

Declaration

The author hereby declares that the work presented in this paper has been carried out and composed by herself as part of a two-year study programmed at the School of Forestry Economics and Management of the Beijing Forestry University, People Republic of China. All views and opinions expressed remain therein the sole responsibility to the author and it has not been presented in any previous application for a degree.

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斯里兰卡 Udadumbara Divisional Secretariat Division 地区农户收集印度醋栗（余甘子）收入的影响因素分析

摘要

印度醋栗是南亚和东南亚最受欢迎的药用水果作物之一，也是斯里兰卡农村森林资源依赖程度较高地区的重要经济来源。然而，当前关于印度醋栗在农村经济中的作用缺乏足够的研究。因此，为实现醋栗的可持续利用，了解其在家庭经济中的贡献程度非常有必要的。本研究通过面对面访谈，焦点小组讨论等方法，利用斯里兰卡 Udadumbara Divisional Secretariat Division 地区 117 户样本数据来分析印度醋栗收入对于家庭收入的贡献。结果表明，印度醋栗收入在家庭总收入中占比 10.1%，仅次于非农收入（53.1%）和农业收入（35.1%），是家庭收入的第三大组成部分。相比高收入家庭中的醋栗收入占比（2.1%），低收入家庭拥有更多的印度醋栗收入（16.4%）。为了探究醋栗收入出现差异性的原因，本文引入了回归分析。结果表明，家庭农业土地规模和农业用水的可获程度与印度醋栗收入息息相关，呈现显著的负相关关系。研究发现，被调查家庭面临的最主要的问题是限制性的林业立法，其次是对森林法律法规认识的缺乏，树木资源稀缺，树木枯死，价格波动和森林火灾等。为了解决这些问题，通过合理的机制去构建一个有效的管理系统是非常必要的。此外，提高生产力，建立以社区为基础的管理制度，搭建和林业部门的伙伴关系以及优化现有政策也是提高当地家庭收入和居民收入的重要手段。

关键词：印度醋栗、非木质林产品，家庭收入，生计， Udadumbara Divisional Secretariat Division

**Analysis on influencing factors of the income of Indian
Gooseberry (*Phyllanthus emblica*) collectors in Udadumbara
Divisional Secretariat Division of Sri Lanka**

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ABSTRACT

Indian gooseberry, one of the most popular medicinal fruit crop in the south and South East Asia, has become an important economic source for rural forest dwellers in Sri Lanka. However, very few information is available on role of Indian gooseberry in rural economy. Therefore, there is an increasing demand for understanding the contribution of Indian gooseberry in household economy. During the study, socioeconomic data of 117 households were used to analyze the economic contribution of Indian gooseberry to the household income in Udadumbara Divisional Secretariat Division of Sri Lanka. Data collection was carried out through face to face interview with Indian gooseberry collectors, focus group discussion and government institutes. Results revealed that income from Indian gooseberry contributes 10.1% of the total household income, and it is the third largest share next to off-farm (53.1%) income and agricultural income(35.1%). Comparing income from three different household levels indicate that, the low-income households(16.4%) earned more Indian gooseberry income than high-income(2.1%) households In terms of regression analysis, results showed that agricultural land owned by households and water availability for agriculture are significantly and negatively correlated to the income of Indian gooseberry. The study found that restrictive forestry legislation was the major problem faced by the collectors followed by lack of knowledge on forest laws and regulations, lack of trees, trees die back, price fluctuation and forest fire. In order to overcome these problems, an efficient management system through appropriate institutional mechanism is required. In addition, increasing the productivity, community based management system, attention and partnership among forestry sector stakeholders and re formulation of policies are recommended by the study.

Key words: Indian gooseberry, NTFPs, Household income, Livelihoods, Udadumbara
Divisional Secretariat Division

目录

摘要	II
ABSTRACT	III
目录-中文	IV
目录-英语	VI
图目录-中文	VIII
图目录-英语	IX
表目录--中文	X
表目录-英语	XI
缩写和缩写列表	XII
1 引言	1
1.1 研究背景	1
1.2 研究问题	3
1.3 研究目标	4
1.4 解决的关键问题	4
1.5 研究的局限性	4
1.6 论文结构	4
2 文献综述	6
2.1 可持续农村生计框架	6
2.2 非木材林产品与农村生计	9
2.2.1 非木材林产品	9
2.2.2 食用非木材林产品	9
2.2.3 非木材森林产品在斯里兰卡	10
2.2.4 非木材林产品产业与市场的政策、法律与规制	13
2.2.5 非木材林产品在农村生计中的贡献	16
2.2.6 食用非木质林产品对农民生计的贡献	19
2.3 非木材林产品印度醋栗	21
2.3.1 印度醋栗植物描述	21
2.3.2 印度醋栗的全球趋势	22
2.3.3 印度醋栗对农民生计的贡献	24
3 材料和方法	26
3.1 概念框架	26
3.2 研究网站描述	27
3.2.1 斯里兰卡概况	27
3.2.2 Udadumbara Divisional Secretariat Division	29
3.3 样本数据和抽样过程	32
3.4 收入核算	33

目录

3.5 数据分析方法.....	34
4 结果和讨论	36
4.1 印度醋栗研究样本的社会经济特征.....	36
4.2 不同收入来源的经济贡献.....	37
4.3 不同收入群体的印度醋栗收入.....	40
4.4 影响印度醋栗依赖程度的社会经济因素.....	42
4.5 印度醋栗采伐和贸易问题.....	44
4.5.1 限制性林业立法与政策缺失.....	45
4.5.2 缺乏森林法律法规知识（如许可证.....	45
4.5.3 树木死了.....	46
4.5.4 缺树.....	46
4.5.5 不恰当的采收技术.....	47
4.5.6 价格波动	47
4.5.7 森林火灾	48
4.5.8 林业官员威胁.....	48
4.5.9 其他	50
5 结论和建议	51
5.1 结论	51
5.2 建议	52
参考	54
附录 1：房屋调查问卷.....	61
附录 2：参与调研的名单.....	69
附录 3：照片资料.....	71
简介	72
主要简介	73
研究成果	75
致谢	76

CONTENTS

摘要	II
ABSTRACT.....	III
表中的内容	IV
TABLE OF CONTENT.....	VI
图目录	VIII
LIST OF FIGURES	IX
表目录	X
LIST OF TABLES.....	XI
LIST OF ABBREVIATIONS AND ACRONYMS.....	XII
1 INTRODUCTION	1
1.1 Background.....	1
1.2 Problem statement.....	3
1.3 Objectives	4
1.4 Research Question	4
1.5 Limitation of Study	4
1.6 Organization of the thesis	4
2 LITERATURE REVIEW	6
2.1 Sustainable rural livelihood framework.....	6
2.2 Non Timber Forest Products and Rural Livelihood.....	9
2.2.1 Non timber forest products	9
2.2.2 Edible non timber forest products.....	9
2.2.3 Non timber forest products in Sri Lanka.....	10
2.2.4 Policy, law and regulation on NTFPs Industry and Marketing.....	10
2.2.5 Contribution of Non timber forest products in rural livelihood.....	16
2.2.6 Contribution of Edible NTFPs to rural livelihood	19
2.3 Indian Gooseberry as Non Timber Forest Products.....	21
2.3.1 Botanical Description of Indian Gooseberry.....	21
2.3.2 Global trends of Indian Gooseberry	22
2.3.3 Contribution of Indian gooseberry to rural livelihood	24
3 METATERIAL AND METHODS	26
3.1 Conceptual Framework.....	26
3.2 Description of research site	26
3.2.1 General overview of Sri Lanka	29
3.2.2 Udadumbara Divisional Secretariat Division	29
3.3 Sample data and sampling procedure.....	32
3.4 Income accounting.....	33
3.5 Data analysis methods.....	34
4 RESULT AND DISCUSSION	36
4.1 Socio- economic characters of Indian gooseberry collecting households.....	36

CONTENTS

4.2 Economic contribution of different income sources	37
4.3 Indian gooseberry income among different income groups	40
4.4 Socio-economic factors affecting on Indian gooseberry dependency	42
4.5 Problems linked t Indian Gooseberry harvesting and Trade	44
4.5.1 Restrictive forestry legislation and Lack of Policy	45
4.5.2 Lack of knowledge on Forest Law and regulations (eg. Permit)	45
4.5.3 Trees die back	46
4.5.4 Lack of trees	46
4.5.5 Inappropriate Harvesting technique	47
4.5.6 Price fluctuation	47
4.5.7 Forest Fire	48
4.5.8 Threaten by forest Officer	48
4.5.9 Other	50
5 CONCLUTIONS AND RECOMMENDATION	51
5.1 Conclusions	51
5.2 Recommendations	52
REFERENCES	52
APPENDIX I: HOUSE HOLD SURVEY QUESTIONNAIRE	61
APPENDIX II: LIST OF NTFPs	69
APPENDIX-III: SOME PHOTOGRAPHS	71
PROFILE	72
SUPERVISOR PROFILE	73
ACHIEVEMENTS	75
ACKNOWLEDGEMENT	76

图目录

图 2-1 农村的可持续生计框架.....	6
图 2-2 印度醋栗的分布	22
图 3-1 概念框架	26
图 3-2 2006 年 7 月各地区的贫困发生率.....	29
图 3-3 研究地区地图	30
图 3-4 Udadumbara DSD 地区不同规模土地的拥有者数量	31
图 4-1 其他非木质林产品（除醋栗外）收入对比.....	39
图 4-2 被调查对象的观点.....	49

LIST OF FIGURES

Fig 2-1 DFID Sustainable Rural Livelihood Framework	6
Fig 2-2 Natural distribution of Indian Gooseberry	22
Fig 3-1 Conceptual framework	26
Fig 3-2 Poverty Head Count Index by Sector in year 2006/07	29
Fig 3-3 Map showing study area.....	30
Fig 3-4 Extent of land own by different household in Udadumbara DSD.....	31
Fig 4-1 Contribution of different NTFPs to the Total Other NTFPs income.....	39
Fig 4-2 The opinion of Indian Gooseberry collectors	49

表目录

表 2-1 南亚和东南亚地区印度醋栗的常见名称	23
表 3-1 Udadumbara DSD 地区不同年龄组性别构成	31
表 4-1 调查样本基本特征	37
表 4-2 不同来源的平均收入与收入占比	38
表 4-3 不同收入水平下各类收入情况及占比	41
表 4-4 关于印度醋栗收入的回归分析	42
表 4-5 调查样本对于各影响因素的认同情况	44

LIST OF TABLES

Tab 2-1 Common names of Indian Gooseberry in South and South East Asia	23
Tab 3-1 Population details in the Udadumbara DSD in terms of age groups	31
Tab 4-1 Socio-economic characteristics of the Indian Gooseberry collecting families	37
Tab 4-2 Average income and income share by different income sources.....	38
Tab 4-3 Mean annual income and income share of different income levels.....	41
Tab 4-4 OLS regression of Indian Gooseberry income by socio-economic variables.....	42
Tab 4-5 Collectors opinion on problem by priority	44

LIST OF ABBREVIATIONS AND ACRONYMS

CBO-Community based Organization
DFID-Department for International Development
DSD- Divisional secretariat division
DCS - Department of Census and Statistics
FAO- Food and Agriculture Organization
FD- Department of Forest
IG- Indian Gooseberry
MOE- Ministry of Environment
NTFPs- Non Timber Forest Products
SRLF- sustainable rural livelihood framework
SLRs- Sri Lanka Rupees

1 INTRODUCTION

1.1 Background

Tropical Forests are the most diverse terrestrial ecosystem in the earth. About 40% of the world's flowering plants, gymnosperms and ferns are found in tropical forest (Corlett and Primack, 2010). These plants provide numerous non timber forest products (NTFPs) which plays foremost role in livelihood and food security of rural communities (Shackleton and Shackleton, 2003; Ghosal, 2011). Those products are namely fruits, nuts, tubers, roots, leaves, seeds, flowers, resins, mushroom and firewood. In some countries, extraction of non timber forest products is a main livelihood strategy of the households living in or near the forest (Quang, 2006). Few developing countries in the African continent mentioned that the NTFPs is the only source of income for the rural people. (Wollenberg and Septiani, 1998). NTFPs are appreciable gift for poor income groups; because they are available in plebian lands at low cost (Basavarajappa, 2008). Incomes derived from NTFPs significantly contribute to reduction of rural poverty and income inequality (Babulo *et al.*, 2009).

