REQUIREMENTS FOR THE DEVELOPMENT OF A STANDARD AND CERTIFICATION SYSTEM FOR SUSTAINABLE FUEL WOOD TRADE IN SRI LANKA

K. J. Sirikumara

(148366 C)

Degree of Master of Engineering in Energy Technology

Department of Mechanical Engineering

University of Moratuwa
Sri Lanka

November 2018

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Kulasekara Jayantha Sirikumara

(148366 C)

A dissertation submitted in partial fulfilment of the requirements for the Degree of Master of Engineering in Energy Technology

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DECLARATION

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ABSTRACT

A standard and certification system for sustainable fuel wood trade suitable for local context is presented. The situation analysis of fuel wood trade in Sri Lanka emphasize on the need for the development of such standard and certification system as the present supply chain system is not sustainable at large and there is an increasing demand particularly in the industrial thermal energy application due to fuel switching and an emerging demand as a source of electricity generation. Development of standard and certification system for sustainable biomass and biofuel including fuel wood has been undertaken by several developed countries such as Netherland, United Kingdom and Germany and international organization such as International Organization for Standardization (ISO), International Energy Agency Bio-energy task 40 and Global bio-energy partnership. Usually these systems comprises of set of principles, criteria and indicators covering sustainability aspect, which are dependent on country to country and therefore need to adopt to the local context with appropriate changes.

The information collected through literature survey and consultation of foreign experts in the field was used to identify 8 principles that are considered to be relevant to local context. In order to establish locally relevant and acceptable standard and certification system for sustainable fuel wood, key stake holders who are involved in Sri Lankan biomass industry were consulted. The output of the consultation process is based on the principle of consensus distillation of successful thinking and expert judgment. Accordingly, 5 principles namely legal and regularity compliance, environment values and impact, benefit to the community, group support and chain of custody (traceability) from the standing-tree to the farm-gate have been established as those relevant to Sri Lanka. Further 11 criteria and 42 indicators were identified under the five principles, covering social, economic and environmental aspects. Further a set of verifiers for each indicator is proposed.

The validation of the proposed standard and certification system for sustainable fuel wood trade was done through field testing in a Community Based Organization

(CBO) covering home garden and small plantation. In order to facilitate the enforcement of the certification system, a cell matrix was designed which could identify the applicability or non-applicability of indicators on supply chain. Further comprehensive procedure manual was developed for the conformity assessment of the fuel wood certification system. The proposed certification system comprises of 8 steps namely pre-assessment, fuel wood producer's preparation, document review, on-site evaluation, reporting, certification, surveillance and re-certification. The last two steps reflect the continuity and reassurance of the established system. It is concluded that the principles, criteria and indicators identified in the standard and certification system could ensure that fuel wood sector contribute to the economic development while ensuring sustainability. It is recommended to test the proposed indicators via application to a divers set of sample cases (large plantation) will help to evaluate the availability of necessary data, prioritize data and methodological efforts, and generate ideas for improvement.

Key words:

Renewable energy, Standards and Certification, Sustainable fuel wood, Sustainability indicator

ACKNOWLEDGEMENT

I have taken lot of efforts to complete this project. However, it would not have been possible without the kind support and help of many individuals and organizations. I would like to extend my sincere thanks to all of them. I am highly thankful to the University of Moratuwa for the continuing support and the facilities provided to me. First and foremost, the author expresses his sincere and heartfelt gratitude to Eng. Dr A G T Sugathapala for igniting the idea of doing a thesis on "Requirements for the development of a standard and certification system for sustainable fuel wood trade in Sri Lanka" and for being the project advisor. His stimulating suggestions, kind guidance and encouragement, helped me not only to complete this project but also to compose the report. It was a golden opportunity for me to turn my theoretical knowledge gained through the MEng in Energy Technology into reality associating and supervision with Eng M M R Pathmasiri, Director General of SLSEA and I would like to take this opportunity to extend my sincere thanks to him. I would also like to thank Professor R.A. Attalage and Professor K.K.C.K. Perera for their support and instructions at the initial stage of this research project.

My heartfelt gratefulness goes to Dr. Himan K.G. Punchihewa, course coordinator MEng in Energy Technology, who gave his maximum support and the respectable guidance throughout the thesis. I am extremely grateful to my employer, Sri Lanka Standards Institution (SLSI), for offering me the sponsorship for the degree of Master of Engineering in Energy Technology. Also, I would like to acknowledge the assistance provided by ISO/TC 248 sustainability criteria for bioenergy experts around the world and experts on technical advisory committee on Biomass in SLSI. The authors would like to thank KMRI SMG Asset Company on granting permission to conduct the field test on established PCI in a small sample of the CBO which are participating in their gliricidia plantation program in the Mirigama-Kegalle-Kurunegala area. Furthermore, I would also like to acknowledge with much appreciation the support and continuous encouragement and patience given by my family members during the period. At last but not least, my thanks and appreciations also go to my colleague in developing the thesis project and people who have willingly helped me out with their abilities.

K J Sirikumara

jayanthasirikumara@gmail.com or kulasekara2005@yahoo.com

2018

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LIST OF ABBRIVATIONS

Abbreviation	Description
ADB	Asian Development Bank
ANP	National Agency for Petroleum
ARENA	Australian Renewable Energy Agency
BECS	Biomass Energy Conversion Systems
BP	British Petroleum
CAR	Corrective Action Report
CB	Certification Body
CBD	Convention on Biological Diversity
CBO	Community Based Organization
CDA	Coconut Development Authority
CEN	European Committee for Standardization
CH	Certificate Holder
CSD	Commission on Sustainable Development
COC	Chain of Custody
DC	Desiccated coconut
DG	Development Group
EC	European Commission
EU	European Union
EIA	Environment Impact Assessment

EO	Economic Operator
FAO	Food and Agriculture Organization
FSC	Forest Stewardship Council
FMU	Forest Management Units
GDP	Gross Domestic Product
GHG	Green House Gas
GMO	Genetically Modified Organism
GSMB	Geological Survey and Mines Bureau
IBEP	International Bioenergy Platform
IEA	International Energy Agency
ILO	International Labour Organization
ILUC	Indirect Land used Change
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organization for Standardization
LCA	Life Cycle Analysis
LPG	Liquid Petroleum Gas
LRS	Long Rotational Species
LRC	Long term Rotation Crop
MDF	Medium Density Fibre
MS	Member State
MSL	Mean Sea Level

NCVA	Non Conformance Verification Audit
NGO	Non-Governmental Organization
NMC	National mirror committee
NTA	Netherland Technical Agreement
NTFP	Non-timber forest plantation
PCI	Principle Criteria and Indicators
PMU	Plantation Management Units
RED	Renewable Energy Directive
RSB	Roundtable on Sustainable Biofuels
RSPO	Roundtable on Sustainable Palm Oil
RTFO	Renewable Transport Fuel Obligation Programme
RTRS	Round Table on Responsible Soy
SAN	Sustainable Agriculture Network
SEA	Sustainable Energy Authority
SFWC	Sustainable Fuel Wood Certification
SLSI	Sri Lanka Standards Institution
SRC	Short Rotation Crops
SMI	Small and medium Industries
SRCS	Short Rotational Crop Species
TPES	Total Primary Energy Supply
UNDP	United Nation Development Programme

UNEP	United Nations Environment Programme
UOM	University of Moratuwa
USAID	United States Agency for International Development
WSSD	World Summit on Sustainable Development

CHAPTER 01

INTRODUCTION

1.1 BIOMASS ENERGY SECTOR

1.1.1 Biomass as a source of energy

Since ancient times, people used biomass as a source of energy. Later stages, different types of fuel came into the market mainly based on fossil fuels. Due to ease of operation, most of industries were switched into new fuel sources. Then due to rapid demand, price went up drastically. Then again, people started thinking of low cost fuel. Low cost, reliability and viability, green fuel source, operational ease are the reason for fuel switching back to biomass. The total primary energy requirement in world is supplied by oil, coal, Natural gas, Renewable and Nuclear. 14% of the global total primary energy supply (TPES) is from Renewable energy sources as shown in Figure 1.1[1]. 67 % of the global bioenergy supply comes from fuel wood as shown in Figure 1.2 [2].

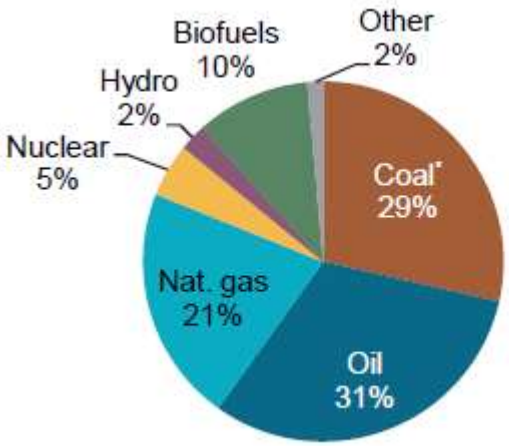

Figure 1.1: Total primary energy supply by fuel in 2014

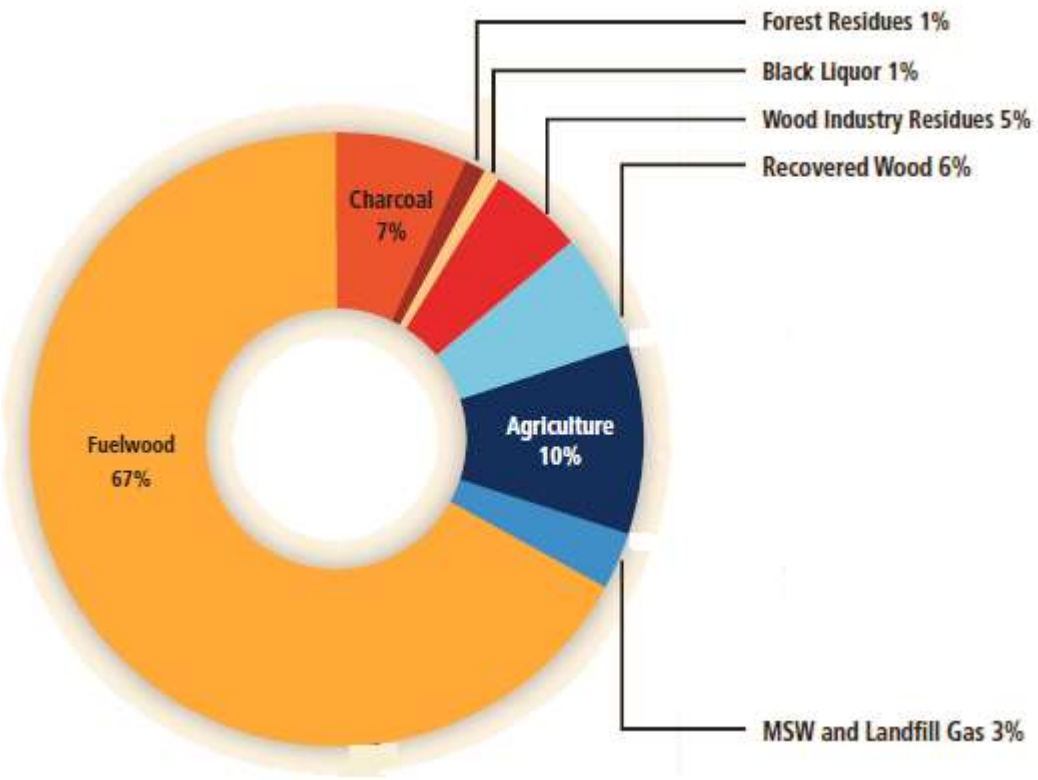

Figure 1.2: Shares of global primary biomass sources for energy

1.1.2 Biomass as a source of thermal energy in Sri Lanka

Biomass shared a prominent role in the Sri Lankan primary energy supply with a contribution of 38.8% [3]. Biomass is the major source of thermal energy in Sri Lanka contributing to 65% of industry and 75% household sector [3]. Although the percentage share decreased gradually, the overall quantity of biomass demand always had an upward trend with increase of total energy demand, primarily due to switching from oil to biomass in industrial thermal energy application. Biomass resource is largely utilized for domestic cooking and water heating applications in Sri Lanka. It is cheaper than cooking with Liquid petroleum gas (LPG) or electricity although it may not be the most convenient method. Many small scale industries (like brick, bakery, tile, lime, pottery, etc.) use biomass as a source of thermal energy. Special cottage industry also says that they need more biomass but they are worried about the supply. In the case of industrial sector, there is a renewed interest on biomass as a source of thermal energy due to increase in cost of fossil fuel and technology development in biomass energy conversion which makes it more

attractive now. Therefore, there is a huge demand for the future energy applications of the industry especially thermal energy application. The ever increasing prices of fossil fuels and removal of fossil fuel subsidy in 2012 have encouraged the industries to use biomass to operate their boilers in the recent years. As a result, biomass became more cost effective. Even with no sign of new fuel wood plantations, gradually, industries have started using biomass to operate their boilers, driers, furnace, etc. For example, vast majority of tea factories over 95% have switched to biomass energy by now.

In addition, biomass has helped some of the large industries to reduce their carbon footprint as well. Pressed by their parent companies, they look at sustainability and green energy. When they want to get certification and other marketing tools for their products, they are looking at carbon foot print. Then they are also looking at biomass source to check, whether these are sustainable or not. There is a pressure coming from their mother companies, in international level, for these local large companies like MAS, Brandix, Holcim for example, a certification process for their fuel supply including biomass. There is a demand in that context, for some kind of certification system which they can submit to their final certification authority. Due to these reasons, an increasing trend in switching from fossil fuel to biomass in the industrial sector is visible. Furthermore, if other industries also switch to biomass from fossil fuel, the total demand would be much higher. Such situation would impose pressure on unsustainable source of biomass harvesting such as from natural forests.

1.1.3 Biomass as a source of electricity in Sri Lanka

In the recent years, there is emerging emphasis on the development of renewable energy sources including biomass for electricity generation, due to the importance of energy security and international commitment for Green House Gas (GHG) reduction. Accordingly, there is number of policy level initiatives to promote biomass. For example, establishment of dendro power (electricity generation from sustainably grown biomass) throughout the country which has been highlighted in the election manifesto of the present president [4] and national circular issued is annexed in Appendix A. Further, the 10 years development plan of the Ministry of

Power and Energy (presently Ministry of Power and Renewable Energy), targets 100% renewable energy scenario by 2030 where biomass for electricity generation is a key intervention [5]. There is an attractive technology specific feed-in tariff for biomass based electricity generation through which 23 MW of power plant has been already commissioned and more than 40 MW of biomass based energy projects are in the pipe line. This situation will pose further pressure on unsustainable sources of biomass supply such as natural forest.

1.2 PROBLEM STATEMENT

It is apparent that, as highlighted above, there would be continuous increase in demand for biomass both in thermal and electricity sector. With no sign of new fuel wood plantations, there is a growing concern on how to meet the increasing demand. In fact, some industrialists have admitted that jungle wood is also being supplied by the fuel wood suppliers in the fuel wood mix, which is obviously unsustainable and environmentally harmful. As there is insufficient amount of sustainable fuel wood easily accessible, it has led to unsustainable fuel wood extraction to meet the demand. Such situation will pose further pressure on unsustainable source of biomass supply such as natural forest.

Further the present fuel wood supply chain systems do not facilitate to distinguish sustainable supply from unsustainable supply sources. For example, when fuel wood is processed (mainly chipping process), type of fuel wood species is difficult to be identified visually. Therefore, loss of traceability takes place due to chipping. Accordingly, expected biomass sector development is challenged by the unsustainable supply chain. There is a great danger due to lack of sustainable biomass supply assurance and certification system in Sri Lanka.

1.3 AIM AND OBJECTIVES:

The aim of the project is to establish a mechanism to distinguish sustainability of the biomass supply chain.

Specific objectives of the project include the following;

1. Identification of sustainability issues of biomass supply chain in Sri Lanka,
2. Synthesis of existing certification systems, organizations and their applicability to local context,
3. Establish Principle, Criteria and Indicators (PCI) for sustainably produced fuel wood,
4. Development of sustainable fuel wood certification system.

1.4 METHODOLOGY OF THE STUDY

Following methods have been used to achieve the aim of the study by fulfilling above mentioned objective. During first phase of the project, a comprehensive literature review and a desk study of various reports from government institutions such as Ministry of Power and Renewable Energy, Sri Lanka Sustainable Energy Authority, Rubber Research Institute, Coconut Research Institute, Tea Research Institute, Ministry of Mahaweli Development and Environment, Forest Department, Ministry of Plantation Industries, Central Environmental Authority and Private organizations such as Bioenergy Association of Sri Lanka, The Planters Association of Ceylon, Green Movement for Sri Lanka, Human Community Development Youth Organization and few private companies was done to identify sustainability issues of biomass supply chain in Sri Lanka. Next, existing certification systems and their applicability to local context is studied using emails, text books, journals, research papers etc. as literature review. To fulfil the third objective, physical committee was formed using experts from above mention government and private organizations to analysis, select and prioritize the PCIs that are found from desk study and by consulting international experts. The diversity of principles needed to broadly assess socioeconomic and environment sustainability may not allow for a uniform, well defined principle selection process. Therefore, small survey was launched among local biomass experts to select and prioritize the principles came out as a results of literature survey. There were lots of debates within the technical sessions about the survey results. Therefore consensus distillation of successful thinking and expert judgment are an important part of the principle selection process. However committee agreed with the survey results. Next key stakeholders in the supply chain

of biomass, especially fuel wood growers were met and piloting was done. Based on overall findings, a conceptual cell matrix was designed and applicability of it along the different stages of the supply chain was analysed. Finally mechanism for sustainable fuel wood certification system was developed.

1.5 STRUCTURE OF THE REPORT

Chapter 1 provides introductory information of current situation of biomass industry and its application in Sri Lanka. Biomass as a source of thermal energy and as a source of electricity was discussed. Furnace oils have been maintained without subsidies since 2012. Therefore, the business case for large industrial thermal plants to be operational on fuel wood prevailed in 2013 onwards. With no sign of new fuel wood plantations, the fuel wood supply chain of industry thermal energy application and steam generation application plants continued to grow. When a middle man (supplier) obtains fuel wood from a home garden, a price has to be paid to the land owner. However, in the case of illegal fuel wood from the forest, there is no payment involved. When fuel wood is processed (mainly chipping process), type of fuel wood species is difficult to be identified visually. Therefore, loss of traceability takes place due to chipping. Channelling of jungle wood is done through the middle men and jungle wood is burnt in many factories, with or without their knowledge. High competition for fuel wood could be threatening due that the supplier (vendor) chain of fuel wood is highly informal, thus illegal tree felling might also take place. Gradually, with the increase of demand by the industries, doubts have occurred whether the supply and demand is having a mismatch with each other now or in recent future.

Chapter 2 discuss the bio energy sector in Sri Lanka. Biomass usages of different industries and biomass supply from different sources are presented. Tea, Coconut, Rubber, Sugar, Textile, power plants, lime, roof tile, brick, pottery and others industries are the industries that consume fuel wood. Rubber wood, mixed fire wood, Gliricidia, cinnamon wood, coconut shells, coconut waste, paddy husk and rice straw and process waste and other waste are considered as main sources of biomass in the country. Further, growing models were identified as dedicated approach, community

based approach, integrated approach (intercrops and under crops), mixed approach and multiple used approach. Out of these five, dedicated approach is the main sources of biomass for power/heat generation for the future and Sri Lanka has a great potential for producing biomass using this model.

Chapter 3 present the international certification system and organization that are existing in the world. Background related to such certification systems and organizations in the development of the biomass certification schemes such as national governments and regional bodies, companies, Non-governmental organizations (NGOs), Networks and round tables and International organization in the world are discussed to examine the facts. Usually these systems comprises of set of principles, criteria and indicators covering sustainability aspect, which are dependent on country to country and therefore need to accept to the local context with suitable changes.

Chapter 4 present activities done and methods used under Methodology to develop new certification system are presented. In the mean time, more than 200 emails were sent to more than 30 countries covering all five continents in the world asking different standards and certification systems available in their countries. Further literature survey and desk study was done with the information received via emails. The issues identified through this literature review were used as a basis for creating initially 8 Principles. Then, most suitable principles were selected and prioritized using a small survey through biomass expert in the country. Seven consultative meeting/workshops were held once in two months during 2016 and first quarter of 2017. Further stakeholder meeting helped to identify 5 principles which is best suit to Sri Lankan conditions.

Accordingly for Sri Lanka in Chapter 5, a set of different social, economic and environmental indicators totalling to 42 were identified under five principles; legal and regularity compliance, environment values and impact, benefit to the community, group support and chain of custody (traceability) from the standing-tree to the farm-gate. These indicators are hypothesized to be practical tools for capturing

key social, economic and environment sustainability effects across fuel wood supply chain. Further a set of verifiers for each indicator is proposed.

Chapter 6 present the output of the validation of the proposed standard and certification system for sustainable fuel wood trade. To evaluate the hypothesis that the toolset meet this goal, and also to help measure variability a wide variety of conditions and to establish targets, the 42 indicators were field tested in a community based organization (CBO) covering home gardens and small plantations. In order to facilitate the enforcement of the certification system, a cell matrix was designed which could identify the applicability or non-applicability of indicators on supply chain.

Further in Chapter 7, complete fuel wood management system was developed for the conformity assessment of the fuel wood certification system. The proposed certification system comprises of 8 steps namely pre-assessment, fuel wood producer's preparation, document review, on-site evaluation, reporting, certification, surveillance and re-certification. The last two steps reflect the continuity and reassurance of the established system. Sustainable fuel wood certification (SFWC) system and guidelines, SFWC auditing system, protocol, process and real time case studies under few indicators were presented.

At last but not least, it is concluded that the principles, criteria and indicators identified in the standard and certification system could guarantee that fuel wood sector have a say to the economic development while ensuring sustainability. However, it is recommended to test the proposed indicators in large plantation in order to fine tune for such context.

CHAPTER 02

BIOMASS ENERGY SECTOR IN SRI LANKA

2.1 DEMAND FOR BIOMASS

2.1.1 Overview

Sri Lankan industries which consume biomass are Tea, Coconut, Rubber, Sugar, Textile, power plants, lime, roof tile, brick, pottery and others. Table 2.1 presents the statistics of the fuel wood consumption of above industries [6]. It shows that the highest fuel wood consumption is from tea industry and it is equal to 24.3%.

Table 2.1: Annul Fuel wood consumption in Sri Lanka based on industrial Sectors [6]

Sector		Fuel wood (MT)	Percentage
Agro Industry	Tea Processing	705,000	24.3
	Coconut Processing	36,000	1.2
	Rubber Processing	408,000	14.1
Manufacturing Industry	Textile and Apparel Industry	276,000	9.5
Manufacturing Industry	Sugar	7,000	0.2
	Brick	601,000	20.7
	Tile	98,000	3.4
	Lime	143,000	4.9
	Pottery	89,000	3.1
Biomass Electricity	Electricity	99,000	3.4
Other Industries	Major Bulk	219,000	7.6
	Other Industries(SMI)	219,000	7.6
Total		2,900,000	100.0

These above industries cannot survive only with fuel wood at the movement, although the focus of this project is only on fuel wood. Therefore these industries

uses saw dust, coconut shell, paddy husk, bagasse and other agro waste and wood waste other than fuel wood.

Table 2.2: Annual Wood waste and Agricultural waste consumption in Sri Lanka by industrial Sectors [6]

Sector		Saw dust (MT)	Coconut shells (MT)	Paddy husk (MT)	Baggasse or other waste(MT)
Agro Industry	Tea Processing	42,000	1,000	24,000	-
	Coconut Processing	34,000	83,000	-	-
	Rubber Processing	56,000	-	-	-
Manufacturing Industry	Textile and Apparel Industry	134,000	5,000	4,000	1,000
Manufacturing Industry	Sugar	-	-	-	251,000
	Brick	-	-	500,000	-
	Tile	24,000	-	-	-
	Lime	-	-	-	-
	Pottery	7,000	-	1,000	-
Biomass Electricity	Electricity	-	65,000	126,000	-
Other Industries	Major Bulk	62,000	16,000	172,000	37,000
	Other Industries(SMI)	-	-	-	-
Total		359,000	170,000	827,000	289,000

Table 2.2 presents the statistics of the wood waste and agricultural waste biomass consumption of above industries. Highest consumption of saw dust is for Textile and Apparel Industry and which is equal to 134,000 MT per year. Highest coconut shell consumption happen within the same coconut industry while second highest is in electricity production. Highest paddy husk consumption reported in brick industry

and it is equal to 500,000 MT. Most of the bagasse produced in the sugar industry consumes industry itself.

2.1.2 Tea Industry

Presently, Sri Lanka is the fourth largest tea producer in the world contributing to about 7% of the world tea production. There are about 203,000 ha of tea lands in 14 administrative Districts in Sri Lanka. Of the total extent, about 58% (120,955 ha) is in the hand of smallholders who own less than 20 ha each and the balance (82,065 ha) is managed by the Regional Plantation Companies [7]. There are nearly 400,000 smallholders engaged in tea cultivation and about 75% of them are growing tea in the low country districts such as Ratnapura, Galle, Matara and Kalutara. The sustainability of the industry is vital not only due to its socio-economic importance, but also in the environmental aspects as majority of tea lands in Sri Lanka are found on steep terrains and in watersheds feeding river system of the country that are vulnerable to erosion and degradation of soil in the event of poor management and abandonment of tea lands. Approximately, the tea industry supports a population of around 2 million, which is about one tenth of the total population in Sri Lanka. There are around 710 tea factories in operation at present.

The process of tea manufacture requires two forms of energy, i.e. electrical and thermal energy. The electricity is used mainly for driving machineries and lighting. Firewood is the main source of thermal energy used for tea withering and drying operations. The energy study done on combustion systems in Sri Lanka, mainly in tea drying, has found that moisture content (43%) and large sizes of firewood used for combustion are directly related to the low combustion efficiency (60%) of the existing furnace. Assuming an average specific fuel wood consumption of 1.5 kg/kg of made tea, the present fuel wood demand for tea processing is approximately 1.7 million m^3 /yr. As there are greater issues with the availability of fuel wood for tea processing, proper evaluation of demand, availability, supply and efficiency of use of fuel wood in tea factories is the need of hour. Gliricidia promotion can easily be adopted by farmers, integrating it with the existing farming pattern. An out-grower system, modelled on the system currently in wide-spread use within the tea industries, would

be the ideal mechanism for dendro power plants, providing a greater margin of profit to the industry. Small-scale home gardens island-wide can supply Gliricidia wood to decentralized power plants. Figure 2.1 shows that Gliricidia and Caliandra are cultivated to provide shade in tea plantations and to avoid soil erosion in steep terrains.

Figure 2.1: Gliricidia and Caliandra are planted in tea plantation

2.1.3 Coconut Industry

Coconut is one of the major plantation crops in Sri Lanka. Total extent of coconut plantation is 395,000 ha of which 80% comes from small holdings. Sri Lanka is the fourth largest coconut producing country in the world. The average land productivity is 6, 625 nuts/ha/year [8]. Coconut industry contributes to the national economy and ensures food security. It provides a lively hood for about 5% of the total work force. The 'coconut triangle' has around 60% of the country's coconut growing lands. Scarcity of the labour has become an issue due to low wage rates, high educational level and poor social acceptance. Economic sustainability has become more important to the plantations owners due to scarcity of physical and financial resource, increasing cost of external inputs and fluctuation of price of coconut. Therefore to face above challenges, they have used other income generation using other parts of the nut and tree. Desiccated coconut (DC) and copra industries use 100% biomass for thermal energy requirements. Recently installed boilers are operated with coconut shells and saw dust. DC industry is very enthusiastic on practicing energy efficiency and reuse process waste as much as possible. All parts of the coconut fruit and coconut tree can be used as raw materials in some other industries. Apart from that, charcoal and activated carbon sectors use coconut shells as raw materials and the

waste heat from process is enough for the energy requirements. According to Coconut Development Authority (CDA), there are seven big activated carbon manufacturers in Sri Lanka.

Figure 2.2: Mono culture plantation

By looking at Figure 2.2 it is evident that mono culture plantation would provide economic benefits however it reduces the ecological benefits and sustainability. The potential for establishing Gliricidia plantation is enormous and the government has entrusted the Coconut cultivation board with the responsibility of promoting Gliricidia as 4th plantation crop in Sri Lanka. Adaptation of environmental friendly methods such as under cropping with Coconut plantation as shown in Figure 2.3, ecological benefits and sustainability can be increased.

Figure 2.3: Adaptation of environmental friendly methods to minimize the negative impact

2.1.4 Rubber Industry

In 2013, the rubber extent of Sri Lanka was 133,668 ha and is spread mainly in Ratnapura, Kalutara, Kegalle, Colombo, Monaragala, Gampaha, Galle, Matara, Kurunagala, Kandy districts of the country [19]. However, it is one of the major industries with high biomass demand as several large scale rubber factories are using biomass for their energy needs. Rubber wood is considered as a by-product from rubber plantations. Smoked rubber industry is mostly based as small and medium Industries (SMI) while bulk rubber manufacturing industry is mainly involved in processing finished products. Major export products are solid tyres and gloves. Some factories produce mats, gaskets, washers, seals & machinery parts, rubber tubes, shoe products, etc. for export and local markets. Price of rubber wood is higher than that of mixed fire wood. The moisture content of fuel wood plays an important role in combustion and overall boiler efficiency apart from the reduction in the gross calorific value in a unit of biomass.

Only about 27 rubber processing factories have installed biomass boilers. For example, in this study more than 60 boiler installations were found in textile industry alone. However, the total amount of fire wood used in 27 rubber processing plants is quite similar to the fire wood demand of entire textile industry. Fuel switching in rubber industry has a competitive edge over the other sectors due to the following facts. Rubber plantations produce rubber wood due to uprooting activities as a necessary part of plantation management. It was seen that plantation groups involved in estate management either own or have shares of the processing factories as well. Moreover, suppliers of latex and semi processed rubber have more connectivity to bulk manufacturers and also the rubber estates. For example Lalan Group has presented a case study on fuel switching and supply chain management activities within the group. They have leased a 7,000 hectare rubber plantation from the government which contributes to 40% the biomass requirement in the company. They have installed nine biomass boilers to date and a saving up to USD 10 million/year by biomass substitution has been realized [10]. Rubber wood is obtained

from rubber plantation. The distance between factory and the source could even go beyond 75 km, in factories with higher fuel wood consumption.

2.1.5 Sugar Industry

Annual sugar requirement of Sri Lanka is around 700,000 MT, and currently Sri Lanka produces only 9% of it [11]. This is done in three processing plants, i.e. Pelwatta, Sevanagala and Hingurana. In earlier days Kantale processing plant also produced sugar, and plans are currently underway to re-develop it. In 2013, Sevanagala plant had received a cane harvest of 177,469 MT while the sugar production was 14,191 MT. Likewise; Pelwatta plant had received a cane harvest of 332,635 MT while the sugar production was 23,338 MT [11]. Hingurana sugar processing plant has also started sugar production from 2013, and according to their corporate website, sugar production of 19,936 MT was done in 2014 [12]. When considering past two year data, about 83 kg of sugar can be made form 1 MT of sugar cane. Sugar industry is trying to regain its strength in producing the sugar requirement of the country, and to fully satisfy Sri Lankan sugar requirement by 2020. Currently Pelwatte, Sevanagala and Hingurana factories are in sound operation. Meanwhile, all three companies are using bagasse to satisfy the thermal energy needs of the factory and some produce electricity for the factory premises. Only Sevanagala factory needs to buy a small amount of fire wood for thermal energy need. All three sugar factories have applied for on grid electricity generation from SEA, taking into account the expected future growth in sugar production.

2.1.6 Textile & apparel Industry

Textile & apparel industry had a significant growth after the economic liberalization in 1977. A decade later, from 1986, it has been the largest gross export earner for Sri Lanka. In 2013, the export value of textile & apparel industry exceeded 4.5 Billion USD (43.3% of total export value) [13]. It is also the country's largest net foreign exchange earner since 1992. The industry is a major contributor for GDP, exports, foreign exchange earnings and direct & indirect employment. Sri Lanka has become a world class apparel manufacturer supplying to global super brands for over three decades [14]. Few reasons for such recognition are the elimination of child labour,

protecting worker rights, human resource development opportunities, providing employment to rural communities, etc. Furthermore, textile & apparel industry in Sri Lanka has been a forerunner in applying green engineering and environment management concepts in their premises. Since textile & apparel industry offers a higher price, issues in supply are minimum than in most other instances. Suppliers contracted by the factories deliver the necessary biomass amount on time. Since biomass comes in pre-processed forms, additional labour for maintenance is also minimal. Most textile factories use alternative forms of biomass like saw dust, paddy husk as well, which are more economical than fire wood. Use of biomass has given environmental benefits, like reduction in carbon foot print. It gives the industry additional market strength in capturing the environment friendly clients. However, certain international clients who are just not satisfied with the quantity of emission reduction only, have questioned the industry on traceability and other parameters of sustainability of biomass use. Thus the textile & apparel industry is very keen on the sustainability criteria regarding biomass use, in order to add more value to the hard earned global recognition 'Garments without Guilt'

2.1.7 Lime Industry

Lime industry has a deep rooted history in Sri Lanka and can be seen in traditional engineering miracles like the Stupas. Dolomite and corals are the mostly used inputs for lime production. After banning sea coral usage to protect the coast from erosion, dolomite is the input used for lime production. Therefore lime industry is mainly spread in the areas with dolomite deposits. Digana, Thalathuoya, Matale, Thumpane, Palabathgala, Kundasale, Pasbage Korale, Rajawella, Manikhinna, Kumbalwewa, Hunuketiya, etc. have such lime kilns operated as a family based industry. Few kilns are operated in coastal areas like Hungama, Ambalantota, where inland deposits of corals are available. According to Geological Survey and Mines Bureau (GSMB) records, production of dolomite in 2012 was 154,296 MT [17]. Glass, ceramic and cement industries have consumed about 40,000 MT and the balance 114,296 MT has been either crushed to be used as fertilizer or has been burned for a temperature of about 950 ^{o}C in biomass fired kilns to produce slaked lime for construction inustry. Lime industry needs further improvements to attenuate the environment and

technical problems they face. Many industrialists struggle hard to keep to environment standards and retaining labour force, as the employees have to work in harsh environments. Industrialists act individually and there is no association for lime manufacturers. Thus most industrialists have now realised the need of an association in facing their common problems. Production rate varies due to availability of resources, workers and buyers. Substitute products and increasing fertiliser exports of dolomite are threats for them. Most of the lime kilns are of traditional pit type, which is loaded with layers of dolomite and fire wood. Both the fire wood and limestone amounts used per layer are decided by hands on experience of operators and this deciding factor also varies from person to person as well as from kiln to kiln. Using coconut trunks is a special scenario in lime burning.

