production	15	Eng. Sena Peiris Ms. Iresha Gurusinghe	Do not use software. s

## 1.4.2 Research for Life Cycle Approach

Although the application of life cycle is at a very low level, there are several research groups in Sri Lanka that engage in LCA-related research. The main emphasis of the research carried out by these groups are on the life cycle environmental impacts of selected products. The impact categories covered under these studies vary from a single category such as climate change to multiple impact categories. Some of the products include wooden furniture (Senadeera, 2017), Tea (ongoing, Vidanagama, Wahala), Desiccated Coconut dairy products (Karunaratne et al., 2015, PET bottles (Ekanayake , 2010), brass and roofing products (Kulathunga et al), fabric dyes (Danthurebandara et al), cements (Fernando et al), garment products (Whala et al), In addition, LCA on application of biochar as a soil amendment has been carried out a team of researchers in University of Peradeniya. Most of the cases, the research groups are led by academics, who have been trained under different capacity building programmes carried out in Sri Lanka or those who have done postgraduate degrees in the areas of LCA. (Source: the report on *Introducing Eco Innovation and Lifecycle approach in Selected Manufacturing Sector*: <http://mmde.gov.lk>)

There have been several research conferences held in Sri Lanka where LCAP related research findings were presented. Table 3 summarizes some of these conferences.

**Table 3:Conferences where some LCA research were presented**

<b>Conference</b>	<b>Year</b>	<b>Institute/ Organization</b>
2 <sup>nd</sup> Sri Lanka Roundtable on Sustainable Consumption and Production	2012	NCPCSL
International Conference on Sustainable Built Environment (ICSBE)	2017	University of Peradeniya

## 2 National LCA Data

According to the present trend, more and more environmental decisions will be taken based on the life cycle approach and the accuracy of the conclusions made by the LCA will depend on the relevance and the accuracy of data used in the analysis. At present, most of the LCA done in Sri Lanka are based on the databases available in the software used and they do not have Sri Lankan data. As such, the conclusions drawn could be misleading. Therefore, measures should be taken to develop life cycle inventory (LCI) databases at least for the commonly needed data categories such as the most important economic sectors in the country. They include data related to electricity generation, transportation, agriculture and common utilities such as water and fuel. Once these datasets are available, focus can be turned to commonly used products such as building materials. However, the quality assurance of methodologies used for generating these databases are very important to establish the credibility and should follow internationally accepted procedures.

The establishment of these databases require a considerable effort and coordination which can be best done with some form of intervention from the government agencies. One way to do this is to use existing mechanisms and such as the carrying out of national energy balance and implementation of environmental protection license scheme. The additional requirements should be identified and the relevant agencies should be strengthened or their activities can be guided by experts in the field of LCA. For this purpose, the assistance of the established professional bodies and organizations such as National Cleaner Production Center, Sri Lanka (NCPC-SL) and also Life Cycle Assessment and Design for Sustainability Network (LCADeSNet) can be obtained.

The other way is to conduct a national level project to produce these databases and come up with a mechanism for their proper management that ensure the required data is acquired, validated, stored, protected, and processed so that its reliability, and timeliness is guaranteed to satisfy the needs of the data users. One of the critical issues in this aspect is to recognize suitable organizations that have the capacity to carry out such demanding tasks. Ensuring compatibility of databases with the commercial LCA software is also important so that LCA practitioners can easily use the data. Due to complexity of this entire process of database generation and management, it is recommended that a comprehensive planning is done to identify the best mechanism to develop national databases. The planning should prioritize the data, identify institutional framework for database management and mechanism to generate and maintain national life cycle inventory datasets.

## 2.1 Capacity for collection and management of LCA data

NCPC SL has conducted a two-day Training of Trainer (ToT) programme on LCI Data base development on June 26<sup>th</sup> and 27<sup>th</sup>, 2017 in Colombo under the project on UN 10YFP's Consumer Information Programme to implement a project on "Promoting SCP in Sri Lanka through facilitating accessibility to information". Selected 20 LCA practitioners from private, government and other institution in Sri Lanka were trained by international resource persons from Green Delta and ecoinvent. Twenty participants were then joined hands with NCPC in developing LCI database for agri food sector and a Green product criterion based on the data for a selected agri food product.