Tropical forest in Sri Lanka has rich floristic wealth while occupying 29.7% of total land area (Edirisinghe, 2012). In most parts of Sri Lanka, forests are crucial for rural livelihoods as source of food, medicine, fuels and building material. In 2001, Bandaratileke estimated that around 30 percent of Sri Lanka rural population who lived near the forests are depend more or less on forest resources for fuel wood, NTFPs and cattle grazing.

The most popular NTFPs in Sri Lankan society are medicinal plants, rattan, bamboo, edible fruits, honey, and sap of *Caryota urens*, bush meat, mushrooms, and resin (Subasinghe, 2009). Due to the lack of inadequate data on extraction and consumption of NTFPs, the real contribution of non timber forest products to the local and national economy is still hidden to the world. (Perera, 2015; Subasinghe, 2009). Very limited numbers of studies have concurrently addressed the biological and socio-economic aspects of NTFPs extraction and trade. NTFPs which are consumed directly are quite important in livelihood of rural community than the money earned with the sale of NTFPs (Delang, 2006).

In developing nations, most of rural households depend on edible NTFPs to meet some part of their dietary and income needs ((Bharucha and Pretty, 2010; Seyoum *et al.*, 2015). Poor rural families utilize wild edible NTFPs for dietary needs but, wealthier families are highly involved on sale (Badimo, 2015). In Sri Lanka, the contribution of wild edible plants might not play significant economic role in national economy, but considerable amount of people who lives nearby forests depends on large number of edible wild products for fulfill their dietary requirements. In dry and intermediate zone forests, rate of collection of wild edible plant products are higher than montane forest

(Bandaratillake, 1995). For rural population, wild food trees remain preferred alternative to commercial food crops (Delang, 2006). Various parts of many forest food tree species have nutritive value and wild edible fruit species rich in minerals and carbohydrate (Leaky 1999). They can also be used to heal variety of sickness and diseases (Deshmukh and Waghmode, 2011). Studies on the economic value and utilization aspects of wild fruit plants will help to conserve genetic resource, improve the productivity, and also enhance welfare of rural community. Unfortunately, few studies have been done on these fields. The information available on wild fruit crops is also scanty.

Phyllanthus emblica commonly known as Indian gooseberry (IG) is one of the major NTFPs in tropical deciduous and Savanna forests in South and South East Asia. It is naturally distributed in Indian peninsula, Sri Lanka, Southern China, Pakistan, Bangladesh, Nepal, Bhutan, Myanmar, Thailand, Taiwan, Malaysia, Singapore, Sumatra, Borneo and Java.(Simons *et al.*,2005).Compare to the other countries it is widely spread in Indian peninsula. Other than the wild species, large scale commercial plantations have been seen in state of Uttar Pradesh and semi arid zone in India (Pathak, 2003). Introduced Indian gooseberry trees have been recorded in different parts of South and North American continent (Simons *et al.*, 2005).

Indian gooseberry is regarded as sacred tree in Buddhism and Hindu religion. It was worshipped tree in India, Nepal and Sri Lanka. Hindus offered this tree for gods. In Buddhism this tree was included into “*Ata Wisi Bodhi Wrucksha*” (the trees under which each 28 Buddha attained enlightenment). Some Hindus and Buddhist believe that once they worship this sacred tree, all their sins are wash off. This multipurpose tree provides fruits, medicines, green manure, wood, fuel wood, tannin and dye.

Among all parts of the tree, the most popular part is fruit. It is one of the highly influential medicinal plants in Indian Ayurvedha, Siddha and Unani systems, Chinese, Tibetan and Sri Lankan system of medicine (Dasaroju and Gottumukkala, 2014). Indian gooseberry fruit can be consumed any time in relation to fruits and it has more health benefit (Jain *et al.*, 2016; singh *et al.*, 2011; Krishnaveni and Mirunalini, 2011) This fruit can be consumed as fresh, dried and bake forms (Kavita and Mallikaet, 2013). Fresh Indian gooseberry fruit has been in use for produce Juice, candy, chutney, jellies and wine (Goya *et al.*, 2008; Soniet *al.*, 2016).Value added Indian gooseberry products are highly valuable items in the international markets.

In Sri Lanka, most common name for Indian gooseberry is *Nelli*. Natural distribution of Indian gooseberry has been reported in savana, dry pathana and dry mixed forest found in Dry and Intermediate zones. This species shows high genetic diversity in Sri Lanka's Forest (Pathak, 2003). Profusely grown trees were found in Badulla, Anuradhapura, Monaragala, Rathnapura, Kandy, Pollonnaruwa, Hambanthota, Jaffna,

Kurunegala, Killinochchi and Puttalam district. However, within the country the commercial cultivation of Indian gooseberry tree as a fruit crop have not been properly exploited and it has been underutilized fruit crop in Sri Lanka (Dahanayake, 2015). But the demand of Indian gooseberry fruit is continuously growing due to its numerous medicinal uses. Most of the Indian gooseberry fruits found in Sri Lanka's local market are collected from natural forest or imported from India. (Pushpakumara and Heenkenda, 2007).

Indian gooseberry tree can survive in harsh environmental condition. It is resistant to fire and pest and disease. This species need little attention and it is easy to cultivate through seeds (Pushpakumara and Heenkenda, 2007). Therefore, this tree species is appropriate for establishment of agroforestry systems, rehabilitation of degraded forest lands, and cultivate in the home garden. Currently, Department of Forest conservation in Sri Lanka establishing Indian gooseberry plantation mix with other native species to rehabilitate degraded forest land due to shifting cultivation (Range Forest Office Hunnasgiriya,2013).

1.2 Problem statement

Udadumbara divisional secretariat Division (Udadumbara DSD) where this study will be based is located in Intermediate Zone of Sri Lanka. In this region, the Indian gooseberry fruits play an important role in local economy. Most of the people living adjacent to the forest extract Indian gooseberry fruits and earn more money. Many of them are poor rural people who have limited extent of agricultural land and suffering from water scarcity. Even though forest law(Forest Conservation Ordinance) prohibiting the access and extraction of forest products from reserved forests, during fruiting season of Indian gooseberry, these people enter illegally in the reserved forests to harvest fruits. Restriction of forest access is mandatory for protection forest resources and services, but it results cost for local community whose livelihoods depend on the capability to freely acquire NTFPs (Howell, 2010). Indian gooseberry fruits are posses significant role in household economy, but only if local management system and national policies ensure their sustainable extraction and use. Lack of appropriate regulation, inappropriate harvesting techniques and excessive dependence affect the decline of NTFPs resources including Indian gooseberry. During forest management activities, forest managers give little attention to the income from all NTFPs including Indian gooseberry. They do not have clear understanding on extent to which the collectors depend on Indian gooseberry for cash income, and the household socio economic characters that decide the collector's income from the Indian gooseberry. So far there is no any studies have been done in the study area focusing on Indian gooseberry income and rural livelihood. Due to the lack of accurate data and the use of inadequate data, the economic return of Indian gooseberry to the rural households is still hidden. This study tries to fulfill this gap by analyzing the contribution of Indian gooseberry to the household income and rural livelihood.

1.3 Objectives

A main objective of this study is to examine the contribution of Indian gooseberry to rural household income. The specific objectives as follows;

1. To study the dependency of local community on Indian gooseberry for household income
2. Investigate the level of dependency of Indian gooseberry based on different social and economic characters
3. To analyze the main constraints in Indian gooseberry sector and provide possible coping mechanism

1.4 Research Question

In this research, I will quantify the economic contribution of Indian gooseberry to household economy of rural community in Udadumbara Divisional Secretariat Division. Specifically five questions are addressed as follows;

- (1) What is the share of Indian gooseberry contributed to the household income?
- (2) How much do households depend on Indian gooseberry, and does that dependence varies among households with different economic status (low income level, medium income level and high income level)?
- (3) How do household socioeconomic factors influence on Indian gooseberry income
- (4) What are the main factors affecting to the Indian gooseberry harvesting and trade?
- (5) How to utilize Indian gooseberry while conserving for future generation.

1.5 Limitation of Study

The study had few problems regarding to the collection of data. Household data on income and expenditure was collected based on IG collectors past memory. The collectors might not remember actual value of those figures. This can make data inaccurate. Also, during the collection some collectors do not support to answer the questionnaire. This difficulty was overcome by collection of extra information other than questionnaire and developing interaction with collectors. In addition, this study focused on the IG harvesters in specific location. They may not represent all collectors in different geographical and socio- economic conditions. Hence, these findings cannot be generalized.

1.6 Organization of the thesis

This Thesis is arranged in five main chapters. Each chapter is further divided in to sub sections. Chapter one described the general introduction of the study. It explains the importance of Indian gooseberry as non timber forest product, followed by problem statement, general and specific objectives, research question and Limitation of the study. The second chapter covers the literature review. The literature review part consists with four sub-sections.. These sub sections contains the findings of past studies manipulated by several researchers around the world. Chapter three explains the research process, study

area, data collection method and builds the regression model and describes the variables and why they would be selected in this model. The fourth chapter is delineated to the presentation of result and discussion with relevant examples. Finally, Chapter five is devoted to conclusion and recommendation of the study.

2 LITERATURE REVIEW

2.1 Sustainable rural livelihood framework

FAO defines rural livelihood as “the capability, assets and activity that rural people require for means of living” (FAO, 2003). Since the early 21st century, global society has accepted sustainable livelihood concept as a vision for global, national and local community. The livelihood framework is a scientific tool that used to improve the personal understanding of livelihoods, especially livelihood of poor community. It adduces the factors that influence the people’s livelihoods and formal affinity between these factors. Sustainable livelihoods framework be able to use in evaluating the contribution of ongoing activities on livelihood sustainability. Also, it can be used in designing or planning new development activities. In 1999 DFID develop sustainable rural livelihood framework (Figure 2.1) that can be applied in different scales in the society from individual household to national level. It is a tool for examining and evaluating the environmental management, poverty alleviation, and rural development (Scoones, 1998).