2.1.8 Roof tile industry

Roof tile industry is a well-established Small and Medium Industry in Sri Lanka. Although many substitute products have emerged, cooling effect of the clay roof tiles have made the industry survive over the years. Dankotuwa, Waikkala, Kochchikade areas are famous for roof tile industry. Few number of tile factories are seen in other areas as well, based on resource availability. Total number of roof tile factories is approximately 300, with different production capacities. Roof tile manufactures have formed an association called 'Samastha Lanka Meti Sevili Ulu Nishpadakayinge Sangamaya' (Association of all island roof tile manufacturers) to commonly address the industrial problems with stakeholders. This has become a strength to the survival of the industry, and we have not found any other instance of formation of an association in the SMI sector. The main strength of the roof tile industry is the availability of raw materials and a recent opportunity they had is the purchasing of roof tiles for the households constructed by the government.

However, the other side of the story is somewhat dark. Weaknesses of the industry as a whole are that system upgrading has not been given any thought due to high cost and uncertainty of demand. On the other hand many roof tile factories are closed down now, due to substitute products like asbestos roofing tiles. Other than that, biomass supply has also become a threat for them. If a ban or limitation on asbestos use is imposed, it might increase the demand for roof tiles. Mass scale industries'

purchase of fire wood have become the biggest threat to them which makes fire wood scarce and make the supply chain uncertain. Using of saw dust has given benefits to the roof tile industry in mainly two forms. Firstly, it has reduced the total energy cost. Secondly it is more convenient for operation, since it retains heat for a longer period, reducing the attention required from the operator. Roof tile industry was one of the first SMI to start using saw dust for energy, and gradually other SMI and also large scale manufacturers have switched to using saw dust for thermal energy requirements.

2.1.9 Brick Industry

Bricks is one of the major walling materials in Sri Lanka. Brick manufacturing is done at rural level, where many villagers are involved in brick making. In such instances, higher production capacity is seen and the vendor chains are also well established. Bricks produced in a distant area could ultimately be used in Colombo or other major cities. In other instances, isolated brick manufacturers are located in many villages, satisfying the needs of the locality. Apart from being unorganised, brick industry is non-mechanised, where technology does not play a major role in manufacturing. Clay is used as the major raw material. All processes like clay preparation, moulding, drying, firing and material handling rely on human labour. Drying is done under sunlight, and therefore production is minimal during rainy seasons, and the seasonality of production is inevitable here. Although the cement block has evolved as substitution for brick, cooling effect of brick have made industry to survive over the years. Brick industry can be considered as the most important micro scale industry in Sri Lanka, since construction industry is heavily dependent on the cost and availability of bricks.

Furthermore, it is equally important in terms of providing employment to rural sector, especially for people with lesser skills and educational levels. Brick kilns in Sri Lanka do not adapt energy efficiency standards and only batch processes are seen. Use of paddy husk for brick production is noticed in many regions, and there is further potential to switch to paddy husk. Specific advantages can be seen in using paddy husk kilns, like more even temperature gradient over the kiln. Some clients are

reluctant to buy paddy husk fired bricks, fearing that they lack quality. Therefore, proper studies to compare quality of bricks made of paddy husk and fire wood should be done by independent organizations. Brick industry is operated as a family owned business. There are certain villages where more than 100 families are involved in brick manufacturing. Traditional brick making does not involve special equipment or skilled labour. Usually, the same person is involved in raw material processing, raw brick making and burning. In other words, the same person makes bricks in moulds for about one or two weeks, and then when a stock of raw bricks is made, he fires it in a kiln using fire wood or paddy husk. These kilns could be either kilns with permanent walls or open kilns. Initial cost of building an open kiln is very low, but its thermal efficiency is poor. Ultimately, people use their own kiln only about once in two weeks, and there are plenty of similar inefficient kilns all over the village. Instead of having many inefficient kilns around the village, one scaled up kiln could be designed like standard high efficient kilns developed by rest of the world. Operation of such a kiln could be done by a co-operative society or another association, where the new kilns could be used through leasing/hiring/renting or another appropriate mechanism with the consensus of the members. Internal transport of bricks to the kiln should also be thought of in the design of such a project.

2.1.10 Pottery Industry

Pottery Industry is located in a number of villages in several districts. This is an industry operated at village level. In the localities where pottery industry is found, it is the major income earning avenue of most of the people in the particular area. However in certain villages, there are a few pottery manufacturers. Pottery industry produces diverse range of products. They include cooking pots of various types and sizes, curd pots, flower pots, oil lamps, ornaments, etc. Small curd pots and LPG cooking pots made out of clay have obtained high demand from domestic market in recent years. Still there are ample possibilities to popularize LPG cooking pots among Sri Lankan households by making people aware of the health, energy efficiency and other benefits of LPG cooking pots. Pottery industry is in a poor stage mainly due to economic factors. Manufacturers have limited bargaining power over

the distributors/vendors to increase the product prices. Raw material, process, energy, labour and other costs have increased over the years, but the manufacturer to middleman prices have remained almost constant.

Pottery industrialists fear that under this situation, the industry would disappear soon. Pottery industrialists have tried to reduce fire wood usage due to the high cost of it. Some of them have completely eliminated using fire wood from the process, while most of the others face no issues with mixed biomass types. Compared to other industries, process temperatures are moderate in pottery industry and therefore alternative types of biomass like agricultural wastes can be used. Thus there exists a high possibility of switching to alternative biomass fuels in the kilns that still use fire wood. It is recommended to do a proper technology assessment on the other types of biomass, and help the individual industrialists to switch to other types of biomass. Past experience shows that pottery industrialists have shown much cooperation in moving ahead with energy management programmes that were held by the Government and NGO firms. These attitudes enabled the success of 'Anagi' cook stove development programme, LPG pots development programme, etc. Innovative cook stoves are being made using clay by industrialists after obtaining expert advice. It can be anticipated that the industry would show the same keenness for future programmes of switching to alternative biomass types.

2.1.11 Electricity Power Plants

In electricity generation, biomass electricity has distinct benefits among the other renewable energy types. Technically biomass power plants can be used as base - load power plants (similar to coal), easy to match supply according to the load curve, can be operated in wide range of capacities, and operates at higher plant factors. Resource flexibility is an added advantage, where resources can be transported to a desired consumption point. When achieving higher renewable energy incorporation to the national grid, contribution of biomass energy would be significant among intermittent energy sources like solar and wind. Since the establishment of Sri Lanka Sustainable Energy Authority in 2007, up to date 30 June 2015, there are 88 applicants under dendro power category and 16 applicants under agricultural waste

power category for on grid power generation using biomass. By the said date, three dendro power plants, two paddy husk fired power plants and one waste heat recovery plant have been commissioned under biomass category. Other applications are in various stages of the project approving process. Some project approvals have lapsed due to unsatisfactory progress [15]. Biomass as an indigenous energy source will play an important role in the country's journey towards energy security. Furthermore, these power plants are located in distant areas, where employment opportunities are being created through biomass supply. It was noted that industries face difficulties in operating biomass based gasification units. Direct combustion technology has shown much better performance than gasification technology in electricity generation. Furthermore, when the fuel received is not uniform in its moisture content, gasifier technology has faced several problems like production of tar as a waste, creating disposal problems and maintenance issues. As said before, there are many more biomass projects in the approval stages, and since biomass resources are limited, commissioning them would pose higher pressure in biomass supply in future. It would lead to competition within existing industrial biomass users and SMIs. Cumulative capacity additions of biomass up to 2015 are presented in Figure 2.4. Table 2.3 present the Grid Electricity Biomass Energy Projects that are commissioned as per December, 2015. Cumulative addition of the six commissioned power plants is 23.9 MW [3].

Table 2.3: Grid Electricity Biomass Energy Projects -All Commissioned as per December, 2015

District in which the plant located	Grid Electricity Biomass plant commissioned
Trincomalee	10.0MW
Rathnapura	5.4 MW
Badulla	5.0MW
Ampara	2.0MW
Gampaha	1.0MW
Anuradhapura	0.5MW

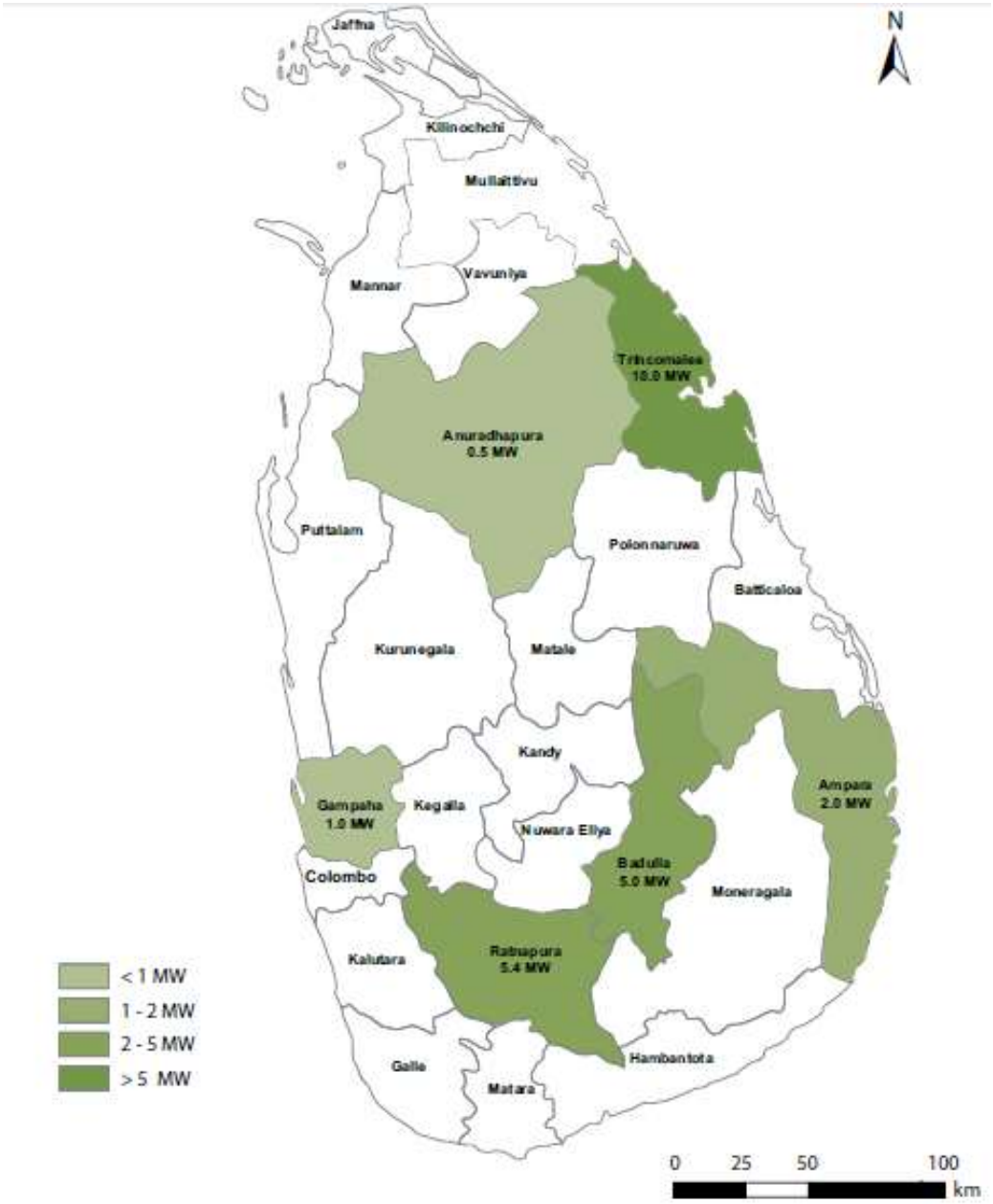

Figure 2.4: Grid electricity biomass energy projects [16].

2.2 THE MAIN SOURCE OF BIOMASS

2.2.1. Overview

Biomass energy refers to energy obtained from organic material, derived from either living or recently died organisms. Biomass is used in non-energy applications mostly and also in energy applications. Biomass used in energy applications are categorized as virgin wood, energy crops, agriculture residues and waste. There is a wide variety

of characteristics and properties of different classes of biomass material. The categorization of widely used biomass resources is given in the Figure 2.5 [18].

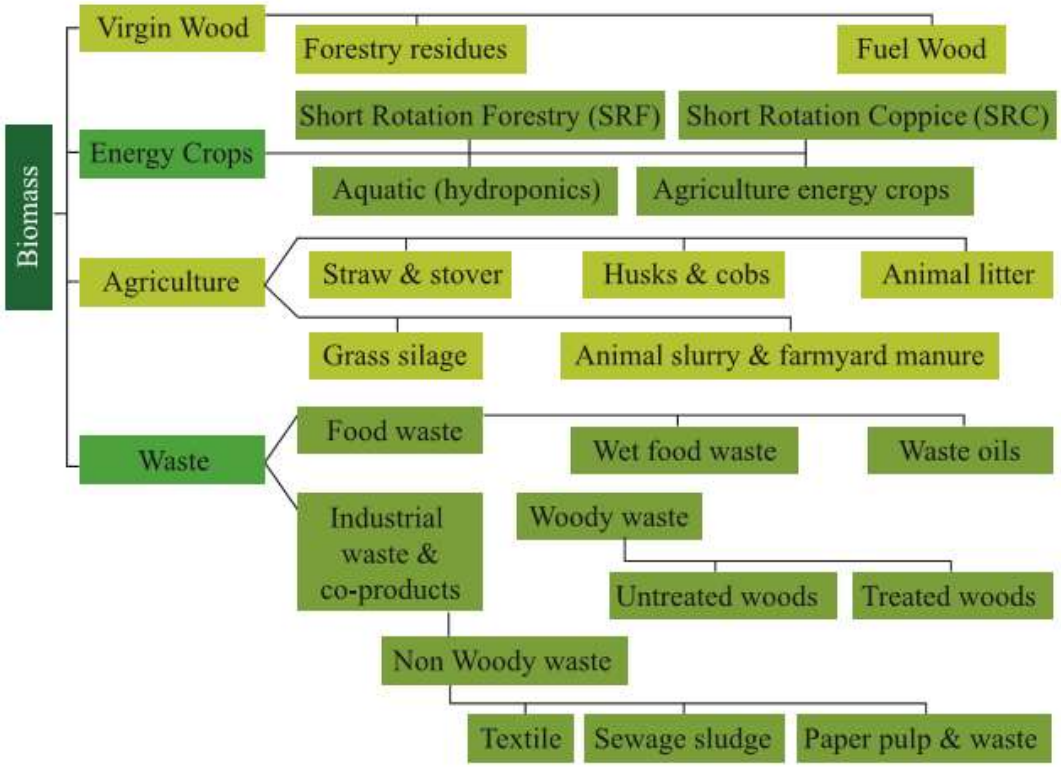

Figure 2.5: Categorization of biomass resources [18]

The main sources of biomass include rubber wood, mixed fire wood, Gliricidia, cinnamon wood, coconut shells, coconut waste, paddy husk and rice straw and process waste and other waste. There is no fuel wood station in current supply chain as it is informal in nature. There is no traceability in the current fuel wood supply chain as it is of ad-hoc nature. There are quality issues such as moisture in the supply of fuel wood. Lot of fluctuations can be seen. Fire wood, saw dust, paddy husk, coconut shells and process waste were the most noticeable biomass types used in energy applications in Sri Lanka.

2.2.2 Rubber wood

Rubber wood is considered as a by-product from rubber plantations. Rubber tree should be removed from the rubber plantation by its 30th year, and the rubber wood is used for several applications like timber, Medium Density Fibre (MDF) board material, and thermal energy for industry, as a prop in mines, etc. However, now the

wood has other uses after it no longer produces latex. Sri Lankan rubber industry face huge challenges such as high labour cost, competitive labour market and lack of skilled workers and high cost of production. Some plantations have chopped it up for firewood and planted new trees instead. One of the many benefits of the rubber tree is the fact that many consider it a commercially sustainable source of wood. Unlike other trees that are felled, rubber trees are always replanted. At the same time, it has many uses across a varied range of commercial sectors, including the furniture and wooden toy industries. Using more rubber wood also ensures that other, less protected trees will be spared the manufacturing purposes. Present supply of wood from rubber plantation per year is 687,733 MT. That account for 7% of the biomass supply.

The moisture content of fuel wood plays an important role in combustion and overall boiler efficiency apart from the reduction in the gross calorific value in unit biomass. Energy loses due to moisture is two folds, major one is the reduction of effective wood mass, and the other is the latent heat carried by moisture to be evaporated. It is a fact that the moisture content of green wood varies from 50 to 60%, so the combustion of biomass with this moisture content won't make the project economically successful. Hence, there should be a method of reducing this moisture content before the combustion. However there is a significant amount of moisture reduction (up to about 45%) during the harvesting and transportation of wood sticks, barks and cut-offs to the site. However in long run the facility should have a methodology as shown in Figure 2.6 in reducing moisture at least up to 30%. The lower limit of the moisture content is dependent upon the fibre moisture saturation point of the biomass that is governed by the relative humidity of the environment and the nature of the fuel. Fire woods extracted in rubber plantations and home gardens is getting scarce over the time due to converting rubber land into real estate and palm oil and substantial consumption of fire wood for energy and non-energy related applications.

Figure 2.6: Rubber wood stored to reduce the moisture before burning

2.2.3 Mixed fire wood

Wood coming from home gardens is consist of a mix, like mango, cashew, tamarind, wood apple, bael (beli tree), Alistonia (Pulun), etc. Mixed fire wood could be a tree removed due to land clearance or in road side, dead tree of a home garden, etc. or a tree felled with a specific purpose like selling. When a middle man (supplier) obtains biomass from a home garden, a price has to be paid to the land owner. However, in the case of illegal biomass from the forest, there is no payment involved. Therefore, increased threats are being gradually posed on natural forest resources. Some people would let the biomass suppliers cut a tree in their premises, if the offer is attractive. Most of these wood log has branches and knots (Gata) and a splitter machine is used to chop the mixed fire wood as shown in Figure 2.7. When fire wood is processed (mainly chipping process), type of fire wood species is difficult to be identified visually. Therefore, loss of traceability takes place due to chipping. Channeling of jungle wood is done through the middle men and jungle wood is burnt in many factories, with or without their knowledge.

Figure 2.7: Splitter machine chopping the mixed fire wood

2.2.4 Cinnamon wood

There has been a constant increase of cinnamon cultivation over the years and Cinnamon cultivation of Sri Lanka in 2009 was 29,415 ha. Cinnamon is planted along coastal strip from Matara to Negambo, Matugama, Kamburupitiya, Elpitya and Ratnapura. Currently available types are not suitable in dry climates [20]. Cinnamon wood is obtained as a peeled stick from the process itself, and it is a by-product of cinnamon processing. Cinnamon is a well-recognized export crop. After 2-3 years, the first harvesting from a cinnamon tree can be taken. The total fuel wood yield from a matured cinnamon plantation has been calculated as 27 MT/ha per annum with 13.2% moisture on wet basis. Financially, an average cinnamon plantation gives 4 times net profits than cultivating Gliricidia [21]. Currently cinnamon wood supply per year is account for 62,333 tons of wood.

2.2.5 Waste wood

There are many registered and un-registered timber business in Sri Lanka. Saw dust, shavings and off cuts (Pitapalu) from these industries could be used as an alternative fuel with appropriate conversion methods to generate heat and power. With time, tile industry and other SMIs carried out various experiments on using saw dust in their thermal applications. Most of them succeeded in partially replacing fire wood with saw dust. With time, biomass boiler suppliers also started installation of saw dust fired boilers. While use of saw dust reduced overall energy cost, some industries found that using saw dust is beneficial for the production process as well, like retention of heat for longer time in small kilns, ability of system automation and

having advanced feeding systems in large scale boilers. Currently, large scale 100% saw dust fired boilers are in sound operation. Altogether, approximately 70 boilers use saw dust partially/fully. Most of these saw dust fired boilers are operating in Western Province. Highest saw dust consumption is seen in Gampaha district (131,400 MT/year), followed by Colombo (60,400 MT/year), Kalutara (56,000 MT/year) districts. Total consumption of saw dust is 360,000 MT/year and subsequently this high demand has lead to high competition. Within the above districts, an attractive price of LKR 3,000-3,600 is paid to the ultimate supplier to the factory gates for 1 metric ton. Presently saw dust prices are attractive and the demand by the industries is rising high. Moisture content of saw dust is higher than the paddy husk. Therefore 100% firing is sometime difficult. Saw dust can be automatically fed to boiler/furnace using bucket elevator.

2.2.6 Waste agricultural biomass

Coconut waste

Annual nut production varies from 2,400 to 3,000 million and a large quantity of coconut shells is produced as a by-product. As in case of paddy husk, coconut shells are also used as a fuel in traditional industries and small quantity in electricity generation and active carbon production. There are 5.4 million households and every day they use one nut and produce waste of coconut shell are scattered all over the country. Per capita consumption is 115 nuts per annum. Waste “Pol kudu” from one nut contains 25ml of coconut oil in it. If we have a mechanism to collect “Pol kudu”, it can be used as a biodiesel production. As such significant quantities of coconut shells are not available for biomass based power generation in commercial scale. Coconut shell fired boilers are mostly seen in coconut processing industry where the coconut shell is a process waste. Since considerable value addition to coconut shells can be done (like producing charcoal, activated carbon, ornaments, etc.), energy applications are somewhat limited. Some coconut processors sell coconut shells without using for energy. According to the Coconut Development Authority, coconut shells are hardly being sold to outside industries as energy product. Mostly used coconut waste in energy applications is coconut shells. Coconut shells are used mostly in coconut processing industry - DC, copra and in factories with coconut shell

fired boilers. Few textile and manufacturing industries located near DC mills also use coconut shells. When activated carbon and charcoal are made using coconut shells as the raw material, waste heat from process is enough for energy requirements. Coconut shell consumption in the charcoal manufacturing process is 112,000 MT/year whereas this is 79,000 MT/year in the activated carbon making industry. These coconut shell amounts are assumed to be unavailable for any other use.

Other parts of the coconut tree are also being used as fuel in a few small and medium industries. For example, topmost part and root of the coconut trunk (which cannot be used for timber) is used in brick kilns with permanent walls in North Western Province. Lime industrialists also prefer to use such coconut trunks to ease the production process, and this is in wet form. Pottery kilns use many parts of the coconut tree like dried fronds and husks. However, coconut fronds are still not being used significantly for biomass energy applications. In certain instances, coconut fronds are being piled up and destroyed by open fire, to prevent fungus growth in coconut cultivations. At 200 trees per 1 ha of coconut land, there would be 395,000X200=79,000,000 coconut trees. At 12 coconut leaves shed per tree per year, annual yield of coconut leaves per year would be 79,000,000 X 12. If one fully dried coconut leaf weighs 1 kg, the coconut leaf harvest would be 79,000X12 tons (0.948 million tons). According to Coconut Development Authority, local consumption of coconut nuts was 1,830 million in 2014 [8]. This is equivalent to about 300,000 MT of coconut shells. From the local consumed nuts, about 50% of the shells is said to be wasted because coconut shell waste generated at domestic level is not collected properly. Piling up of coconut shells can be seen in households that use LPG only. Disposal of them should be done properly, to prevent mosquitoes and other pests at premises or municipal dump sites. These coconut shells can be used in traditional domestic cooking. Furthermore, improved cook stoves using (coconut shell) charcoal are being developed by local manufacturers through local R&D. These stoves have eliminated many disadvantages of traditional biomass cooking. Institutional cook stoves have also been introduced to market, which can be operated hassle free with coconut shells. This resource could be used either for industries that produce shell products like charcoal, activated carbon, coconut shell powder, etc. If there is a

mechanism to obtain these waste coconut shells or to use it for domestic cooking at the point of waste generation (kitchen itself), it would reduce the LPG and fire wood usage.

Paddy husk and rice straw

Paddy land sown in Sri Lanka is 800,000 ha and the paddy production is 4,000,000 MT in both Yala (southwest monsoon period) and Maha (northeast monsoon period) seasons. Every metric ton of paddy would produce around 200 kg of paddy husk and annual production of paddy husk is about 800,000 MT. Given the calorific value of about 12 MJ per kg of paddy husk, if 1 kg of paddy husk could generate 1 kWh (3.6MJ) of electricity after making all the allowances for energy loss in conversion, using, using this paddy husk alone 1000 GWh of electricity could be generated. A considerable amount of rice straw is available after rice harvesting and most of it is put back to the rice fields as a soil conditioner and organic fertilizer. Therefore, rice straw is not available in sufficient quantities for power generation. Though this is a sizable quantity, the surplus rice husk is rather small as it is already being used in the rice industry for parboiling of rice and in other traditional industries as a source of fuel. Problems associated with the collection and transportation of surplus paddy husk further constrains the use of this material in commercial scale power generation. One of the advantages of paddy husk is low moisture content. Therefore temperature and pressure variation can be minimized. It can automatically be fed from top. High ash content due to presence of silica (16%-17%) is a disadvantage.

Bagasse and other wastes

Present sugar cane cultivation is 17,400 ha of land and it will be increased by six time in the future (up to 104000 ha). Bagasse is the most used process waste in Sri Lanka. When considering last two year data of Sri Lankan sugar industry, bagasse production per 1 kg of sugar cane harvested from fields is about 30-33% by weight. In Pelwatte and Hingurana factories, bagasse generation is enough for thermal energy requirement. Sevenagala factory which has a higher specific energy consumption requires 7,000 MT/year of fire wood apart from its' own bagasse resources. Pelwatte, Sevanagala and Hingurana sugar processing plants have planned

to boost their production and involving more farmers to cultivate sugar cane. Pelwatte, Sevanagala and Hingurana factories have applied for on-grid electricity generation from agriculture waste, which will saturate the generation of bagasse and its consumption in the future.

30,000 ha of land were under corn cultivation. Process waste generated in corn processing can be used in thermal energy generation. Similar to coconut products, palm oil industry uses process waste in their biomass boilers in Nakiyadeniya, Galle.

Some factories use their defect products for their biomass boilers. Similarly tea industry uses tea prunes and waste tea. Even sludge cake from water treatment plants is used in some biomass boilers after drying. Some factories integrate waste management and energy management to eliminate waste generation. Moreover, companies like Geocycle Sri Lanka which is the waste management arm of Holcim Lanka Limited provides solutions to manage industrial waste through co-processing waste in cement kilns and energy recovery is possible at the kiln, with the use of waste material as inputs. According to their company web site, biomass based waste and non biomass waste of industries, are co-processed in cement kilns, and more than 250 companies have worked with Geocylce. The possibility to use domestic and office waste like old papers, broken furniture etc. in biomass boilers after pre-processing should be also be investigated. Every year certain grass lands are set on fire at the peak of dry season in Sri Lanka. If managed properly, this valuable source can be channeled to produce thermal energy in industry.

2.2.7 Dedicated plantations

Sri Lanka has only limited amount of waste agricultural biomass and waste wood. Above mention existing non-dedicated fuel wood supply cannot cater to increasing demand. Therefore new method of fuel wood supply is required to fulfil the future demand. In the absence of a reliable and adequate waste agricultural biomass supplies and waste wood, short rotation energy plantations seems to be the only viable option for producing materials required for commercial scale biomass based power generation in Sri Lanka. These plantations, especially the dedicated plantations, have the advantage of stability of supply, producing the best quality biomass and increased efficiency in harvesting and processing. At present there is no significant extent of dedicated energy

plantations developed for biomass production in Sri Lanka. As net primary production of biomass production of the countries that are near to equator is 15 times higher than the countries near to north pole and south pole, the concept of biomass based electricity generation holds much promise for Sri Lanka. Dedicated plantation is one of the source of fuel wood that could fulfil the future demand of fuel wood coming from both biomass based power generation and industry thermal energy application. Among identified fuel wood plants, there is general agreement in Sri Lanka that Gliricidia is the fuel wood plant of optimal.

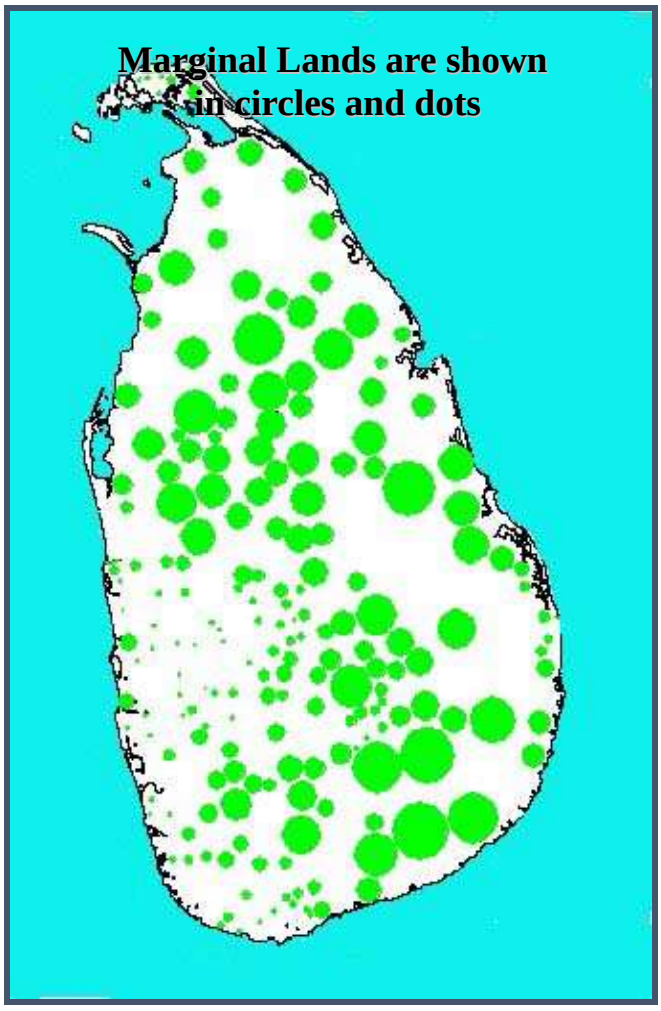

Figure 2.8: Spatial Distribution of Land identified for Energy Plantations

Sri Lanka Renewable Energy Master Plan Study undertaken by RMA with the assistance of Asian Development Bank (ADB) indicates that potential for electricity generation using grown biomass is 2,370 MW, out of which 1,319 MW will be from dedicated energy plantations and the remaining 1,050 MW of capacity will be from

mixed crops under various commercial plantations. Figure 2.8 shows the land identified for dedicated energy plantation to produce 1319 MW without hampering the food crop production and would be in total harmony with tradition and culture. The three traditional major cash crops in Sri Lanka; Tea, Rubber and Coconut were introduced during the colonial period. Since then the economic potential of a number of other crops has been exploited: pepper, cinnamon, cardamom, sugarcane etc; but none of them has had a large enough economic impact to be declared the Fourth Cash Crop of Sri Lanka.

Figure 2.9: Gliricidia tender leaves

Gliricidia as shown in Figure 2.9, was declared as the fourth plantation crop in Sri Lanka with the intervention of the Ministry of Plantation Industries from 30th June 2005. Nitrogen - fixing Gliricidia trees can be used as fuel wood as they are fast growing, coppiced once or twice a year and well suited for tropical country like Sri Lanka. Fuel wood plantations can be established in association with other crops in home gardens. For instance, Gliricidia can be planted as under crop in 394,836 ha of coconut plantation and Gliricidia can be planted as shade tree in 203,000 ha of tea plantation. Also, Gliricidia can be planted for reforestation. All off-grid villages in Sri Lanka have enough barren land to establish fuel wood plantations as shown in Figure 2.10, in order to generate electricity throughout the year from village Dendro scheme. This would be done without interfering with food crop production and would be in total harmony with the tradition and culture. Electricity and thermal

energy using dedicated Gliricidia will definitely fulfil the future energy requirement of the country.

Figure 2.10: Dedicated fuel wood (Gliricidia) plantation in marginal land

Maintaining a regular supply and having credible supplies of fuel wood to fuel the plant has been foreseen as the major challenge for effective implementing dendro plants at a commercial scale. Since the beneficiaries are dispersed among several sectors, coordinating and monitoring the cross sectoral collaboration of private and public actors could also be a challenge.

Common fuel wood growing model has to be studied to get an optimal plantation model for dedicated plantation. Therefore, following section would discuss the common fuel wood growing models currently available in Sri Lanka to select the best model.

2.3 COMMON FUEL WOOD GROWING MODELS IN SRI LANKA

2.3.1 Overview

Sri Lanka is primarily based on farming and agricultural economy by major rural population with a tree planting culture. Farmers used to grow fuel wood species in their garden and farms with or without a pre defined use to him. Fuel wood species have been planted for many other purposes rather than the fuel wood production. After understanding the possibilities of such species and increasing demand these can be promoted with farmers, as fuel wood models. There are different models which naturally fit with different districts based on geographical as well as climatic conditions of the country. Some approaches were modelled carefully understanding the available scenarios. They are dedicated approach, community based approach, integrated approach (intercrops and under crops), mixed approach and multiple use approach. Out of these five, dedicated approach is the main sources of biomass for power/heat generation for the future and Sri Lanka has a great potential for producing biomass using this model.