**Trainers:** Amir Safaei, ecoinvent Association and Andreas Citroth, GreenDelta

**Dates:** 26<sup>th</sup> and 27<sup>th</sup> June 2017

One of the activities of the project is to develop a Life Cycle Inventory (LCI) Database for selected products of agri-food sector in Sri Lanka. Understanding the need for knowledge on the particular subject, NCPC planned to conduct a Training of Trainers (ToT) programme for NCPC staff and selected LCA practitioners in the country.

Accordingly, 20 participants successfully completed 2 full days ToT.

**Table 4: Participants of the LCI ToT**

<b>NCPC</b>	<b>Designation</b>	<b>Organization</b>
Eng. Samantha Kumarasena	Chief Executive Officer	National Cleaner Production Centre
Ms. Upendra Arjeewani	RECP Expert	National Cleaner Production Centre
Eng. Lakmini Edirisinghe	Senior RECP Expert	National Cleaner Production Centre
Ms. Iresha Gurusinghe	Senior RECP Expert	National Cleaner Production Centre
Eng. Ruwan Wijemanna	Energy Engineer	National Cleaner Production Centre
<b>External</b>	<b>Designation</b>	<b>Organization</b>
Ms. Sachira Vilochani	RECP Expert	National Cleaner Production Centre
Ms. Uthpala Sankalpani	RECP Expert	National Cleaner Production Centre
Mr. Tharindu Maddumage	RECP Technologist	National Cleaner Production Centre
Mr. M.M.Munsif	RECP Technologist	National Cleaner Production Centre
Dr. Asela Kulathunga	Senior Lecturer	University of Peradeniya
Dr. Parakrama Karunaratne	Senior Lecturer	University of Peradeniya
Dr. Sampath Wahala	Senior Lecturer	University of Sabaragamuwa
Mr. Chalaka Fernando	General Manager- Sustainability	MAS Fabrics Pvt Ltd

External	Designation	Organization
Dr. U P K Epa	Senior Lecturer	University of Kelaniya
Dr. Erandathie Lokupitiya	Senior Lecturer	University of Colombo
Dr. Shiromi Karunaratne	Senior Lecturer	Sri Lanka Institute of Information Technology
Mr. Jagathdeva Vidanagama	Phd Student	University of Colombo
Mr. H.M.M.M. Jayawickrama	Mphil student	University of Peradeniya
Ms. Nilanka Weerasinghe	Temporary Demonstrator	The Open University of Sri Lanka
Mr. Rajitha Peiris	Mphil student	University of Peradeniya



**Figure 1: Participants of the ToT on LCI Data Base Development**

Training covered the topics

- Primary raw data acquisition
- Process modeling for primary datasets
- Secondary data acquisition
- Process modeling for secondary datasets
- National dataset development by adjustment
- Process datasets for Sri Lanka
- Datasets in databases including use of MS Excel and Linking databases and LCA software including exchange formats and import functionality

Lectures, group work and discussions were taken place during the ToT

## 2.2 LCA data collection and availability

NCPC SL has developed a national life cycle inventory dataset for agri food sector Sri Lanka under project of UN 10YFP's Consumer Information Programme to implement a project on *"Promoting SCP in Sri Lanka through facilitating accessibility to information"*.

SCP can play an important role to change current unsustainable practices in Sri Lanka's agriculture and food sector. Agriculture in Sri Lanka, utilizing 43% of the total land area of the country, is one of the key environmental concerns; having a tremendous impact on various issues, from climate change to soil deterioration. The lack of awareness on sustainable produce among consumers, the lack of standards, limited certification systems at affordable prices and the lack of third-party verification have so far hindered the switch to environmentally sustainable and healthy practices in the agriculture sector. Progress towards environmentally sustainable agri-food systems in Sri Lanka requires improving the methods for quantitative, integrated assessment, and promoting the use of these methods in different domains. But the shortage of data has restricted Sri Lanka in its analysis of a number of food-related challenges and to advance the currently available approaches and methods. The project aims to develop a Life Cycle Inventory (LCI) database for dairy, tea and rice processing sub sectors in Sri Lanka. This work has been carried out in several phases. Initially, secondary information related to these agri-food sectors have been referred and data collection sample frames have been developed based on them.