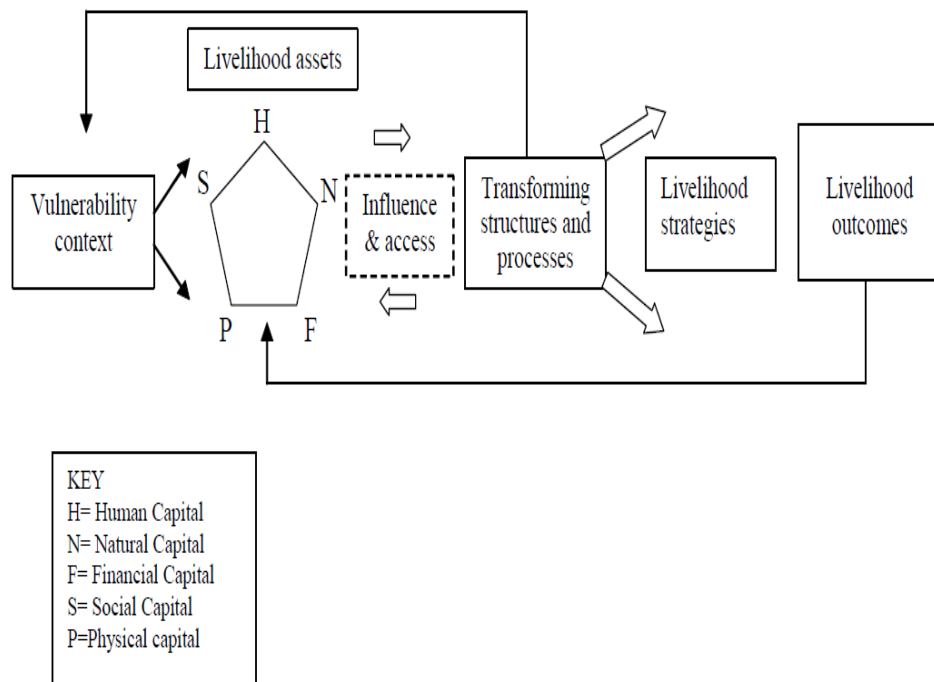


图 2-1 农村的可持续生计框架

Fig 2-1 DFID Sustainable Rural Livelihood Framework

Source: DFID, 1999

FAO revealed that, when livelihood is sustainable, that livelihood can control and withstand on shocks and stresses, and wield or upgrade its capabilities an asset without harming to natural resources (FAO, 2003).

The sustainable rural livelihood framework (SRLF) affords a list of significant issues and illustrates the suitable approaches that can link these issues to each other. Also it focuses on main influences and processes. Moreover, it is accentuation the several interactions between the multiple factors which are affected to rural livelihoods. According to the Kollmair *et al.* (2002), *“The framework depicts stakeholders as operating in a context of vulnerability, within which they have access to certain assets. Assets gain weight and value through the prevailing social, institutional and organizational environment (policies, institutions and processes). This context decisively shapes the livelihood strategies that are open to people in pursuit of their self-defined beneficial livelihood outcomes.”*

In developing countries, rural households are conventionally fragile, faced to wide range of shocks, seasonal fluctuation and trends which have higher influence on household livelihoods and assets. These vulnerability contexts illustrate the external factors that influence the people life. Vulnerability is defines as the degree of exposure to risk and uncertainty, and the capability of individual or household to prevent mitigate and withstand, with risk. Rural household have limited or no ability to control these vulnerability contexts (DFID, 1999). Reviewing global studies on livelihood- forest linkage, the role of NTFPs in household coping strategies in South Africa was analyzed by Poumgarten and Shackleton (2011). They used sustainable livelihood framework as the basic framework of the study and designed interview questionnaire with respect to vulnerability context. They reported that the gender of the household head do not affected to the nature of the shocks and response. But, physical capital (wealth) influenced the responses as well as experienced of stress.

The assets display the base of the livelihood; they are the resources that a household can utilized to promote its livelihood and well-being. In connection with the SRLF, the number and type of assets which can be found in the society is varies among the studies. (Ellis, 2000). The most popular version is the one with the five capitals: natural, human, social, physical and financial capital. Framework shows the way how natural, financial, human and social and physical capitals used as resource to achieved Sustainable livelihoods (Scoones, 1998). It is essential to understand and analyze how households attempt to transform assets into positive livelihood outcomes.

Livelihood strategies consist of various combinations of activities and choices that household undertakes in order to pursue their attempts to achieve and maintain their livelihood objectives or goals. In spite of the fact, there are many population dynamics and other relevant factors that should be considered when evaluating rural livelihoods. The

studies at international level have revealed that rural households adopt a range of livelihood strategies, emerged from various types of income sources and invest in a range of assets to achieve their livelihood outcomes as well as support for economic hardship (Ellis, 2000; Block & Webb, 2001).

Achievements of the livelihood are called as livelihood outcomes. Namely more income (more cash or assets), Increased well being (better life through increase in health status, sanitary, access to services), reduce vulnerability (better resistance through increase in assets status) improved food security (enhance the ability of buying food through increase in financial capital) and sustainable use of natural resources (establishment of appropriate property rights, Policies). These livelihood outcomes directly influence the capital and change their level and form dynamically to provide a new way for other livelihood strategies and outcomes.

The main concept of sustainable livelihood framework is focused on the poor rural community. The poor people are often insecure and vulnerable to adversity; also define their own potentials, strength, and goals by themselves. They follow various livelihood strategies to secure their livelihood while achieving their desired outcomes. A sustainable livelihood is a way that can recover from shocks and improve and maintain its assets while maintaining the sustainability of natural resource (DFID, 1999). Hence, the SRLF provides a comprehensible and effective outlook on how rural poverty will reduce and how to accomplish sustainable development. In general, sustainability comprises of three dimensions namely environmental, social and economic sustainability. Sustainability in all these three dimensions is needed to be achieved to build the sustainability in livelihood. Especially in developing countries many rural livelihoods depend heavily on natural resources and are threatened if resources are not used in a sustainable manner.

Many researchers apply the SRLF as a basic framework for their studies. Pereira *et al.*, (2014) studied the contribution of the retail sector to the rural food security in South Africa. In their study, they applied sustainable rural livelihood framework to understand the relationship of current food system and a role of the retail sector in Mpumalanga province, Northeast Johannesburg. Further, they developed livelihood strategies for future food security in the study community. In China, Rong *et al.*, (2006) have provided a detailed set of information on the application of sustainable livelihood framework with related to their study of ecological shelter construction in upper reaches of Changjiang river. In their research they set the objectives such as improve the access of farmer households to credit, advance technology, facilitate public service, encourage to practice advanced agriculture technology and strengthen the resources conserving investment. These objectives are supported to convert their weak assets (land use and Livestock) base livelihood strategies into strong wealthier one.

The significant of policies, institutions and processes cannot be neglected in livelihood framework, because these facts functioning at all levels and all spheres, from household to global and from most private to most general. Policies, institutions and processes are highly concerned the access to different types of capital, livelihood strategies, decision making bodies and source of influence. As well as, these facts determined the terms of exchange among various types of capitals and returns to specific livelihood strategy.

2.2 Non Timber Forest Products and Rural Livelihood

2.2.1 Non timber forest products

Terminology of non timber forest products (NTFPs) is quite complex. Several kinds of alternate terms are used as synonyms. In simply NTFPs is negative term which describes all forest products other than timber that derived from forest. Different authors and institutions use the term NTFPs, but have developed the definition which is most suitable for their idea. de beer and Mcdermott (1989) in their research on economic value of NTFPs in South East Asia defined NTFPs as “biological materials other than timber which are extracted from forest for human use”.

According to the FAO, NTFPs defined as “*goods of biological origin other than wood derived from forests, other wooded lands and trees outside forest*”. It comprise small woods and fuel wood, wide range of food and food additives including edible nuts, fruits, mushrooms, spices and condiments, herbs, aromatic plants, fibers (used in clothing ,utensils ,construction, or furniture,) gums, resins, plant and animal products (used in medicine, cosmetics and cultural events) (FAO,2008). Another definition mentioned NTFPs as biological material excluded industrial round wood and its derivatives (swan timber, wood based panel and pulp, wood chips) that extracted from the wild or natural ecosystem and consumed within household, sold in market or have cultural value (Neumann and Hirsch, 2000). This definition modified by Jimoh in 2006 by adding ecosystem services such as prevention of soil erosion and water purification (Mulenga *et al.*, 2011).

2.2.2 Edible non timber forest products

Edible NTFPs include wide range of edible forest products which consumed as staple food, as minor food supplements, as thickening agents and as flavoring or condiments. It includes product such as fruits, seeds and nuts, leafy vegetables, edible flowers, yams, roots, shoots, mushrooms, Honey and bush meat (FAO, 1991). Another definition mentioned that edible wild plants means, indigenous and naturalized exotic plant with edible parts that grow naturally on fallow and farmlands (Badimo, 2015).

These edible forest products are rich in almost all nutrients in balanced diet namely Protein, Carbohydrate, Lipids, vitamins, minerals, and other essential nutrients. Their

dietary contribution is very important for rural communities especially who lives in areas where fail to produce agriculture crops. In some instance, wild edible NTFPs are contribute to the household food security by providing foods when the staple foods are scarce (FAO, 1991). For example, In Sri Lanka *Dioscorea* species locally named as katuala, Kodol, Jamburala, hiritala are available during the hardship period when staples such as rice, vegetable have been cultivated but are not yet ready to harvest(Epitawatta,1994).

2.2.3 Non timber forest products in Sri Lanka

Sri Lanka's forests contain a large number of trees, shrubs and herbs which provide numerous products other than timber. These products are generally known as NTFPs. Most of NTFPs are used locally while a few enter the export market (Liyanaarachchi, 2004).According to Section 78 of the Forest conservation Ordinance of Sri Lanka (1966), the materials mentioned in below which are found in or extract from a forest are proclaim as NTFPs;

- (a) *Leaves, flowers, fruits, seeds, roots, juices, wood oil, natural varnish, barks, lac, gum, resins, caoutchouc, catechu and myrabolans,*
- (b) *plants not being trees, including grasses, creepers, reed, mosses and all parts or produce of such plants,*
- (c) *Tusks, horns, shed horns, edible birds' nests and honey,*
- (d) *Peat, surface soil, rocks, minerals, sands and gems, including limestone, coral, laterite, bitumen, asphalt, bituminous shale, mineral oils and all products of mines and quarries.*

All these NTFPS have numerous direct and indirect uses. They play a notable role in reducing rural poverty in Sri Lanka by providing the subsistence requirements of communities living in rural villages. And also, generate cash income and a wide range of employment opportunities in the field of collection, transport, trade and processing. Moreover, provide material for small industries.

Among the NFFPs, some of them which have medicinal value play remarkable roll in Sri Lankan traditional medicinal systems. The historical data on collection and usage of medicinal plants and plant products from the Sri Lanka's forest goes back to pre historic age. Currently, Growing demand of herbal products increases the rate of extraction of medicinal plant from natural forest. Within the country, more than 600 plant species are used to treat or cure over 300 ailments (Fernando, 1996). Studies revealed that the extraction of medicinal materials was an important income source for communities living in or near the savanna forests in Sri Lanka. In savanna forest area; over 60%of the households are involved in extraction of medicinal NTFPs from forest. It's comparatively higher than other forest areas that represent 20-55% households (Bandartillake, 1995). The average incomes from the collection of medicinal product contribute to 70 % of the total NTFPs income (Liyanaarachchi, 2004).Other than medicinal plants, NTFPs such as Rattan,

Bamboo, and product of *Caryota urens* and edible products play considerable role in Sri Lanka economy (Gunatilake *et al.*, 1993).

It is clear that NTFPs have higher value in Sri Lanka's economy. The extraction, consumption, and trade of NTFPs have been taken in to account as an important livelihood strategies for the local as well as national economy. However, the income and employment potential of extraction, processing and trade of NTFPs has not yet been estimated and very few data are available on the demand and supply of NTFPs. Commonly used NTFPs in Sri Lanka have been classified as follows;

(a) Tree Leaves, flowers and Barks;

Forest tree leaves are widely used in traditional Ayurvedic medicine and as leafy vegetables. The leaves of Bovitiya (*Osbeckia octandra*), Nika (*Vitex negundo*) Madatiya (*Adenantha Pavonina*), Neem (*Azadirachta indica*), Polpala (*Aerva lanata*) widely use for medicinal preparations. Wel pennela (*Cardiospermum halicacabu*), Anguna kola (*Wattakaka volubilis*), Kurakola (*Amaranthus viridis*), Gotu Kola (*Centella asiatica*) are some examples for leafy vegetables. Moreover, a few species are utilized as wrappers. Consider the wrappers; the most popular wrappers are Beru (*Agrostistachys hookeri*), Kanda (*Macaranga peltata*), Beedi (*Diospyros melanoxylon*) and Bata (*Ochlandra stridula*). Blue gum (*Eucalyptus globulus*) is an exotic species planted in forest plantations. The leaves of this plant used to extraction of oil which contains cineole. Other than that, forest tree leaves are used as fodder for live stock (cattle, buffaloes and goats).