2.3.2 Growing approaches

Dedicated approach

Fuel wood growing models can be basically divided into two groups based on rotational time length. Species having more than one year rotational length can be considered as Long Rotational Species (LRS). Fuel wood species grown for fuel wood production purpose as shown in Figure 2.11 in tea plantation are entirely exotic trees with 7 to 10 year rotation with the objective of fuel wood production.

Figure 2.11: Dedicated LRS fuel wood production

Those exotic fuel wood species have been planted in blocks for the purpose of fuel wood production in plantation industries to serve the fuel wood demand which exist within the industry. For example, tea industry require fuel wood for tea processing and hectares of fuel wood LRS plantation have been established in tea plantation. Same species also require long years for the maturity to harvest as timber production is also on objective.

Rotational period of the other group of growing model is less than one year. It is known as Short Rotational Crop Species (SRCS). SRCs are grown in every agro-climatic region in Sri Lanka under different managements in plantations and agricultural systems. Plantations, homestead, farmer fields and naturally grown in road/stream sides are commonly seen in such species. Primary objective of planting such species in most of such places are not for fuel wood production and there are different services in most of such as shade, green matter, support to creeper, fencing, wind breaks and many more. Recent developments in environmental concerns and sustainability measures and increased demand for fuel wood for industrial utilization make fuel wood from SRCs much in demand.

Figure 2.12: Dedicated SRCs fuel wood production

These SRC plantations shown in Figure 2.12, especially the dedicated plantations, have the advantage of stability of supply, producing the best quality biomass and increased efficiency in harvesting and processing. At present there is no significant extent of dedicated energy plantations managed for biomass production in Sri Lanka. Therefore, one such SRC plantation is established in Eppawala in 2016 under the fund and guidance of FAO & UNDP biomass project and name board of that project is shown in Figure 2.13. This land belongs to forest department is entirely allocated for fuel wood production for particular time period.

Figure 2.13: Model fuel wood plantation in Eppawala

Community based approach

One community Fuel Wood plantation is established in Nuwara Eliya district in 2016 under the fund and guidance of FAO & UNDP biomass project and community participation in planting is shown in Figure 2.14.

Figure 2.14: Community fuel wood planting

The objectives of the project is conservation of existing natural forests while providing alternative supply for the fuel wood demand in up country and rehabilitation and improved tree cover in state and private sector lands. There are lots of demand for fuel wood from each tea factory in the district. Low income rural population with traditional and cultural behavior can be seen. Community involvement is sought in different degrees for fuel wood farming. Name board of the community fuel wood plantation in Nuwara Eliya is shown in Figure 2.15.

Figure 2.15: Community fuel wood plantation in Nuwara Eliya

Integrated approach

When Fuel wood species are planted in different arrangement with commercial crops, it is known as integrated approach. Gliricidia sepium is historically grown as boundary fence tree which does not require any special agronomic practices, care of pest control measures due to some inherited genetic characteristic of it. It is a drought resistant tree crop which has the capacity of absorbing nitrogen from the atmosphere

with the least intake of soil nutrients, while fixing nitrogen in to the soil. When Grilicidia is grown as low shade in tea, support tree in papper, vanilla and betel, fences, alleys with seasonal crops, SALTs, it is in integrated approach. Grilicidia can be integrated with coconut plantation as shown in Figure 2.16 and used as a shade tree in tea as shown in Figure 2.17. It was learnt that presently Kurunegala district yield biomass around 225,000 tonnes per annum mainly from coconut plantation and home gardens.

Figure 2.16: Integrated fuel wood production

Figure 2.17: SRC species grown for medium shade in tea plantation

Caliandra is a good shade tree integrated with low shade in tea plantation, successfully uses in up country tea plantations where Gliricidia is not much success as shown in Figure 2.18. Caliandra is recommended for elevations above above 1500m.

Figure 2.18: SRC Caliandra species grown for medium shade in tea plantation

Mixed approach

Mixed approaches are models that are limited to zero involvement in management or naturally evolved and are shown in Figure 2.19.

Figure 2.19: Mixed fuel wood production

Multiple use approach

Multiple used approach can be applied in Matara and Galle district as it has cinnamon and tea plantation. Figure 2.20 shows how monoculture or grown in combination with other crops to obtain more than one economic products.

Figure 2.20: Multiple fuel wood production

For example, Matara district can yield around 225,000 tonnes per annum mainly from tea and cinnamon plantation. FAO and UNDP had funded pilot fuel wood plantation project in Matara district about 5 ha land in forest department and they have cultivated four crops namely Gliricidia, Acacia, Alstonia and Eucaliptus. Name board of the Pilot fuel wood production plantation in Matara is shown in Figure 2.21. It is understood that there no one model fit for all.

Figure 2.21: Pilot fuel wood production plantation in Matara

(a) Gliricidia **(b) Alstonia**

(c) Eucalyptus **(d) Acacia**

Figure 2.22: Species used in pilot fuel wood plantation in Matara

Above four species that are shown in figure 2.22 are planted as fuel wood in Matara pilot project funded by UNDP Biomass energy project.

2.4 SECTOR GOVERNANCE

2.4.1 Overview

Biomass sourcing and supply, variety of source, variety of applications and involvement of many stakeholders are discussed under this section. Some sort of mechanism/sector governance should be there to monitor this issue and assure sustainability. There is pressing reason for addressing this issue to maintain sector

dignity. It is very important to study how other countries addresses this issue. Next chapter is aiming to study how other countries handles this situation, and the mechanisms available.

2.4.2 Biomass sourcing and supply

The fuel wood distribution network is quite simple, and in most cases, non-existent. The majority use of fuel wood is at the domestic level, where the source and the point of use happen to be within the same home garden. Even in industrial usage, the distribution is a one-to-one arrangement, which links the source to the user through a direct fuel wood transport. The fuel wood sector operates with very little interaction with the governing structure of the energy sector. While the industry is moving more and more towards biomass as the preferred fuel mainly due to high furnace oil price in the local market, it is vital to study biomass as a sustainable energy source. Currently there is no biomass storage in the industry. While industries are moving more and more towards the biomass, especially towards fuel wood as the preferred fuel for boilers, inevitably there is a challenge to ensure the supply is sustainable. When the market for the biomass is expanding, there arises a question whether the market is strong enough to cater to the future demand. The increasing demand with limited resources may create a vacuum in the market. The ultimate result is the collapse of the industry. Thus, it is important to ensure the supply of biomass is strong enough to cater the market needs.

Current fuel wood supply chain is informal and volatile. Due to this reason, industry has lack of confidence in both supply (fuel wood production/sourcing biomass) and demand (industrial need) sectors. By developing PCI and establishing fuel wood certification schemes, it can be demonstrated viability of plantations through a livelihood-based approach with a border scope for its application and implementation at the national level. If there is insufficient amount of sustainable biomass, it will lead to unsustainable fuel wood harvesting to meet the demand. When a middle man (supplier) obtains biomass from a home garden, a price has to be paid to the land owner. However, in the case of illegal biomass from the forest, there is no payment involved. Therefore, increased threats are being gradually posed on natural forest

resources. High competition for biomass could be threatening due that the supplier (vendor) chain of biomass is highly informal, thus illegal tree felling might also take place. The fuel wood supply should be available close (around 50 km radius) to the production facility where the boiler or furnace to be installed. The biomass supply from the vicinity would be the most sustainable way to develop the mechanism. The supply of fuel wood may be from large number of suppliers like individual farmers would increase the reliability of supply that a centralized single supplier. However, having signed agreements with suppliers will provide a security for an uninterrupted steam supply as well as for the investment.

2.4.3 Variety of source

Any wood used as a fuel is called as fuel wood. Fuel wood may be in different forms such as fire wood, charcoal, chips, sheets, pellets, and saw dust. End product characteristics of fuel wood such as bulk density, calorific value, and ash content are the key factors of the demand equation of fuel wood in the market. Some processing operations are taken place to manipulate properties of fuel wood for value addition and end product optimizing to suit in industry utilization.

The type and forms of biomass used and their quality vary widely, and there are no local standards for biomass to be used in biomass energy conversion systems. What currently followed are different forms of biomass, such as wood logs, wood chips, saw dust, coconut shells, paddy husk, etc. without any quality aspect-size, moisture levels, calorific value, and density. However, the biomass energy conversion systems are design to use certain form and qualities of biomass for optimum performance. Unfortunately, much of this is inefficiently used in low-tech and absence of standards, conventional systems that cause pollution and wastage of valuable resources.

2.4.4 Variety of application

<u>Cooking</u>

Large quantities of firewood and other biomass resources are used for cooking in rural households despite the fact that they have access to grid electricity and to a lesser extent, in urban households. Even though a large portion of energy needs of

the rural population is fulfilled by firewood, there are possibilities to further increase the use of biomass for energy in the country, especially for thermal energy supply in the industrial sector. Since the major use of fuel wood is in the household sector where about 75% of the total population use biomass for home cooking, the priority has been given to introduce a measure of efficiency to the traditional 5-7% efficient three stone fire hearth to around 20-30%. At the moment there are biomass cooking devices with around 15% efficiency and the programme of improving further is in progress. Unfortunately, much of this is inefficiently used in low-tech, conventional systems that cause pollution and wastage of valuable resources. A recent development in this sector is the emergence of a home cooking stove working on gasification process. This version is initially filled with chipped wood up to the brim, fire it using paraffin, candle wax, or even a trace of kerosene oil. Once the stove starts, it gives a smokeless flame without any suite and ready for cooking. This stove is made of mild steel with the inner lining of refectory material so that its life span is around 4-5 years. There are two versions of it the first model has a small fan located at the bottom to blow clean air into it at the bottom to provide sufficient air needed to maintain the flame. The model does not have the electric motor to drive a blower as the natural draft created due to the hot air rising principle but it works as the first one.

Thermal energy service

Rural industries have the additional opportunity of using fuel wood in heating requirement. It has been estimated that 19% reduction in petroleum usage and 7.5% increase in fuel wood consumption is possible. Furthermore, some industrialists have admitted that jungle wood also is being supplied by the biomass suppliers in the fire wood mix, which is obviously unsustainable and environmentally harmful.

Electricity

Utilization of biomass for electricity generation is gaining a new momentum in Sri Lanka. The concept of biomass based electricity generation – commonly referred to as Dendro – holds much promise to Sri Lanka. Biomass is the most common source of energy supply in the country, with the majority usage coming from the domestic

sector for cooking purposes. Due to the abundant availability, only a limited portion of the total biomass usage is channelled through a market and hence the value of the energy sourced by biomass is not properly accounted. Electricity production using fuel wood is still developing industry. In the longer term, grid connected fuel wood generation (using full range of possible technologies), may become competitive; the greatest potential is for small scale embedded generation using steam turbine, gasification, pyrolysis or high-speed steam engine-based plant.

2.4.5 Involvement of many stakeholders

There are many stakeholders in the biomass sector in Sri Lanka. There are different public authorities function in different roles in the biomass industry. Ministry of power and renewable energy, ministry of environment, Ministry of finance and planning, Ministry of land and land development, Ministry of agriculture, Ministry of coconut development, ministry of wildlife resource conservation, ministry of economic development, ministry of investment promotion, ministry of irrigation and water resource management, ministry of local government and provincial, ministry of public administration and home affairs, Ministry of labour, Ministry of plantation industries are actively involving in biomass sector. About 25 institution coming under above 14 ministries are actively involving in Biomass industry. Among them, Sri Lanka sustainable energy authority, Forest department, Sri Lanka Standards Institution (development of standards and certification systems for biomass), National Engineering research and development center (development of biomass technologies) are played an important role in biomass industry. There are 33 number of acts and ordinance, 16 number of regulations and 2 number of policies exist in the country related to biomass industry. There are international development organization such as UNDP and FAO associations such as Bioenergy Association of Sri Lanka and Integrated Development Association working on Biomass related areas.

2.4.6 Challenges

Current fuel wood crisis is due to so many reasons. There can be research issues, resource issue and supply chain issue, traceability issue, sustainability issue standard and certification issue. One of main barriers for improving efficiency in technology

used in supply chain is the non-availability of standards for biomass used in Biomass Energy Conversion System. This has prevented introduction of new technology, especially for improving quality of biomass produced and transporting biomass. For example, size of wood logs vary widely and, therefore, introduction of standardized handling equipment and transportation vehicles are difficult. Similarly, no standards are available for the wood chips, and, therefore, there is no requirement for introducing modern wood processing equipment which can produce wood chips of pre-determined quality. Lack of standards/regulations against overloading of biomass, especially wood logs, prevents proper adaptation/modification of existing lorries/tippers/tractors, etc. for safe transportation of biomass to end users.

Some sort of mechanism should be there to monitor the above issue and assure sustainability. There are pressing reasons for addressing above issue to maintain sector dignity. It is very important to study how other country addresses this issue. Next chapter is aiming to study how other country handle this issues and situation and the mechanism available. This certification is aiming not only for dedicated plantation but also for the other sources mention above except waste agricultural biomass and waste wood. Having considered above facts, in depth study is required to develop a certification scheme. Next implementation challenges also have to be considered when designing a new certification for the country for the first time. To implement a certification scheme successfully, very detail study is required.

CHAPTER 03

GLOBAL CERTIFICATION SYSTEMS AND ORGANIZATIONS

3.1 OVER VIEW

This chapter addresses international systems and organizations. Some of them are country specific, while others are regional or international. Background related to such certification systems and organizations in the development of the biomass certification schemes, such as national governments and regional bodies, companies, Non-governmental organizations (NGOs), Networks and round tables and International organization in the world are discussed to review the facts. This chapter discusses the different initiatives in the field of current biomass certification system and organizations and acronyms, full name, and URL of the international and national initiatives given in appendix B. The numerous initiatives being undertaken are in various stages of development, ranging from the discussion phase to full implementation. Most of the literature are discussed to continue the study under this chapter. This research performs a review of a large portion of existing scientific literature on effective principles and criteria that can be used to identify and quantify the sustainability attributes of bioenergy options.

3.2 COUNTRY SPECIFIC CERTIFICATION SYSTEMS

3.2.1 Over view

Possible roles of any government would be to set minimum standards for biomass certification through biomass energy policy frame work. Government can introduce subsidies and regulation as policy measure to promote sustainable biomass. Further national government can support to build up expertise in implementing biomass certification system. Most of the developed countries around the world have recently adopted policies that require, or strongly encourage, increases in the production and use of bioenergy and in specific biofuels over the next 5–10 years. It was very difficult to find any certification system developed by Asian region. Currently, there are a number of countries active in biomass and biofuels certification, including the

Netherlands, Germany, the United Kingdom, Switzerland, Brazil, Canada and the United States. There is no PCI standard and certification system established in Sri Lanka.

3.2.2 Netherlands

At the request of the government a project group was formed under the chairmanship of Prof. Dr. Jacqueline Cramer for 'sustainable production of biomass' in 2006. The developed sustainability criteria for biomass and bioenergy, the so-called 'Cramer Criteria' [22] are translated into a national standard: Netherland Technical Agreement 8080 (NTA 8080) [23]. NTA 8081 is the successor of NTA 8080. NTA 8081 will include the European guidelines. Criteria of NTA 8081 will be linked to the subsidies for electricity companies in 2010. The 'Corbey' Commission that was established in 2009, advises the government on sustainability issues of biomass and bioenergy. Recent recommendations include an advice on the implementation of the EC-RED reporting obligation, how to deal with ILUC and including sustainability criteria for solid biomass on European level [24].

3.2.3 United Kingdom

The Renewable Transport Fuel Obligation Programme (RTFO) is the United Kingdom's primary policy aimed at delivering on the objectives established by the European Union Biofuels Directive. The RTFO requires suppliers to ensure that a certain percentage of their aggregate sales are made up of biofuels from April 2008.

As well as obliging fuel suppliers to meet targets for the volumes of biofuels supplied (3.5% in 2010/11 of biofuel use by volume), the RTFO requires companies to submit reports on the carbon emission savings and sustainability of the biofuels [25].The reporting standard is based on a 'meta-standard' approach under which existing voluntary agro-environment and social accountability standards have been benchmarked against the RTFO Meta-Standard. Transport fuel suppliers are allowed to report, at least initially, that they do not have information on the sustainability or otherwise of their biofuel [26].

3.2.4 Germany

There is a long lasting discussion on legal requirements for the sustainability of solid and gaseous biomass for Europe. However, the EU-Commission decided in 2014 not to draft respective requirements on EU level but to leave that issue to the member states. There is no legally binding 3rd party certification for fuel wood in Europe or Germany, respectively. There are certification systems like FSC and PEFC in place for sustainable forestry which have a high coverage (average 90%) in most of the EU Countries including Germany. There is, however, no distinction made between wood for bioenergy and other forest products. Rather these are management standards. There are private sector/ voluntary schemes [27]. The discussion on legally binding criteria will start again soon as the 'Post 2020 Agenda' is on the table for discussion and many stakeholders are unhappy with the lack of sustainability requirements for solid (and gaseous) biofuels in the EU. In Germany, the Biomass Sustainability Ordinance for the Electricity Sector is designed to grant feed-in-tariffs for electricity production from liquid biomass on the basis of the EC-RED Directive requirements [28].

3.2.5 Australia

At the government level there is an Australian Renewable Energy Agency (ARENA) that supports and funds Bioenergy development along with other renewables. In terms of industry collaboration, there is Bioenergy Australia that acts as the engagement point for national information sharing and connection to international networks like IEA Bioenergy Tasks, ISO standard development and IRENA. If it is about environmental impacts, it is managed by the same environmental enforcement agencies as all other industry. Any residues captured in forest supply chains are covered by forestry sustainability certification (ie. FSC) but these do not cover biomass/bioenergy specific issues. There have been a number of projects discussed in different regions of Australia to use both woody weak management material as well as residues from bush fire risk mitigation work, but there is no any sustained programs using the material for energy. Due to a range of reasons, Australia is not as advanced in the use of bioenergy as regions like Europe. As such development of technology and systems in Australia is leveraged heavily by developments and

experience in Europe and North America. While it is not simply an importation or transfer of the technology, it is often the basis on which local solutions are developed and deployed. This has also allowed Australian industry to be uniquely placed to identify opportunities to target innovation to advanced solutions and has allowed them to take some leadership in second generation liquid fuel development [29].

3.2.6 Brazil

Brazil has a long tradition on biofuels. So institutions have a long history and evolved along time. Nowadays they have a mandate on ethanol (27% blends to gasoline) and biodiesel (7% blend to diesel). And a large portion of Brazilian light fleet are flex, that means, cars can run with any mix of gasoline and ethanol. Mandates are defined by the National Agency for Petroleum, Natural Gas and Biofuels (ANP). As ethanol is widely used for more than 40 years, regulations are mature in this case. Anhydrous ethanol is mixed with gasoline and hydrate ethanol is sold apart. Every gas station shall also provide hydrate ethanol for consumers and gasoline distributors deal directly with ethanol producers to buy the hydrate and anhydrous ethanol they need. There are regulations for quality of ethanol that are well established by legislation. Biodiesel mandate was established last decade and blend increased from 2% to the 7% in place now. Biodiesel supply is organized through auctions. From time to time (in general every 3 months) an amount of biodiesel is commercialized in auctions. A centralized system connects producers to distributors and solves possible supply bottlenecks. To be able to participate in these auctions, a supplier shall have a social seal. The social seal is a mechanism created to include smallholders into the supply chain. The biodiesel producer shall buy a percentage of its raw material (oil) from smallholders and also shall provide technical assistance to these smallholders. There is a federal structure to supervise these operations and assign the social seal. In fact, a producer receives social seal for a certain amount of biodiesel. Recently it was allowed to blend up to 20% of biodiesel in private or public fleets (not mandatory) which was seen by the sector as an opportunity to improve markets near oil production areas where biodiesel price may be competitive with diesel. In the same Act, it was signalled that rural machines

and fleet (tractors, trucks, farm machinery etc.) could use an up to 100% biodiesel fuel [30].

3.2.7 Canada

Canada, which is a major producer and exporter of wood pellets and produces ethanol from grain as well as biodiesel from a variety of feed stocks. There is currently no mandatory certification to promote sustainability in the biofuels industry. The environmentally beneficial attributes of ethanol-blended gasoline have resulted in its designation as an "Environmental ChoiceTM" product by the Canadian General Standards Board, and it is therefore eligible to have the "EcoLogoTM" displayed at licensed retail outlets. Launched in 1988 as Canada's national eco-labelling programme, EcoLogoM is an independent, third-party, green certification organization. The certification label serves to mark a wide range of products and services deemed preferable or less harmful to the environment. The label depends on consumer preference for environmentally-sustainable products, hence, providing a marketing advantage to companies who acquire certification. The EcoLogoM has criteria for renewable energy sources with specific criteria for biomass and biogas. The Canadian grains sector has established the Canadian Roundtable for Sustainable Crops, and is intending to develop an assurance protocol that can be used to assess the sustainability attributes of the grains (oilseeds, corn, wheat, etc.) that are used for food but that can also be used as biofuel feedstock. The protocol is in early stages of development. Canadian canola oil and seed that is used for biodiesel production in the EU must comply with the sustainability requirements of the Renewable Energy Directive (RED). Significant tonnage of oils and seed are certified every year in Canada. Currently, ISCC is the predominant certification scheme used in Canada [31].

3.3 REGIONAL BODIES

3.3.1 Overview

Role of regional bodies is to formulate policy or legal framework on biomass certification on regional level, integrating standards certification system into regional policy. Regional bodies can promote coherence of national policies on regional level.

Regional bodies can formulate specification of set of biomass standards by refining national standards into regional conditions. Regional bodies can support to build up expertise in implementing biomass certification system. On the supranational level, the European Commission is active in the development of certifying biofuels and biomass.

3.3.2 European Commission

CEN (European Committee for Standardization) had established CEN/TC 383. The main expected benefit of CEN/TC 383 is to define standards that support certification for sustainably produced biomass for energy application and introduction of it on the EU market. Next , it will brings confidence for the consumers with respect of sustainably produced and processed biomass. Mandatory targets for an overall share of 20% renewable energy and a 10% share of renewable energy in transport in the EU's consumption in 2020, was set by The European Commission (EC) and translated into individual targets for Member States (MS). Environmental criteria such as GHG emission reductions, biodiversity conservation and good environmental management practices are developed and laid down in the Renewable Energy Directive (RED) to guarantee the sustainability of biofuels and other bio liquids. Biofuels and other bio liquids that do not meet those criteria are not taken into account for the mandatory targets. Sustainability criteria for biofuels and other bio liquids had been implemented from 2011 onwards. The requirement for a sustainability standard for solid biomass is under discussion at the EC. Sustainability standards are introduced by various individual European Member States.

3.3.3 Asia

The Chinese government has said that biofuels should not jeopardize food production. Current policies imply to discourage food crops in biofuels production but continue to provide production subsidies for ethanol from corn, wheat, and other Crops [32]. The central government in Indonesia has established laws and regulations guiding biofuels expansion, including a ban on further forest destruction. Indonesia's Agricultural Ministry announced, however, in 2009 that it would lift the moratorium on palm oil plantations on peat lands. Indonesia considers Jatropha and

coconut oil in its next phase of expansion in order to avoid competition with crude palm oil. The Japanese Government has established a voluntary label, called the 'Biomass Mark', that can be obtained when a commodity originates totally or partly from biomass [33, 34]. This is, however, not coupled to any sustainability requirement.

3.4 PRIVATE COMPANIES

3.4.1 Overview

Company have built experience in certification through (pilot) studies over the complete biomass chain, gradual learning and expansion of system over time. Promoting, coordination and cooperation is done between companies on development of biomass certification system. A company can do technical improvement to biomass related product. In recent years, companies and company associations have taken the initiative to develop (business-to-business) standards to guarantee the sustainability of bioenergy for fuel, heat and electricity. The numerous developments in the field of certification of biomass and biofuels have motivated companies in the industry to initiate their own standards and certification schemes. Various companies involved in the biofuel and biomass supply chain are active in the discussion of biofuel and biomass certification. While nations and international actors tend to have a broader view of certification, corporate initiatives tend to focus on their own sectors when defining principles and criteria. Companies have taken steps to explore and establish certification schemes through international initiatives and collaborations with Governments as well as establishing their own standards.

3.4.2 Cargill B.V, Cefetra and the bank Rabobank International

Cargill B.V. and Cefetra – as traders and raw material suppliers of biomass – and the bank Rabobank International are among the members of the Dutch "Sustainable Production of Biomass" project group (see section above under Netherlands). The bank has recommended that bio-energy projects be judged on a case-by-case basis, taking ecological, social and economic criteria into account.

3.4.3 BioX

BioX has also joined the Green Gold Label programme and has developed its own code of conduct for energy generation. Additionally, BioX, in collaboration with Control Union, is evaluating RSPO criteria for auditing and certification purposes. Furthermore, BioX has initiated a study on the carbon dioxide emissions related to the growing, production and transport of palm oil, an issue that has not been covered by RSPO criteria. It is through collaborations such as the Dutch project group, RSPO and the Roundtable on Sustainable Biofuels that many companies are pursuing certification efforts. Recognizing the certification will require a harmonization of standards and criteria, they have chosen to work in collaboration with other interested parties. However, several companies also continue to pursue sustainability standards on their own.

3.4.4 British Petroleum (BP)

British Petroleum (BP) has been actively engaged with the United Kingdom Government in the formulation of the RTFO. In addition, through its membership of the Low Carbon Vehicle Partnership, it has continued to support the development of the United Kingdom Biofuels Assurance Scheme. BP participates in the Roundtable on Sustainable Biofuels.

3.4.5 Shell International

Shell is working with its suppliers to incorporate clauses in supply contracts that ensure biofuel components are not knowingly linked to violation of human rights (including child/forced labour) and recent clearing of areas of high biodiversity value as defined by feedstock specific multi-stakeholder initiatives and national regulations. The company encourages its suppliers to establish a supply chain traceability system and reserves the right to conduct independent audits of its suppliers and to terminate contracts. It has appointed a biofuels sustainability compliance officer and team to oversee and coordinate implementation of Shell’s commitments on sustainable sourcing of biofuel components. Shell participates in the Roundtable on Sustainable Biofuels and the Roundtable on Sustainable Palm Oil.

3.4.6 Electabel

Electrabel label is a certification procedure for imported biomass and developed by Electrabel, a European energy company based in Belgium, part of the GDF Suez group. For Electrabel, it is necessary to notify a potential supplier of all requirement made by Electrabel concerning the sustainability criteria for being accepted within the Belgian green certificate systems and the technical specification of the product for firing it in a thermal power plant. The company has drafted a "Supplier Declaration" which details the requirements that biomass must meet in order to be accepted under Electrabel's standards. This document must be signed by the producer and verified and stamped by a certified inspection body. The inspection company is responsible for checking the document and carrying out an audit of the plant and supply chain [35].

3.5 NON-GOVERNMENTAL ORGANIZATION

3.5.1 Overview

Non-Governmental Organization (NGO) keep watch over the reliability of the system in development. They are representing and involving the less powerful in discussion on biomass certification. They build up experience through pilot studies and work in the field, mainly on the biomass production side. NGOs trigger the discussion proposals by the development of principles and pathways for implementation of a biomass certification system. Most of the NGOs have voiced fear that biofuels have been regarded in an excessively positive light and that officials must recognize the drawbacks that following the growth of the biofuels industry will bring. Following NGOs are dynamically involved in the development of a biomass certification system. NGOs are mainly dynamic in production side of the biomass supply chain and have a strong concern about the environment and well-being of the poor in rural areas. Position papers, including sustainability principles or key concerns for sustainable biomass are developed by, as far as known, the following NGOs:

3.5.2 NGO in South Africa

NGO in south Africa [36] are interested in full Life Cycle Analysis (LCA) and energy balance. No extension is given for productive land to be used as biomass production. They are interested in energy to poor by their own production and economic stimulus to rural communities. They give training to build capacity to acquire require capabilities, conserving of farming techniques and intercropping are maintained. Genetically Modified Organism (GMO) are prohibited. No extension of irrigated land is used for biomass. Environment Impact Assessment (EIA) is used to determined pollution control.

3.5.3 WWF Germany

WWF Germany [37] defined level of GHG output and efficiency in full LCA. WWF has given priority for food supply and food security, includes regional impacts. Health impact, worker rights, and no human right violation are considered under working condition. Right to land used is clearly defined. No additional negative biodiversity impacts is allowed and no negative land used changed is allowed. They give training to build capacity to acquire require capabilities. Additional soil erosion and degradation is not allowed. Conserving of water bodies is paramount important. Land used planning is deployed.

3.5.4 Energy working group of the Brazilian Forum of NGOs and Social Movements for Environment and Development (FBOMS) in Brazil

FBOMS [38] is focusing on diversification of energy mix, crop diversity and food security and no monocultures. FBOMS is concerned on rural credits, job income and generation, labor relations and decentralization of activities. FBOMS want to minimize or eliminate of pesticide use and comply with ecological zoning. They give training to build capacity to acquire require capabilities and technology transfer and regulatory compliance. FBOMS has included ‘gender equality’ as a separate criterion while this criterion is not or hardly mentioned in other NGOs. These difference arise from the different backgrounds and aims of the NGOs described. However, it would be beyond the scope of this project to describe these aims as well.

3.5.5 IATP in the USA developed sustainability principles for bio industrial crop production

IATP [39] is a USA based NGO and has 11 principle in place. They are energy efficiency and conservation, economic sustainability, Safe and healthy working condition, Respect social and cultural heritage, promote biological diversity and nature, Sound nutrient management, Strengthening the soil protecting water, protecting air, Prohibit GMO and stakeholder participation and transparency.

3.5.6 NGOs in The Netherlands, including Milieudefensie, BothEnds, WWF, Greenpeace, Natuur en Milieu, Oxfam Novib.

Dutch NGOs [40] and [41] located in Netherland. Principle listed in reports and position papers are Significant GHG emission reduction and positive energy balance, No violation of right to food security, concern for indirect land use competition, Promote local socioeconomic development, respect human right, revenue invested in environment, maintained, production energy crops increases ecological quality, Sustainable use of soil water air resources, and good governance and land use planning. In conclusion, NGOs play an active role in forums for certification, engaging in research and publishing papers presenting proposals for principles and criteria for sustainable biomass and biofuels certification. They tend to not only present environmental concerns, but also champion the interests of the rural poor. Some NGOs have initiated pilot studies and suggested implementation strategies for certification systems.

3.6 NETWORKS AND ROUND TABLES

3.6.1 Eugene

European Green Electricity Network (Eugene) has created a standard of quality for green power to provide a benchmark for environmental labelling schemes. Eugene is an independent network that pursues no commercial interest and acts to bringing together non-profit organizations such as national labelling bodies, experts from environmental and consumer organizations, and research institutes. The Eugene Standard applies to geothermal, wind, solar, electric, hydropower and biomass energy and is given to defined “eligible sources”. Eligible sources for biomass

include dedicated energy crops, residual straw from agriculture, etc. Specific criteria for eligible biomass resources, such as production methods, are not specified by the standard. The Intelligent Energy Europe project, "Clean Energy Network for Europe (CLEAN-E)", was designed to accompany the establishment of new green electricity product labels and the improvement of existing ones in selected European Union member States. The CLEAN-E project has supported the efforts of Eugene and correspondingly Eugene has served as the major point of orientation for the project. Among other things, the project has explored the development of ecological minimum standards for biomass. The studies undertaken by the project are meant to support the possible certification of biomass and included a proposal of biomass criteria for application by the Eugene Standard. The project has also published a report evaluating the experiences with the pilot application of the developed biomass standards [42].

3.6.2 Roundtable on Sustainable Palm Oil

The Roundtable on Sustainable Palm Oil (RSPO) [43] is a multi-stakeholder platform, which aims to promote the growth and use of sustainable palm oil. The objective of the RSPO is to support the growth and use of sustainable oil palm products through trustworthy global standards and engagement of stakeholders. The RSPO standards is created upon the following eight Principles, namely: (a) commitment to transparency; (b) compliance with applicable laws and regulations; (c) commitment to long-term economic and financial viability; (d) use of appropriate best practices by growers and millers; (e) environmental responsibility and conservation of natural resources and biodiversity; (f) responsible consideration of employees and of individuals and communities affected by growers and mills; (g) responsible development of new plantings; and (h) commitment to continuous improvement in key areas of activity. None of these principles has a direct link to energy or CO2 emission as the standard was developed for food application. A GHG working group was formed in 2008 but could not come to consensus so far.

In November 2007, the RSPO certification system for sustainable palm oil was launched. RSPO certification audits need to be initiated by palm oil producer, by

contracting one of the approved certification bodies accredited by the RSPO. The cost of audits is in principle born by the producers. Cost are a problem. Palm oil has to compete with oil and electricity which are very cheap at this moment. There is no motivation to pay more for 'sustainable' palm oil. It is necessary to offer added value or subsidy; this is not the case in the current situation.

3.6.3 Roundtable on Sustainable Biofuels

The Roundtable on Sustainable Biofuels (RSB) [44] was initiated and coordinated by the energy centre (CEN) of the Ecole Polytechnique Fédérale de Lausanne, Switzerland. The objective of the RSB is to achieve global, multi stakeholder consensus around the principles and criteria of sustainable biofuel production. The RSB is a multi-stakeholder initiative, which develops a standard for sustainable biofuel production through an international consultation process (it host meeting, teleconferences and on line discussions). It gathers experts from about 40 countries and various sectors, from NGOs to oil companies, from academic to government representatives. Its aim is to bring together farmers, companies, NGOs, experts, Governments and intergovernmental agencies concerned with ensuring the sustainability of biofuels production and processing. The RSB is involved as an observer in the CEN/TC 383.