Next, life cycle inventory data collection questionnaire has been developed in parallel to the pilot survey. Subsequently, the LCI questionnaires were referred to LCA expert's in order to get their feedbacks and suggestions followed by enumerators training in order to collect data from the field. A detailed field survey was carried out for 50 tea leaf processing factories 50 rice processing mills, and 15 dairy processing factories. Selection of enumerators, selection of data collection points (factories/mills, plants), coordination of enumerators was undertaken by NCPC Sri Lanka where they have born the total responsibility of conducting detail survey and to produce field data for LCI preparation. Once data were collected, they were verified by the Manufacturing/process Engineers who were having sound knowledge on three processes and LCA methodology. Based on this verification, further scanning and refining of data were done by contacting enumerators and developed the data verification summarize for three agri-food sectors. Subsequently, life Cycle Inventories were prepared for three agri-food sectors. The LCI's were prepared based on the ecoinvent guidelines which consist of pedigree matrices as well.

## **2.3 Preceding National LCA database initiatives**

National Cleaner Production Centre, Sri Lanka is preceding the national LCA data base initiatives by developing national LCA roadmap for the country and further development of the Technical Helpdesk for National LCA Databases through the implementation of the UNEP funded LCA road map development project.

### 3 Stakeholder Mapping

Without stakeholders, there would be no projects to manage. The stakeholders are all the interested parties in this project - the people who affect and influence the project, as well as those who will be influenced by it. Focusing on development of LCA roadmap project, it's critical to do a stakeholder analysis and mapping exercise. This will help to identify the key stakeholders in this field, as well as the types of input they require, what kind of communication they might need and more.

Accordingly, the stakeholder mapping done and it was based on three types of stakeholders including;

- Key stakeholders: those with significant influence upon or importance within an organization; can also belong to the other groups.
- Secondary stakeholders: the "intermediaries," that is, persons or organizations who are indirectly affected by an organization's actions
- Tertiary stakeholders: those who will be impacted the least

#### 3.1 Stakeholder groups

Table 5: Stakeholder Identification

Stakeholder Type	Stakeholder group			
	<i>Public sector</i>	<i>Industry and the private sector</i>	<i>Academia and research</i>	<i>Civil society and others</i>
Key stakeholders	National Cleaner Production Centre, Sri Lanka	MAS Holdings	University of Moratuwa	LCADeSNet Sri Lanka
	Ministry of Mahaweli Development and Environment (MoMDE)	INSEE/Siam City Cement	University of Peradeniya	Wijaya Newspapers Pvt Ltd
	Sri Lanka Sustainable Energy Authority		University of Colombo	Bio diversity Sri Lanka
	Sri Lanka Standard Institution (SLSI)	Eswaran Brothers Exports (Pvt) Ltd	University of Sabaragamuwa	
	Department of Census and statistics	Dynawash Pvt Ltd	University of Sri Jayawardenapura	

	<b>Stakeholder group</b>			
<b>Stakeholder Type</b>	<b><i>Public sector</i></b>	<b><i>Industry and the private sector</i></b>	<b><i>Academia and research</i></b>	<b><i>Civil society and others</i></b>
	Ceylon Chamber of Commerce	Certification Body – Control Union Pvt Ltd	University of Ruhuna	
	Ministry of Industry and Commerce		University of Kelaniya	
	Industrial Development Board		Sri Lanka Institute of Information Technology	
	Export Development Board			
	Research Institutes (Tea,Rubber,Coconut)			
<b>Secondary stakeholders</b>	Consumer Affairs Authority	Unilever Sri Lanka Limited		Sri Lanka dairy Association
	Ministry of Power and Energy			Planters Association, Sri Lanka
	Ministry of Sustainable Development Wildlife and regional development			
	Ministry of Primary Industries			
<b>tertiary stakeholders</b> (those who will be impacted the least)				

### **3.2 Organization of the national LCA community**

In 2013, NCPC-SL established Life Cycle Analysis and Design for Sustainability Network (LCADeSNet), Sri Lanka to popularize LCA concept in the country. Currently this organization is functioning actively with the membership of most of the LCA practitioners in the country

### **3.3 International connections and collaborations**

Sri Lanka is closely working with Life Cycle Initiatives at United Nation Environment Programme. Also, we are working with Federation of Indian Chambers of Commerce & Industry, India for organizing LCA awareness programmes in Sri Lanka.

## 4 Conclusions and Recommendations

In an ideal situation, where the concept of LCA is fully embraced in society, this concept would be widely applied, from products over organizations to the government level, to drive sustainability. In order for us to move from the present status to such a society a carefully planned set of actions must be taken from various fronts. The success of the implementation of LCA depends on the suitable framework/roadmap in place to embed these concepts to decision making process at government and institutional levels in Sri Lanka.