Wild flowers are one of the common NTFPs that used for the preparation of herbal beverages. Beli (*Aegle marmelos*), Mee (*Madhuca longifolia*) and Ranawara (*Cassia auriculiformis*) flowers are collected in large scale for beverage. In addition, few species are used as curry (e.g. *Careya coccinea*). In wet and intermediate zones of Sri Lanka, the inflorescences of *Caryota urens* tree play a significant role. This inflorescence tapped to get phloem sap which used to produce a range of value added products namely vinegar treacle, jaggery and toddy (alcoholic beverage). The sap is originating mostly in the rainy period therefore tapping is seasonal. The period from August to March is peak production time. A research conducted in wet zone of Sri Lanka revealed that, around 70 % of the total income from NTFPs gained from *Caryota urens* products (Bandartillake, 1995).

Tree barks are another important NTFPs used in extraction of tannin and also for indigenous medicinal preparations. Ranawara (*Cassia auriculata*), Kadol (*Rhizophora* spp.) and *Acacia decurrens* are the most common tannin producing barks. Tannin obtained from these barks is locally used for tanning of leather and fishnet. The popular examples for the barks that used for Ayurvedic preparations are Ankenda (*Acronychia pedunculata*) Etdemata (*Gmelina arborea*), Kumbuk (*Terminalia arjuna*), Madan (*Syzygium cumini*) and Munamal (*Mimusops eleng*). The country exports the Goda Kaduru bark (*Strychnos nuxvomica*) for the production of strychnine. In addition, Hal

(*Vateria acuminata*) bark is used for fermentation of *Cryota urens* and *Cocos nucifera* sap which obtain from tapping inflorescences (Gopalakrishnan *et al.*, 2005)

(b)Fruits and seeds;

The value of fruits and seeds in agrarian society highlighted during ancient times. Ensuring that, a large number of varieties are available in today was used for different purposes. Moreover, other than the household consumption these fruits and seeds have high economic demand in national as well as international markets. Rural households collect a range of wild fruits and seeds for dietary and medicinal purposes. Diwul (*Limonia acidissima*), Nelli(*Phyllanthus emblica*), Damba(*Syzygium cumini*) Palu (*Manilkara hexandra*), Mora (*Dimocarpus longan*), Veera (*Drypetes sepiaria*) are highly abundant wild fruits that used as food. Dried seeds of Wal Enasal (*Elettaria cardamomum*) and Dried fruit flesh of Goraka (*Garcinia quaesita*) are used as food seasoning ingredients (Fernando, 1996).

Beraliya (*Shorea megistophylla*) and *Vateria copallifera* fruits and their seed are ingredients for different traditional food items. According to the finding of Gopalakrishnan *et al.*, (2005) villages who lived in Sinharaja periphery utilize *Hal* fruit to make different food items. Their Study found that, the community applies traditional techniques to exclude the bitterness of *Hal* fruit. Other than fruits, many varieties of seeds are used in traditional medicine. Some of the examples are Puswel (*Entada pusaetha*) Neem(*Azadirachta indica*) Madan (*Syzygium cumini*), Ingini (*Strychnos potatorum*) and Attana (*Datura metel*) (Fernando,1996;Liyanaarachchi, 2004).

(c)Bamboos, Canes, Creepers and Grasses;

Bamboo is a vital substitute for timber in Sri Lanka. Especially, used as construction material, building bridges and fences, making furniture and domestic utensils, ladders and crafts. Five different bamboo species were recorded in the country, including 3 native species and two exotic species. Out of this, four bamboo species namely *Bambusa vulgaris*, *Ochlandra stridula*, *Dendrocalamus giganteus* and *Davidsea attenuata* are highly utilized in construction industries (De Zoysa and Vivekanandan, 1991). Native species called *Ochlandra stridula* and *Davidsea attenuata* widely used for traditional handicraft industries and to make basket ware, kites and religious decorations. Also bamboo is well known for making curios for the tourist industry. Another useful NTFPs is rattan. Sri Lanka is rich in rattan resources, with 10 native species. *Calamus zeylanicus*, *Calamus rivalis*, *Calamus ovoideus*, *Calamus pseudotenuis*, *Calamus thwaitesii*, *Calamus pachystemonus*, *Calamus rotang* and *Calamus delicatulus* are mainly used for commercial purposes (De Zoysa and Vivekanandan, 1991).

Rattan is predominantly used for cottage industries. It is most important building material for the housing of poor people (wattle houses). Also it used as raw material for

many industries including furniture, kitchen utensils and making curios. A study by Epitawatta (1994) found that the rattan grown on wet zone forest lands contributed to household economies, as 20-60% of household collect rattan for cash income or for their subsistence use.

Consider the creepers *Coscinium fenestratum* and *Entada pusaetha* are woody climbers which profusely grown in rain forests in Intermediate and Wet Zone. These climbers play significant role in indigenous medicinal system. Because of the higher value as a diuretic and anti-tetanus drug, the species namely *Coscinium fenestratum* is under the threaten of extinct. Currently, Forest Department has taken several actions to avoid the overexploitation of *Coscinium fenestratum* from forest (Bandartillake, 1995). Different kinds of grasses are valuable in livestock production as well as roofing material and medicinal extraction. Lemon grass or citronella species (*Cymbopogon spp*) are commonly widespread within natural and planted forest. The oil distilled from these species is used as an insect repellent and manufacturing of perfume and beauty products. More recently, the aromatic oil extracted from these grasses are exported to produce perfume. In addition, some of the sedges available in marshy forest lands are used for handicraft industries (Fernando 1996).

(d) Resins and oleoresins and Gums;

Resin and gum extraction is not so popular activity in Sri Lankan society. But, there are some tree species which used for extraction of gums and resins. As an example, Dorana (*Dipterocarpus glandulosus*), Gammalu (*Pterocarpus marsupium*), Dawu (*Anogeissus latifolia*), hik (*Lannea coromandelica*) and Kekuna (*Canarium zeylanicum*) are used for extraction of resin. The resin extracted from Gammalu is used as an ayurvedic medicine to cure diabetes. Dorana oil, which is extracted from the tree of *Dipterocarpus glandulosus* is used to paint murals in Buddhist temples by mixing with other organic substances (Fernando, 1996). Among all resin producing trees, Pine (*Pinus caribaea*), which is an introduced tree species in forest plantations, is used for extraction of oleoresin on a commercial scale. Natural gums obtained from Neem (*Azadirachta indica*) and Kaju (*Anacardium occidentale*) trees are widely used as adhesive.

2.2.4 Policy, law and regulation on NTFPs Industry and Marketing

The first scientific policy for forestry sector in Sri Lanka was formulated by the British in 1929. The main objective of this forest policy is management of forest focused on the maximum amount of quality timber. After the country gains independent from British in 1948, policy for forestry sector was modified in year 1953, 1980 and later in 1995. The priorities of the policy changes focus on conservation of forest and forest resources. In terms of forestry development, the year 1995 is most important. The new forestry sector policy and Sri Lanka Forestry Sector Master Plan (FSMP) were adopted by government in 1995. The main objectives of new policy were conservation of forests for posterity, with particular regard to biodiversity, soil, water and historical, cultural, religious

and aesthetic values, to increase the tree cover and productivity of the forests to meet the needs of present and future generations for forest products and services, to enhance the contribution of forestry to the welfare of the rural population and to strengthen the national economy, with special attention being paid to equity in economic development.

The new FSMP emphasized the ecological, economical, social, political, technical and scientific aspects and overall administrative functions of forestry sector. It has been formulated strong guideline for forestry decision making in local regional and national level. This plan covers 25 years and it will be ended in 2025. Master plan formulated policies on state owned forest resources, private owned forests and trees, extraction, production, marketing of wood and non wood forest products, development of forestry sector institution, policy on inter sectoral linkage and international forest related conventions.

After the formulation of FSMP, Forest laws and regulations are being amended to suit the current and future conditions. Also, management systems are being formulated and operated in accordance with this new policy. Two forest laws namely Forest Conservation Ordinance and National Heritage and Wilderness Area Act, assistance the implementation of the National Forest Policy. The existing Forest Conservation Ordinance (Act No 16 of 1907) amended in 2009, was the ordinance amended lastly. The Forest ordinance and regulations published under the ordinance have stipulated provisions to protect forest and meaningful implementation of the National Forestry Policy and the FSMP.

The forest Ordinance No 16 of 1907 amended at several occasions is still the forest law enforced in the country. There are other ordinance and acts which support the implementation of the forest law. In addition, provisions in the constitution, the supreme law of the country, in regard to the environment and natural resources illustrate the responsibility and duties of the government and the public. The constitution of Sri Lanka (1978), the supreme law of the country in regard to the environment and natural resources illustrate following two clauses for the government and public. Article 27 (14) of chapter (vi) in the constitution states that the “state shall protect, preserve and improve the environment for the benefit of the community.” Article 28 (f) Says that “It is the duty of every person in Sri Lanka to protect nature and conserve its riches.” These articles invite attention of everybody. In brief though, these two articles define the responsibility of protecting all aspects of the environment (Ekanayake and Theodore, 2017).

The policy on management of state forest in the FSMP revealed that every state forest will be utilized sustainably to supply the ever growing demand of wood, NTFPs, bio energy and services for the welfare of the rural people. Also, FSMP promotes contribution of both forestry management and other activities that developed to create additional income

in rural areas. This type of programs will be based on participatory approach which developed in village level. The policy on wood and NTFPs industries and marketing states are as follows;

1. In commercial level NTFPs production, industrial manufacturing and marketing, the greater responsibility will be given to the local people, organized groups, cooperatives, industries and other private bodies.

2. Development of competitive forest industries based on sustainable wood sources, and efficient forest products utilization and manufacture of value-added forest products will be promoted.

3. Undertaken an effective measure to protect the forests and prevent illegal trade in wood, NTFPs and in endangered species of flora and fauna will be instituted.

According to the FSMP the forest lands classified in to three groups namely Class I, II and III. The regulations related to the NTFPs extraction is differing in each category of forest (Liyanaarachchi, 2004).

- Class I forest or Strict conservation Forest- these forests are strictly conserved or preserved to protect biodiversity, soils, water and historical, cultural, religious and aesthetic values. Only research activities are allowed in these forests. All extractions including NTFPs were restricted
- Class II forests or conservation forests- These forests are managed mainly for non extractive uses such as scientific research, protection of watersheds and habitats of wildlife, and regulated nature-based tourism as well as controlled collection of NTFPs, and possibly dead fuel wood by the local people living adjacent to the forest should be allowed. In these forests, all the activities should be controlled according to the management plans that will be prepared with peripheral communities.
- Class III forest or multiple- use reserved forest – these forests are mainly managed for sustainable production of wood for national demand and for sustainable production of timber and NTFPs for the benefit of rural communities.

Section 78 of the Forest conservation Ordinance states that, the materials which are declared as NTFPs. According to there is a large number of forest produce collected by the public from the forest and regulations to issue such products for public use, are given in the Forest ordinance and in the regulation under the ordinance. Fees payable to the government to collect specific quantities of such produce are given in the regulations and permits should be obtained from the Range Forest Office of the area. Provisions are also given in these regulations for rural communities to collect firewood from forests free of charge. While obtaining permits to collect materials such as minerals from the forests under the control of the FD, permission should also be obtained from relevant authorities under other laws in connection with the collection of any produce from forests (Liyanaarachchi, 2004)

When a person makes an application to collect and remove NTFPs from the forest, the Range Forest Officer should personally examine the following

- The requested NTFPs area available in sustainable quantities in the forest concerned.
- The place proposed to collect NTFPs is clearly identified.
- The proposed procedure of extraction should not be destructive to the sustainability of the NTFPs concerned
- Such extraction should not be destructive to the forest and should not violate other laws and regulations.