In August 2008, RSB released its "Draft Global Principles for Sustainable Biofuels Production" for global stakeholder feedback and the requirements for biofuel producers are divided into the following twelve broad principles; they are (a) Legality; (b) Planning, Monitoring and continuous improvement; (c) greenhouse gases emissions; (d) Human and labour rights; (e) socioeconomic development; (f) Local food security; (g) conservation; (h) soil; (i) water; (j) air; (k) Use of Tehnology, Inputs, and Management of waste; (l) Land rights. According to the RSB, the 12 draft principles are highly aspirational, and represent an ideal performance of biofuels. By complying with the RSB requirements, producers ensure that their production remains sustainable and beneficial compared to fossil energy.

3.6.4 Round Table on Responsible Soy [45]

The stated goal of the Round Table on Responsible Soy (RTRS) is to promote economically viable, socially equitable and environmentally sustainable production, processing and trading of soy. In November of 2006, a final draft of the principles of the RTRS was approved. It put forth three main principles – economic responsibility, social responsibility and environmental responsibility – each with a number of sub-principles. Currently, RTRS is inviting nominations for participation in the RTRS Principles, Criteria and Verification Development Group (DG). The DG is tasked with producing a set of verifiable principles, criteria and indicators that define responsible production and early stages of processing of soy beans and with developing a verification system.

In summary, international networks and round tables serve a role in (a) facilitating discussions on biomass and biofuels certification among stakeholder groups; (b) promoting certification initiatives by providing a forum for developing principles, criteria and indicators; and (c) carrying out pilot studies to better understand the implication of certification implementation. Additionally, these efforts may have the advantage of being able to develop sustainability schemes and achieve results in relatively short time frames in comparison to multilateral/international processes, which are inherently long and complex.

3.7 INTERNATIONAL ORGANIZATION

3.7.1 Overview

A number of international organization have been active in discovering certification for sustainable biomass and biofuels. Their work ranges from policy guidance to principle, criteria and indicator development. In the policy field there is some overlap of interests and many corresponding initiatives.

3.7.2 United Nations-energy

United Nations-energy is an interagency mechanism aimed at promoting coherence in the United Nations system's multi-disciplinary response to the World Summit on Sustainable Development (WSSD) and engaging non-United Nations stakeholders. In April of 2007, United Nations-Energy published a paper titled "Sustainable

Bioenergy: A Framework for Decision- Makers" [46]. The paper speaks of the need for an international certification scheme that ensures that bioenergy is produced using the most sustainable methods possible and that "includes GHG verification for the entire life cycle of bioenergy products, particularly biofuels".

3.7.3 UNCTAD Biofuels Initiative

UNCTAD launched its Biofuels Initiative in June 2005. The Biofuels Initiative seeks to provide technical analysis of issues related to biofuels production and trade that will impact member countries, especially with the objective of sharing experience and providing support to developing countries. Certification of biofuels has been an issue raised in numerous meetings organized by the Biofuels Initiative and has been addressed in past reports by the agency. The analysis of labelling, certification and other market instruments fall within the core mandate of UNCTAD. The agency has provided along the years support to policymakers, especially from developing countries, on those issues.

3.7.4 Food and Agriculture Organization of the United Nations

In May of 2006, the Food and Agriculture Organization of the United Nations (FAO) launched the International Bioenergy Platform (IBEP). One of the activities IBEP seeks to tackle is to assist in the development of an international scheme to develop workable assurances and certification bases principles, methodologies, criteria and verifiable indicators. The agency has stated that, starting in December 2006, it would work to develop an analytical framework to assess the implications of different types of bioenergy systems for a set of different food security contexts. The result will be the formulation of national strategies, based on recommendations on how to undertake bioenergy development [26]. The Forestry Department of FAO is also working on biomass certification. In cooperation with IEA task 31, they are evaluating principles, criteria and indicators for both biomass from forest used for energy, as well as for wood fuel and charcoal production systems. The study includes a review of existing forest certification schemes. Based on this, criteria are formulated to cover forest biomass for energy. The agency stated that these criteria would be tested in the field using case studies starting at the end 2006. Using the

results of the assessment, a set of criteria covering ecological and socio-economic aspects of the production cycle will be developed and eventually be tested in the field.

3.7.5 United Nations Environment Programme

The United Nations Environment Programme (UNEP), through its involvement in the Roundtable on Sustainable Biofuels (RSB), is pursuing a multi-stakeholder approach in developing an international scheme to assure the sustainability of bioenergy. Such a scheme should fulfil several purposes: (a) provide Governments with guidance on how to ensure sustainable and therefore longlasting use of their natural resources; (b) advise industry on managing risk, both reputational and financial; and (c) allow consumers to make an informed choice. UNEP has asserted that the scheme should be formulated around a set of internationally accepted principles and criteria, addressing the main risks and concerns while remaining manageable and avoiding excessive administrative burden on producers of biofuels. The organization has acknowledged that said principles and criteria will need to take into account and build on criteria used in existing national and commodity-based systems. UNEP has singled out biodiversity, climate change, land use, and water and labour issues as areas that must be addressed under a certification scheme [47].

UNEP, in collaboration with the RSB, is organizing joint regional outreach events to ensure involvement of different stakeholder groups in the different regions. In collaboration with DaimlerChrysler, WWF, and the Ministry of Agriculture of Baden Wuertemberg, UNEP produced a set of preparatory documents. A working paper was published that reviews existing certification systems linked to biomass certification, compiles overviews of certification labels (forestry, bioenergy and palm oil, agricultural and trade labels), details the crop requirements for a number of utilized crops, and examines ongoing initiatives by the international communities and country policies on biofuels [48].

3.7.6 Global Bio-energy Partnership

The Global Bio-energy Partnership (GBEP) was launched during the Ministerial Segment of the fourteenth session of the Commission on Sustainable Development (CSD14) in New York on 11 May 2006. Partners of the organization are Governments, intergovernmental organizations and some private sector associations [29].Among the activities the partnership is carrying out is the task of developing methodologies for measuring the greenhouse gas (GHG) impacts of biofuels and, more specifically, focus work on the harmonization of such methodologies. A specific task force has been established to deal with this highly technical issue. In June 2008 GBEP established a task force on sustainability with the aim to develop a voluntary framework of international sustainability principles for bio-energy.

3.7.7 IEA Bioenergy Task 40

IEA Bioenergy provides a canopy organization and structure for a mutual effort where national experts from research, government and industry work together with experts from other member countries. The objective of the task is to support the development of a sustainable, international, bioenergy market, recognizing the diversity in resources, biomass applications.

The IEA Bioenergy Task 40 on International Sustainable Bioenergy Trade [49] is active in research and initiatives to investigate the requirements for the creation of a commodity market for bioenergy. Task 40 has made certification, standardization and terminology for sustainable biomass trade key priorities. Past studies from Task 40 members have covered the development of a certification system for sustainable bio-energy trade [50]. At this point in time, international bodies and initiatives have mainly been involved in supporting research and the publication of papers that address the development of criteria and indicators as well as the implementation of certification schemes. Additionally, they have been active in case studies, collaborating with other international initiatives and round tables, and providing country specific analysis.

3.7.8 International Organization for Standardization (ISO)

In response to the growing international interest in bioenergy, and lack of globally harmonized sustainability criteria, the International Organization for Standardization (ISO) has decided to form a standard for sustainability criteria for bioenergy. The preparing of International Standards is normally carried out through technical committees referred to as ISO/TC. ISO/TC 248 prepared a global standard for sustainability criteria for bioenergy. The development of ISO 13065 Sustainability criteria for bioenergy standard was originated from a proposal of Brazil and Germany in the year 2008 (in which the title was "Sustainability criteria for biofuels"). A majority of voting ISO members agrees with the proposal, but suggested to start as a preliminary project. Subsequently in June 2009, a preliminary meeting was held in Berlin, Germany, where the present title was agreed upon with the scope of "Standardization in the field of sustainability criteria for production, supply chain and application of bioenergy". This includes terminology and aspects related to the sustainability (e.g. environmental, social and economic) of bioenergy. Presently, there are thirty three (33) participating countries (referred to as P-Members with voting power) and twelve (12) observing countries (referred to as O-Members without voting power). Sri Lanka is a P-Member and it has national mirror committee (NMC) to vote and send comments.

3.8 CRITICAL REVIEW

One may question that when there is national standards and certification system, why they want international standards and certification system to operate in the same country. On the other hand, one country may develop national standard and certification system looking at global standard and certification systems. The answer is that different governance mechanisms have arisen to make sure biomass and bioenergy sustainability ensured at a number of levels, in many regions of the world. Those mechanisms may take the shape of legislation, international agreements, jurisdictional guidelines, company policies, or market-based certification schemes. One important example is the European Union, which decided in 2009 to put into action legislative sustainability criteria for liquid biofuels (included in the EU-RED).The sustainability criteria in the EU-RED must be adhered to in order for

bioenergy production to calculate toward Member States' renewable energy targets. Group certification, national verification and certification of entrepreneurs were among the support tools that were studied as most effective alternatives to ensure sustainability. Multilateral initiatives (such as the Global Bioenergy Partnership) and bilateral or multilateral agreements were not seen to be as effective as the other presented alternatives by a large number of papers. Any paper did not seem to support non-certification systems as a viable alternative. Examples of these systems include best practice guidelines, labeling systems, producer manuals, environmental or social impact assessments. Some of the papers reviewed mention that there was redundancy in the multiple certification schemes and initiatives operating in their countries, there is overlap or redundancy among schemes. Among these papers it was mentioned that the larger number of schemes have value so that various experiences can be gained; that they are needed to address country specific conditions; and that competition is important in the market place in the absence of common international standards. They further indicated how the supposed redundancy caused problems in the market. The vast majority of papers indicated that redundancy creates a lack of transparency in the market, and a lack of consistency due to different requirements.

Some papers commented that there is confusion around definitions of sustainability. Auditing and accreditation requirements may also be quite different. Some paper mentioned that the redundancy creates or reinforces trade barriers, while some other papers said it does not. Few authors believe that the redundancies in certification systems lead to an unwarranted discrimination in the use of raw materials. The most supported solution to addressing the redundancies was through mutual recognition of different schemes. Authors also believed that introducing meta-standards endorsing existing voluntary systems and reducing the number of schemes were also important solutions to consider as well. Many of these suggestions are currently taking place in certain regions of the world, such as the EU-RED which has endorsed a number of voluntary schemes as meeting the necessary sustainability criteria for biofuels in the EU. This review shows that there are several risks associated with certification, including high administrative burdens, increasing commodity costs, and applicability of criteria varying by location. It was understood that from the literature survey, it is

required to develop a PCI which applies to local conditions. As a country we can not in isolation move towards sustainability. We can not rely only on national certification system. Mixture of both national and international is recommended.

CHAPTER 04

METHODOLOGY

4.1 OVERVIEW

Description of the method and list of activities are presented. Results of the activities are presented in chapter 5. The issues identified through the literature review were used as a basis for creating the Principles. Later Criteria, Indicators and Verifiers were identified for selected Principles. Methodology comprises of following stages. These key stages are planning, analysis of stakeholder feedback, prioritization and selection of Principles, establishment of criteria and indicators, validation of PCIs and establishing a certificate system as shown in Figure 4.1. Stepwise process is used to develop Principles based on intensive stakeholder interaction. It was started with comprehensive review of available literature on biomass and on various methods for measuring PCIs. Further, small survey was designed and launched among biomass related local experts to select and prioritize the eight principles that come out from literature survey. Based on the experience on the subject, the relevant Principles were double checked during the stakeholder meeting. Stakeholder meeting helped to identify principles which are best suited to Sri Lankan conditions. Interviews and consultations took place with the participation of twenty experts meeting seven times.

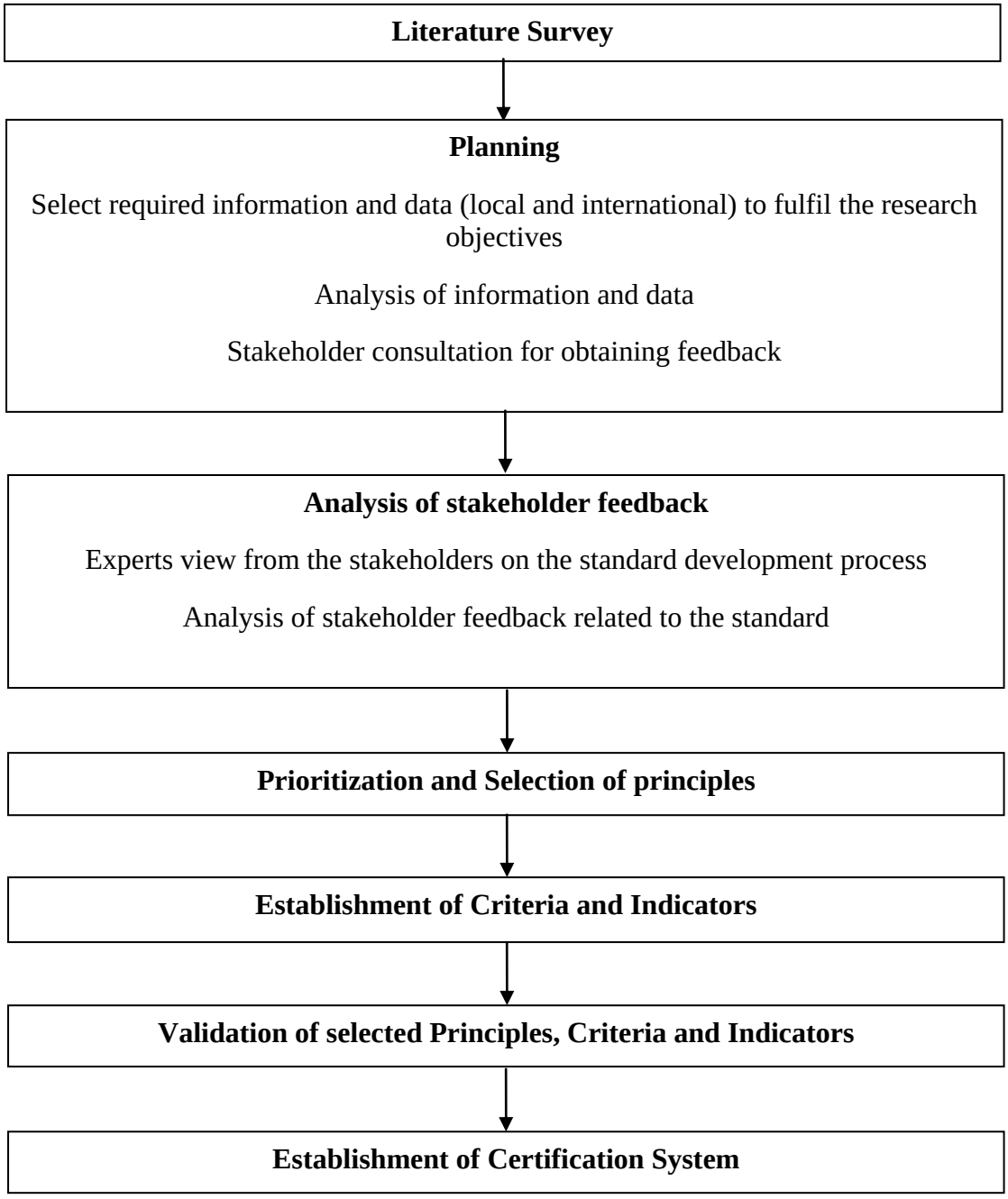

Figure 4.1: Framework of the methodology.

4.2 PLANNING

A comprehensive literature review and a desk study of key research papers written on bioenergy were analyzed in this research study. PCIs were collected from above literature survey which was called secondary information. First-hand information of Principles related to bioenergy certifications around the world were gathered

consulting international bioenergy experts through author's personnel contracts. After that, Principles developed from desk study were double checked using international expert consultation. Next, a physical committee was formed to analyse the Principles that were developed from desk study and consulting international experts. The material collected from literature survey is highly complex with varying different focus and aims, and divided into eight principles. Further, a small survey was designed and launched among biomass related local experts to select and prioritize the eight principles that came out from literature survey. Results of the literature survey was again discussed at the meeting. After lengthy discussion, committee agreed with the output of the survey. Finally, criteria and indicators were identified for selected principles.

4.3 ANALYSIS OF STAKEHOLDER FEEDBACK

The feedback from all the relevant stakeholder of the biomass energy sector have to be taken to develop nationally appropriate standard and certification system, covering the following stakeholder group.

- Sector research institution
- Academia
- Regulatory authority
- Industry: Producers
- Industry: End users
- Traders
- International development organizations
- Associations
- General public

The consultative workshop/meetings should be conducted to obtain experts judgement on principle identified from literature survey. Equal weighted was given to all principles during survey. First prioritize and then select based on the committee requirement.

4.4 PRIORITIZATION AND SELECTION OF PRINCIPLES

A survey has to be conducted to prioritize the identified Principles. Eight principle that was identified from the literature survey was presented as shown in Table 4.1.

Table 4.1: Overview of the structure and question of the survey

No	Principles	Put the ranking as 1, 2, 3…
1	Legal compliance	
2	Workers' rights and employment conditions	
3	Community relations and engagement	
4	Long-term economic and ecological viability	
5	Environment aspects	
6	Origin of plantation	
7	Planning and monitoring	
8	Group management	

Note: Please give number "1" for the most important principle and number "8" for the least important principle

The typical questions required to be answered as classified into 1, 2, 3, and so on giving number "1" for the most important principle and number "8" for the least important principle. Under this survey, eight principle was presented in a Table 4.1 and asked expert to number the principles as in ascending order of importance to the local situation giving equal weightage. In other words, it was asked to arrange the

order of the principles as per the applicability, relevance, and importance to the local Biomass industry. In 2017 July, the survey was sent to more than 50 potential respondent of different capacities such as fuel wood producers, fuel wood processor, trader/distributor, energy producers, standardization, Administrator, Regulators, Associations, NGO and experts in the biomass sector in the country. When the survey was closed in August, total of 23 responses had been recorded. Using simple analysis, prioritize principle were presented in section 5.4. Priority order presented is analysed by the committee and they would take the final decision.

4.5 VALIDATION OF PRINCIPLE, CRITERIA AND INDICATORS

Principles, Criteria and Indicators that were established through consensus distillation of successful thinking and also from expert judgement needs to be validated to develop nationally appropriate standards and certification system. Therefore the established Principles, Criteria and Indicators (PCI) has to be field tested in different land scape models such as community based organization, agro energy plantation, large plantation as well as dedicated energy plantation to see the local applicability as well as viability of the PCIs. Results of field testing is presented in chapter 6.

4.6 DEVELOPMENT OF CERTIFICATION SYSTEM

4.6.1 Overview

Certification is a procedure by which a third party gives written assurance that a product, process or service is in conformity with certain standards. Certification can be seen as a form of communication along the supply chain which provides assurance that a product, process or service is in conformity with certain requirements. The certificate demonstrates to the buyer that the supplier complies with certain standards. A label is a symbol indicating that compliance with the standards has been verified.

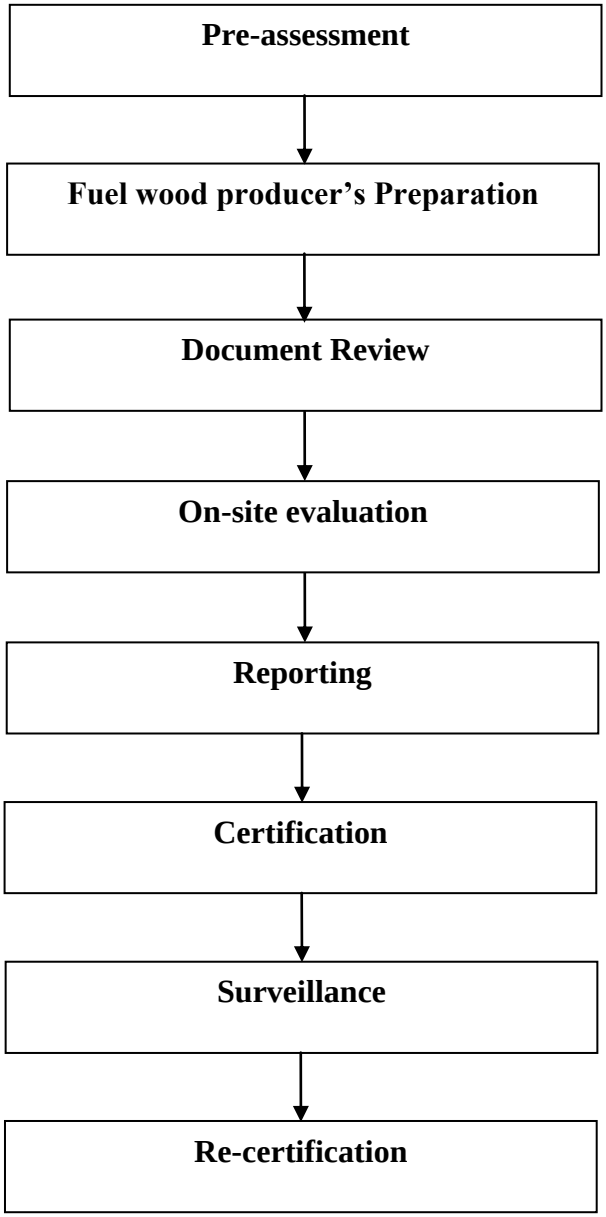

Figure 4.2: The certification process

Sustainable Fuel Wood Certification (SFWC) demonstrates the ability of certificate owner to deliver or source legal and responsible fuel wood. The certification process includes pre-assessment, future certificate holder's preparation, document review, on-site evaluation, reporting, certification, surveillance and recertification as shown in Figure 4.2.

4.6.2 Pre-assessment

First of all fuel wood producer should collect the application from certification body and submit the filled application with relevant documents. Then certification body evaluates the application and relevant documents and an officer from the certification body will visit fuel wood producer's facility for pre-assessment. Then it entails the initial review of fuel wood producers SFWC system. Fuel wood producer identify major gaps in his/her system, thus helping his preparation for certification.

4.6.3 Fuel wood producers preparation

Fuel wood producer should demonstrate the compliance with established 42 Indicators. He should comply with relevant Sri Lanka Standard specification for Principles, Criteria and Indicators for sustainably produced fuel wood. Among other steps, he will collect generic requirements, specific requirements and regulatory requirements related to his business.

4.6.4 Document review

Fuel wood suppler submits documented procedure and other documents, including supplier based report, audit report on fuel wood , static fuel wood profiling data, to certification body, prior to the main evaluation. Then certification body will review and inform the producer about any major gaps. Information that is requested when testable indicators are not available in the indicator set. In reporting, information is requested, but no minimum requirements are set that have to be met.

4.6.5 On-site evaluation

SFWC audits are normally conducted on-site. This includes, among others, (a) procedure for sampling, testing and inspection; (b) evaluation, verification and assurance of conformity with relevant standards. Sri Lanka Standards Institution (SLSI) auditor will typically conduct interviews, review documents and review producers mass or volume accounting system. The auditor will also inspect producer's facilities and verify the quality of supplier verification programme, including visits to the place of origin.

4.6.6 Reporting

After the on site assessment, a report is prepared presenting the results, including any noncompliance. Then the producer needs to correct major issues before certification body issue a certificate. Once certification body have reviewed the draft report, certification body will send it to fuel wood producer for comments before certification body issue the certificate.

4.6.7 Certification

If the evaluators are satisfied that the producer has met the minimum requirements for the certification, then fuel wood producers certificate is issued valid for three years. However, fuel wood producer need to undergo annual surveillance audits to maintain his certificate. Fuel wood producer certificate is made public on the certification body web site.

CHAPTER 05

ESTABLISHMENT OF PRINCIPLES, CRITERIA, INDICATORS AND VERIFIERS FOR SUSTAINABLY PRODUCED FUEL WOOD FOR SRI LANKA

5.1 OVERVIEW

Feed back of the planning, analysis of stakeholder feedback, prioritization and selection of principles, establishment of criteria and indicators are presented. Eight principles was identified during literature review. Then survey was conducted to prioritize and select the principles. After analysing the survey result, five principle were selected. Those results were again presented to the committee for further analysis. Then, they discussed the survey findings in detail and finally agreed with it. Further, framework of the output is shown in Figure 5.1. Finally through, consensus distillation of successful thinking and expert judgment of local expert committee, identified criteria and indicators for selected principle. These identified criteria and Indicators are presented under each selected principle. Principle 1 contains one criterion and 6 indicators. Principle 2 contains 4 criteria and 14 Indicators. Principle 3 contains 2 criteria and 8 indicators. Principle 4 has 2 criterion and 6 indicators. Principle 5 has 2 criterion and 8 indicators. Finally, 13 criteria and 42 indicators were identified for selected 5 principles.

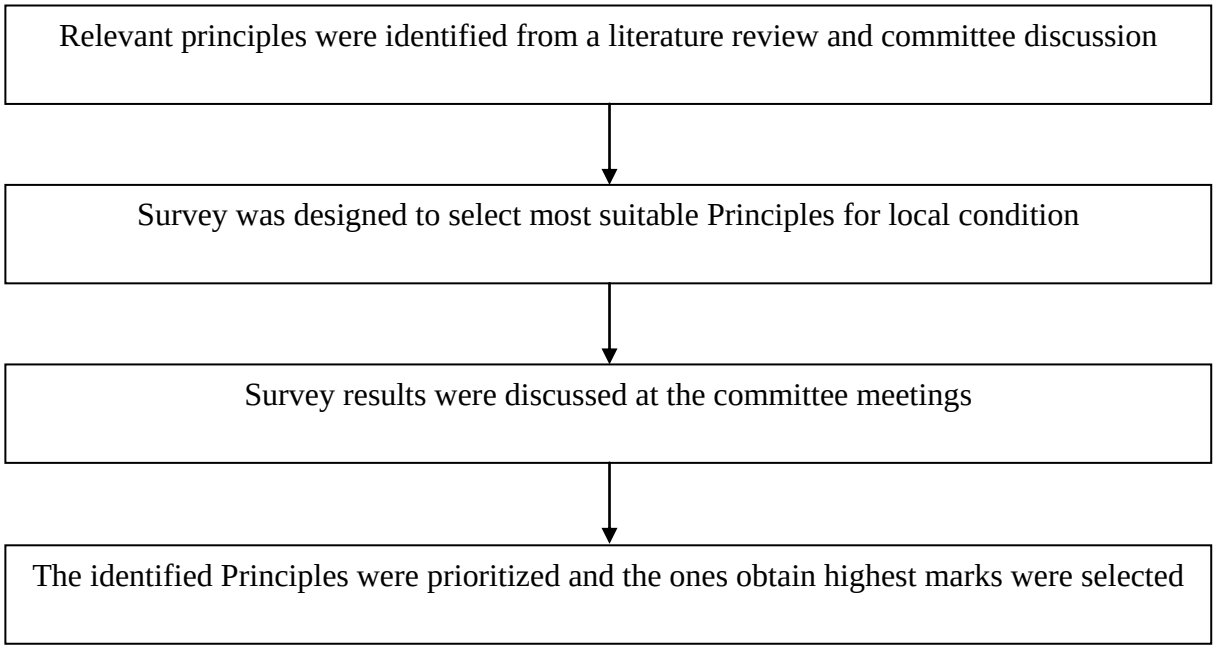

Figure 5.1: Framework of the output

5.2 PLANNING

Literature review and desk study was done to study current certification schemes related to bioenergy in the world. Most important eight principles were gathered as overall output. Eight principles gathered from literature review and desk study are;

P1: Legal compliance

P2: Workers rights and employment conditions

P3: Community relations and engagement

P4: Long-term economic and ecological viability

P5: Environment aspects

P6: Origin of plantation

P7: Planning and monitoring

P8: Group management

Above eight principles that were extracted from literature review and desk study were tabled for experts analysis. After going through all eight principles, the experts were saying that this was designed to destroy the whole industry. One expert said that "All these are very nice and good but whatever we do must be realistic and I got so scared when I look at this list. This is designed to destroy the whole biomass industry in the country. Their requirements are there, I know tea people, and they know very well that these (fuel wood) are coming from unsuitable sources. So what we first need is a regulation not a standard. We do not have energy plantation full stop. But we need to have. That is what we are trying for last 10-15 years. But there are nice ideas nothing would happen". In its current form, the draft (8 principles identified from literature survey) are not able to secure a sufficiently satisfactory sustainability assessment. It can be seen as a danger that this draft could not be communicated and lead to in proper application. As a technical standard, it should only cover the technical indicator of biomass energy for the assessment of social, environmental and economic aspects of sustainability, and not cover the political topics involved in GHG Emissions, labour rights and human rights, etc. Committee think that this is a very important aspect in terms of securing sustainable fuel wood processes in Sri Lanka. However, we cannot really find any principle that follow up on all of the listed aspects that the operator shall respect.

Therefore experts committee wants to start formulating PCI for local context with blank white paper. As a result, experts suggested one principle by one principle based on their experience in the local context and know how in the subject, and discussed in detail as follows. During the planning stage, above eight principles were analyzed together with the results of the survey. Analysis and discussion of the eight principle presented under clause 5.3 at the end of the planning stage, with the experience and expert judgment of the stake holders and experts in the subject of biomass, they select only five principle that scored more marks out of the eight. Those selected five principles are presented in clause 5.5.

5.3 RESULTS OF ANALYSIS OF STAKE HOLDER FEEDBACK

5.3.1 Stakeholder consultation

In this study, key stake holder groups that are presented in Table 5.1 were identified first. Then organization that represent above interested parties were identified such as: Sri Lanka Sustainable Energy Authority (SLSEA), Coconut Research Institute (CRI) of Sri Lanka, Universities, Tea Research Institute (TRI) of Sri Lanka, Ministry of Mahaweli Development and Environment (MOMDE), Forest Department (FD), Ministry of plantation Industries, Central Environmental Authority (CEA) , The Planters Association of Ceylon, Rubber Research Institute (RRI) of Sri Lanka, Green Movement for Sri Lanka, a selected set of large scale industrial end users of biomass, Sri Lanka Carbon Fund, Human Community Development Youth Organization, Bioenergy Association of Sri Lanka (BEASL) and Food and Agriculture Organization of the United Nation (FAO). A number of technical discussions were held involving the representatives of above organizations were held within 2015 and 2016. Analysis of ideas, selection and prioritization of principles were done based on consensus distillation of successful thinking and expert judgment within the experts and presented in next section. The diversity of indicators needed to broadly assess socioeconomic and environment sustainability may not allow for a uniform, well define indicator selection process. There were lots of debates within the technical sessions. Therefore consensus distillation of successful thinking and expert judgment are an important part of the indicator selection process.

Table 5.1: Stakeholder groups involvement in the development of the Principles

Stakeholder Groups	Involved (Y/N)	Name of stakeholders
Sector research institution	Y	CRI, TRI, RRI
Academia	Y	UOM
Traders	Y	Large Scale traders
Industry: Producers	Y	Large scale producers

Industry: End-users	Y	Large scale end users
Regulatory Authority	Y	SEA,FD, CEA
Associations	Y	BEASL, Green Movement
International Development organization	Y	FAO,UNDP
General Public	N*	General Public

Note* though general public were not involved in the development of the principle, their consultation has been done through public comments for the final draft.

Detailed feedbacks on each principle have been obtained from the stakeholders to identify it relevance and importance in the national context, as presented in the following sections.

5.3.2 Principle of legal compliance

Committee is in a view that this future fuel wood certification system should respect all applicable laws of the country in which they occur, and international treaties, agreements and conventions to which the country is a signatory, and complied by all principles in this fuel wood certification system. The main aim of this principle is facilitating wood fuel harvesting permits for producers (Ex: tea and rubber estates). Forest authorities in Sri Lanka are very reluctant to issue cut permits to estates. It is hoped that by obtaining a wood fuel sustainability certification, estates will be able to better demonstrate to the authorities what the objective of their plantation is and hopefully this will help them get their cut permits. While this is obviously important, it is found that a) there is risk that obtaining a certificate will not help the estates get their permits; b) estates who had sustainability certificates such as SAN or FSC have not been unsuccessful in convincing authorities to let them cut their timber plantations; c) the issue of cut permits are an administrative issue, that might be resolved through other means than certification; d) while I find the environmental impacts of harvesting in the estates are significant, it was believed that certifying established estate plantations is not where it will achieve most incremental changes

in practices. In other words, estates practices can certainly be improved but they are not the worst. If producers (estates) are certified then fuel wood consumers/industries and biomass power plants will not continue to source unsustainable wood.

When the plantation operations are considered, there are many applicable laws as well as regulations. For example, timber transport permit is a legal requirement but restrictions for felling trees in areas over 5,000 ft above Mean Sea Level (MSL) or pre-harvesting approval from district secretaries or District Environment Committee etc are regulations imposed by government authorities. Any operator should respect the applicable laws as well as the applicable regulations. Approved management plans for the plantations will require not only by law but also to fulfil the regulations imposed by government authorities i.e. Forestry Management Plans for plantations in Regional Plantation companies are regulatory requirement of Ministry of Plantation industries. Having considered above facts, there was a consensus among biomass experts to include legal compliance as first principle.

Principle “Legal compliance” has been the number one from the survey results. This principle has not received any objections from experts even if it is about legality, so therefore it is assumed that it is acceptable to them, which is in line with the advice they have given so far (that it may require reporting on fulfilment of the law but not that the law is followed since this is a baseline requirement for all standards). But this was the compromise reached between listing of offences (both resolved and unresolved) and removing the principle completely. There was a discussion about possibly removing "regulatory", but there was opposition to this. After some discussion there is consensus on the first principle as presented in document after a small change (changing " Legal compliance “to” Legal and regulatory compliance " in accordance with one expert comment).

5.3.3 Principle of works rights and employment conditions

Principle of workers rights and employment conditions in standards tend to focus most on International Labour Organization (ILO) conventions addressing health and safety and employment conditions. Several certification and standards systems make reference to contributions to community development. When analyzing the mark received for this principle, it was ranked as 6th place. Committee unanimously

decided to initially agree upon 5 most suitable principle for local condition. As this principle took 6th place and also after lengthy discussion, committee rejected this principle.