According to the present trend, more and more environmental decisions will be taken based on the life cycle approach and the accuracy of the conclusions made by the LCA will depend on the relevance and the accuracy of data used in the analysis. At present, most of the LCA done in Sri Lanka are based on the databases available in the software used and they do not have Sri Lankan data. Therefore, measures should be taken to develop life cycle inventory (LCI) databases at least for the commonly needed data categories.

Accordingly, NCPC-SL is planning to develop a national LCA roadmap for the country with the support of UN Environment. The desired final outcome of this project will be developed a national LCA database roadmaps for the country and to further develop the *Technical Helpdesk for National LCA Database*. According to the stake holder mapping done, we have identified relevant public/government, industries/private, academic/Research and other interested parties to functioning LCA in the country. This will happen through the formation of *National Database Working Group (NDWG)* by public and private sector representation.

According to the results of the stakeholder mapping, below list of individuals/organizations are committed to contributing to the National Database working Group (NDWG). The members of the database project working group represent the following government and private institutes (*refer annex 2*).

- Ministry of Mahaweli Development and Environment
- Life Cycle Analysis and Design for sustainability Network (LCADeSNet)
- Central Environmental Authority
- Ministry of Industry and Commerce
- Coordinating Secretariat for Science Technology and Innovation
- Ministry of Industry and Commerce
- Universities

- Industrial Chambers
- Representatives from leading industries

## 5 References and Resources

- *UNEP 2007, Life Cycle Management-A Business Guide to Sustainability*
- *<https://www.switch-asia.eu/policy-support-component>*
- *EUROPEAN COMMISSION 2006b. Competitiveness and Innovation Framework Programme 2007-2013. 1639/2006/EC. OJ L 310/15: OJ L 310/15.*
- *JAMES, P. 1997. The Sustainability Circle: a new tool for product development and design. Journal of Sustainable Product Design, 1(2), 52-57.*
- *<http://mmde.gov.lk>:National Policy on Sustainable Consumption & Production for Sri Lanka*
- *The report on Introducing Eco Innovation and Lifecycle approach in Selected Manufacturing Sector: <http://mmde.gov.lk>*
- *K.C.A Fernando, Life cycle assessment (LCA) analysis towards a sustainable cement industry for Sri Lanka : an analysis of three process pathways URL; <http://dl.lib.mrt.ac.lk/handle/123/2057>*

## 6 Appendix A - List of Stakeholders

Sector	Stakeholder	Involvement	Contact established
Public	National Cleaner Production Centre	Direct	Eng. Samantha Kumarasena Chief Executive Officer
	Ministry of Environment and Mahaweli Development	Direct	Yes, Ms. Dammika Wijayasinghe Director -Environment planning and economics
	Central Environment Authority	Direct	Yes Mr. Muthukuda Arachchi Deputy Director General
	Sri Lanka Standard Institution (SLSI)	Direct	Yes Ms. Samanthi Narangoda – Director Certification
	Sri Lanka Sustainable Energy Authority	Direct	No
	Department of Census and statistics	Direct	No
	Ceylon Chamber of Commerce	Direct	No
	Ministry of Industry and Commerce	Direct	Yes, Mr. Asitha Seneviratne, Consultant
	Industrial Development Board	Direct	No
	Export Development Board	Direct	No
	Research Institutes (Tea,Rubber,Coconut)	Direct	No
	Consumer Affairs Authority	Direct	Yes, Ms. Shakila,, Additional Director
	Ministry of Power and Energy	Indirect	No
	Ministry of Sustainable Development Wildlife and regional development	Indirect	No
Industry/private	MAS Holdings	Direct	Yes Eranga Dilhan General Manager-Sustainability
	INSEE/Siam City Cement	Direct	Yes Arosha Hemali Business Development Officer
	Eswaran Brothers Exports (Pvt) Ltd	Direct	Yes Dr. Lakmini Senadeera,Lecturer