After deciding that extraction of NTFPs can be allowed, the Range Forest Officer should forward the application to the approving authority. Upon the receipt of the approval, the range forest officer should issue the permit. The applicant should pay the prescribed fees before issuing permits. Fees collected in issuing NTFPs from forest have been published in the gazette extraordinary 1600/18 of May 06, 2009 by the subject Minister and the conservator of Forest (Gamage, 2010).

When permits are issued to the collect NTFPs after recovering the fees indicated in the above mentioned gazette notification, it is responsibility of the range forest officer to determine the number of persons engaged in the activity. This is precautionary measures to prevent illicit activities inside the forest and minimize damage to the environment. The permit should be always in the possession of the permit holder in the site or with a person stationed at the site who is authorized in writing by the permit holder. Removal of NTFPs should be supervised by the Beat forest officer of the area or an officer authorized by him. Attention should be drawn to in this regard; the removal of the NTFPs does not exceed the approved quantities, the removal does not harm the forest and the environment, removal activities are confined to the approved areas and they do not expand to other areas, only the authorized number of persons are engaged in the activity, collected material is removed from the land within the stipulated period and extraction is carried out only during the time period allow in the permit.

If any of these condition are violated. Range Forest Officer immediately suspends the removal activity and takes action to cancel the permit. Legal action should be taken according to the section 6 (2, 3), 7(1, 2), 17 and 20(1, 2) of forest ordinance (Gamage, 2010).

2.2.5 Contribution of Non timber forest products in rural livelihood

NTFPs have been creating a salient role in the livelihood of a wide range of forest-dependent communities who living in all over the world. Non timber forest products are extracted from different ecosystems including dense forest, grass lands, agro forest and farm lands (Mulenga *et al.*, 2011). In developing countries, the majorities of rural

households are directly or indirectly depends on natural resources. (Babulo *et al.* 2009). Roughly 60 million indigenous people utilize NTFPs to fulfill their subsistence uses and gain supplemental income (Howell *et al.*, 2010). World health organization revealed that 80% of the developing nations used plant origin NTFPs for their health and nutritional need. For instance, billion of people particularly who are living in rural villages in developing countries used NTFPs on daily basis. Most of NTFPs collected from the forest are primarily consumed by the collecting families and are not selling in the market. Currently, nearly 150 non timber forest products including honey, bamboo, rattan , resins ,gum arabic, cork, essential oils, pharmaceutical raw material (animal and plant parts) mushrooms and nuts are involved in international trade(FAO,2008).

Global studies related to the assessment of NTFPs contribution in the livelihood of rural families have increased drastically over the past decade. With rising international concerns about deforestation, environmental issues and rural poverty; the forest and NTFPs have been the topic of highly concern. (Hogarth *et al.*, 2013). Several findings have shown that the dependency on NTFPs varies across the households. These variations depend more or less on socioeconomic and demographic characteristics (Gunatilake, 1998). Far away from the market, higher transportation cost and higher cost of commodity items or even unavailability in rural areas caused to heavily dependent on the NTFPs. Extraction and selling of NTFPs are important livelihood activity for the rural low income households (Fisher, 2004; Jimoh 2006; Shackleton and Shackleton, 2006).Moreover, NTFPs serve as safety net for poor families when they face economic hardship (Mulenga *et al.*, 2011). Extraction of NTFPs is attractive to the rural low income families because it requires low capita and skills (Basavarajappa, 2008). In some instance, NTFPs have higher value in ritual and religious activities of traditional communities. For example, the drink made by Kava fruit is regularly used in the Pacific Island as a ceremonial drink. Countries like Ethiopia, Cameroon and Eritrea are used several NTFPs to symbolized peace, victory, friendship and hospitality. Fruits and nuts of *Elaeis guineensis* and *Cola spp* are exchanging for welcome the guest in marriage celebration (Andel, 2006).

A study by Paumgarte and Shackleton (2011) in South Africa find out that use of NTFPs to be a highly accepted manifestation of the household safety net function than sale. With respected to the income classes, the results revealed that both high and low income households make extensive use of NTFPs as a safety net but it is more important to low income level. The study by Hogarth *et al.* (2013) highlighted that, NTFPs are the second most important income source after crop income in three ethnics groups in Tianlin County, in China. They observed that forest dwellers obtained 31.5 % of their household income from NTFPs such as bamboo, tea oil, fuel wood, Tung oil seeds, charcoal, wild mushroom, medicinal plant and fodder.

A Study by Shackleton and Shackleton (2003) in South Africa depicted that, the 80% of or more of households in rural South Africa collected NTFPs for financial and non-

financial benefits. They reported that the households collect NTFPs such as wild spinaches, Fuelwood, edible fruits, grasses and twigs for hand brushes in major quantities while collecting wild honey, edible insect, bush meat, and reeds for weaving in minor quantities. Results showed that the total direct use value of NTFPs range between Rand1000 to over Rand 12 000.

Beyene (2011) revealed that lack of communication, poor infrastructure facilities, high transaction cost, inadequate transportation services and weak marketing systems are major risk of the livelihood in rural Ethiopia. NTFPs are an integral component of their livelihood. Study examined the household forest dependency across the different socioeconomic and local institutions characteristics. Study found that socioeconomic variables such as age of HH, access to private sources, livestock ownership, off farm activities, forest density are highly influence on forest dependency than local level institutions. Furthermore, Result of regression analysis showed that the wealth status of the household have negative correlation to the share of income derived from NTFPs.

Bwalya (2013) studied the household dependency on forest and woodlots in six forest fringe villages in Zambia. He observed that rural families in study area derived 30% of cash income from forest products. He opined that availability of forest product, market condition, and household socioeconomic factors influence the dependency of forest product. Study highlights that the factors such as scarcity of NTFPs, less household income and less consumption of forest products within harvesting families are leads to the extraction of forest product for sale.

Forest incomes and poverty alleviation in the Bale highlands of South Ethiopia was analyzed by Yemiru *et al.* (2010). They observed that forest products contributed 53% of the annual cash income of the household followed by livestock. With regard to cash income in different quarters of the year, 31% of household earn greater net cash income from forest during first two quarters when crops have been cultivated with higher agriculture expenses. In contrast, crops were contributed to greater net cash income in the third quarter. In their study, they found that the per capita income was positively correlated with value of physical assets, education level and number of large livestock. On the other hand per capita income was negatively related to sex and age of house hold head, house hold size, the distance from city.

Khosravi *et al.*, (2016) in their study on forest dependence communities in Zagros region of Iran reported that socioeconomic factors significantly contribute to deciding the absolute and relative household income from NTFPs. In terms of three income groups, higher and middle income groups received significantly low income from NTFPs such as Firewood and oak corns than low income level household. The study reported that the relative income from NTFPs is negatively related to the average education of adult

members of the household, relative income from the agriculture and income from trade with Iraq. Moreover, income from NTFPs is positively related to the household size.

Svarrer and Olsen (2005) examined the factors influencing the extraction of NTFP by the Jah Hut indigenous people lived in Krau Wildlife reserve in Malaysia. They observed that the rapid economic development, higher cash income from alternative income sources and integration of Jah Hut into Malaysian society are replaced the dependency of NTFP. In addition, they analyzed the average value of extracted NTFPs per year. It was US\$40.7 ha/year based on purchasing power parity. Although, there was evidence that low income families derived More NTFPs income.

Resource availability versus resource extraction in Lower Himalayas was analyzed by Pandey *et al.*, (2014). They observed that households are highly dependent on the forest for fodder collection. The collection of fodder is an integral part of their livelihood. Continuous extraction of fodder from forest leads to forest degradation. Hence, they suggested to policy reform that focused on integrated farming. In their study croplands were managed more or less combined with forest trees to reduce the forest dependency.

A study by Saifullah *et al.*, (2016) in Peninsular Malaysia revealed that some indigenous household in Malaysia earns approximately 24% of total income from NTFPs. majority of rural poor households which have limited alternative income highly depend on NTFPs. This study found that the demographic and socioeconomic factors such as location, Age, Gender, education level and health condition play a important role in forest dependent and rural poverty. Furthermore, they observed the main problems that encounter by the indigenous people in NTFPs extraction. Those problems were absents of legalized right on forest land, fragmented and informal market structure, massive deforestation, clearing of forest land for development scheme and conversion of forest land into plantation based crops.

Study in Sri Lanka by Bandaratillake (1998) estimated the annual income of different NTFPs. He reported that average annual income from medicinal plant varied from SLRs 20000-25000 in Savannah forest to SLRs3000-800 in other forest. Further, he reported that in dry savanna and dry monsoon forest annual collection rate of honey was 50 bottles per household and obtained SL Rs 3000-5000 annual income. Also, forest dwellers in polonnaruwa district earn SLRs 20000-3000 average annual income from rattan. With regard to the dry zone protected area, sale of bush meat provided highest annual income (SLRs120000-150000).

2.2.6 Contribution of Edible NTFPs to rural livelihood

In most part of the world, edible wild fruits and plants available in different seasons are supplying dietary and income needs of rural people. (Badimo *et al.*, 2015; Saleh 2010, Seyoum *et al.*,2015). But only few varieties of forest foods have been documented as a potential for cash income. (Prana &Ahirwar, 2015).

Mbuvi and Boon (2009) stated that 90% of NTFPs collectors were females in Mbooni division in Makueni district Kenya and higher proportion NTFPs collected was used for food and medicine. They reported that the quantity of harvesting of fruits and seeds were higher than other NTFPs. Similar study conducted in Ethiopia (Fentahun & Hager 2009) depicts that wild fruits serve as timely food supplement and valuable provider of essential nutrients to the cereal base diet in Amhara region of Ethiopia.

Vikram *et al.* (2011) examined the Non-timber forest production in central Himalaya. The study reported that a total 75 household in 11 villages of Garhwal region has adapted to value addition of wild edible fruits as off farm activity. Average annual earning of household was 5212.00 Indian Rupees. Similar study in India revealed that wild fruits support to the portion of daily diet of rural family with an average consumption of 73kg per year per household. Tribal communities in some part of the country derive 15% of their income from sale of wild edible fruits (Paul, 2013).

The study conducted in Isaan village, Kalasin Province, Thailand (Stetalaphruk and Price, 2007) on children's traditional ecological knowledge of wild food resources highlights that rural population in this area counted wild foods as a necessity rather than supplements. Study on the role of forest based economies and rural livelihoods in the border region, Southern China indicate that cash income gotten from the sale of bamboo shoots (*Dendrocalamus latiflorus*) was the main contributor of forest related income of the household in Tianlin County. Bamboo shoots were an important product for diets and food security. The study reported that almost 60% of households engaged in bamboo shoots harvesting (Hogarth *et al.*, 2013).

The economic contribution of wild food plant in two Pwo Karen villages in Thung Yai Naresuan Wildlife Sanctuary in Thailand was estimated by Delang (2006). He stated that Karen villagers were eaten 134 wild food plants collected from forest; including herbaceous annuals, bushes, non lignified perennials, bamboo shoots, epiphytic and non epiphytic vines and grasses. The analysis of income shows that households of those two villages earn 11505 Baht per month from wild food plants.