5.3.4 Principle of community relations and engagement

It was found that having a plantation only for energy is not viable in Sri Lanka. That is how the cabinet approved the Gliricidia as an Agro energy plantation. In future, as per one expert's view, having Long term Rotation Crop (LRC) for fuel wood is useless. If the tree is big enough, it should not be used for energy (as per economic value). It can be used for sawn timber purpose. Modern trend should be only coppices SRC. Along with that, you get foliages that come as by products. Then only the whole exercise becomes viable and sustainable. When it comes to energy plantation, it should be multipurpose. You cannot have dedicated energy plantation any more in the country. It should be multipurpose. If you really look at the income from foliage, it is much more than the income from fuel wood. In that case wood is a byproduct. This fuel wood management operation shall encourage the efficient use of Short Rotation Crops (SRC) intercrops, under crops such as multiply product and service to ensure economic viability and wide range of environment and social benefits. It is important to notice here that the principle "community relation and engagement" received second highest marks under the first theme of the survey conducted. However, second theme of the survey expect the priority order of the principle. Third priority was received for this principle under second part of the survey. After lengthy discussion on "community relation and engagement", committee decided to change the name to "Benefits to the community" and accept it as third principle. Further, experts agreed two criteria for this selected principle that can be used to assess the effective stakeholder consultation and how operator contributes to the social and economic development of local community.

5.3.5 Principle of long term economic and ecological viability

The aim of this principle is generally to improve economic and social conditions of the fuel wood growing small holders and thereby improving their lifestyle, without harming the ecosystem and biodiversity on which they depend. During the small

holder fuel wood certification process economic, technical, informative, institutional support will be required. Economical support, which covers all expenses for field cost including assessing and auditing fees. The principle "Long-term economic and ecological viability" scored 7th place during the survey and it was an unfortunate situation, although this is an important principle. Having respected the survey results, committee reject this principle. Then next principle was discussed for its suitability to include it in sustainable certification scheme.

5.3.6 Principle of environmental Values and impacts

Committee is in a view that this fuel wood certification should conserve biological diversity and its associated values, water resources, soil, and unique fragile ecosystem and landscapes and maintain a healthy ecosystem services. It is unrealistic to demand so wide measurements from single fuel wood plantation owner. That is why grouping is required. One purpose of this principle is to avoid undue burden for Community Based Organizations (CBO). The demand for measurements will do that. The CBO can gain necessary information from statistics, national authorities etc. without direct measurements done by itself. The economic operator has to have proper practices in place to be able to use chemical products safely and avoiding unnecessary environmental burden. This principle "Environment aspect" was ranked as third place, within the first part of the survey. However, second theme of the survey expect the priority order of the principle. This principle was prioritized as second important principle during the second part of the survey. As there were no objection to the survey results, committee seconded it. However, after lengthy discussion, experts agreed four criteria for the selected principle that can be used to assess the significance of impacts on environmental values and impacts.

<u>Ecosystem</u>

Well functioning ecosystem services are at the core of the concept of sustainability as they are essential for meeting human needs. Due to their relevance, ecosystem services should be included as a criteria under this principle. Definition of Natural Ecosystems should clarify the period that naturally regenerated vegetation in a bare land would take to transform to a secondary forest. We wish to highlight this as there

would be misinterpretations from different authorities pertaining to the identification of natural ecosystems. For examples, an estate would decide to keep an uprooted rubber or tea field in wet zone, fallow for 3 -4 years. In such case the natural vegetation especially the pioneer tree species such as Kenda and Gedumba would grow naturally creating a canopy cover with a shrub undergrowth of other spp. In such event, should we treat the field as a natural ecosystem, converting an existing production area into a conserved area? We need to discuss and clarify such situations as this would affect to the plantation sector. Road construction along the buffer areas can be restricted but carefully planned watercourse crossing should be allowed.

Biodiversity

The scientific concept of "biodiversity values" is valuable and useful in the conservation discourse. However, as it contains a broad range of use categories (direct-use values, ecosystem services, recreation and aesthetics, non-use values etc.) it might be hard to handle within this standard; especially those which refer to existence values and option values. Furthermore, here it is aimed to promote biodiversity within the area of production and minimize negative impacts. Hence, it would suggest resigning from this term and refer only to "biodiversity (protection)". A very important thread for biodiversity protection is the prevention of destruction of natural habitats in order to create new cropping areas. Hence, a conservation of habitats should be ruled out when the sustainability of the operation is to be assessed. Finally it was agreed to introduce "species at risk shall be protected" as criteria under above selected principle.

Invasive species are controlled

The indicators under this section should be carefully reviewed by experts. Ipil Ipil (Leucaena leucocephala) is a common fuelwood species in home gardens of intermediate zone. Mahogany (Swietenia macrophylla) and Alstonia (Alstonia macrophylla) are another invasive species common in wet zone. Can we guide fuelwood growers to refrain from planting Mahogany or eradicate them from their land to be complied with sustainable fuel wood production standards? Removal of

alstonia in wet zone and Clusia rosea in hill country lands would be impractical. There again Bata (Ochlandra stridula) also very common along watercourse in wet zone which is a forest invasive species but impossible to eradicate. If we do not develop applicable and practical standards, there is a risk of reporting continual noncompliance at every audit. After lengthy discussion committee agreed to introduce "Invasive species shall be controlled and controlled to a resource when feasible" as a last criteria under selected principle.

5.3.7 Principle of origin of plantation

Having accepted the principle 5, experts discuss the principle 6 to see its applicability eligibility to use as a principle in this PCI set. The aim of this principle is to ensure that participating operators/CBO put in place a healthy and transparent chain of custody system that provide traceability for the certified material acquired from and/or delivered to other operator in the supply chain. This principle also aims to ensure that sustainability claim based on compliance with this standard only accompany material that is acquired, handled, and forwarded by fuel wood certified operator/CBO according to the requirement included in these PCIs. Not all the fuel wood comes from the big enterprise which is easy to trace back. It is an important consideration, since it will be difficult and costly to have the certificate related to traceability. It will potentially discourage the small holder (produced by the family/small holders) from taking part in the fuel wood business. From a general point of view committee think that the systems of ensuring knowledge on origins of products and the up-stream impacts related to sustainability aspects needs more elaboration under this principle. It also necessary that it should be made more explicit to what extent auditing of the information provided from the standard would be managed. For example if one operator in a value chain does not have third party auditing, the information along the whole value chain will be affected. The chain-of-custody is required in order to have knowledge on the impacts linked to the products and processes up-stream from the process assessed. There is a need to improve the framework of chain-of-custody and how these systems are interlinked.

Committee considers that traceability is necessary when the principle links to life cycle perspectives. This becomes relevant in the case of for example GHG calculations. The traceability is also an integral part, if an operator in the last step of the supply chain wants to add sustainability data to their operations. In the present form with the present PCIs there is need for traceability to be treated in the standard. As of now this is not done. It is not evident why detailed information acquired within the process should be reduced to score card format information. As some certifiers at the end of the value chain might want to have a rather complete picture to assess whether it meets their requirements, communication rules are preferred that ask for comprehensive information. However, a combination of score card and comprehensive information seems viable. It is important to highlight that the principle "origin of plantation" is ranked as 4th place in first part of the survey and fifth place in second part of the survey. Committee analysed the survey results and finally agreed with it. At last committee decided to change "origin of plantation" to "chain of custody (traceability) from standing tree to farm gate" as that term is widely used in certification business and accepted to include into PCI set, looking at impact and depth of its ability to maintain sustainable production of fuel wood. Further, after lengthy discussion, experts agreed two criteria for the selected principle that can be used to assess the traceability of the supply chain.

5.3.8. Principle of planning and monitoring

Both first and second part of the survey result show that the principle "planning and monitoring" had got lowest score. Therefore without going into much detail, committee decided to not accept the principle having respected the survey results. Having not accepted the principle 7, the last principle of the set was discussed.

5.3.9. Principle of group management

Smallholders, often operating with some degree of resources and technical skills, may lack the competence and financial resources to implement this kind of new thinking. There is a risk that only bigger producers can fulfil these new demands in short time, which involves a risk for noticeable interruption as only few producers

can offer certified feedstock resulting in artificial high prices. While a certification scheme should be systematic, and reliable, it should not create a hurdle for smallholders. Therefore, committee is in a view that it is advisable to have a principle to look for possibilities for group certification to guarantee that small producers are not excluded. This Principle applies to operations which are organized as groups where applicable. There is a group leader, and group members. The helper is there to help the members achieve and maintain conformance. He is also the point of contact between the certifier and the group, to help organize audits, present evidence, etc. What happens when there is no group activity? We cannot include a group as a mandatory requirement. Proper stakeholder consultation process (with particular emphasis on local community) has to be adopted during development and implementation of the business. In the development of fuel wood standard and certification system may promote the involvement of small holders. There was a discussion about possibly removing "group management", but there was opposition to this. But fortunately, principle “Group management” has been ranked as 5th place in the first part of the survey results. Hence committee had to accept it. After some discussion there is consensus on the fifth principle as presented in document after a small change (changing " management” to “support “in accordance with one expert comment). Including this principle in the standard can then be achieved over time by mutual consultation. Because of the difficulties for smallholders, a certification scheme would have to be accompanied by capacity building.

5.4 RESULTS OF PRIORITIZATION AND SELECTION OF PRINCIPLES

Feedback of the survey results indicate that highest priority has been given to principle 1; “Legal compliance”. Second priority is given to principle 5; “Environmental aspects” while third priority was given to principle 3; “community relation and engagement”. Principle 8; “group management” has been taken by the fourth priority while principle 6; “Origin of plantation” is scored 5th priority. Principle 2 “Workers’ rights and employment conditions” was 6th place in the priority list. Seventh place taken by principle 4 “Long-term economic and ecological

viability" while lowest priority is taken by the principle 7 "Planning and monitoring".

Committee unanimously decided to select initially 5 most suitable principle for local condition for effective monitoring, as this is the starting for standard and certification system for Sri Lanka. Again this results was analysed by the committee and through extensive discussion among expert committee, three Principles that had lowest priority were rejected and other five were accepted. At the end of selection, committee decided to select P1, P3, P5, P6 and P8 for this set.

These survey results were again discussed at the committee. It was decided not to deform the survey result as it has been a result of wider stake holder consultation. After lengthy discussion, committee agreed to have following sequence of the principle without changing the technical meaning but with little editorial changes to the principles and it was renamed as P-1, P-2, P-3, P-4 and P-5 respectively. This is the finally approved list and also the order.

P-1: Legal and regulatory compliance

P-2: Environmental values and impacts

P-3: benefits to the community

P-4: group support

P-5: chain of custody (traceability) from standing tree to farm gate

5.5 IDENTIFICATION OF CRITERIA UNDER EACH PRINCIPLE

In discussion about principle and criteria for sustainable fuel wood trade, the following major concerns on the impact of fuel wood trade are addressed. The Table 5.2 contains selected principles and 11 criteria that were identified in the systems reviewed and that committee consider as relevant for sustainable fuel wood trade in Sri Lanka.

Table 5.2: Principle and criteria under Socioeconomic and Environment

	Principle	**Criteria**
Social	P-1: Legal and regulatory compliance	C-1.1 The operator complies with all applicable laws and regulations.
	P-3: Benefits to the community	C-3.1 Effective stakeholder consultation ensures concerns are addressed
		C-3.2 The operator contributes to the social and economic development of local communities.
	P-4: Group support	C-4.1 The group is structured, functional and transparent
		C-4.2 Group records are kept
Economic	P-5: Chain of custody (traceability) from standing tree to farm gate	C-5.1 Plantation gate defined and controlled
		C-5.2 Claim and identification
Environmental	P-2: environmental values and impacts	C-2.1 There is no conversion of natural forests to plantations.
		C-2.2 Environmental services (soil, water) are maintained or restored on the farm/plantation.
		C-2.3 Species at risk shall be protected
		C-2.4 Invasive species shall be controlled

5.6 IDENTIFICATION OF INDICATORS FOR EACH CRITERIA

5.6.1 Principle of legal and regulatory compliance

Table 5.3 shows first criteria on "The operator complies with all applicable laws and regulations" and six indicators under the first principle. It is about compliance with law.

Table 5.3: Indicators under P-1 and C-1.1 are presented

Indicators	Description
I-1.1.1	The operator has the legal right to harvest. This includes land tenure and ownership of where the fuel wood comes from, harvesting permits when required by laws and regulations.
I-1.1.2	When required by law and regulations, the operator has an approved management plan and it is followed and implemented.
I-1.1.3	When required by laws and regulations, charges and taxes are paid.
I-1.1.4	Laws and regulations related to environmental protection (slope, reservation strips, use of chemicals, road building, etc.) are respected.
I-1.1.5	The operator complies with national labour laws and regulations including but not limited to requirements for contracts, child labour, insurance for workers, minimum wage, etc.
I-1.1.6	When required by laws and regulations, the operator complies with transport requirements.

5.6.2 Principle of environmental values and impacts

This is the second principle and has four criteria and fourteen indicators. Table 5.4 shows first criteria on "There is no conversion of natural forests to plantations" and four indicators under the first first criteria. It is about natural forest.

Table 5.4: Indicators under P-2 and C-2.1 are presented

Indicators	Description
I-2.1.1	The fuel wood shall not come from legally protected areas.
I-2.1.2	Natural forests inside the plantation shall be identified and mapped by the operator as shown in Figure 5.4.
I-2.1.3	Fuel wood shall not be harvested inside a natural forest.
I-2.1.4	Natural forests shall be voluntarily protected. This standard considers the conversion of natural forest as unsustainable. Therefore, if a natural forest was removed to establish a plantation after the date this standard was approved, this plantation does not qualify for sustainability certification.

Figure 5.2: Legally protected area

Five Indicators under second criteria on "Environmental services (soil, water) are maintained or restored on the farm/plantation" of principle two, are presented in Table 5.5. It is about environmental services.

Table 5.5: Indicators under P-2 and C-2.2 are presented

Indicators	Description
I-2.2.1	The operator shall map or demarcate on the ground the sensitive areas that are prone to erosion and degradation, and all water bodies.
I-2.2.2	The operator shall adopt and implement planting, harvesting, water crossing and transport guidelines to prevent land degradation, and to protect water from pollutants such as silt, oil, fuel and other chemicals.
I-2.2.3	The operator shall develop and have begun implementing plan for conservation or restoration of reservation strips along all water bodies. The plan shall contain timelines, measurable benchmarks and a budget for its implementation.
I-2.2.4	Reservation strips are left to grow wild. Road construction, machinery access, planting of exotic species, clearing, brushing and the spraying of chemicals are prohibited inside the reservation strips. A road may be built perpendicularly across it for water crossing in conformance with I-2.2.4 Workers may access reservation strips for manual collection of Non-timber forest plantation (NTFP)s. Already existing exotic trees can remain standing but if harvested, shall not be replaced inside reservation strips. Diseased exotic trees can be removed manually, as long as measures are taken to minimize disturbance and prevent soil from entering the adjacent water body.
I-2.2.5	Waste water, oils and solid waste generated by all activities including domestic, worker facilities, processing and use of chemicals shall be disposed of in accordance with regulations and best practices.

Table 5.6 shows third criteria on “Species at risk shall be protected” of second principle. This third criteria has two indicators. This is about the protection of species at risk.

Table 5.6: Indicators under P-2 and C-2.3 are presented

Indicators	Description
I-2.3.1	The operator is aware of the National Red Listed species (fauna and flora) which are or can be present on its farm/plantation, is able to describe their habitats and identify these habitats on its plantation.
I-2.3.2	The operator has identified and implemented practices to protect the species at risk.

Three Indicators under last criteria on "Invasive species shall be controlled" of second principle, are presented in Table 5.7. It is about control use of invasive species.

Table 5.7: Indicators under P-2 and C-2.4 are presented

Indicators	Description
I-2.4.1	The operator shall be well conversant on the invasive plant species.
I-2.4.2	Invasive species can only be introduced in the farm/plantation if the operator clearly demonstrates he has the technique, staff and resources to prevent them from spreading.
I-2.4.3	The operator controls existing invasive species inside the farm/plantation, and in the surrounding areas if invasive species present on the farm/plantation are spreading to the surroundings.

5.6.3 Principle of benefits to the community

This is the third principle and has two criteria and eight indicators. Table 5.8 shows first criteria on "Effective stakeholder consultation ensures concerns are addressed" and four indicators under the first first criteria. It is about consultation of stakeholder and so on.

Table 5.8: Indicators under P-3 and C-3.1 are presented

Indicators	Description
I-3.1.1	The operator conducts consultation meetings with the community affected by its operators. While those meetings may include a short information session, they are true consultations where community members are invited to comment on the plantation activities and share their concerns.
I-3.1.2	Records of comments and concerns are kept.
I-3.1.3	The operator documents the mitigation actions taken to address the concerns presented by the community.
I-3.1.4	The operator demonstrates the mitigation actions have been implemented in the field.

Table 5.9 shows second criteria on "The operator contributes to the social and economic development of local communities" and four indicators under the second criteria. It is about socioeconomic development of the local community.

Table 5.9: Indicators under P-3 and C-3.2 are presented

Indicators	Description
I-3.2.1	Opportunities are communicated and provided to local communities, local contractors and local suppliers for employment, training, and the sourcing of products by the operator.
I-3.2.2	For industrial plantations: Opportunities for social and economic development are identified jointly through engagement with local communities.
I-3.2.3	For industrial plantations: The operator's annual budget has provisions for social and economic development projects in the community.

	Those projects are implemented.
I-3.2.4	Community and worker requests and grievances are recorded and responded to and both parties agree they have been resolved.

5.6.4 Principle of group support

This is the fourth principle and has two criteria and six indicators as shown in Table 5.10 and Table 5.11. This PCI does not require operators to be organized as groups. This Principle applies to operators which choose to be organized as groups. There is a group helper called the 'coordinator', and group 'members'. The coordinator is there to help the members achieve and maintain conformance. He is also the point of contact between the certifier and the group, to help organize audits, present evidence, etc. Indicator 4.1.5 aims at addressing one of the root causes of low prices offered to producers, for example by minimizing the dependence on 'middle men'.

Table 5.10: Indicators under P-4 and C-4.1 are presented

Indicators	Description
I-4.1.1	The division of responsibilities between the group coordinator and the group members are well defined.
I-4.1.2	The group coordinator has the capacity and resources to effectively help the group members achieve and maintain conformance.
I-4.1.3.	The group has adopted procedures to cover: a) Internal audits (frequency, what to do when a non-conformance is identified, etc.); b) The conditions by which a new member is included or a member is excluded from the group; c) Training of members; d) The process by which group members select the coordinator, how she or he is paid and how she or he can be laid off;

	e) The sharing of group expenses such as training, internal and external audits, coordinator salary, etc.
I-4.1.4	The group coordinator fulfills her or his role and does not behave like a boss or supervisor of group members. She or he does not receive money directly from individual group members.
I-4.1.5	In cases where big disparity exists between the market price for fuel wood and the price paid to members, the group shall identify the causes of such disparity and demonstrate progress towards eliminating them.

One Indicator under last criteria on "Group records are kept" of fourth principle, are presented in Table 5.11. It is about records maintenance.

Table 5.11: Indicators under P-4 and C-4.2 are presented

Indicators	Description
I-4.2.1	The group coordinator maintains a complete and up-to-date record of: a) Group members and contact details; b) Group size in hectares and yield of fuel wood; c) A map showing the location of all members; d) Records of training, visits, advice and support provided to each member and their workers; e) Results of internal audits including non-conformances identified; f) For members who have been issued corrective actions during internal or external audits, follow-up audits to verify corrective actions have been implemented.

5.6.5 Principle of chain of custody (traceability) from standing tree to farm gate

This is the fifth (last) principle and has two criteria and eight indicators as shown in Table 5.12 and Table 5.13 respectively. The purpose of this principle is to ensure fuel

wood which is sold with the claim of being SFW certified truly does come from a SFW certified farm or plantation. This chain of custody applies to fuel wood from the standing tree to the farm gate. The farm gate is when the SFWC certified operator no longer has control over his certified wood. It will normally be when the certified fuel wood is sold to the next owner, but there can be exceptions. The farm gate is defined by the certified operator.

For example, if a contractor purchases the standing trees, in practice the certified operator loses control over the certified fuel wood. For example the contractor who purchased and cut the certified trees and then transports the fuel wood to the local purchaser may choose to stop at other non-certified plantations and fill the remainder of its lorry with non-certified wood. This would contaminate the certified fuel wood and the certified chain would be broken. However, if the certified operator can design a traceability system together with its contractors that brings a low risk of contamination, it can include the contractors in the scope of its traceability system (inside the "plantation gate"). It is then the certified operator's responsibility to ensure and verify conformance inside its plantation gate. The same concept (being included in the plantation gate) applies to wood depots.

This chain of custody can include processing facilities inside the plantation gate if it only processes certified material. It cannot cover processing facilities outside the plantation gate, or processing facilities inside the plantation gate if non-certified material is stored or processed.

Table 5.12: Indicators under P-5 and C-5.1 are presented

Indicators	Description
I-5.1.1	The operator shall clearly define the plantation gate, by identifying the contractors and any other step included in it. The plantation gate shall expand to the point where the operator no longer has sufficient control to minimize the risk of contamination with non-certified fuel wood.
I-5.1.2	The certified fuel wood must be clearly identifiable during transport

	and storage as shown in Figure 5.5.
I-5.1.3	In order to avoid contamination with non-certified fuel wood, the operator must involve employees, contractors, transporters and any other person in the supply chain with appropriate training and make sure they have the needed competences, knowledge and experience to identify and handle certified fuel wood.
I-5.1.4	The operator shall appoint a member of the management who shall have overall responsibility and authority for the operator's chain of custody.
I-5.1.5	The operator may use vehicles entirely for certified fuel wood material, or use, physical separation or documentation that allows to clearly quantify the certified fuel wood if vehicles transport a mix of certified and non-certified wood.
I-5.1.6	The operator's management shall carry out a regular periodic review (internal audit) of its chain of custody and its compliance with the requirements of this standard
I-5.1.7	The operator shall establish and maintain records of its chain of custody to provide evidence of conformity with the requirements of this standard and its effectiveness.

Table 5.13 shows second criteria on "Claim and identification" and one indicator under this criteria. It is about identification and claim.

Table 5.13: Indicators under P-5 and C-5.2 are presented

Indicators	**Description**
I-5.2.1	The invoice and bill of lading used in transport must contain at a minimum the following information:

	a) Producer's identification including list of fields the fuel wood comes from; b) Formal documentation confirming the sustainable certified status of the fuel wood c) Species identification and quantity (weighed or measured) d) Date of collection e) Identification of the customer for the delivery

Figure 5.3: Maintaining the certified fuel wood without contaminating, while transporting

5.7. VERIFIERS FOR INDICATORS

The means of checking and controlling the performance of indicators here are called verifier tools, including data or information that enhances the specificity or the ease of assessment of an indicator. At the fourth level of specificity, verifiers provide specific details that would indicate or reflect a desired condition of an indicator. They add meaning, precision and usually also site-specificity to an indicator. They may define the limits of a hypothetical zone from which recovery can still safely take place (performance threshold/target). Some of the verifiers are proposed against each indicator based on auditing experience in the industry and trade, for audit team as well as auditee's reference for preparation for audit and compliance with the indicators laydown in the SFWC and any interested party reference. P-Principle, C-Creteria, I-Indicator and V-Verifier abriviation are used. On the other hand, they may also be defined as procedures needed to determine satisfaction of the conditions postulated in the indicator concerned (means of verification).

E.g., "Records of illegal activities and actions taken against them or incidents of unauthorized activities".

5.7.1 Legal and regulatory compliance

Six verifiers corresponds to six indicators are presented in Table 5.14 under first principle. The operator complies with all applicable laws and regulations. This six potential verifiers will be helpful when auditing is done for compliance when doing certification.

Table 5.14: Six verifiers under first Principle is presented.

Principle	Criteria	Indicators	Verifier
		I-1.1.1	V1.1.1 Document such as Company registration to show that the company is a legal entity, Ask for Permits and approvals obtained, Records of offences and complaints, if any
		I-1.1.2	V1.1.2 It is not a must to have management plan. when required by law, Ask for

P-1	C-1.1		management plan, Interviews with managers
		I-1.1.3	V1.1.3 Receipts & Accounts as evidence
		I-1.1.4	V1.1.4 Relevant acts, ordinances and regulations, if it is not covered in the particular country law, how company ethically acts on particular item.
		I-1.1.5	V1.1.5 Interviews with managers and employees. (Managers display knowledge and awareness of relevant conventions). Availability of relevant documents, Evidence of protection of species, labour contracts and conditions of employment
		I-1.1.6	V1.1.6 Fuel wood transport Permits and approvals obtained if law requires.

5.7.2 Environmental values and impacts

Nine verifiers corresponds to nine indicators are presented in Table 5.15 under second principle. Some of these indicators are design to stop “jungle wood” from rain forest, entering to the supply chain. This could happen at different stages of the supply chain. Therefore, record control and documentation system has to be in place that makes sure, that the fuel wood is traceable from the cultivation to end use. Water is a scare resource in several districts of Sri Lanka. Therefore, the cultivation of energy plantation can lead to an increased water use. This may be due to the removing of water for the irrigation of energy crops or to increasing evapotranspiration on the land where fuel wood species are cultivated. Energy plantation cultivation disturb the water supply situation in areas with an already water scared.

Table 5.15: Nine verifiers under second Principle is presented.

Principle	Criteria	Indicators	Verifier
		I-2.1.1	V2.1.1 Ask map to check "legally protected areas” Interview local people, Check

P-2	C-2.1		transportation species on the spot, "Records of illegal activities and actions taken against them, Incidents of unauthorized activities
		I-2.1.2	V2.1.2 Show me "maps", Boundary posts indicated as in the maps as shown in Figure 5.6 as evidence
		I-2.1.3	V2.1.3 Interview operator, Check the area, Stop transporting vehicle on the spot and check the species, Harvesting records, Transportation records, and processing records
		I-2.1.4	V2.1.4 GSP locations, Date of approval for plantation, Asking villages and verify, All young plantations are suspicious for what was before.
	C-2.2	I-2.2.1	V2.2.1 The water bodies in lands of some members were not shown in the location map as (Seasonal, Run off, Perennial)
		I-2.2.2	V2.2.2 Planting records, Harvesting records, Transportation records, Processing records, and relevant documents, Ex: Pick up going through water bodies is NCR, it is cheaper to drive through streams.
		I-2.2.3	V2.2.3 No proper demarcation of the reservation strips (natural water bodies of different size within the estate)
		I-2.2.4	V2.2.4 Exotic trees if harvested, shall not be replaced inside the reservation strips.
		I-2.2.5	V2.2.5 Operator has no proper mechanism to manage different waste generated at different operations and locations. Show me what you do with your used oil, Forest management plan, ROP guide line, handbook of rubber-Volume1,RRISL, RRI/CRI Advisory circulars, Company guidelines

Figure 5.4: Boundary post in real land with reservation

Table 5.15: Five verifiers under second Principle is presented, Cont…

Principle	Criteria	Indicators	Verifier
P-2	C-2.3	I-2.3.1	V2.3.1 Show me what are the Red list species in your plantation, Site visit, relevant guidelines/documents and records as shown in Figure 5.7 as evidence
		I-2.3.2	V2.3.2 For example, operator identified endanger habitat Red list monkey living in their plantation nearby forest, Operator knows that habitat need tree cover and they eat mango, Operator maintain mango tree cover in his property connecting forest
		I-2.4.1	V2.4.1 Documented policy on invasive species, Records on species trials and research, Site visit

	C-2.4	I-2.4.2	V2.4.2 Justification on the selection of plant species (invasive or otherwise) in the management plan
		I-2.4.3	V2.4.3 this is costly indicator for operator, Ask for maps, look for natural forest and if available, then look at the budget to control it spreading jungle, see the reviewing of the activity with time, Records on species trials and research

Figure 5.5: Reservation areas and species at risk

5.7.3 Benefits to the community

Eight verifiers corresponds to eight indicators are presented in Table 5.16 under third principle.

Table 5.16: Eight verifiers under third Principle is presented.

Principle	Criteria	Indicators	Verifiers
P3	C3.1	I-3.1.1	V3.1.1 Go and ask from villages what are their concern of last meeting, Show me records of comments, documented policies and procedures,
		I-3.1.2	V3.1.2 Evidence of free and informed consent
		I-3.1.3	V3.1.3 Documented policies and procedures, Interviews with managers and Absence of disputes
		I-3.1.4	V3.1.4 Site visit, Interviews with local community
	C3.2	I-3.2.1	V3.2.1 Ask documents and bills, check for local address, Interview local people, Site visit, Records on training, relevant documents
		I-3.2.2	V3.2.2 CSR projects of the operator, Discussion with community, Relevant documents
		I-3.2.3	V3.2.3 Records of meetings with local communities indicates that tables and chairs of the school are broken, Show me you budget for CSR, Ex; For village school, Operator can give lumber for villager to make them.
		I-3.2.4	V3.2.4 It was found that a worker request on providing safety equipment to be used during the harvesting had not been resolved

5.7.4 Group support

Smallholders, often operating with limited resources and technical skills, may lack the capacity (knowledge, financial resources) to implement necessary PCI and V. Therefore, verification of this principle applied to the smallholders who operate as groups. It is recommended to pair a certification scheme with assistance and incentives and to look for possibilities for group certification to guarantee that small producers are not exclude. Because of the difficulties for smallholders, a verification would have to be accompanied by capacity building. Six verifiers corresponds to six indicators are presented in Table 5.17 under fourth principle.

Table 5.17: Six verifiers under fourth Principle is presented.

Principle	Criteria	Indicators	Verifiers
P-4	C-4.1	I-4.1.1	V4.1.1 Documented evidence for responsibilities
		I-4.1.2	V4.1.2 Documented evidence of job description, education qualification and experience of the group coordinator
		I-4.1.3.	V4.1.3. Show me your procedure for internal audits, Relevant documents, records, evidence, manual, procedure, meeting minutes/attendance/certificate/notes.
		I-4.1.4	V4.1.4 There is no evident indication of discrimination (distinction, exclusion of preference) practiced that denies or impairs equality of opportunity, conditions or treatment based on individual characteristics and group membership or association. For example, on the basis of money, gender, religion, caste, race, nationality, disability etc.

		I-4.1.5	V4.4.5 Invoice of the fuel wood buying and selling harvesting record, transporting records, processing records, selling records and financial records.
	C-4.2	I-4.2.1	V4.2.1 Group coordinator is responsible for communicating to the authorities and relevant organization. The development of documentation (particularly those who are not literate) should be undertaken by group coordinator together with support for implementation. Records are maintained at least for 5 years. Group coordinator may provide documented procedure and maintain records of internal audits, NCRs, training and advice etc.,

5.7.5 Chain of custody (traceability) from standing tree to farm gate

Some of these indicators are designed to avoid "jungle wood" from rain forest, entering to the supply chain. This could happen at different stages of the supply chain. Therefore, record control and documentation system has to be in place that makes sure, that the fuel wood is traceable from the cultivation to end use.The chain of custody is the course taken by the raw material (biomass) from the cultivation place (home garden, agricultural land, fuel wood plantation, etc.) to the final consumer. This path includes therefore all successive steps from cultivation, crushing, manufacturing, transport, distribution. A method for traceability is applied in order to keep record of the transformations occurring at each step. There are three main methods for traceability, generally called:

- track and trace - strict tracing and labeling at every step
- Book and claim - full decoupling of the physical and the logical flow (e.g. green certificates for electricity)
- Mass balance - a mix between the two methodologies above

Considering the particularities of biomass for energy applications, the optimal traceability method is considered to be “Mass Balance”. This method takes account of the difficulty to trace the molecule of biomass or of any other bundled products. In the same time it keeps sufficient restrictiveness to ensure with accuracy that the product is meeting a certain standard. Eight verifiers corresponds to eight indicators are presented in Table 5.18 under last principle.

Table 5.18: Eight verifiers under fifth Principle is presented.

Principle	Criteria	Indicators	Verifiers
P5	C5.1	I5.1.1	V5.1.1 Operator identifies the gate according to the uprooting areas
		I5.1.2	V5.1.2 Records of transportation and storage.
		I5.1.3	V5.1.3Training records of employees, contractors, transporters to build the capacity to have required capabilities.
		I5.1.4	V5.1.4 Appointment and responsibilities matrix
		I5.1.5	V5.1.5 To be weighed at the point of loading as well as point of unloading. Transport records, 100% way bridge system
		I5.1.6	V5.1.6 Randomly one day supply from the beginning to end use. All the activities on that sample have to be audited.
		I5.1.7	V5.1.7 Permit approval (Ex: Check number of ha given to cut.)
	C5.2	I5.2.1	V5.2.1Check the few sample invoice/labeling/marking, witness a reference to the SFSC certificate number.

CHAPTER 06

VALIDATION OF PRINCIPLES, CRITERIA AND INDICATORS

6.1 OVERVIEW

As the last stage of methodology, established Principles, Criteria and Indicators set is now in its last phase of development and was time for us to test it on the ground. The functionality of hypothesis PCI set is an important pre condition for the success of standard and certification system. Next key stakeholders in the supply chain of biomass, especially fuel wood growers were met and piloting was done. Field test team comprise expert from UOM, SLSI, UNDP, FAO, SEA, industry and international expert. Each field testing expert (Auditor) had a copy of hypothetical PCls set (see appendix D). Further, feedback of validation of the established Principles, Criteria and Indicators (PCI) in community based organization and agro energy plantation are presented. From the results of field test, it was found that above PCI set were:

- Relevant
- Unambiguous related to the assessment goal
- Precisely defined
- Easy to detect, record and interpret
- Providing a measure over space/time
- understood by the auditee
- it was well received by auditee

6.2 FIELD TESTING

6.2.1 Overview

Principles that were prioritize from consensus distillation and successful thinking was tested in the field. The most important aspect of the certification is to address the technical and coordination issues that hinder large scale fuel wood plantations and biomass supply. In this regards, set of principle criteria and indicators for sustainably produced fuel wood was developed. This set is now in its last phase of development and was time for us to test it on the ground. It also have undergone few field testing

on small scale community based organization (CBO) and more field testing have to be done with respect to large scale dedicated energy plantation as well as intercrop fuel wood plantations in the future to balance the set of indicators for both small scale and large scale producers in the country before this set of indicators are published. In the meantime, KMRI SMG Asset Company is establishing a Dendro power plant of 3.8 MW in Mirigama and they have supported the establishment of biomass plantations (Gliricidia) on home gardens organized around CBOs within Gami Sarana Kendraya, Thunthota, and Kegalle. Therefore, field visit was made to a small sample of the home gardens which are participating in their program in the Mirigama-Kegalle-Kurunegala area, to test the above set of PCIs. This field test is not to evaluate them or their members, but to test our 42 indicator set that had been developed and design by experts committee to see if and how its above mention 11 categories of indicators to be modified to be practical on the Sri Lankan home garden together with community based organization.