Sector	Stakeholder	Involvement	Contact established
	Dynawash Pvt Ltd	Direct	Yes Mr. Shahid Dangani Managing Director
	Certification Body – Control Union Pvt Ltd	Direct	Yes Chathuranga Deshapriya, Programme Manager
	Unilever Sri Lanka Limited	Indirect	Yes Anushka Kumarasinghe Manager-Corporate Safety, Health & Environment
<b>Academia and research</b>	University of Moratuwa	Direct	Yes Prof. Ajith De Alwis Prof. Jagath Premachandra
	University of Peradeniya	Direct	Yes Prof. Parakrama Karunaratne, Senior Lecturer Dr Asela Kulathunga, Senior Lecturer
	University of Colombo	Direct	Yes Dr. Erandathej Lokupitiya, Senior Lecture
	University of Sabaragamuwa	Direct	Yes Dr Sampath Wahala Senior Lecturer
	University of Sri Jayawardenapura	Direct	Yes Dr. Suraji Senanayaka Senior Lecturer
	University of Ruhuna	Indirect	No
	University of Kelaniya	Direct	Yes Dr. U P K Epa, Senior Lecturer
	Sri Lanka Institute of Information Technology	Direct	Yes Dr. Shiromi, Senior Lecturer
<b>Organization</b>	Life cycle and Design for Sustainability, Sri Lanka	Direct	Yes Prof. Parakrama Karunaratne, President
	Biodiversity Sri Lanka	Indirect	No
	Wijaya Newspapers Pvt Ltd	Indirect	Yes Janaka Rathnakumara, Assistant General Manager
	Sri Lanka dairy Association	Indirect	Yes Dr. Nelum Withana, Manager Cooperate
	Planters Association, Sri Lanka	Indirect	Yes Mr. Lalith Obesekara, Secretary general

## 7 Appendix B - Stakeholder Engagements

Stakeholder Organization	Reason to include	Commitment for the project
National Cleaner Production Centre, Sri Lanka	The main organization which is promoting LCA in the country,	project implementation partner of the LCA road map project in Sri Lanka
Ministry of Mahaweli Development and Environment (MoMDE)	The Ministry of Mahaweli Development and Environment is the cabinet ministry of the Government of Sri Lanka with oversight of the environment and the Mahaweli Development programme	Members of the board of directors of NCPC SL. Accordingly they are committed to support in this process
Sri Lanka Sustainable Energy Authority	The Sri Lanka Sustainable Energy Authority is the primary body responsible for the issuance of licenses for sustainable energy developments in Sri Lanka. In addition to being the key licence provider, it is also the organization responsible for promoting renewable energy and sustainable developments in the country	Members of the board of directors of NCPC SL. Accordingly they are committed to support in this process
Central Environment Authority (CEA)	Environment regulatory body of the Country	Supportive letter for the project has given by CEA
Life Cycle Analysis and Design for sustainability Network (LCADeSNet)	LCA network in the country	Supportive letter for the project given by the president. Accordingly, members of the network will be committed to support the roadmap development process
Coordinating Secretariat for Science Technology and Innovation (COSTI)	LCA Practitioners, Reserchers, etc	Through membership LCADeSNet and Board of directors of NCPCSL
Ceylon Chamber of Commerce	The Ceylon Chamber of Commerce is the oldest and one of leading business chambers in Sri Lanka. It is a confederation of trade associations, regional- and sectoral chambers of commerce and industry, business councils and employer organisations in the country.	Waiting for commitment letter
Ministry of Industry and Commerce	Ministry which is control the industries of the country	Members of the board of directors of NCPC SL. Accordingly they are committed to support in this process
Industrial Development Board	Government institute which is control the SME's	waiting
MAS Holdings	LCA Practitioners, Reserchers, etc	Through LCADeSNet
INSEE/Siam City Cement	LCA Practitioners, Reserchers, etc	Supportive letter has given by this company
Eswaran Brothers Exports (Pvt) Ltd	LCA Practitioners, Reserchers, etc	Through LCADeSNet
Dynawash Pvt Ltd	LCA Practitioners, Reserchers, etc	NCPC has conducted LCA for their products. through that their committed to join with the project
Certification Body – Control Union Pvt Ltd	Certifying Product carbon footprints	Waiting commitment letter
Universities (University of Moratuwa, University of Colombo, University of Kelaniya, University of	Members of the LCADeSNet	Supportive letter received from university of Moratuwa and also through LCADeSNet

Stakeholder Organization	Reason to include	Commitment for the project
Sabaragamuwa, University of Sri Jayawardenapura, etc		Also, members of the board of directors of NCPC SL. Accordingly they are committed to support in this process