Research on the wild edible fruits and it's important to the livelihood of indigenous tribal in Eastern India indicated that 49 tribal villages in Orissa state depend on up to 15% of their income on wild fruits. In addition, study found that the annual average consumption of wild fruits was 75 kg per household (Mahapatra and Panda, 2012).

Boedecker *et al.*, (2014) examined the dietary contribution of the wild edible plant by analyzing the women's diets in the buffer zone villages in Lama Forest, Benin. They found that wild edible products were important in the period of food shortage when agriculture crops were failed. And also they examined that wild edible products have the ability to enhance dietary diversity in the rural household in Lama Forest region. Another study in Timor-leste by Erskine *et al.*, (2015) stated that wild food consumption in food

insecure system was significantly higher than normal food secure year. Whereas in food insecure months 48.1 % of household consume wild food, it was 5.2 times more than food secure months. Research by Kalaba *et al.* (2009) in Mwekera area in Zambia reconfirmed that the indigenous fruits contributed to 42% of the daily diet in rural families in Southern Africa. Yet, this study also confirmed that 95% of studied community collect indigenous fruits from forest, mainly *Uapaca Kirkiana*, *Anisophyllea boehmii* and *parinari curatellifolia* as a food supplement and marketable products. The 46% of families in this studied community are processed fruits juice for household consumption. In year 1995, Bandartillake has listed the common edible plants collected from the Sri Lankan forest. According to his study, he found that the wide range of plants parts such as fruits, seeds, flowers, leaves, roots, bark and tubers are used as foods. The study conducted by Gunatilaka *et al.*(1993) on the role of non timber forest products in the economy of 3 villages(Meemure, Narangamamuwa and Ranamure) in Knuckles national wilderness area of Sri Lanka revealed that the NTFPs contributed up to \$253 of cash income per household per year. It was 16.2% of the total household income. The study depicts that there was higher dependency of villagers on the wild edible products which mainly provide substantial input for the poor. Gunatileke and Chakravorty(2003) in their study on NTFPs sector in Sinharaja forest of Sri Lanka was observed that about 78.7% of the cash income from non timber product is obtained from edible Kithul (*Caryota urens*) product. The study highlighted that sap of *Kithul* tree is used for making jaggery, honey and local beer.

2.3 Indian Gooseberry as Non Timber Forest Products

2.3.1. Botanical Description of Indian Gooseberry

Phyllanthus emblica belongs to family euphorbiaceae. The genus *phyllanthus* is one of the largely distributed genus in the world which contain about 700 species. The name *phyllanthus* is derived from two Greek words (“*Phullon*”-A Leaf, “*anthos*”- A Flower). It refers bearing of flowers on the axils of leaves.

Indian gooseberry is small to medium size tree, grows 8 to 18 meters in height. The tree has crooked trunk with thin, smooth, greenish gray color bark. The tree is showing Phyllanthoid branching habit, have two types of shoots namely indeterminate shoot and determinate shoots. The indeterminate shoots are growing continuously to provide annual growth of the tree. These shoots are remaining on the tree and do not fall, also do not bear flowers. The determinate shoots are comparatively long than indeterminate shoots. They bear flowers and small sized leaves. Determinant shoots are defoliated and fall; new shoots have emerged on indeterminate shoots. Simple leaves are closely arranged on glabrous or finely pubescent branchlets. At young stage leaves are purplish green in color, later color change into dark green with ashy color underneath. Indian gooseberry is monoecious species and bears staminate and pistillate flowers separately. It produces small greenish

white flowers. Female flowers bear at the upper end of the branchlet, while male flowers beneath them (Kumar *et al.*, 2012; Dasaroju and Gottumukkala, 2014; Singh *et al.*, 2011).

The fruit is round to oblate shape, fleshy drupe. They are 2.3-3cm long and 1.3-2.5cm wide. Skin is light greenish yellow color and smooth, 6-8 vertical ridges runs from base to apex. This ridges giving the appearance of being divided into lobes. Fruit endocarp is crustaceous. It consist 6 trigonous with dark brown color seeds. The endocarp enclosed by fleshy mesocarp (Pushpakumara and Heenkenda, 2007).The tree is deciduous species. Usually in dry season trees are leafless. The new flush may start at the beginning of rain. Fully develop leaves can be seen only after fruit set. The flowering of Indian gooseberry is sensitive to the day length. Flowers usually appear after shoot growth. These flowers are naturally pollinated by Insects. After the fruit sets, those fruits took around 5 to 7 months to become mature.

2.3.2 Global trends of Indian Gooseberry

Indian gooseberry (*Phyllanthus emblica*) tree is native to the tropical deciduous and Savanna forests in south and south East Asia (Figure 2.2).

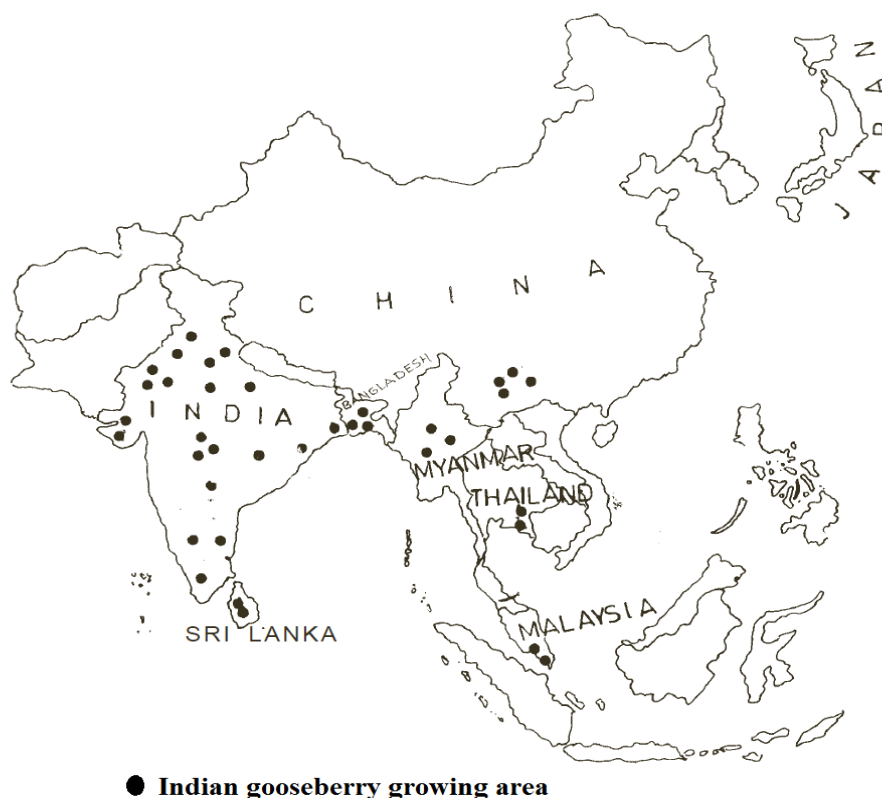


图 2-2 印度醋栗的分布

Fig 2-2 Natural distribution of Indian Gooseberry

Source: Pathak, 2003

LITERATURE REVIEW

Natural distribution of Indian gooseberry is reported in Indian peninsula, Sri Lanka, Southern China (Guangxi, Sichuan, Yunnan, Guangdong, and Fujian Province), Cuba, Puerto Rico, Pakistan, Bangladesh, Nepal, Bhutan, Myanmar, Thailand, Taiwan Malaysia, Singapore, Sumatra, Borneo, Java, Hawaii, Florida Iran, Iraq and West Indies (Simons *et al.*,2005;Pathak ,2003). Because of its wide distribution, it has variety of common names. The name is varying within and from country to country (Table 2-2).

表 2-1 南亚和东南亚地区印度醋栗的常见名称
Tab 2-1 Common names of Indian Gooseberry in South and South East Asia

Country	Common name
India	Amlaki,Amla,Amliki,Anola,Anuli,Anvula,Anvurah,Anwera,Aonla,Aungra,Aunra, Daula,Usiniki,Amali,Ambala,Amalakamu,Embali,Aonli,Anvala,Arola,Avala,Bhui awali, Ambala, Ambri, Bhoza, Bhoza mali,Sohmyrlain, Aamaro, Ambolati, Amlaki, Amulati,Aunlah, Yeonlah,Amalakam,Nelikka,Nelli,Tani,Nellimaram,Ambul,Amlo phal,Pullayusirika,Triphalamu,Usirika,Usirikaya,Usiriki,Usiri,
Sri Lanka	Nelli, Aushda Nelli, Ambula,Nellikai,Nellimar,Tani,Tanttri,Indul,
Nepal	Amla
Pakistan	Anwala
Bangladesh	Aamaro,Yeonlah,Amlaki,Amolati,Amla
China	An mole,Ganlanshu,Yeowkandianglan, Yougan, Youganzi
Thailand	Kam thuat,Kantot,Ma Kham pom
Cambodia	Kam lam,Kam lam ko,Ngop
Laos	Khaam poomz,Ma Kham pom,
Malaysia	Asam Melaka, Laka, Boa malaca, Melaka
Myanmar	Hziphyu,Ta Sha Pen,Shabju
Philippine	Nelli
Vietnam	Bong ngot,Chum ruot, Kamalam,Merung,Chume
Java	Kemloko
Indonesia	Malaka,Kimalaka,Kemloko

Source: Pushpakumara and Heenkenda, 2007

Currently, IG is cultivated in more than 20 countries in all over the world. India is a biggest net producer of IG. India reports nearly 50000 hectares of Indian Gooseberry forest. Annual production of IG in the year 2003 was around 1.75 million tons (Pathak, 2003). The result from Balachander showed that in the year 1996, the economic value of I.G fruits produced in India amounting to some US\$5-6.25 billion (Pushpakumara and Heenkenda, 2007). However, reliable production data were lack in other countries. India

has been exporting dried IG fruits to the many Asian countries, including Sri Lanka. Recently due to the higher demand in medicinal preparation, market was developed in Europe and United States (Pushpakumara and Heenkenda, 2007). Sri Lanka import 50000 kg of dried IG from India, amounting to some one million rupees annually. On the past decades, a number of researchers are been investigated the nutritional and medicinal value of Indian gooseberry fruit (Srivasuki, 2012; Dasaroju and Gottumukkala, 2014; Krishnaveni and Mirunalini, 2011; Nadheesha *et al.*, 2007). Fruit is highly nutritious. It is rich with vitamin C, minerals and amino acids. It contains two hydrolysable tannins called Emblicanin A and Emblicanin B. These tannins have antioxidant properties (Ghosal *et al.*, 1996; Krishnaveni and Mirunalini, 2011). In addition, fruits contain many other antioxidants, including vitamin C, Gallic acid, Catechol, Ellagic acid, Pyrogallol, Trigalloylglucose, Phloroglucinol, indol acetic acid, carotene and superoxide dismutase enzyme. In addition to human, wild animals such as sambar, bear, Chital, barking deer and macaque prefer to eat Indian gooseberry fruits (Ganesan &Setty, 2004).

2.3.3 Contribution of Indian gooseberry to rural livelihood

(a)Global Studies

In India and Nepal, most of the rural and tribal communities are collect Indian gooseberry from the forest (Pathak, 2003). India holds the monopoly in world trade for Indian gooseberry (Baboo, 2016). Many scientists are conducted the research on Pharmacological perspective of Indian gooseberry (Kumar *et al.*, 2016; Bandyopadhyay *et al.*, 2000; Suresh and Vasudevan, 1994; Srivasuki, 2012; Dasaroju and Gottumukkala, 2014; Krishnaveni and Mirunalini, 2011; Liu and Liu, 2015) and they revealed its high importance in medicine. However, the economic contribution of Indian gooseberry to household income is poorly documented.