Ultimately, this indicator set could be adopted voluntarily by producers/users like KMRI SMG Asset Company who are concerned about the sustainability of their fuel wood supply. KMRI SMG Asset Company and Gami Sarana Centre, had sign a MOU to supply fuel wood to KMRI SMG Asset Company plant boiler from home gardens belongs to members of Gami Sarana Centre. Above both company volunteered to do field testing on the Established PCIs and later certification system would be developed for biomass produced from branches pruned from live fences of gliricidia trees as supporting trees to betel leave cash crop and pepper cultivation supporting trees and dedicated plantation as well. The potential future one group certificate covers Biomass Supplies' work with 30,000 small farmers who have planted 10 million new trees on their fences as well as supporting trees to betel leave cash crop and pepper cultivation supporting trees. Gliricidia is a fast-growing, short-rotation tree found naturally in Sri Lanka. Principally grown for its leaves, which provide base materials for fertilisers, pesticides and fungicides, the species saves farmers considerable money on their annual agrochemical expenditures. It also finds use in plantations as a shade tree and soil improver, by functioning as a "live fencing", and for animal fodder. The coppicing of gliricidia branches once a year also provides smallholders additional income after selling LKR 2/kg at wet basis at

farm gate for thermal energy generation for Silver Mill Boiler. The main root and trunk of the tree remains sequestering carbon for 20 years.

The company has also currently conducted over 50 training programs over the span of two-and-a-half years to help educate farmers on how to save money on chemical input, efficiently collect firewood, and switch to organic vegetation for their families (as chronic kidney disease is a growing concern in these areas).

6.2.2 Activities conducted during the field testing

There were two main components in the field test:

- Field testing of a Mr Sampath Jayalal and Ms Rohini Wasantha's home garden against the draft specification for principle criteria and indicator for sustainably produced fuel wood
- Field testing of a Mr Gamini Pathirana and his wife's home garden against 42 indicators for principle criteria and indicator for sustainably produced fuel wood

Above both plantations are small scale Community Based Organization (CBO) plantations having group manager.

6.2.3 Field test results

Field test auditors find that the indicator set as worded now is generally appropriate for small scale farmers organized as a group. The few indicators which are non-applicable for this kind of operation do not need to be re-worded. Experienced auditors will be able to distinguish between applicable and non-applicable indicators while auditing in community based organization as this PCI set is developed not only for community based organization but also for agro energy plantation, large plantation as well as dedicated energy plantation. For the rest of the indicators only a few minor wording changes are suggested. Detailed field test findings are presented below.

During the field test the auditors found the Indicator should also require the operator to demonstrate he is aware of the laws and regulations. The auditors cannot be expected to be aware of all laws in all jurisdictions, and so it can become difficult for

them to evaluate this otherwise. Auditors found that instructions on how to plant and harvest had been provided to the group members, but other topics had not been covered. Also the guidelines were not presented to the auditors. This is normal and expected from an operation who has not yet considered certification. Auditors are very confident if and when the operation decides to conform to this standard; there will be no obstacle in satisfying this and other currently non-compliant indicators.

The members visited during this field test did have some knowledge of invasive plant species, but not to the point required by this indicator.Auditors found the operator has demonstrated great care in involving members in the decisions of establishing plantations on their lands.While the group coordinator does have many of this information on its members, there remain gaps, which is normal for an operation at this stage of certification. There was a question that, Should the group coordinator keep up to date records of member's legal documentation such as tax payment receipts, etc.? As per the indicator set, that has to be carried out. These systems are simply not in place right now. However this will not be problematic, like most of the other indicators, if and when the operator decides to go ahead with compliance with this standard. Some of the records that are required to maintain as a requirement had been witnessed during the field test and see the appendix H, appendix I and appendix J for more information.

From the authors experience, for the field testing of a C&I set for sustainably produced fuel wood certification, author planned 2 days. From authors experience it can be concluded that this time was not enough, and two weeks can be recommended. Author indicated that the time needed for the development of a sustainability standard also depends on the resources available. From this discussion, it was concluded that the operationalization of a standard on national to local level in 6–12 months is feasible, provided a generic C&I set is available. To develop a certification system for sustainable biomass trade, PCI set will have to be developed that appropriately explain the requirements on sustainable fuel wood cultivation, crushing, manufacturing, transport, distribution, trade and use.

Principle of legal and regulatory compliance

First of all Indicator I-1.1.1 require an operator or group should be a legal entity. Even association should be a legal entity. Gami Sarana Centre was a legal entity and company registration was witnessed. The other requirement of the indicator is getting relevant approval and cut permits. As fuel wood is Gliricidia and it comes from home gardens, there is no need of permits to cut trees. Then Indicator I-1.1.2 demands a management plan, when required by law. Gami Sarana Centre had not documented management plan although they manage. Receipts & Accounts were witnessed as evidence for charges and taxes in third indicator I-1.1.3.Then next indicator I-1.1.4 was checked for compliance. Gami Sarana Centre respect all the law and regulations related to environmental protection, during the visit, it was witnessed. In indicator I-1.1.5 demand labour laws to be complied with. There was no child labor involved, as per the ages of the employees, and we did not see any young children working during the visit. Indicator I-1.1.6 demands transport requirements. During the field visit lorry load of fuel wood was checked. It was found that there is no document other than the weight. Auditor requested to comply with Indicator I-5.2.1 given in this standard and practice it.

From an audit point of view, there should be an up-to-date register or summary of all relevant national and local statutes and regulations, relevant public acts etc. It is better to ensure that an operator has the ability to check up-to-date references rather than audit what may be older copies of legislation. As Gami sarana centre did not have a list of national regulations and relevant public acts, it is recommend to maintain updated register with copies of legislation as it may be modified at some stage in the life of this Standard. Compliance with these indicators can be achieved by maintaining the capacity to view relevant legislation and a capacity to ensure that the certificate holder is aware of changes to legislation. A procedure is now in place for Gami Sarana Centre to be said over the lands concerned before undertaking harvesting and planting operations. Maps describing the forest resource base including protected areas, planned management activities and land ownership are to be developed.

Principle of environmental values and impacts

First Indicator I-2.1.1 of the first criteria of second principle demands to stop jungle fuel wood entering to the market. To find the compliance of this indicator, there are two steps. First of all, we need to check their map at the desk study whether "legally protected areas" are marked. If it is not marked simply we can go to next indicator. If it is marked, during field visit, it can be physically seen on the ground. Sample of tractor of wood checked for Jungle wood. Experienced auditor can recognized the species such as rubber wood, Gliricidia wood, cinnamon wood etc. Local nearby village people were also interviewed for checking.

As large scale maps are not available in Gami Sarana Center, large scale maps shall be developed for all compartments prior to harvesting, identifying compartment boundaries, protected areas, extraction routes and depots within the compartment, and storage sites for consumer and production wastes. The design and layout of management units should promote the protection, restoration and conservation of natural forests, and not increase pressures on natural forests. Wildlife corridors, streamside zones and a mosaic of stands of different ages and rotation periods, shall be used in the layout of the management unit, consistent with the scale of the operation. The scale and layout of management unit blocks shall be consistent with the patterns of stands within the natural landscape. All riparian zones (indigenous or mixed species) bordering areas due for harvest are mapped and management plans to protect the biodiversity are prepared before harvesting occurs. Any planting in new areas shall have riparian zones identified on maps before planting begins. The intent of the Criterion seems to be the protection of natural forests, including riparian zones etc. As per Indicator I-2.1.3, fuel wood shall not be harvested inside a natural forest. With respect to illegal activities, Gami Sarana Centre had provided appropriate assistance to the police consistent with legal obligations and the safety of forest, personnel and the public. The Gami Sarana Centre plantation area did not occupy land converted from natural forests after the date this standard was approved. Therefore Gami Sarana Centre complies with the Indicator I-2.1.4. The Gami Sarana Centre had systematically identified and assessed the potential environmental

impacts of all activities (including on-site processing facilities) carried out within their management unit appropriate to the scale and intensity of plantation. This assessment process shall include consideration at a landscape level, taking into account interaction with adjoining land, nearby habitats and downstream impacts.

a. The assessment process in accordance with indicator I-2.2.1 shall have been completed prior to harvest planning.

b. The management plans and other relevant policies and procedures of the enterprise shall clearly identify the actions to be taken to mitigate or reduce the environmental impacts identified as a result of the assessments.

c. Site specific assessments of the potential environmental impacts of all plantation operations are carried out prior to commencement of the activity on site, in a manner appropriate to the scale of the operations and the sensitivity of the site. The assessment process shall identify the environmental values present, potential impacts on those values by the proposed plantation operations, and site specific requirements to manage risks and potential impacts. The outcome of this process must be documented in a site specific work prescription or harvest plan.

Principle of benefits to the community

Individuals are identified with responsibility for liaison and consultation with local communities and resolution of grievances relating to the operation of this principle. The Gami Sarana Centre and/or certificate holder shall promote employment and training opportunities.

Provisions for the following have been made:

- Provisions that demonstrate a commitment to hiring and contracting, locally, to the extent feasible in light of local capacity and required workplace skills, cost considerations and any legal obligations, relative to the employment of local people.
- The plantation operator shall maintain a record of the type of training opportunities organised for the workforce.
- Certificate holders contribute to the development of training programmes aimed at enhancing the skills and qualifications of the local workforce

- Contributions can be financial or in-kind. The standard can be satisfied if the certificate holder:
    - Contributes financially towards the training programme; or
    - Provides in-kind support by using staff to provide the training; or
    - Provides in-kind support by providing the training venue, food etc; or
    - Pays contractors while they are being trained; or
    - Includes a training component in the contractors' rate; or
    - Contributes in a similar manner appropriate to the scale of the Operation

97.5% of the workforce is local. The CBO supports a variety of specialised training for its employees. Plantation Coordinators' records of learning and records of contractors' crews' achievements were seen. The group coordinator records and responds constructively to community or other stakeholder complaints or requests provided the complaint or request is neither annoying nor laughing and acts fairly to all parties. Planning of planting and harvesting has taken account of forestry impacts on the visual aspects of significant natural features, backdrops to urban areas, tourist and state highways and other issues of local significance. A willingness to negotiate solutions with the community of interest is to be demonstrated.

Principle of group support

This principle is applicable to the community based organization that was used for validation of the developed PCIs. Under this principle, group members get organized under a group entity. Size of member, size of group would be decided by the group members. During the visit, it was observed that group entity has no legal title and little or no authority over the members. Further, it was observed that group entity can be a cooperative, association, purchaser, or any other organization that can provide support, monitoring and oversight and they are entitle to one single certificate – group entity.

It was learned during the validation period that not all members have to be certified;

- Group entity hires a coordinator;

- Coordinator recruits, trains, supports;
- Coordinator prepares group procedures, gathers group data, prepares for certification;
- Coordinator does internal audit, issues NCs, verifies correction of NCs.
- Sampling:
    - Certification audit: $0.8 * \sqrt{y}$
    - Annual audit: $0.6 * \sqrt{y}$
    - Recertification audit: $0.6 * \sqrt{y}$

      Where 'y' is the number of group members
- NCs are issued to the Group entity but may identify individual members

Certification takes place for a group of farms on which the same target crop or multi crops are cultivated in the same geographical region using similar agricultural management practices. Implementation and auditing takes place at individual farm level using a sample mention above. The methodology for yield increase including multi-cropping focuses on group-level certification for reasons explained in criteria 4.1 and 4.2. We recommend that the methodology for unused land focuses on certification at the level of a specific plot of land (farm-level certification), because this measure can involve land conversion. Due to the sensitivities around land conversion it makes sense that all projects are audited rather than a sample of participating group members. According to this project group certification of fuelwood flows will eventually be an absolute necessity, since it is the only way to determine the sustainability of national biomass flows properly. Operators will then be able to prove with certificates that they are complying with the testing framework. Companies will be able to prove by means of certification that they are complying with the testing framework.

Principle of COC

It is operator's responsibility to establish a mechanism to Chain of Custody (COC) as per last principle of the new project. It was observed that during validation, the point at which the operator transfers his ownership/possession to the purchaser of the fuel

wood is conformed to the set PCIs. For example, written procedure was established when operator sells fuelwood in following three situations.

1. The Stump: When Operator sells standing timber to a contractor.
2. Wood depot: Transfer of ownership occurs at a concentration yard under the control of the Operator.
3. The factory: Transfer of ownership occurs when offloaded at purchasers facility

Operator can choose to include contractor/transporters inside its gate, but needs control. Potential Non-conformances that can be available under COC are;

- Plantation gate not well defined;
- Control over contractors not defined;
- Same invoice used for certified and non-certified wood: confusing;
- % used instead of volume: can't keep track of volumes that way;
- No procedure to control/report/monitor/measure wood sold on roadside by other members. Is that wood certified?
- Date of collection?
- What else?

Assurance of the origin of the wood for the purchaser is observed on site, during the field test validation as per the set PCI. Gami Sarana Centre present invoice (see appendix I) contain minimum information required as per indicator 5.2.1.

6.3 CONCEPTUAL CELL MATRIX DESIGN FOR CERTIFICATION AND AUDITING

6.3.1 Overview

Next key stakeholders in the supply chain of biomass, especially fuel wood growers were met and piloting was done. Based on overall findings, a conceptual cell matrix was designed and applicability of it along the different stages of the supply chain was analysed. Finally models proposed to popularize the energy plantation in the country. This conceptual cell matrix system design is methodological. When auditing is done,

this kind of system is practice. This cell matrix is proposed to do the sustainability evaluation against the developed Principles.

6.3.2 Cell Matrix

The following cell can be proposed to capture socio economic and environmental indicators to be evaluated through whole supply chain during certification and auditing are presented in Figure 6.1

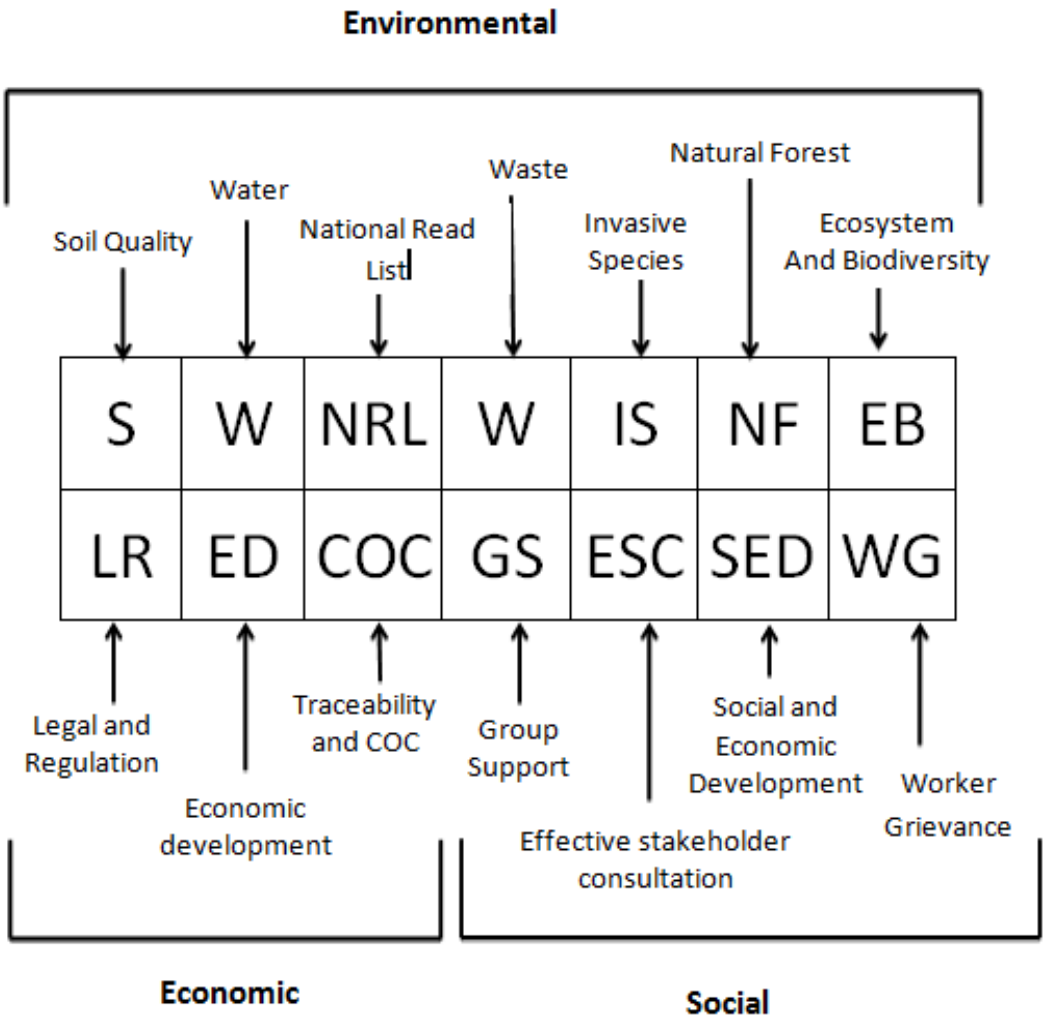

Figure 6.1: Cell matrix

6.4 SUPPLY CHAIN

Above cell matrix can be used in following supply chain when certification and auditing are presented in Figure 6.2.

6.4.1 Overview

The fuel wood should be available close to the production facility where the boiler is to be installed. Fuel wood sustainability is the key parameter for a successful project. The supply of fuel wood may be from large number of suppliers like individual farmers would increase the reliability of supply that a centralised single supplier. However, having signed agreements with suppliers will provide a security for an uninterrupted heat/steam supply as well as for the investment. After applying above 42 indicators into the supply chain of fuel wood now operating ad hoc nature, we can clearly define four main stages as fuel wood production, fuel wood logistics, fuel wood depot and end use.

Figure 6.2: Structure of applicability or non-applicability of criteria and indicators in whole supply chain are shown in matrix cell.

Above cell matrix can be applied along full supply chain and also for the part of the supply chain under different condition.

6.4.2. Fuel wood production

Fuel wood production also can be divided into three stages. First stage is the resource condition that describes whether it is CBO or intercrops or dedicated fuel wood plantation and some time it can be belonged to trade and industry. Sawn industry residue, wood industry residue, used wood and organic residue and belong to trade industry category. All 42 indicators developed can be applied here.

Second sub stage of the fuel wood production is feed stock indicators come s under soil quality, water waste, legal and regulation, economic development, COC, group support, effective stake holder consultation, social and economic development and worker grievance can be evaluated. Third sub stage of fuel wood production is management indicators that are belongs to this stage are presented in Figure 6.2 for assessing the sustainability.

6.4.3 Fuel wood logistics

Five sub stages can be identified under fuel wood logistics as shown in Figure 6.2.Those are harvesting, collection, storage, primary processing and transport to fuel wood depot that is a new concept coming up soon with the help of FAO and UNDP project operating under GEF. When evaluating sustainability one can use Figure 6.2 cell matrix to audit the fuel wood logistic checking records and other necessary documents. Generally, for fire wood transportation costs around 10 -15 cents/kgkm, and this also contributes to GHG emission into the environment.

6.4.4 Fuel wood depot - Biomass Energy terminal

Three sub stages can be identified under fuel wood depot namely mechanical processing, thermal and/or chemical drying and transport.

This is a facility to convert biomass to that required by the industry for thermal requirements. Normal capacities are ranged from 50MT to 100MT per day to serve around three to five

industries. Main expected out put forms of the fuel wood depot would be Briquettes/pellets, Chips and Split wood. Identified locations (based on study by SLSEA, Assessment and Mapping of Biomass in Sri Lankan Industries) are in Moneragala, Ratnapura, Kegalla, Gampaha, Galle, and Nuwaraeliya. Indicator that are relevant to each sub stages are presented in Figure 6.2. However it can be further stressed that joining with the UNDP backed fuel deport may laid a very strong foundation for continuous fuel supply as well as a security for biomass price. The moisture content of biomass plays an important role in combustion and overall boiler efficiency apart from the reduction in the gross calorific value in unit biomass. Energy loses due to moisture is two folds, major one is the reduction of effective wood mass, and the other is the latent heat carried by moisture to be evaporated. It is a fact that the moisture content of green wood varies from 50 to 60%, so the combustion biomass with this moisture content won't make the project economically successful. Hence, there should have a method of reducing this moisture content before the combustion.

6.4.5 End Use

As per the current practices in the industry, four sub stages can be identified namely boiler type, mixing with saw dust, appropriate technology and combine heat and power plant. Biomass Energy Conversion systems (boiler type) provide service such as steam, hot water, hot thermic oil, hot air and electric power by using wood logs, multi-fuels, paddy husk, wood chips, saw dust and coconut shell as fuel. Despite the fact that the Biomass Energy Conversion systems (BECS) are designed to use certain quality of biomass, the biomass used in Sri Lanka varies widely in quality and more over, there are local standards for biomass. It is, therefore, inevitable that our BECS underperform due to unavailability of quality biomass. There are some institutional barriers to promote sustainable BECS in the country. There are enough opportunities to introduce new technology for improving performance of BECS. Local value addition can be played major role in improving the performance of BECS.

CHAPTER 07

CERTIFICATION SYSTEM

7.1 OVERVIEW

Any company should not focus on certification. Certification is a secondary thing. Sustainable Fuel Wood Certification (SFWC) system is a remarkable management tool. Certification is just a marketing tool. Unfortunately 99% of the companies are focusing on certification. They want to get certification. They say; they will get sustainable fuel wood certification. There is nothing to get. Company need to practice it. As a secondary objective, as a marketing tool, company can obtain certification. Any company's prime objective is to establish a sound fuel wood management system, not for certification but to manage the quality and give quality product.

Fuel wood purchasers such as manufactures and power plants need to be held accountable for the wood they purchase. We need to certify the sustainability of the sources of wood (estates and other acceptable sources) but even if they favour certified sources, fuel wood purchasers will continue to buy wood from anywhere including unsustainable and illegal sources. This will undermine the impact of sustainable fuel wood certification because the market will continue to reward (purchase wood from) unsustainable sources. For this reason, we would like your opinion on the following option: What if the entity subject to certification (the entity whose practices are being verified, the entity who holds the certificate if they meet the standard) was the fuel wood user (the manufacture, the power plant, etc.)? Of course the fuel wood user is not always the one cutting the trees, so the auditing would also have to include the fuel wood sources of that user. In that sense, the standard would have two parts: A purchasing policy part, which would apply to the manufacture, and a forest management part which would apply to its fuel wood suppliers. However there would be a single certificate, held by the fuel wood user.

Fuel wood users (fuel wood purchasers) have a wood 'basket', which is an area around the manufacture where the wood comes from. This could be anywhere in a radius of 50 km

around the manufacture, maximum. The standard would require the fuel wood user (the certificate holder) to:

- Define its wood basket (how wide, which estates or other forests does its wood come from, what species, etc.);
- Identify unsustainable sources within this basket (are there protected areas within 50km? Are there protected tree species in the area?);
- Demonstrate that the wood they purchased in the last 12 months excludes all the unsustainable sources they identified;
- Demonstrate 'internal' audits of its wood basket were conducted by the fuel wood purchaser (the certificate holder) before the external auditors (SLSI) come to do their own audit.

This above is the purchasing policy part of the standard.

The standard is also a forest (or plantation) management standard, so it requires a certain level of good, sustainable practices by the fuel wood sources (suppliers within a manufacture's basket). So after their visit to the fuel wood user, the auditors would sample some of the fuel wood suppliers within the certificate holder's (the manufacture's) basket and verify conformance with the standard, like for erosion control, protection of biodiversity, protection of workers, etc. If non-conformances are found, the suppliers would have to make the required changes if they want to be able to continue selling to the certificate holder.

The next pillar of sustainability is the practical implementation of the standard or of the principles and criteria that are aimed for. This step requires a tracking method and a labelling process and it is known as the certification of the product under assessment. Certification is the practice that implies third party assessment of the management procedures with respect to a certain standard as shown in Figure 7.1. A good or service that is required to comply with a certain standard has to pass through the certification procedure as shown in Appendix G. Here, the product will be translated from the pool of unidentified goods/ services into the smaller category of labelled goods. The product will be recognizable and its compliance with the standard in question will be indubitable. Certification is the final step in the chain. However in order to fully develop the certification phase, one should discuss the previous segment, which is the traceability or the chain of custody.

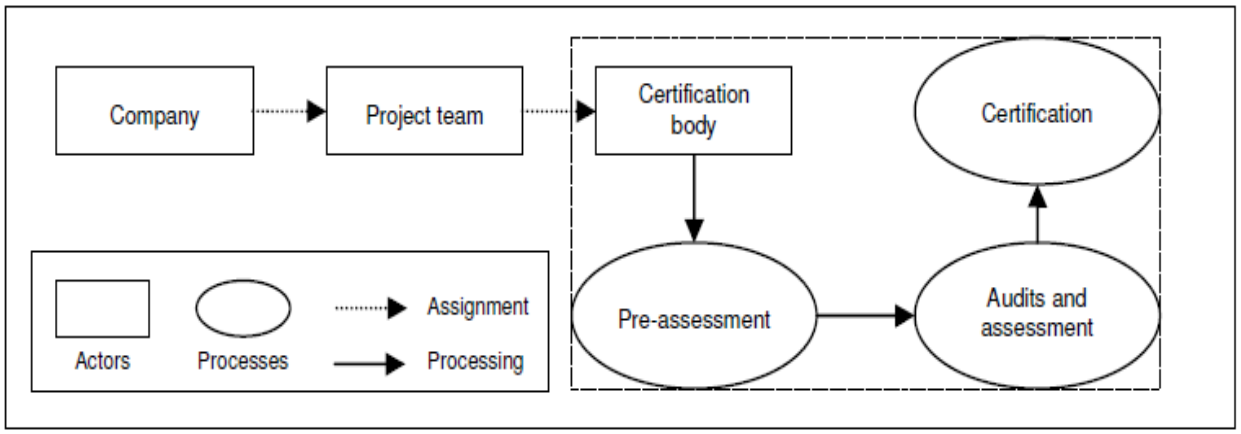

Figure 7.1: Process of certification

In the recent past, the production of energy from biomass has often been associated with land-use competition, increasing commodity prices and deforestation of rainforest. Until today, the markets for bioenergy have not come up with a label for fuel wood, liquid biomass or biofuels from sustainable production. Thus, buyers do not have the possibility to choose between sustainable and non-sustainable products. The price is what makes a product successful. The market offers no incentives for sustainable producing farmers and bioenergy producers. To overcome this deficit, this new certification Scheme can be launched to avoid unwanted ecological and social side effects of the expanding biomass production. Certification is an instrument to distinguish sustainable products from non-sustainable ones on the market. It puts buyers in the position to opt deliberately for sustainability and greenhouse gas reduction. Hence, certification supports responsible farms and processing companies and reduces the risk of unsustainable production. These newly proposed certification systems allow differentiation of sustainable products from non-sustainable ones including information on the greenhouse gas emissions at the different stages of the supply chain. The certification of sustainable biomass for energetic use is a complex procedure. This newly developed certification system describes procedures and standards in its reference documents that allow an easy handling for the users. Sustainable production is a precondition for the further expansion of bioenergy use. The use of biomass for fuel, heat or electricity bears a big potential for climate protection and can reduce the dependency on energy imports. It is also expected that sustainability standards will be introduced on a voluntary or legal basis for the traditional markets as well as in the

chemical / technical industries. Independence, transparency and national scope are the characteristics of this new system.

The SFWC logo reliably distinguishes sustainable biomass and bioenergy from non-sustainable ones. SFWC provides a platform for the necessary dialogue. The essential characteristics of the SFWC system are:

• Nationally applicable certification system for sustainability and the reduction of greenhouse gas emissions

• Not restricted to certain types of biomass only; covering all relevant raw materials

•Multi-stakeholder approach (farmers, processors, trade, industry, NGOs, associations, research institutions, authorities)

• Audits by independent 3rd party auditors, free from conflict of interest and competent

• Specific control points for sustainability audits

• Traceability based on mass balances

• Registry and Internet-publication of certificates issued

• Cooperation with other recognized certification systems

7. 2 AUDIT TEAM COMPOSITION AND AUDITOR ETHICS

7.2.1 Audit team size and composition

A stage II SFW audit shall be executed by a team of at least two (one lead auditor, one auditor). Annual audits can be conducted by a single Lead Auditor when the operation is small enough. The use of technical experts is never mandatory for any type of audit. For larger COs, for candidates with multiple PMUs or for large groups, the Certification Body (CB) shall consider using three (3) or more auditors for stage II, and two (2) or more for annual audits. The design of the audit team depends upon the scale and complexity of the operation being evaluated. Auditors shall be chosen to ensure a diversity of expertise (e.g. one forester and one biologist; a forester and a socioeconomic expert, etc.).

7.2.2 Confidentiality, independence, conflicts of interest and ethics

To gain the privileged access to information that is needed to assess conformance to the requirements of the standard, it is essential that auditors and the CB keep confidential any proprietary information about a client. The confidentiality policy and procedures shall be communicated to the auditee. As a rule all information gathered during an audit process is kept confidential. Draft confidential statement is given in the Appendix C. All assessors need to declare to the CB if they have a conflict of interest with the auditee, and sign a commitment to confidentiality as part of their contract with the CB. They shall conduct their evaluation of the candidate's performance compared to the standard without any pressure, advice, threat or any other form of influence from the CB, the candidate, stakeholders and authorities. When translators are needed during the audit, they shall be identified and hired by the CB or the auditor. Translators provided by the auditee shall never be used by the auditors. When interacting with stakeholders, auditors shall use great caution to not be perceived as defending the practices of the auditee. Auditors conduct stakeholder meetings in order to gather evidence of compliance or non-compliance. Auditors never enter into arguments with the stakeholders. Auditors are there to take note of stakeholder comments, and to afterwards verify (triangulate) whether there is conformance or if the issues brought up by the stakeholders indeed result in non-conformances with the requirements of the standard.

Content of online publicly available summary report (see report template in Appendix D):

Designated sections of the assessment report (those not marked confidential) will become the Public Summary Report, which is posted on the SLSI and/or CB database prior to certificate issuance. In other words, assume that the public summary sections of the report will receive wide circulation, either internally or publicly. The auditor and report reviewers shall take into consideration and ensure the quality of their writing is adequate for circulation. Special attention must be paid to keep confidential information out of the public summary. Writing and editing drafts of the assessment report can be the most time consuming and difficult part of the assessment process.

7.2.3 Complaint resolution process

Stakeholders who have concerns about a certificate holder must follow these steps. If the stakeholder wants to remain anonymous, she or he can skip to step 3. Otherwise, steps 1 and 2 must be followed to begin with the process:

1- Bring up the issue with the auditee verbally or in writing. If made verbally, the concern must be documented by the auditee, in conformance with the requirements of Indicator 3.1.2 "Records of comments and concerns are kept";

2- The auditee decides on actions to be taken, or not, to address the issue raised by the stakeholder. Decision and action taken is documented and communicated to the stakeholder;

3- If the stakeholder is not satisfied with the actions taken by the auditee, or if the stakeholder does not want to be identified by the auditee, then and only then can the issue be brought up to the CB directly, ideally in writing or by email, but verbally in person or via phone is also acceptable. The CB documents the complaint and discusses the issue with the auditee. Identity of the stakeholder is kept confidential;

4- The CB can decide to perform a desk or field audit to verify the issue raised by the stakeholder to verify if it represents a non-conformance with the SFW standard. The cost of this non-scheduled audit is covered by the auditee. If non-conformances are identified, corrective actions can be imposed to the auditee. Whether the issue raise represents a non-conformance or not, the CB communicates its decision to the stakeholder;

5- If the stakeholder remains dissatisfied with the situation and/or corrective actions implemented, she or he can decide to notify the CB. At this point, both parties will jointly identify an independent reviewer they are comfortable with who will review the case and take a decision. If costs are involved, those are covered by the auditee. The reviewer's decision is final executory.

7.3 AUDIT CYCLE

7.3.1 Application

Applicant fills out an application. Application is sent to one or various SFW accredited CBs. The CB prepares and sends the applicant a proposal which includes at the minimum:

- The scope of the assessment;
- Whether the Stage I (pre-assessment) will be done with site visit, or documented only;
- The budget;
- The names and qualification of the auditors;
- The sampling in case of group certification;
- Timelines for fieldwork, report writing, internal review by CB, review by client, and report finalization with certification decision.

7.3.2 Audit agreement

Once the candidate operation has chosen its CB, the CB prepares and sends an agreement (contract) by which, at the minimum, the CB commits to confidentiality, to executing the audit and to providing the client with a report, and the auditee commits to paying the fees and to allowing the CB to conduct audits.

7.3.3 Pre-assessment (or Stage I)

A pre-assessment does not result in certification. It is a scoping of the client's performance compared to the requirements of the established PCI. A report is produced by the CB outlining the most important/obvious gaps in the auditee's systems, documentation and on the ground performance. The objective is to identify in advance the elements that need to be addressed by the auditee in order to minimize the risk of having non-conformances during the assessment.