A study by Basavarajappa (2008) In Kodagu district of Karnatska in India revealed that the tribal household collect Indian gooseberry in negligible quantities. Then the collected IG are sold either to local retailers or kept for home consumption. Research by Ganesan and Setty (2004) confirmed that the I.G is the one of the most important NTFPs in the indigenous community who lived in Biligiri Rangaswamy Temple Wildlife Sanctuary in South India.

Socio economic important of some plant species used by the tribes of Chanda forest district, Dindori Madhya Pradesh in India was analyzed by Prana and Ahirwar (2013) .They observed that a large number of IG trees are naturally distributed in the study area and those who collect Indian gooseberry fruits and leaves are earned more money. A study by Somnath Ghosal (2011) in Arsha range of Purulia district in Bengal estimated that in the year 2011 commercial harvest of Indian gooseberry fruits per household is around 10kg, which generate income of 30 Indian rupees. The study in Bangladesh (Islam *et al.*,

2015) depicts that people lived in Sylhet Sadar Upnazila Sub district cultivate Indian gooseberry

trees in Agro forestry home garden. Moreover, this study also confirmed that 13.34% of Agroforestry home garden tree species were Indian Gooseberry.

(b)Studies in Sri Lanka

Few studies in Sri Lanka have revealed that NTFPs provide considerable income to the livelihoods of forest dependence population (Gopalakrishnan *et al.* 2004; Gunatilake *et al.*, 1993; Abegunawardena and Wikramasinghe, 1992).Although very little effort has been taken to identify the contribution of Indian gooseberry to rural household income.

In their study in Sri Lanka, Pushpakumara and Heenkenda (2007) reported that a fully grown Indian gooseberry tree yield 187-299kg of fruits per year. This study also reported that naturally grown seedling trees return to fruiting stage after 10-12 years. Furthermore, their research confirmed that *Nelli* (Indian gooseberry) has high potential to increase the income of rural people.

Study by Gunatilaka *et al.*,(1993) in 3 peripheral villages of Knuckles wilderness area estimated that 55 extractors were harvesting *Nelli*(Indian gooseberry) from the forest and earn \$ 0.5average income per year.

3 METIERIALAND METHODS

3.1 Conceptual Framework

According to the sustainable rural livelihood framework, this study developed conceptual framework. (Figure1). This conceptual frame work is based on the research objectives and research question which are mentioned in chapter 1. This study focused on socio economic characteristic of IG collecting household and income levels.

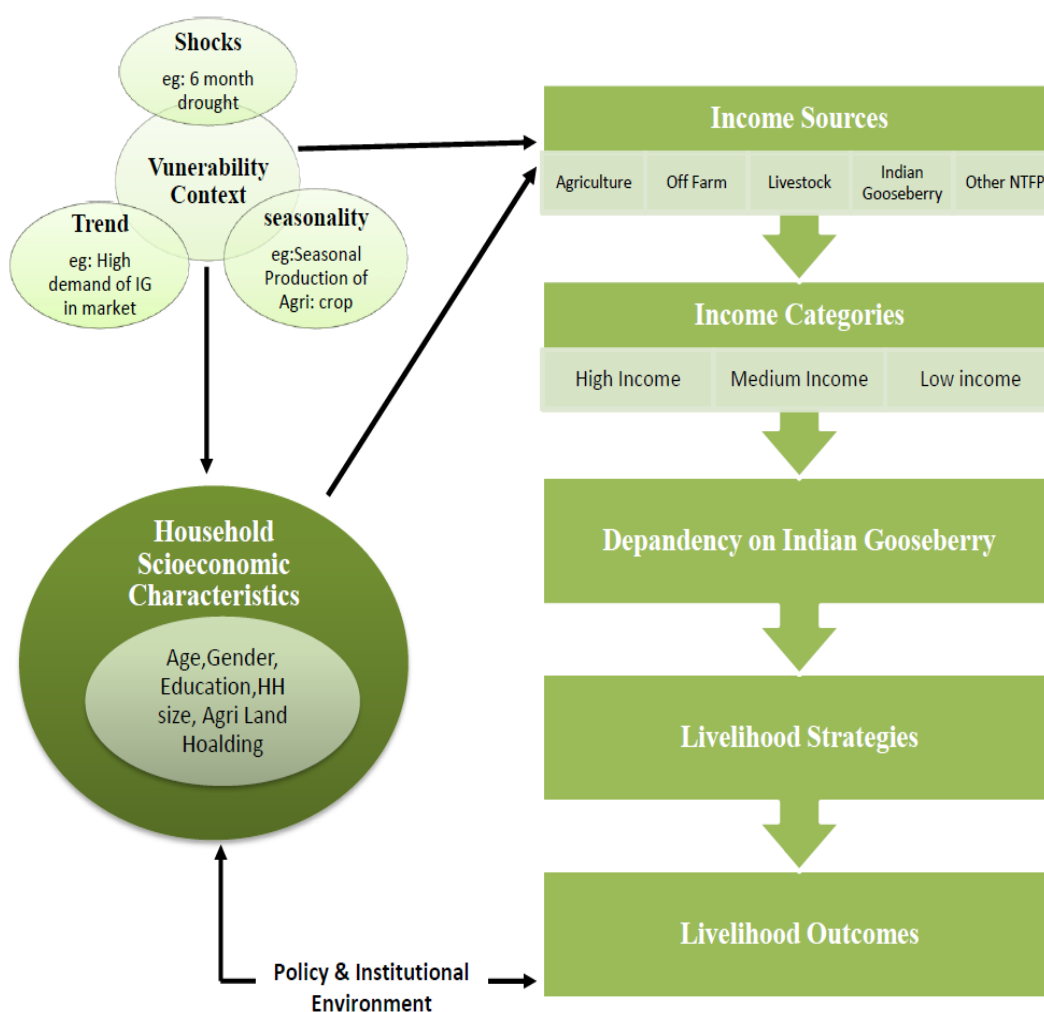


图 3-1 概念框架
Fig 3-1 Conceptual framework

In this framework, there are three categories of households (Low income, Medium income, High income). Indian gooseberry income is one of their main livelihood strategies

corporate with off farm income, agriculture income and livestock income. This research is focused on dependency of three levels of household on Indian gooseberry for their family income and understanding the behavior of dependency with respect to the different household characteristics such as age of Indian gooseberry collector, education of Indian gooseberry collector, household size, distance travelled from home to forest for harvesting Indian gooseberry, experience of Indian gooseberry fruit harvesting, time spent for collection of Indian gooseberry, agricultural land owned by household, water availability for agriculture and total household income without Indian gooseberry income. Following the livelihood outcomes of sustainable rural livelihoods, this study is only concerned on the two livelihood outcomes called, increased income and sustainable use of Indian gooseberry.

Managing vulnerability context is the spirit of sustainable livelihood approach. It can be accomplished through supporting poor people to build up their assets. It is one approach to reducing vulnerability. Another way is, help ensure from the main institution and organization which are responsive to the needs of poor. In this study, one aim is build up their natural capital assets (Indian gooseberry) while understanding of people strengths such as human capital (household size, education, skill levels), social capital (community based organization), Physical capital (land availability, adequate water availability, affordable transportation), financial capital (income from agriculture, livestock, off farm and other NTFFPs). In the study, semi structural questionnaires will be used to understand the vulnerability context and assets of the household.

To enhance the rural livelihood through the higher income of Indian gooseberry more secure access and better management of natural resources is needed. Therefore, institutional support for the process of assets accumulation, livelihood strategies and livelihood outcomes are concerned in the study.

3.2 Description of research site

3.2.1 General overview of Sri Lanka

The island of Sri Lanka lies in Indian Ocean between 5°55'-9°50' North latitudes and 79°42'-81°55' East longitudes. The area of the country is 65 525 km². Two foremost mountainous regions in the central and the south central parts of the country comprise about 20% of the land area over 300 meters altitude. Mean annual temperatures in the country vary from 25- 32 °C in the lowlands and about 16 °- 20 °C in the high elevations. The average annual rainfall varies between 1270 and 2570 mm. In the absence of apparent temperature variance, the rainfall determines seasonal variation. Country climate is tropical, dominated by two monsoons namely South West and North East Monsoon. Country is divided into three climatic regions based on the rainfall level. The wet zone covers 65% of the country, intermediate zone occupy 12% and the dry zone covers 23% of the total land area (Ekanayake and Theodore, 2017).

Sri Lanka has vast diversity in forest types due to spatial variations in rainfall, soil, and altitude. The forests have been classified broadly as tropical wet lowland evergreen forests, wet sub montane forests, wet montane forests, and tropical dry mixed evergreen forests, tropical moist evergreen forest, thorny scrub, mangrove forests, Grasslands and savannas. Tropical forest in Sri Lanka has rich flora and fauna diversity while occupying 3154 flowering plants, half of all South Asian reptiles and amphibians with vast endemism (MOE, 2012).

Similar to other Asian countries, Forest cover in Sri Lanka has shown steady decline over the last decade's. Between 1984 and 2005 reported a drastically reduction of forest land from 84% to 19% of land area. According to the data of forest cover assessment in 2010, 29.7% of the total land area or about 1.95 million hectares of Sri Lanka is forested by natural forest. Of these 1.44 million hectares or 21.9% classified as dense forests (over 75% canopy cover) rest of 0.51 million hectares or 7.8% of the land area classified as open forests, Mangrove Forest and Savannah (Edirisinghe *et al.*, 2012). Moreover, Sri Lanka has about 90,000 hectares of planted forest including Teak, Mahogany, Eucalypts, Pine and other local species.

Sri Lanka is a highly populated country in the world. In 2015, the total population is 21 million, giving an average population density of 334 persons /km². Sri Lanka's economy is gradually transforming from a previously predominantly rural based agriculture economy to a more urbanized service based economy. According to the World Bank data in 2015, the service sector contributed 62.4% of Gross Domestic Product (GDP), followed by Industrial Sector (28.9%) and Agriculture and Forestry Sector (8.7%) (World Bank, 2016). Even though service sector contributes to the largest share of GDP, Sri Lankan society is predominantly an agrarian based. Still, the rural agricultural sector has a very large employment rate. The income expenditure survey conducted in 2006/07 by Department of Census and Statistic estimated the poverty in Sri Lanka throughout the country excluding Northern Province due to the civil war. The results of this survey indicate that 12.6 % of the country's total households are poor. Program has found that the higher number of poor household in estate sector (25.8%), followed by 13.1 % of the rural sector and 5% of urban sector (DCS, 2009). According to the survey results, poverty in terms of Head Count Index (HCI) is shown in figure 2.3.

Over 90% of all poor people in country are accumulated in rural or plantation (Estate) areas (Silva, 2003). Unequal distribution of the benefits of the development is the main reason for the very low per capita monthly income in rural and estate sector. In addition, since agriculture persists the main income generation activity in the rural sector it has substantial effect on rural poverty. Consider the family size; the rural families in Sri Lanka have a large number of family members; that in itself has considerable influence for

the rural poverty. In addition, Land scarcity and unproductive lands are another reasons for high incidence of rural poverty.