Pre-assessments are tailored to suit the auditee's needs and particular situation. For example, to save costs, a pre-assessment can be done from a distance, without any field nor site visit, and focus on the auditee's systems and documentation, obviously overlooking field performance. The pre-assessment can include stakeholder consultation, but this is not mandatory. Again, the objective is to identify, for the auditee, the issues (or non-

conformances) that are likely to arise during the certification assessment. The CB delivers a confidential pre-assessment report to the auditee within the agreed-to timeframe.

7.3.4 Certification audit (assessment or Stage II)

The certification assessment (assessment) is the formal evaluation of the plantation management operation to determine whether they meet SFW certification requirements. The evaluation is limited to the defined scope of certification as detailed by the applicant. The assessment results in a positive or negative certification decision by the CB. In the case of a positive certification decision, upon the signing of a certification agreement with the auditee, the CB issues a SFW certificate for a 3 year period.

The issuance of a SFW certificate provides a credible guarantee that there is no major failure in conformance with the requirements of the SFW Standard in any plantation management unit within the scope of the certificate. In order to provide such a guarantee, SFW assessments must achieve the following tasks:

a) Define the scope of the evaluation: Analyze and describe the plantation area to be evaluated in terms of one or more distinct Plantation Management Units (PMUs);

b) Evaluate the auditee's management system: Confirm that the management system is capable of ensuring that all the requirements of the certification standard are implemented within every PMU within the scope of the evaluation;

c) Verify implementation of the management system: Carry out sampling of sites, documents, management records and consultation with stakeholders sufficient to verify that the management system is being implemented effectively and consistently across the whole scope of the evaluation; and,

d) Identify non-conformances: The evaluation of the auditee's management system and PMUs provides a credible guarantee that there are no major non-conformances with the SFW standard in any of the PMUs within the scope of the evaluation.

7.3.5. Surveillance (or annual) audits

Surveillance audits shall be conducted at least once annually to evaluate corrective actions issued previously and ongoing conformance. All certificates will be audited at least twice during each three-year certification period. If an audit is not conducted once within each calendar year, the certificate must be terminated. The certification contract signed at the time of certification is valid for three years and covers the execution of the annual audit: There is no need to sign a new contract for each annual audit. The CB simply presents a budget and team proposal to the auditee (can be done via email). The auditee signifies its acceptance or desire to adjust the proposal by responding to the email.

The objectives of the annual audit include:

- to evaluate the certified operation's continued conformance with requirements of the SFW certification standard;
- to verify and document continued conformance of the auditee with each individual indicators of the SFW standard;
- to verify if the corrective actions implemented by the auditee since the last audit are sufficient to close the previously issued non-conformance;
- to follow-up on any complaints, disputes or allegations of non-conformance with any aspect of the SFW standard received since the last audit; and,
- To evaluate a sample of sites and records, and interviews with affected stakeholders sufficient to verify that management systems (documented or undocumented) are working effectively and consistently in practice, in the full range of management conditions present in the area under evaluation.

Annual audits can be conducted by smaller audit teams than assessments and reassessments. They do not require stakeholder notification, but do require consultation. Finally, annual audits require a smaller sample of PMUs, documentation and stakeholders than assessments and reassessments. For further explanation see Table 7.1.

CASE STUDY on root cause:

Auditors find invasive Alstonia is well controlled inside the plantation, but find it is abundant inside a natural, protected forest patch inside the plantation. Auditors find the operator has not implemented its procedure regarding control of invasive species, which requires control even in protected jungles, buffers, etc. A non-conformance is issued and corrective action is required as per I2.4.2 and I 2.1.2.

At the following audit, the auditors find the corrective action implemented by the certified operation did not address the root cause: Staff removed Alstonias from the protected areas shortly after the audit. This created good results and greatly decreased the presence of the invasive species inside the jungles. However, this action which happened 10 months ago was never repeated, and the auditor now finds Alstonia regeneration continues to spread inside the same jungles. This shows the root cause has not been addressed. The non-conformance remains open and is upgraded to major with a 3 month timeline.

--- In this case the root cause was the absence of a trained person made responsible for the periodic monitoring and control of invasive species. The operator simply did the job once, but did not put a system in place to ensure continued conformance over the long term.

7.3.6 Non-conformance verification audits

Non-conformance verification audits (NCVA) are conducted when a corrective action is imposed with a timeline that requires evaluation by the CB before the scheduled annual audit. Shorter timelines (three (3) months) are typically issued for major non-conformances, but there may be situations where the auditor issues short timelines for minor non-conformances as well.

NCVAs are paid for by the auditee. They can be desk based or require a visit to the field. In either case, a short report is produced (using the universal SFW template). During a NCVA, conformance with each open non-conformance shall be carefully evaluated in order to determine if the auditee has addressed the non-conformance in a sufficient manner and has eliminated the root cause of the non-conformance. The process of evaluating conformance with non-conformances is the same for major and minor NCRs, although the consequence of not fulfilling a major is different from that of a minor.

See sections 6.2.9 and 6.6.2 for guidance on evaluating conformance, on issuing CARs and for procedures in case the CARs are not properly addressed.

7.3.7 Re-assessment

In order to avoid a gap between the expiry of a certificate and its renewal, a reassessment must be conducted and finalized (including certification decision) before expiry of the three year certification contract. Reassessments require audit teams follow assessments requirements with regards to audit team, stakeholder notification and consultation, but follow annual audit requirements with regards to sampling.

7.3.8 Change of scope audit

An audit to verify procedures and systems in order to expand or reduce the scope of a certificate. This can take place, for example, when new members join a group certificate, when an auditee wants to include a new crop in the scope or acquires new land. In some cases a change of scope audit is done as part of the normal annual audit. The level of effort and sampling requirements depends on the extent of scope change. New group members or PMUs are sampled following assessment sampling requirements.

7.3.9 Certification decision, suspension, termination and certification contract

When a report has been reviewed and accepted by the CB and AUDITEE, the CB then proceeds with its certification decision. This is the CB's ultimate quality control of the audit report, where a senior CB staff officially accepts the findings of the auditor with regards to the issuance of the CARs and recommendation with regards to maintenance, removal or issuance of certification. A very basic checklist of items to be verified during quality assurance is inserted in the report template itself. If the reviewer finds problems with the audit report prepared by the auditor, he can either fix them himself (for small formatting issues) or send it back to the auditor (for more fundamental issues such as unclear or insufficient findings) for correction.

As soon as possible (within a day or two) after a positive certification decision/report review, the CB sends a 3 year certification contract to the auditee for signature. The contract covers at a minimum:

- Confidentiality clauses;
- A clause by which the auditee commits to conforming to the SFW standard and to allocating the resources needed to do so;

- A mention that the contract covers subsequent annual and NCVA audits, conditional to acceptance of annual and other audit budgets;
- A clause about communication and claims about certification;
- A clause that mentions the certificate can be cancelled by either party at their discretion with a 30 day notice;
- A clause that the CB can also cancel the certificate at any time without notice in the case of intentional or grave wrongdoing by the auditee;

A major non-conformance found during an assessment or reassessment results in a negative certification decision (suspension in the case of a reassessment). Majors need to be closed before a certificate can be issued or renewed. There are no timelines for majors issued during assessments and reassessents, but if more than 12 months pass between the assessment (or reassessment) and the NCVA to close the major non-conformance, the full assessment (reassessment) needs to be re-done.

When during an annual audit an auditee is issued a major non-conformance which could not be closed within three (3) months, or when more than four (4) major non-conformances are identified during an annual audit, the certification decision is suspension. Suspension is valid for up to 12 months. Suspension is a pause in the validity of the certificate during which the auditee can take the time needed to apply the corrective actions necessary to close the outstanding major non-conformances. Within 12 months, a NCVA can be done and if all non-conformances are close, the certificate can be reinstated. The next annual audit (or reassessment) is performed as originally scheduled, within 12 months of the last audit which resulted in suspension. The NCVA can be combined with the annual audit (or reassessment) if the auditee took a long time (but less than 12 months) to close its major non-conformances. After 12 months without any audit (NCVA, annual audit, reassessment), a certificate is terminated.

7.4 AUDIT PROCESS

7.4.1 Public notice

Within 30 days of assessment and reassessment fieldwork, the auditee (or the CB at the auditee's expense if costs are incurred) notices local communities, authorities, elected officials

and the general public that the operation will be audited to the SFW standard, and inviting any stakeholder to confidentially submit comments regarding the auditee.

7.4.2. Audit plan

Within 2 weeks of fieldwork, for assessments, annual audits and reassessments, the CB prepares and sends to the client a brief audit plan outlining at a minimum the scope and schedule of the audit, contact information for the auditors and point person for the client.

7.4.3. How auditors should prepare for the audit

The secret to a stressful audit is to not take the time to prepare. A good preparation, at least a few days to a week before fieldwork, is key to a smooth audit. Auditors should prepare by:

- Reading the standard. The auditor needs to know what to look for before he arrives on site;
- Reading past reports. When client is an auditee, past reports provide excellent background on the auditee's past or on-going issues;
- Familiarizing himself with outstanding CARs. The auditor will have to document conformance on those. Best if he makes sure he knows and understands the CARs before going on site;
- Reading the evidence sent in advance by the client and drafting findings for some indicators and/or CARs in advance based on that evidence. This is key. Of course findings are not complete until the auditor has full evidence and had a chance to triangulate, and this is best done while on site. However, by starting to work on some findings based on documented evidence sent in advance by the client, the auditor can take the time to review the more complex or lengthy evidence and begin documenting findings. This kind of evidence is harder to review in the frenzy of the on-site audit;
- Setting up meetings with some stakeholders in advance. Last minute meeting requests done during the on-site audit are less likely to be successful.

In summary, the well prepared auditor has a much better idea of what to look for and of higher risk elements of the client's system, and will be able to focus on the essential.

7.4.4. How auditees should prepare for their audit

Needless to say, auditees have to make sure they are in conformance with, and be prepared to present evidence for, each and every indicator of the SFW standard. It is not sufficient to elaborate the systems and procedures and implementing the actions to attain conformance, it is also necessary to be prepared to readily present the evidence to demonstrate conformance. To prepare for an audit, the auditee needs to think like an auditor. Auditees need to present information to the auditors in a way that avoids confusion and streamlines the audit. Time spent by the auditee on preparing for the audit will result in less non-conformances and will reduce cost of certification. One of the ways to do this is by creating a checklist (some CBs will provide that checklist template) with the standard to keep track of advancement of work towards conformance for each indicator, to identify actions left to be implemented, to allocate responsibility to team members, etc. Sample checklist shown in Table 7.1, once filled out, could be shared with the auditors.

Table 7.1: Sample check list need to prepare by the auditee

Indicator	Action needed to reach conformance	Responsibility	Advancement	Evidence to demonstrate conformance
I-2.1.3 Fuel wood shall not be harvested inside a natural forest.	- Identify natural forests; - Mark natural forests and train staff to not enter; - Adopt CoC procedures.	- Lands manager	- Natural forests identified	- Mapped natural forests; - Staff training records; - Chain of custody

7.4.5. Opening meeting

Conducting the opening meeting

A formal opening meeting shall be held with the client's management and those responsible for the functions or processes to be audited and participant should sign in attendance sheet given in appendix F. The purpose of the opening meeting, which shall usually be conducted by the audit team leader, is to provide a short explanation of how the audit activities will be undertaken and shall include the following elements. The degree of detail shall be consistent with the familiarity of the client with the audit process:

a. Introduction of the participants, including an outline of their roles;
b. Confirmation of the scope of certification;
c. Confirmation of the audit plan (including type and scope of audit, objectives and criteria), any changes, and other relevant arrangements with the client, such as the date and time for the closing meeting, field sampling;
d. Confirmation of formal communication channels between the audit team and the client;
e. Confirmation that the resources and facilities needed by the audit team are available;
f. Confirmation of matters relating to confidentiality;
g. This is a sample audit
h. Audit team collect information through observation, interviewing with employee and going through documents
i. Confirmation of relevant work safety, emergency and security procedures for the audit team;
j. Confirmation of the availability, roles and identities of any guides and observers;
k. A reminder of the definition of major VS minor non-conformance, and the consequence when minor NCs cannot be closed;
l. Confirmation of the language to be used during the audit;
m. Confirmation that, during the audit, the client will be kept informed of audit progress and any concerns;

n. Opportunity for the client to ask questions.

Conducting the closing meeting, explaining the NCR s and conclusions.

A formal closing meeting shall be held with the client's management and, where appropriate, those responsible for the functions or processes audited and participant should sign in attendance sheet given in appendix F. The purpose of the closing meeting, which shall normally be conducted by the audit team leader, is to present the audit conclusions, including the recommendation regarding certification. If Non-conformities have been presented and discussed throughout the audit, as they should have been (see section 3.8 below), the closing meeting will be a short formality with minimal discussions. It is inappropriate to present non-conformances for the first time at the closing meeting.

The closing meeting shall also include the following elements. The degree of detail shall be consistent with the familiarity of the client with the audit process:

a. Advising the client that the audit evidence collected was based on a sample of the information; thereby introducing an element of uncertainty;
b. The method and timeframe of reporting;
c. The certification body's process for handling nonconformities including any consequences relating to the status of the client's certification;
d. Information about the complaint handling and appeal processes.

The client shall be given opportunity for questions. Any diverging opinions regarding the audit findings or conclusions between the audit team and the client shall be discussed and resolved where possible. Any diverging opinions that are not resolved shall be recorded and referred to the certification body.

7.4.6. Evidence gathering – "show me" audits

Auditor has to verify the conformity of each indicators as per list given in Appendix K. Auditors should not have to work through the client's documents when gathering evidence.

Evidence needs to be presented to them by the client for evaluation. Auditors need to gather evidence from a variety of sources in order to determine conformance, including stakeholder input and field sampling. However, the smoothest, most efficient and often most successful audits are "show me" audits, by which the auditee is actively involved in presenting evidence to the auditors. Much time is lost (and audit costs rise) when auditors have to look for the evidence in the documents of the client. The client should therefore make lists, summaries, etc. specifically to facilitate the work of the auditor. The auditee should consider sharing his preparation checklist with the auditors. The auditor does not need to keep physical evidence to support his findings.

CASE STUDY on communication during the audit

The auditor finds the client has adopted a plan with timelines, measurable benchmarks and a budget for the restauration of reservation strips along water bodies (I2.2.3), but during field sampling the auditor finds riparian areas along many water bodies inside the plantation are still bare or have very little vegetation. The auditor notes the non-conformance but fails to mention it immediately to the client. At the closing meeting, the client reacts very strongly when presented with this non-conformance, and says restauration has indeed started in some areas of the plantation. Should the auditor have mentioned his finding during fieldwork, the client would have taken him to see restoration activities. This causes the client to doubt the auditor's judgement and affects his credibility for all his other findings.

7.4.7 Communication during the audit

Throughout the audit, it is very important that the auditors inform the client of their findings. The closing meeting is not the appropriate time to present non-conformances for the first time. When an auditor finds a non-conformance, he has to present it immediately, when possible, in order to give the client the opportunity to react, respond and maybe present additional evidence. Presenting the client with non-conformances as they are found also allows the client to acknowledge and accept them at the same time as the auditor, therefore reducing discussions and arguments at the closing meeting.

7.4.8 Report writing

SFW has a unique report template to be used for all types of audits. As reporting requirements differ from one audit type to the other (e.g. there might not be stakeholder comments nor auditor response needed during a NCVA), sections of the report which are not relevant can be deleted.

The public summary of all SFW reports is prepared by simply removing the sections identified as confidential. This means two different versions of the report are created: The original full report, and the public summary. The public summary is posted online on the SLSI and/or CB website.

The approach to writing findings in the report's indicator checklist is to do it so that another qualified auditor will reach the same conclusion as the original auditor when reading the finding.

Corrective Action Request (CAR) tables are inserted in the report. The auditor must write up a summary of the requirement of the indicator, and a description of the situation (non-conformance) that clearly shows where the auditee has failed to meet the summarized requirement. Minor non-conformances have 12 months for resolution, which is typically audited at the next audit. A minor non-conformance that is not closed at the end of the timeline is upgraded to major with a three (3) month timeline. Major non-conformances can also be issued directly without having first been minors (see section 6.6.2 below). At the end of the three (3) month timeline a NCVA is conducted. If the major cannot be closed, the certificate is suspended. The auditee then has another few months (maximum 12 months from the time the certificate is suspended), while his certificate is suspended, to try again to close the non-conformance (via another NCVA or annual audit). After 12 months of suspension the certificate is terminated if the non-conformance is still open.

Draft reports are submitted to the CB for review and approval. The CB can send the report back to the auditor if significant corrections are needed, or can fix them directly if they are minor issued. The report is then sent by the CB to the auditee for review and approval. The auditee can comment and request adjustments/changes to the report. Report can be edited again by the auditor or the CB. The CB should not make significant changes to the findings without at least discussing with the auditor. Once the report is finalized, it goes through the certification decision process by the CB (see section 6.8).

7.5 STAKEHOLDER CONSULTATION

With the SFW certification system, openness and transparency have been taken to a higher level than in most other certification systems worldwide. Stakeholder consultation is a central part of the certification process. The audit report summary is made publicly available and includes many important details of certification (such as non-conformities, comments received from stakeholders, how those were treated by the auditors, etc.).

The wide scope of stakeholders who might have interest in the outcome of audits need to be kept in mind when designing the audit plan (See Appendix E). Important stakeholders in the audit process include but are not limited to: the customers of the organization being audited; governmental authorities; non-governmental organizations; communities, lower level (field) workers, consumers and other members of the public.

It is important to note that according to international auditing rules, information obtained from sources other than the client for the purpose of auditing (e.g. complainants, regulation bodies, stakeholders, subcontractors) shall be also treated as confidential in the same manner as the information obtained from the client. When in doubt about the confidential nature of information, auditors should use a precautionary approach. Stakeholders are not identified in the public summary, only their comments are.

During interviews with stakeholders, group members, workers and managers of the auditee, auditors shall not be perceived as defending or representing the auditee. To maintain independence and ensure accuracy, when when translators are needed during the audit, they shall be identified and hired by the CB or the auditor. Translators provided by the auditee shall never be used by the auditors. Auditors shall schedule and organize stakeholder meetings themselves. Many auditees will offer to organize group or individual meetings between the auditors and the auditee's workers. It is a conflict of interest for the auditor to accept this. The auditee shall request a list of all workers and their representatives including contact information, and organize the meetings themselves with a sample of workers, in a neutral space and without the presence of any auditee employees/representatives (except from the low-level or field workers themselves).

In the report, the auditors summarize the comments received from stakeholders, how those comments have been addressed by them, and whether they led to non-conformances being identified.

Ultimately, the process of consultation is about respect - for peoples' perspectives, respect for differences of opinion, and respect for due process. It is the job of the auditors to be open to stakeholders' comments, no matter what they say, and to be fair and civil to both the auditees and stakeholders in considering these perspectives as they relate to the auditee's conformance with SFW requirements.

7.6 GROUP AND MULTIPLE PMU CERTIFICATION

7.6.1 Definition and function

Group certification is available for landowners who wish to combine resources in order to get certified. It can apply to small, medium or large landowners and there is no limit on the size of a group, except the group's own capacity to manage itself. Groups designate a coordinator who serves as point of contact for the CB and the public, performs internal audits, and generally accompanies the group members towards conformance.

A plantation company with multiple PMUs does not constitute a group. There can only be a group if there are multiple (minimum 2) landowners.

Auditing a group is like auditing a single auditee with multiple PMUs. Individual group members can have multiple PMUs in the certified pool. Each member must be in full conformance with all requirements of the standard, but demonstration of such conformance is often done at the group level. For example, there should be a single group procedure for minimizing erosion during plantation management operations, and there shall be no significant erosion on any of the properties in the certified pool. A non-conformance found on a single property through sampling is issued to the group as a whole. The precise property where it was found can be identified, but because the root cause must be eliminated, it is highly likely the group coordinator will have to make sure the non-conformance is not present elsewhere.

7.6.2. Sampling

The number of PMUs to be visited during annual audits and reassessments of multiple FMUs shall be at least half the number of FMUs visited during the main evaluation. If new FMUs (e.g. newly acquired FMUs) have been added to the scope of the certificate since the last evaluation, the new FMUs shall be treated as separate set(s) of like FMUs and sampled at the rate of a main evaluation.

Table 7.2: Sampling requirements by audit type

Audit type	Minimum audit team size	Audit plan needed	Stakeholder notification	Stakeholder consultation	Multiple PMU Sampling	Group sampling
Assessment	2	Yes	Required	Extensive	0.8 * x	0.8 * √x
Annual audit	1	Yes	Not required	Limited to specific issues	0.6 * x	0.6 * √x
NCVA	1	No	Not required	Only if needed to document conformance	Field sampling only if needed to document conformance	Field sampling only if needed to document conformance
Reassessment	2	Yes	Required	Extensive	0.6 * x	0.6 * √x
Change of scope	1	No	Not required	Limited to specific issues	For new PMUs: 0.8 * x	For new group members: 0.8 * √x

'x' is the number of PMUs or group members. The number of PMUs often corresponds to the number of management plans. Multiple adjacent or disconnected plantations covered under the under a single operational (often annual) plan count as one (1) PMU. Multiple plantations under a single quinquennial or general plan, but for which there are multiple separate operational plans count as many PMUs.

These are minimal requirements. The CB can decide to increase the sample size in higher risk operations or operations with a history of non-conformance. Sampling calculation results are rounded up to next whole #. For example: An auditee with 7 PMUs in now adding 5 new ones

at the annual audit (which needs to include a change of scope audit). The sampling will therefore be:

Annual audit of current PMUs	Expansion audit of new PMUs
0.6*7 = 5	0.8*4 = 4

In this example, the auditors must sample 9 of the 11 PMUs this year: 5 of the old ones, and all 4 of the new ones.

7.7 EVALUATING CONFORMANCE

7.7.1 Gathering evidence

The audit team must design and carry out audit activities across the plantation operation and at different levels of the company's organization and management systems that provide evidence of the auditee's performance for each of the standard requirements as shown in Table 7.3. Auditors should take clear notes during all phases of the audit to document findings which may be done by recording evidence in field notebooks, directly on the audit checklist, or by securing separate documentation.

Table 7.3: Check list for Gathering evidence

Type of evidence	Description	Documentation of evidence
Interviews	Information gathered from interviews with auditee staff across the operation, from contractors, stakeholders, government agencies, etc. Comments may be provided either in verbal or written form.	Notes from interviews, minutes of meetings
Direct observation	Direct auditor observations to evaluate performance as auditee procedures are being carried out (e.g. direct implementation of company procedures), examining site conditions,	Auditor field notes, photos

	facilities or products to evaluate auditee practices and performance. Auditor should be constantly aware of the surrounding environment and conditions.	
Documentation review	Involves review of auditee documents such as policies, objectives, plans, maps, procedures, instructions, licenses, permits, receipts, specifications, contracts and orders. May also include documents from other parties (e.g. regulatory bodies, customers, suppliers etc.).	References to specific documents or sections in a document. Copies or photos of documentation.
Records	Review of records, such as inspection reports, volume records, supplier documentation, invoices to customers, databases, minutes of meetings, records of monitoring programs, internal audit reports, results of various measurements (e.g., erosion, yield), etc.	Records or reference to specific record or section or point in the record
Stakeholder comments	Comments from stakeholders are obtained in response to assessment notification and request for comments or through targeted interviews. These comments are an important source of audit evidence subject to further investigation. They are quoted in the public section of the audit report, along with the actions taken by the auditor as a result of each comment, including non-conformances issued when applicable.	Written correspondence, notes of interview
Direct measurements	Involves measurement of structures or features to evaluate conformance with standard or legal regulations (e.g. width of reservation strips, depth of erosion gully, etc.)	Field notes, company records (e.g. production report), maps

Auditors must make every effort to verify that the audit evidence obtained during the audit is true, accurate, and objective. In order to verify the evidence, auditors can:

- ✓ Find evidence from various sources. For example, if documentation suggests non-conformance, talk to relevant staff and observe the activities in the field in order to confirm the non-conformance;
- ✓ Give feedback to the auditee about evidence which suggests non-conformance to ensure that the evidence has been correctly understood and interpreted (see section 6.3.8 above);
- ✓ Share evidence and findings with other team members to calibrate findings and if needed, ensure that additional evidence is gathered by other team members.

As a rule, the evidence should be collected from different sources and also from different levels in the organization. Auditors should ask the same questions to different people at different levels of the organization, to contractors and stakeholders.

7.7.2 Analyzing evidence and determining conformance

Analyzing audit evidence means comparing the evidence with the requirements in the standard. This is to determine conformance or non-conformance between what is demonstrated through evidence and what is required in the standard.

CASE STUDY on evaluating conformance

While conducting field sampling in an uprooted rubber plantation on a steep slope, the auditor finds erosion beyond what the standard allows.

The auditor immediately and transparently explains to the client what the standard requires (indicator 5.2.2) and that he is going towards a finding of non-conformance on the site. This is to allow the client to present additional evidence if appropriate, explain this particular situation, etc.

The client believes their procedures and guidelines are adequate and were well applied on this site, but that they have had strong rain. According to him, the erosion is caused by the rain, not by the uprooting. Remedial actions such as terracing and ground cover are taken after erosion has taken place.

The auditor concludes of a major non-conformance : Strong rain is to be expected in Sri Lanka, and the clients' operational guidelines and procedures are insufficient to prevent erosion. Remedial actions (terracing etc.) are not preventing erosion, only repairing after the harm.

This is a systemic problem of the client, and a major non-conformance is issued.

Based on the audit evidence gathered by the audit team, each non-conformance shall be separately evaluated to determine whether it constitutes a minor or major non-conformance. This evaluation should take into account the scope and the impact of the non-conformance, considering how it affects the integrity of the certified system and the credibility of the SFW program as shown in Table 7.4.

Table 7.4: Characteristics of minor and major non-conformances

Minor non-conformance	**Major non-conformance**
Non repeated, isolated issue, not encountered in other areas where it could have been present, and;	Systemic error. A failure or absence of the system which should ensure conformance throughout the operation, or;
An issue that affects a small area, and;	An issue that affects a large area, or;
An issue that is temporary.	An issue that continues over a long period of time.

Minor non-conformances are given 12 months for implementation of corrective actions. Major non-conformances are given 3 months.

7.8 COMMUNICATIONS AND CERTIFICATION CLAIMS

CHs can claim to be certified on their printed and digital publications, websites and products. When all lands or products from an auditee are not certified, the auditee shall avoid greenwashing by making it very clear what is SFW certified and what is not. An auditee whose certification is suspended or terminated must remove claims from publications and websites. Products in store which were produced during the time the certificate was valid can be sold as certified.

CHAPTER 08

CONCLUSIONS AND RECOMENDATIONS

This chapter presents the conclusions and recommendations of the research. It is discussed the research in several aspects in the body and findings are mentioned in the conclusion of the research as follows.

8.1 CONCLUSIONS

The level of sustainability of Sri Lankan fuel wood supply chain is questionable. Therefore implementation of appropriate standard and certification system for sustainably produced fuel wood is required for socio economic development of the country. After implementing this proposed certification schemes, sustainability of fuel wood supply chain could be assured. The Principles, Criteria and Indicators developed under this certification scheme can be used in a whole supply chain or part of the supply chain depending on the requirement. Further they can be applied in any type of situation including community based organization, agro energy plantation and dedicated energy plantation and also useful to diverse stakeholders, including resource managers, policymakers, planners and designers. In addition, they could also be used to capture key socioeconomics and environmental effects of fuel wood across a range of fuel wood systems, including different pathways, locations, and management practices. As the proposed Standards and certification system for sustainable fuel wood trade in Sri Lanka is comprehensive its application is more viable for large scale commercialized supply biomass chain system and there would be difficulties for small scale economic operators individually.

8.2 RECOMENDATION

A standard and certificate system for sustainable fuel wood trade suitable for local context is recommended.It is recommended that Principle, Criteria, Indicators and Verifiers set presented in this paper can provide a template to guide including sustainable home gardening, agro energy plantation for fuel wood production and harvesting and dedicated energy

plantation, and can be adapted according to local ecological and institutional, economic and information capacities. It is recommended to evaluate the hypothesis that the group meets this goal, and also to help measure variability and establish appropriate targets, the group should be field tested in systems spanning a wide variety of conditions. As above indicator set are field tested in community based organization and agro energy plantation, it is recommended to do field testing it in a large plantation as well as dedicated energy plantation for it to be more comprehensive. As the next step, it is recommended that the proposed Standards and certification system for sustainable fuel wood trade in Sri Lanka are reaching consensus on measurement protocols, selecting baselines and targets, testing the proposed set of indicators in diverse situations, exploring and documenting the variability in indicators, soliciting feedback and recommendations based on field testing, and jointly considering social, economic and environmental indicators. It is recommended to test the proposed indicators via application to a diverse set of sample cases will help evaluate the availability of necessary data, prioritize data and methodological efforts, and generate ideas for improvement.

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APPENDIX A: Sri Lankan Government Circular SP/DSP/07/16

2016-12-23

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මෙම වගාව පිළිබඳ උනන්දුවක් දක්වන අය ඇතොත් ඔවුන්ගට පැල ලබා දීමට කටයුතු කිරීම සඳහා නම් ලැයිස්තුව 2017-01-11 දිනට් පෙර පරිපාලන අංශය වෙත ලැබීමට සළස්වන මෙන් කාරුණිකව දන්වා සිටිමි.

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சனாதிபதி அலுவலகம்
PRESIDENTIAL SECRETARIAT

චක්‍රලේඛ අංකය : SP/DSP/07/16
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ප්‍රාදේශිය ලේකම්වරුන්,

<u>වස විස නැති රටක් ගොඩනැගීම</u>
<u>ගිනිසිරියා (ග්ලිරිසිඩියා) පැළ බිලියනයක් අලුතින් සිටුවීමේ ජාතික වැඩසටහන.</u>

"ගිනිසිරියා" මීට බොහෝ කලකට පෙර අප රටට පැමිණි ආගන්තුක ශාකයකි. "ගිනිසිරියා" ශාකය ඕනෑම භූමියක වේගයෙන් වැඩෙන නිසාත්, නියං කාලයට ද ඔරොත්තු දෙන නිසාත් මෙය වගා කිරීමට පවතින විභවතාවය ඉහලය. ගල් අඟුරු භාවිතයෙන් විදුලිය නිෂ්පාදනය කිරීමෙන් විශාල පරිසරය දූෂණයක් ඇති වන අතර ජාතික ධනය පිටරටට ඇදී යාමට ද හේතු වේ. ගිනිසිරියා දඩු භාවිතා කර විදුලිය ජනනය කළ හැකි අතර එය පරිසර දූෂණය අවම කිරීමටද හේතු වේ. තවද එමඟින් ජාතික ධනය පිටරටට ඇදී යාම නතර කර ගත හැකිය. එමෙන්ම බෝග වගාවන් සඳහා නයිට්‍රජන් ලබා ගැනීමට යූරියා පොහොර භාවිතය නිසා ද විශාල මුදලක් පිටරටට ඇදී යයි. "ගිනිසිරියා" කොළ යෙදීමෙන් බෝග වගාවට අවශ්‍ය නයිට්‍රජන් පහසුවෙන් ලබාගත හැකිය. ගම්මිරිස් ඇතුළු විවිධ බෝග වගාවන් සඳහා "ගිනිසිරියා" ගස යොදා ගත හැකි අතර එහි අතුරු ඵලයක් ලෙස නයිට්‍රජන් ලබා ගැනීම මෙන්ම විදුලිය නිපදවීමද කළ හැකිය.

අතිගරු ජනාධිපතිතුමාගේ සංකල්පයක් වන වස විස නැති රටක් ගොඩ නැගීමේ අරමුණින් ක්‍රියාත්මක වන ආහාර නිෂ්පාදන ජාතික වැඩසටහන ජනාධිපති කාර්යාලයේ පූර්ණ අධීක්ෂණය යටතේ ක්‍රියාත්මක වේ. ඒ සඳහා අවශ්‍ය කාබනික පොහොර නිෂ්පාදනය සඳහාත්, ජෛව ඉන්ධනයක් වශයෙන් විදුලිය නිපදවීම සඳහාත් ගිනිසිරියා ශාකය ප්‍රධාන වශයෙන් භාවිතා කළ හැක. එබැවින් ගොවි ජනතාවට අමතර ආදායමක් උපයා ගැනීම සඳහා ප්‍රජා වන වගාවක් ලෙස මෙම ශාකය දීප ව්‍යාප්තව වගා කිරීමට සුදුසුම වගාවකි.

එහෙයින් බහුවිධ ප්‍රයෝජන සහිත මෙම ශාකය දීප ව්‍යාප්තව වගා කිරීම සඳහා, රජයේ හා පෞද්ගලික අංශයේත්, සියලුම ප්‍රජාවගේත් දායකත්වය ඇතිව අලුතින් ගිනිසිරියා පැළ බිලියනයක් සිටුවීම, අතිගරු ජනාධිපතිතුමාගේ අපේක්ෂාවයි. ගොවිපලවල, ගෙවතුවල, රජයේ ආයතන භූමිවල, මෙම වගාව ප්‍රවර්ධනය කළ හැකිය.

එබැවින් ඔබ අමාත්‍යාංශවල, පළාත්වල, දිස්ත්‍රික්කවල, කොට්ඨාසවල, ඉලක්ක සහිතව මෙම වගාව ප්‍රවර්ධනය කිරීම සඳහා කටයුතු කිරීමට අවශ්‍ය පියවර ගන්නා ලෙසත්, ඔබ ගත් ක්‍රියාමාර්ග පිළිබඳව වාර්තාවක් මා වෙත එවීමට කටයුතු කරන ලෙසත් මෙයින් අවධාරණය කරමි.

ජී.බී. අබේකෝන්
ජනාධිපති ලේකම්.

පිටපත්:
1. සියලුම ගරු අමාත්‍යවරුන් වෙත
2. සියලුම ගරු පළාත් ආණ්ඩුකාරතුමන්ලා වෙත
3. සියලුම ගරු පළාත් ප්‍රධාන අමාත්‍යවරු වෙත
4. සියලුම ගරු පාර්ලිමේන්තු මන්ත්‍රීවරුන් වෙත
5. සියලුම ගරු පළාත් සභා අමාත්‍යවරුන් සහ මන්ත්‍රීවරුන් වෙත

කාරුණික අවධානය යොමු කිරීම සඳහා

වසවිස නැති රටක් වෙනුවෙන් දියත් වන ගිනිසිරියා මෙහෙයුම

අපි ගිනිසිරියා වවමු

වසවිස නැති රටක් තුන් අවුරුදු සැලැස්ම - පිටු 30

'ආහාර භෝග නොවන ගිනිසිරියා, බාලොලියා වැනි වායු ගෝලයෙන් නයිට්‍රජන් ලබා ගෙන පසට එකතු කරන ශාක වර්ග භාවිතා කර සකස් කර ගන්නා ජීවමාත්‍ර, කොළ පොහොර සහ කොම්පෝස්ට් මිශ්‍රණ ද නයිට්‍රජන් ගොවි බිමට එක් කිරීම සඳහා භාවිතා කළ හැකිය. තවද ගිනිසිරියා කොළ, පොහොර ලෙස භාවිත කරන අතර ගොවි ජනතාවගේ ආදායම් මට්ටම ඉහළ නැංවීම සඳහා ගිනිසිරියා ශාකයේ දර, විදුලිය නිපදවීම සඳහා භාවිතා කිරීමට හැකි වන පරිදි දර විදුලි බලාගාර, ගම් මට්ටමින් ස්ථාපිත කිරීමට අවශ්‍ය පියවර ගැනීම රජයේ ප්‍රතිපත්තිය වේ.'

මෛත්‍රී පාලනයක් - ස්ථාවර රටක් - පිටුව 56

'විශේෂයෙන් මෙතෙක් කලක් ගල් අඟුරු හා බනිජතෙල් මාෆියාව වෙත ඇදී ගිය විදුලි පාරිභෝගිකයාගේ මුදල් ග්‍රාමීය ප්‍රදේශවල ගොවිජනතාව වෙත ගලායාම සඳහා රට පුරා දර විදුලි බලාගාර ස්ථාපිත කිරීමට කටයුතු කරන්නෙමි. එමගින් විදුලිය නිපදවීම ගොවි ජනතාවගේ ජීවන මට්ටම ඉහළ නංවන ප්‍රධාන මාර්ගයක් බවට පත් කරන්නෙමි.'

ගිනිසිරියා, ශ්‍රී ලංකාවේ හසරවන වාණිජ භෝගය ලෙස 2005 ජූනි 30 වන දා කැබිනට් මණ්ඩලය ප්‍රකාශයට පත් කළා.

මොකද්ද මේ ගහ

- ✓ ශ්‍රී ලංකාවේ ඉබේ වැවෙන
- ✓ බොහෝ ප්‍රයෝජන තියෙන
- ✓ කවුරුත් දන්නා ගහක්
  - ගිනිසිරියා
  - මකුලත
  - ලාඩප්පා
  - නන්චි
  - වැටහිරියා
  - වැටමාර
  - ඇල්බිසියා
  - සෙවන
  - කොළ පොහොර

මේ කොයි නමින් කිවුවත් මේ එකම ගහ එහි උද්භිද විද්‍යාත්මක නාමය - ග්ලිරිසීඩියා සේපියම් (*Gliricidia sepium*)

වගා කරන හැටි

ගිනිසරියා පැල කරගන්න හරිම පහසුයි. සිටුවීම කළ යුත්තේ ඉතා හොඳින් මෝසම් වර්ෂාව ඇති කාලවලයි. අප්‍රේල් - ජූනි හෝ ඔක්තෝබර් - නොවැම්බර් කාලය වඩාත් සුදුසුයි. ප්‍රමාණවත් තෙතමනයක් ඇතිනම් වසරේ ඕනෑම කාලයක සිටුවිය හැකියි.

- හොඳින් මේරූ ගිනිසිරියා කෝටු උස අඩි 4 ට පෙත්තට කපා, පහත කෙළවර ඇල කැපුමක්- ඉහළ කෙළවර හරස් කැපුමක් වන පරිදි අලවංගුවකින් හදා ගන්නා වලක කෝටුව අඟල් 8 ක් නැතිනම් ඇස් තුනක් පසෙන් යට වන සේ සිටුවා, දෙපසින් පස් තද කරමු. ඉහළ කෙළවර උණුකරගත් පැරපින් ඉටි ද්‍රාවණයක අඟලක් පමණ සුළු මොහොතක් ගිල්වීමෙන් වියළි කාලයේ පොත්ත වියලීම හා තෙත් කාලයේදී පොත්ත කුණුවීම අඩුකරයි.
- බීජ මඟින් පැළ ලබා ගත්තේ බදුන් ගතව හෝ ක්ෂේත්‍රයේ බීජ සිටුවීමෙන්.

අපේ ඉලක්කය

හැම ගමකම තවත් ගිනිසිරියා ගස් 100,000 සිටවමු. අපේ ඉලක්කය ගම් 10,000 ක්. ඒ කියන්නේ මේ මහ කන්තෙදි වැස්සත් එක්ක අපට පිළිවත් ගිනිසිරියා ගස් බිලියනයක්,අළුතින් හිටවන්න.

බිලියනයක් හිටවන්න පැල කෝ?

හුඟක් ගම් වල දැනටමත් ගිනිසිරියා ගස් 50,000 විතර තියනවා. අවුරුදු පහක් වයසැති එක ගහක රිකිලි 5ක් වත් තියනවා. මෝරපු ගස් වල රිකිලි 20-40 තියනවා. ඒ නිසා හිටවන්න ඕනෑ තරම් දඬු හොයාගන්න පුළුවන්.

කවුද හිටවන්නේ?

- තේ වත්තක - ගස් 600
- ගම්මිරිස් - ගස් 600-700
- වැනිලා - 900
- කෝපි - 200
- බුලත් වගාව - 1200

කොළ හා දර සඳහා ගිනිසිරියා ගස් කප්පාදු කිරීම

- කප්පාදු උස මීටර 1ත් 1.5ත් අතර
- පළමු අස්වැන්න සිටුවා මාස 12කින්
- කොල වලට නම් මාස 4කට වරක්
- දරට නම් මාස 9 කට වරක්

50kg of processed Gliricidia leaves can reduce annual chemical fertilizer requirements, yielding the equivalent of 0.8kg Urea, 0.25kg Eppawala Phosphate, 0.6kg Mu of Potash and 0.5kg Dolomite

අවශ්‍යතාව වී අක්කරයකට
නයිට්‍රජන් 90 කිලෝ ගිනිසිරියා කොළ - කිලෝ 5000 - 6000 ක් - ගස් 1000ක් අක්කර 100ක ගමක් සඳහා
පොස්පරස් - 20 කිලෝ 5000ක්
පොටෑසියම් -22 කිලෝ 1800 ක්
කොහොමද එලදාව

කොළ දාව

APPENDIX B: Acronyms, Full name, and URL of the International and National initiatives mentioned in the text

Acronym	Full name	URL
International Conventions		
CBD	Convention on Biological Diversity	http://www.cbd.int/
CCD	United Nations Convention to Combat Desertification	http://www.unccd.int/
ILO	International Labour Organization Conventions	http://www.ilo.org
IPCC	Intergovernmental Panel on Climate Change	http://www.ipcc.ch/
KP	The Kyoto Protocol	http://unfccc.int/kyoto _protocol/items/2830.php
UNFCCC	United Nations Framework Convention on Climate Change	http://unfccc.int/
Certification and standardization		
2BSvs	Biomass Biofuel, Sustainability voluntary scheme	http://en.2bsvs.org/
AFS	Australian Forestry Standard	http://www.forestrystandard .org.au/
ATFS	American Tree Farm System	https://www.treefarmsystem .org/
BonSucro	BonSucro	http://www.bonsucro.com/
CCOF	California Certified Organic Farmers	http://www.ccof.org/
CENTC383	CEN TC383/EN 16214 Sustainably produced biomass for energy applications by the European Committee for Standardization	http://www.cen.eu/
CSA	Canadian Standards Association	http://www.csasfmforests.ca /
CSBP	Council on Sustainable Biomass Production	http://www.csbp.org/
Drax	Drax Sustainability Policy for BiomassDrax Sustainability Policy for Biomass	http://www.drax.com/biomass/
ENplus	ENplus by European Pellet Council	http://www.enplus-pellets.eu/

FSC	Forest Stewardship Council	https://ic.fsc.org/
GGL	Green Gold Label	http://www.greengoldcertified.org/
ISCC	International Sustainability and Carbon Certification	http://www.iscc-system.org/
ISO TC 248	ISO TC248/ ISO 13065 Sustainability Criteria for Bioenergy by the International Organization for Standardization	http://www.iso.org/iso/standards_development/
IWPB	Initiative Wood Pellet Buyers (now Sustainable Biomass Partnership, SBP)	http://www.laborelec.be/ENG/
LBE	Laborelec Biomass Verification Procedure	http://www.laborelec.be/ENG/
NTA8080	NTA 8080 Sustainably Produced Biomass	http://www.sustainable-biomass.org/
RSB	Roundtable on Sustainable Biomaterials	http://rsb.org/
RSPO	Roundtable on Sustainable Palm Oil	http://www.rspo.org/
RTRS	Round Table on Responsible Soy	http://www.responsiblesoy.org/
SAN	Sustainable Agriculture Network	http://san.ag/web/

APPENDIX C: Confidential Statement

Name of the Certification Body		
	Sustainable Fuel wood Certification Scheme	Doc No. PCI-XX
	CONFIDENTIALITY STATEMENT	
Issue No: 01	Date of issue: 2017-09-21	Page No: 01 of 01

1. Name & address: ……
   ……

   ……
2. Type of audit : ……
3. Date(s) : ……...
4. I undertake that

- I shall treat all the documentation and information provided by the Organization audited as strictly confidential.
- I shall neither copy and documentation nor divulge any information to any third party without the written prior consent of the organization assessed or Certification body.
- I shall keep all documents relating to my work for the Certification body in such a way that those may reasonably be expected to be inaccessible to unauthorized persons.

Date: …… ……..

Signature

APPENDIX D: Content of online publicly available summary report

Sustainable Fuel wood Certification standard

Stage I - preassessment report (ENTER YEAR)

[this is a drop down menu. Double click to choose option]

1. OPERATION INFORMATION

Full legal name of organization:

Address:

Contact person:

Contact information:

Date of beginning of fieldwork:

Date report finalized:

2. SCOPE OF THE CERTIFICATE

List of PMUs included (lot name or number, or any other designation)	**New this year? (Y or N)**	**Area (ha)**
[add lines as required]		
TOTAL AREA IN SCOPE		
List of products included in the scope	**New this year? (Y or N)**	**Quantity (m^3, kg, etc.)**

[add lines as required]		

[Just update table from one audit to the next, or keep the same if no change]

3. AUDIT PROCESS

A. Auditors

Auditor name and function	Qualifications
[name + role]	[short bio, 4-5 lines max]

B. Evaluation strategy

[Describe here how the audit unfolded, how sampling was decided, how stakeholder meetings were organized, if there were group stakeholder meetings, where and who organized them and how. Also describe how the auditee presented its evidence (sent in advance via email? On site only? Etc.]

C. Audit schedule

Date	Activity	Location
[day 1]	Examples: [opening meeting] [documentation review] [company staff interviews]	[auditee's office]
[day 2]		

[Delete sections that don't apply to audit type performed]

4. STAKEHOLDER COMMENTS AND ACTIONS TAKEN BY THE AUDITORS

In this section the auditors summarize the comments received from stakeholders, how those comments have been addressed by them, and whether they led to non-conformances being identified.

Comment received	Actions taken
[Example 1: A worker mentioned he and other workers were as unclear whether all legally required allocations were being paid.]	[Example 1: Auditors reviewed this specific worker's pay slip and found all allocations were being paid. However, through a random sample of payslips of other workers, the auditors found that for some the housing allocated had been miscalculated. This is a non-conformance. CAR 01/16 is issued.]

5. CORRECTIVE ACTION REQUEST (CAR) TABLES

CAR #: XX/YR	**Minor Major**	**Non-conformance with indicator:**
Summary of indicator requirement	"Indicator x.x.x requires…"	
Detailed description of non-conformance		
Corrective action	Within the prescribed timeline, the operation shall identify the root cause of the non-conformance, then adopt and implement the corrective actions required to ensure long term conformance across the whole certified area.	
Timeline	By the next audit [this is a drop down menu. Double click to choose option]	

CAR #: XX/YR	**Minor Major**	**Non-conformance with indicator:**
Summary of indicator requirement	"Indicator x.x.x requires…"	
Detailed description of non-conformance		
Corrective action	Within the prescribed timeline, the operation shall identify the root	

	cause of the non-conformance, then adopt and implement the corrective actions required to ensure long term conformance across the whole certified area.
Timeline	By the next audit [this is a drop down menu. Double click to choose option]

CAR #: XX/YR	**Minor Major**	**Non-conformance with indicator:**
Summary of indicator requirement	"Indicator x.x.x requires…"	
Detailed description of non-conformance		
Corrective action	Within the prescribed timeline, the operation shall identify the root cause of the non-conformance, then adopt and implement the corrective actions required to ensure long term conformance across the whole certified area.	
Timeline	By the next audit [this is a drop down menu. Double click to choose option]	

CAR #: XX/YR	**Minor Major**	**Non-conformance with indicator:**
Summary of indicator requirement	"Indicator x.x.x requires…"	
Detailed description of non-conformance		
Corrective action	Within the prescribed timeline, the operation shall identify the root cause of the non-conformance, then adopt and implement the corrective actions required to ensure long term conformance across the whole certified area.	
Timeline	By the next audit [this is a drop down menu. Double click to choose option]	

CAR #: XX/YR	**Minor Major**	**Non-conformance with indicator:**
Summary of indicator requirement	"Indicator x.x.x requires…"	
Detailed description of non-conformance		
Corrective action	Within the prescribed timeline, the operation shall identify the root cause of the non-conformance, then adopt and implement the corrective actions required to ensure long term conformance across the whole certified area.	
Timeline	By the next audit [this is a drop down menu. Double click to choose option]	

6. CERTIFICATION DECISION

Certification decision	Certification can be granted. No non-conformance. [this is a drop down menu. Double click to choose option]	
Quality assurance reviewer	NAME	
Date of quality review		
Formatting (CAR numbering, all sections filled out, finding at each indicator, non-conformances adequately classified as majors and minors, etc.)		Yes ☐ No ☐
Findings sufficiently detailed to document conformance		Yes ☐ No ☐
Stakeholder consultation sufficient		Yes ☐ No ☐

7. STANDARD CHECKLIST (CONFIDENTIAL)

4. LEGAL AND REGULATORY COMPLIANCE	
4.1 The operator complies with all applicable laws and regulations.	
Indicator	**Finding on operation conformance**
4.1.1 The **operator** has the legal right to harvest. This includes land tenure and ownership of where the fuelwood comes from, harvesting permits when required by laws and regulations.	Conformance with indicator : Yes ☐ No ☐ N/A ☐
4.1.2 When required by law and regulations, the operator has an approved management plan and it is followed and implemented.	Conformance with indicator : Yes ☐ No ☐ N/A ☐
4.1.3 When required by laws and regulations, charges and taxes are paid.	Conformance with indicator : Yes ☐ No ☐ N/A ☐
4.1.4 Laws and regulations related to environmental protection (slope, **reservation strips**, use of chemicals, road building, etc.) are	Conformance with indicator : Yes ☐ No ☐ N/A ☐

respected.	
4.1.5 The operator complies with national labour laws and regulations including but not limited to requirements for contracts, child labour, insurance for workers, minimum wage, etc.	Conformance with indicator : Yes ☐ No ☐ N/A ☐
4.1.6 When required by laws and regulations, the operator complies with transport requirements	Conformance with indicator : Yes ☐ No ☐ N/A ☐
5. ENVIRONMENTAL VALUES AND IMPACTS	
5.1 There is no conversion of natural forests to plantations.	
Indicator	**Finding on operation conformance**
5.1.1 The fuel wood shall not come from legally protected areas.	Conformance with indicator : Yes ☐ No ☐ N/A ☐
5.1.2 Natural forest inside the plantation shall be identified and mapped by the **operator**.	Conformance with indicator : Yes ☐ No ☐ N/A ☐
5.1.3 Fuelwood shall not be harvested inside natural forest	Conformance with indicator : Yes ☐ No ☐ N/A ☐
5.1.4 Natural forests shall be voluntarily protected. This standard considers the conversion of natural forest as unsustainable. Therefore, if a natural forest was removed to establish a plantation after the date this standard was approved, this plantation does not qualify for sustainability certification.	Conformance with indicator : Yes ☐ No ☐ N/A ☐
5.2 Environmental services (soil, water) are maintained or restored on the farm/plantation.	
5.2.1 The **operator** shall map or demarcate on the ground the sensitive areas that are prone to erosion	Conformance with indicator :

and degradation, and all **water bodies**.	Yes ☐ No ☐ N/A ☐
5.2.2 The operator shall adopt and implement planting, harvesting, water crossing and transport guidelines to prevent land degradation, and to protect water from pollutants such as silt, oil, fuel and other chemicals.	Conformance with indicator : Yes ☐ No ☐ N/A ☐
5.2.3 The operator shall develop and have begun implementing plan for conservation or restoration of **reservation strips** along all water bodies. The plan shall contain timelines, measurable benchmarks and a budget for its implementation.	Conformance with indicator : Yes ☐ No ☐ N/A ☐
5.2.4 Reservation strips are left to grow wild. Road construction, machinery access, planting of exotic species, clearing, brushing and the spraying of chemicals are prohibited inside the reservation strips. A road may be built perpendicularly across it for water crossing in conformance with 5.2.2. Workers may access reservation strips for manual collection of NTFPs. Already existing exotic trees can remain standing but if harvested, shall not be replaced inside reservation strips. Diseased exotic trees can be removed manually, as long as measures are taken to minimize disturbance and prevent soil from entering the adjacent water body.	Conformance with indicator : Yes ☐ No ☐ N/A ☐
5.2.5 Waste water, oils and solid waste generated by all activities including domestic, worker facilities, processing and use of chemicals shall be disposed of in accordance with regulations and best practices.	Conformance with indicator : Yes ☐ No ☐ N/A ☐
5.3 Species at risk shall be protected	
5.3.1 The **operator** is aware of the National Red Listed species (fauna and flora) which are or can be present on its farm/plantation, is able to describe	Conformance with indicator : Yes ☐ No ☐ N/A ☐

their habitats and identify these habitats on its plantation.	
5.3.2 The operator has identified and implemented practices to protect the species at risk.	Conformance with indicator : Yes ☐ No ☐ N/A ☐
5.4 Invasive species shall be controlled	
5.4.1 The **operator** shall be well conversant on the invasive plant species.	Conformance with indicator : Yes ☐ No ☐ N/A ☐
5.4.2 Invasive species can only be introduced in the farm/plantation if the operator clearly demonstrates he has the technique, staff and resources to prevent them from spreading.	Conformance with indicator : Yes ☐ No ☐ N/A ☐
5.4.3 The operator controls existing invasive species inside the farm/plantation, and in the surrounding areas if invasive species present on the farm/plantation are spreading to the surroundings.	Conformance with indicator : Yes ☐ No ☐ N/A ☐
6. BENEFITS TO THE COMMUNITY	
6.1 Effective stakeholder consultation ensures concerns are addressed.	
Indicator	**Finding on operation conformance**
6.1.1 The **operator** conducts consultation meetings with the community affected by its operators. While those meetings may include a short information session, they are true consultations where community members are invited to comment on the plantation activities and share their concerns.	Conformance with indicator : Yes ☐ No ☐ N/A ☐
6.1.2 Records of comments and concerns are kept.	Conformance with indicator : Yes ☐ No ☐ N/A ☐
6.1.3 The operator documents the mitigation actions taken to address the concerns presented by	Conformance with indicator :

the community.	Yes ☐ No ☐ N/A ☐
6.1.4 The operator demonstrates the mitigation actions have been implemented in the field.	Conformance with indicator : Yes ☐ No ☐ N/A ☐
6.3 The operator contributes to the social and economic development of local communities.	
6.2.1 Opportunities are communicated and provided to local communities, local contractors and local suppliers for employment, training, and the sourcing of products by the **operator**.	Conformance with indicator : Yes ☐ No ☐ N/A ☐
6.2.2 For industrial plantations: Opportunities for social and economic development are identified jointly through engagement with local communities.	Conformance with indicator : Yes ☐ No ☐ N/A ☐
6.2.3 For industrial plantations: The operator's annual budget has provisions for social and economic development projects in the community. Those projects are implemented.	Conformance with indicator : Yes ☐ No ☐ N/A ☐
6.2.4 Community and worker requests and grievances are recorded and responded to and both parties agree they have been resolved.	Conformance with indicator : Yes ☐ No ☐ N/A ☐
7. GROUP SUPPORT	
7.1 The group is structured, functional and transparent	
Indicator	**Finding on operation conformance**
7.1.1 The division of responsibilities between the group coordinator and the group members are well defined.	Conformance with indicator : Yes ☐ No ☐ N/A ☐
7.1.2 The group coordinator has the capacity and resources to effectively help the group members achieve and maintain conformance.	Conformance with indicator : Yes ☐ No ☐ N/A ☐

7.1.3. The group has adopted procedures to cover: f) Internal audits (frequency, what to do when a non-conformance is identified, etc.); g) The conditions by which a new member is included or a member is excluded from the group; h) Training of members; i) The process by which group members select the coordinator, how she or he is paid and how she or he can be laid off; j) The sharing of group expenses such as training, internal and external audits, coordinator salary, etc.	Conformance with indicator : Yes ☐ No ☐ N/A ☐
7.1.4 The group coordinator fulfills her or his role and does not behave like a boss or supervisor of group members. She or he does not receive money directly from individual group members.	Conformance with indicator : Yes ☐ No ☐ N/A ☐
7.1.5 In cases where big disparity exists between the market price for fuel wood and the price paid to members, the group shall identify the causes of such disparity and demonstrate progress towards eliminating them.	Conformance with indicator : Yes ☐ No ☐ N/A ☐
7.2 Group records are kept	
7.2.1 The group coordinator maintains a complete and up-to-date record of: g) Group members and contact details; h) Group size in hectares and yield of fuel wood; i) A map showing the location of all members; j) Records of training, visits, advice and support provided to each member and their workers; k) Results of internal audits including non-	Conformance with indicator : Yes ☐ No ☐ N/A ☐

conformances identified; l) For members who have been issued corrective actions during internal or external audits, follow-up audits to verify corrective actions have been implemented.	
8. CHAIN OF CUSTODY (TRACEABILITY) FROM STANDING TREE TO FARM GATE	
8.1 Plantation gate is defined and controlled	
Indicator	**Finding on operation conformance**
8.1.1 The **operator** shall clearly define the plantation gate, by identifying the contractors and any other step included in it. The plantation gate shall expand to the point where the operator no longer has sufficient control to minimize the risk of contamination with non-certified fuelwood.	Conformance with indicator : Yes ☐ No ☐ N/A ☐
8.1.2 The certified fuelwood must be clearly identifiable during transport and storage.	Conformance with indicator : Yes ☐ No ☐ N/A ☐
8.1.3 In order to avoid contamination with non-certified fuelwood, the operator must involve employees, contractors, transporters and any other person in the supply chain with appropriate training and make sure they have the needed competences, knowledge and experience to identify and handle certified fuelwood.	Conformance with indicator : Yes ☐ No ☐ N/A ☐
8.1.4 The operator shall appoint a member of the management who shall have overall responsibility and authority for the operator's chain of custody.	Conformance with indicator : Yes ☐ No ☐ N/A ☐

8.1.5 The operator must either use dedicated vehicles to transport certified fuelwood material, use physical separation or documentation that allows to clearly quantify the certified fuelwood if vehicles transport a mix of certified and non-certified wood.	Conformance with indicator : Yes ☐ No ☐ N/A ☐
8.1.6 The operator's management shall carry out a regular periodic review (internal audit) of its chain of custody and its compliance with the requirements of this standard.	Conformance with indicator : Yes ☐ No ☐ N/A ☐
8.1.7 The operator shall establish and maintain records of its chain of custody to provide evidence of conformity with the requirements of this standard and its effectiveness.	Conformance with indicator : Yes ☐ No ☐ N/A ☐
8.2 Claim and identification	
8.2.1 The invoice and bill of lading used in transport must contain at a minimum the following information: a) Producer's identification including list of fields the fuelwood comes from; b) Formal documentation confirming the sustainable certified status of the fuelwood c) Species identification and quantity (weighed or measured) d) Date of collection e) Identification of the customer for the delivery	Conformance with indicator : Yes ☐ No ☐ N/A ☐

APPENDIX E: Sample Audit Plan

AUDIT PLAN

Name of the Company : XXXXXXXXXXXXXXX

File Number : XX/XXXX

Assessment sites : XXXXXXXXXXXXXXXXXXX

Applicable standards : SLS 1551: 2016 (Specification for Principle criteria and Indicators for Sustainably produced fuelwood)

ISO 9001:2015 (Requirements for Quality Management System).

Type of Audit : Final Assessment Audit

Scope : Supply of fuel wood as per customer requirement

Dates of Audit : XXXXXXXXX

Audit Team

Mr. K J Sirikumara (KJ) - Assistant Director - Team Leader-A

Mr. XXXXXXXXXXX - Assistant Director - Team Member-B

Mr XXXXXXXXXXXX - - Technical Experts-C

Assessment Site : XXXXXXXXXXXXXXXXXXXXXX

0900 h – 0915 h- Document Review (Site Specific)

0915 h – 0930 h- Tea Break

Time	***Dept./Functions***
	Site Office/Technical Testing

0930 h – 1100 h	Monitoring & Measurement of Product (8.2.4) Validation of Processes (7.5.2)	Control of Production and Service Provision (7.5.1) Work Environment (6.4)	Control of Records (4.2.4) Infrastructure (6.3)
Auditor	***A***	***B***	***C***

1100 h – 1130 h: Proceed to Head Office - XXXXXXXXXXXXXXXXX

Assessment Site : Head Office - XXXXXXXXXXXXXX

1130 h – 1200 h- Document Review

1200 h – 1215 h– Auditors' meeting

1215 h – 1230 h- Opening meeting

1230 h – 1245 h– Review of effectiveness of the CAs taken on previous audit findings

1245 h – 1315 h- LUNCH

Time	**4.1. Dept./Functions** **MD's/MR's Responsibility**		
1315 h – 1345 h	C1.1 The operator complies with all applicable laws and regulations.	C2.1 There is no conversion of natural forests to plantations.	C2.2 Environmental services (soil, water) are maintained or restored on the farm/plantation.
Auditor	***A/B/C***		
1345 h – 1445 h	**Business Promotion/ Technical Dept**	**Account(Purchasing)/ HR**	**MR's Office**
	C2.3 Species at risk shall be protected	C2.4 Invasive species shall be controlled	C3.1 Effective stakeholder consultation ensures concerns are addressed
Auditor	***A***	***B***	***C***

	Dept./Functions		
1445 h – 1545 h	**Technical/ Testing Dept**	**Technical/ Testing Dept**	**Technical/ Testing Dept/ MR's Office**
	C3.2 The operator contributes to the social and economic development of local communities.	C4.1 The group is structured, functional and transparent	C4.2 Group records are kept
Auditor	***A***	***B***	***C***
1545 h – 1600 h	***Tea Break***		

Time	**MR's Office**	**Technical/ Testing Dept**	**Technical/ Testing Dept**
1600 h – 1730 h	C5.1 Plantation gate defined and controlled	C5.2 Claim and identification	Use of Certification LOGOs
Auditor	***A***	***B***	***C***

1730 h - 1745 h - Use of Certification LOGOs

1745 h - 1830 h - Auditors meeting and Acknowledgement of NCRs

1830 h onwards - Closing meeting

APPENDIX F: Attendance of Opening / Closing Meeting of Audit

Attendance of Opening / Closing Meeting

Fuel wood certification Scheme

Name of the manufacturer:

……..…

Date: ……..

Time: ……..…

Serial No.	Name of the Participant	Designation	Signature

APPENDIX G: SFW Auditing system, protocol and process

SFW CERTIFICATION SYSTEM AND GUIDELINES

SFW AUDITING SYSTEM, PROTOCOL AND PROCESS

TABLE OF CONTENTS

- Interviews with stakeholders, group members, workers and managers of the audited organization
- Communication during the audit
- Closing meeting
- Report writing

GROUP CERTIFICATION

- Definition (group ≠ multi-site)
- Sampling

EVALUATING CONFORMANCE

- Gathering evidence
- Analyzing evidence and determining conformance
- Classification of nonconformances (minor VS major)
-

REPORT TEMPLATE

--- *This document excludes certification admin rules such as application, application review, contracting, legal responsibility, financing, report review, certification decision, certificate issuance, use of marks, some of the legal aspects of confidentiality, switching certifiers, etc.* ---

Example:

EVALUATING CONFORMANCE

Audit findings documenting conformity and nonconformity shall be recorded in a way that allows another Lead auditor or certification decision maker to reach the same conclusion without going to the field.

CASE STUDY:

While conducting field sampling in an uprooted rubber plantation on a steep slope, the auditor finds erosion beyond what the standard allows.

The auditor immediately and transparently explains to the client what the standard requires (indicator I 5.2.2) and that he is going towards a finding of non-conformance on the site. This is to allow the client to present additional evidence if appropriate, explain this particular situation, etc.

The client believes their procedures and guidelines are adequate and were well applied on this site, but that they have had strong rain. According to him, the erosion is caused by the rain, not by the uprooting. Remedial actions such as terracing and ground cover are taken after erosion has taken place.

The auditor concludes of a major non-conformance : Strong rain is to be expected in Sri Lanka, and the clients' operational guidelines and procedures are insufficient to prevent erosion. This is a systemic problem of the client.

A finding of nonconformity shall be recorded against a specific requirement, and shall contain a clear statement of the nonconformity, identifying in detail the objective evidence on which the nonconformity is based. Nonconformities shall be discussed with the client in real time during the audit to ensure the evidence is accurate and that the nonconformities are understood. The auditor shall not suggest the root cause of nonconformities or their solution.

APPENDIX H: Records of Gliricidia collection

ගිනිසිරියා දැව එකතු කිරීමේ ලේඛණය

ක්ෂේත්‍ර නිලධාරියාගේ නම :.....

දිස්ත්‍රික්කය : .....

ප්‍රා.ලේ. : .....

ග්‍රා. නි. : .....

දිනය	අංකය	ගොවියාගේ නම	දැව වර්ගය	බර ප්‍රමාණය	අත්සන

APPENDIX I: Records of payments

සරුබිම ව්‍යාපෘතිය

ගැමිසරණ කේන්ද්‍රය, කහගල්ල, තුංතොට

ගෙවීම් වවුචරය

දිනය : .....
වවුචර් අංකය : .....
දිස්ත්‍රික්කය : .....
ප්‍රා. ලේ .....
ග්‍රා.නි. වසම : .....

ගොවියාගේ නම : .....
ලිපිනය : .....
අංකය .....

දැව සැපයීම පිළිබඳ විස්තර

දැව වර්ගය	මර ප්‍රමාණය	Kg මල	මුළු මුදල
එකතුව			

සහතික කරන ලද්දේ

නම ..... අත්සන ..... දිනය .....

රු. ..... මුදලත් භාරගතිමි.

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අත්සන

APPENDIX J: Sample Logo used

APPENDIX K: Total PCI List

Total 5 principles, 11 criteria, 42 indicators and 42 verifier aims at guiding sustainable fuel wood production are presented.

Principle	Criteria	Indicators	Verifier
P1	C1.1	I 1.1.1	V 1.1.1
		I 1.1.2	V 1.1.2
		I 1.1.3	V 1.1.3
		I 1.1.4	V 1.1.4
		I 1.1.5	V 1.1.5
		I 1.1.6	V 1.1.6
P2	C2.1	I 2.1.1	V 2.1.1
		I 2.1.2	V 2.1.2
		I 2.1.3	V 2.1.3
		I 2.1.4	V 2.1.4
	C2.2	I 2.2.1	V 2.2.1
		I 2.2.2	V 2.2.2
		I 2.2.3	V 2.2.3
		I 2.2.4	V 2.2.4
		I 2.2.5	V 2.2.5
	C2.3	I 2.3.1	V 2.3.1
		I 2.3.2	V 2.3.2
	C2.4	I 2.4.1	V 2.4.1
		I 2.4.2	V 2.4.2
		I 2.4.3	V 2.4.3
P3	C3.1	I 3.1.1	V 3.1.1
		I 3.1.2	V 3.1.2
		I 3.1.3	V 3.1.3
		I 3.1.4	V 3.1.4
	C3.2	I 3.2.1	V 3.2.1
		I 3.2.2	V 3.2.2
		I 3.2.3	V 3.2.3
		I 3.2.4	V 3.2.4
P4	C4.1	I 4.1.1	V 4.1.1
		I 4.1.2	V 4.1.2
		I 4.1.3	V 4.1.3
		I 4.1.4	V 4.1.4
		I 4.1.5	V 4.1.5
	C4.2	I 4.2.1	V 4.2.1
		I 5.1.1	V 5.1.1
		I 5.1.2	V 5.1.2
		I 5.1.3	V 5.1.3

P5	**C5.1**	**I 5.1.4**	**V 5.1.4**
		I 5.1.5	**V 5.1.5**
		I 5.1.6	**V 5.1.6**
		I 5.1.7	**V 5.1.7**
	C5.2	**I 5.2.1**	**V 5.2.1**