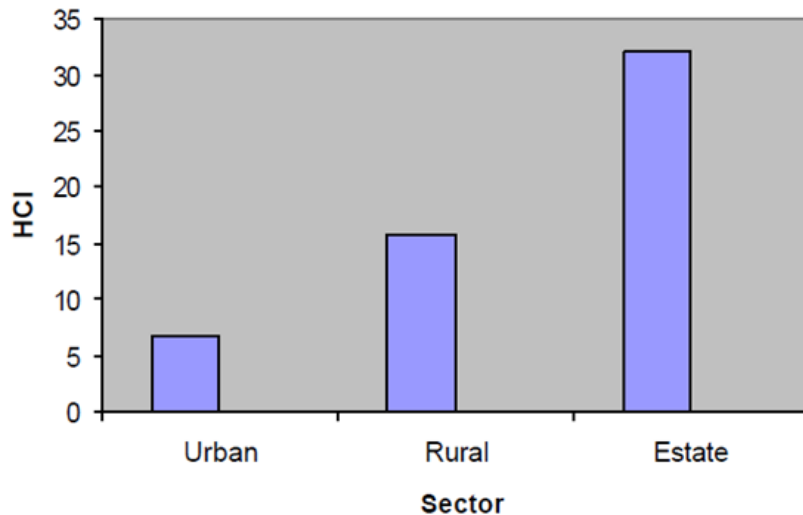


图 3-2 2006 年 7 月各地区的贫困发生率
 Fig 3-2 Poverty Head Count Index by Sector in year 2006/07
 Source: Department of Census and Statistic

3.2.2 Udadumbara Divisional Secretariat Division

This study was conducted in Udadumbara Divisional Secretariat Division which is a forest associated administrative division in the Central province of Sri Lanka. It is situated in between the latitudes of 7^o 16’N-7^o24’N and longitudes of 80^o51’E-80^o56’E. It occupied 280km² of Geographical area. (Udadumbara DSD, 2015).

Almost all the land area of the Udadumbara DSD lies in the intermediate zone of Sri Lanka. The terrain of this area is rolling and undulating. Elevation varies between 400m to 1500m from the mean sea level. North and North East part of the Divisional Secretariat, around 6500ha of the land is occupied by the part of the Knuckles mountain range which is the first conservation forest and as well as one of the world heritage site in Sri Lanka. In addition, there are 5 conservation forests, 9 reserved forests and 24 other state forests occupied 1807 ha of the land (Hunnasgiriya Range Forest Office, 2015). Dominant forest type in the area is Tropical Semi -Mixed Evergreen forest with Keena (*Calophyllum spp*), Kahata(*Careya arborea*), Nelli(*Phyllanthus emblica*) Mora(*Dimocarpus longan*) and Karanda (*Pongamia pinnata*) species. Due to altitudinal differences Montane forest, Submontane forest and grass lands found in Knuckles peak.

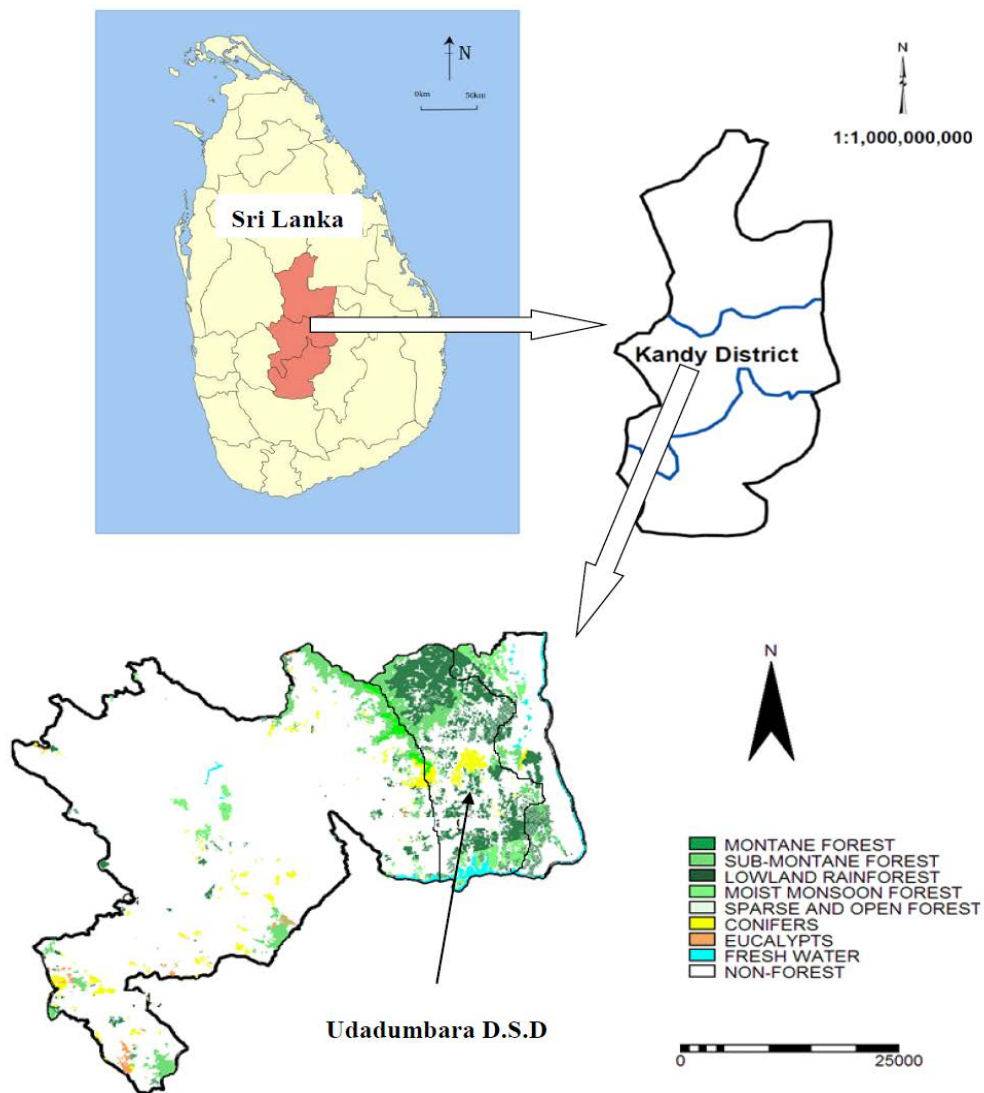


图 3-3 研究地区地图
Fig 3-3 Map showing study area

Udadumbara Divisional Secretariat Division has an average annual temperature ranging from 15⁰C to 28⁰C, with highest temperature measured in July and August. Average precipitation is 15-32 Inches. It is largely restricted to the North East monsoon from December to May. From the month of June to September, the area experience drought period with heavy wind (Udadumbara DSD, 2015)

Total population of this area is 25570 with 7966 households and a population density of 89/km². The DS comprises of 7289 Sinhala families, 616 Tamil families, 50 Muslim families and 11 other families. About 30% population in this area lives under the poverty line (Udadumbara DSD, 2015). Population details in the Udadumbara DSD in terms of age groups are shown in the table 3.1. Among the population, majority of them were 30-60 years old.

表 3-1 Udadumbara DSD 地区不同年龄组性别构成
Tab 3-1 Population details in the Udadumbara DSD in terms of age groups

Gender	Age Group				
	0-5	6-14	15-29	30-60	>60
Female	1060	1843	3005	5097	1901
Male	1018	1813	3184	4331	1712
Total	2078	3656	6189	9428	3613

Source: Udadumbara DSD, 2015

In the study area in general, the dropout rate of primary education is 7%. Percentage of student qualified for secondary education is 21%. But, there has been a gradual increase in literacy rate over the last ten years.

Consider the land ownership, the extent of private owned lands are comparatively low than state owned. Large extent of the land owned by FD, Department of Wildlife and Temple of the Tooth. Moreover, many farmers own less than 0.5 Acers of land (Figure 3.3).

Land Ownership of the Udadumbara Divisional Secretariat
(Number of Households)

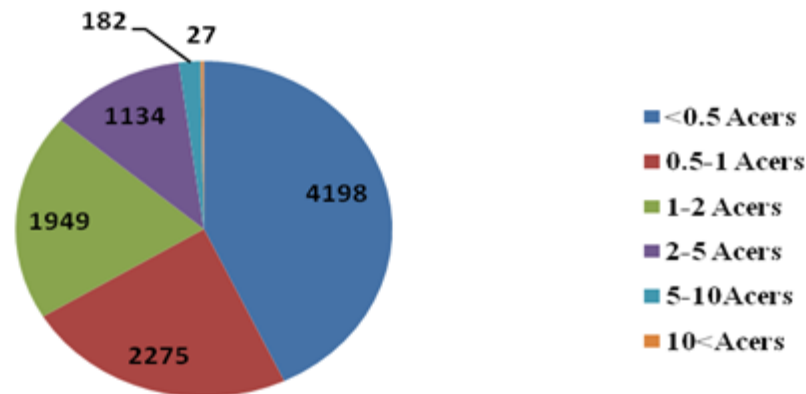


图 3-4 Udadumbara DSD 地区不同规模土地的拥有者数量
Fig 3-4 Extent of land own by different household in Udadumbara DSD
Source: Udadumbara DSD, 2015

Statistic of Udadumbara D.S.D shows that in the year 2009 the percentage of land encroachment was 65%. The forest conservation ordinance modified in year 2009 have broadly addressed the most of the forestry sector issues in the country, and increased the

penalty for the forest offences including illicit felling and encroachment. Moreover, from 2010 onward most of the forest lands in this area have declared as conservation and reserved forest. Hence, encroachment of forest lands has been reduced to some extent over last 6 years.

Agriculture is the major income generation activity in this area. Paddy, vegetable, minor export agricultural crops and *chena* (Shifting) cultivation are the main farming practices among the farm households. During the drought period of six months, some villagers in this study area faced severe water scarcity. Majority of paddy farmers do not have enough water for paddy cultivation. Therefore, some farmers cultivate drought resistant vegetables, corn and tobacco in paddy fields. The villagers who do not have their own land for cultivation are rented lands from land owners. But, during the dry spell poor farm families unable to rent the land due to high land cost.(rental cost of one 1 Acers is around SLRs 25000) So, their livelihood depends on *chena* cultivation working as labor and selling of NTFPs extracted from natural forest.

Due to the legal action taken by the FD, *chena* cultivation is limited in to small extent. Therefore most of the men move to another area for working as a labor. Onset of North East monsoon they may return to village for cultivation. The people in this area were rural dwellers, mostly peasant farmers. However, drought, high cost for agriculture inputs (seeds, fertilizer, pesticides), limited arable land make their living condition harsh. From December to March every year, it is the fruiting period of Indian gooseberry. This period provides income source for rural livelihoods which suffer from drought and low agricultural cash income.

3.3 Sample data and sampling procedure

The villages used in this study were purposefully selected to represent the socioeconomic and geographical variation in the divisional secretariat. The 14 villages were randomly selected from out of 62 villages spread over 2 Agrarian Divisions in Divisional Secretariat Division. List of households in the 14 villages were collected from the divisional Secretariat office. Then the households which are not involved in Indian gooseberry collection were excluded from the list. The data were collected from each and every household which are engaged in Indian gooseberry collection. During the study, 126 Indian gooseberry collecting households were interviewed, due to the incomplete information 9 collectors were excluded and remaining 117 households were used for further analysis.

Primary Data were collected through household face to face interviews using semi structured questionnaire and focus group discussion. Questionnaire was answered by only one collector from each household. The information collected included socio economic characteristic of the Indian gooseberry collector, information about Indian gooseberry harvesting and marketing, and other NTFPs. Focus group discussions were carried out in

each village with 6-8 members including villagers, village headmen (Grama Niladhari) and economic development officer. This study was conducted in the period of September to October in 2016. The recall period of household income accounting was 12 month period. During the survey, Sinhala, a local and national language was used to collect data and later translated into English. All interviews were carried out with the guidance of three forest officers in Hunnasingiya Range Office who had previous experience in household survey.

In addition, Secondary data were collected from Sri Lanka Department of Forest Conservation and Udumbara Divisional Secretariat office.

3.4 Income accounting

According to the Cavendish (2002), this paper defines household income as sum of cash and subsistence income. Results presented in this paper are net household income of the last 12 month. Because cost of all purchased input for Agriculture, livestock management, forest product extraction, transportation cost and hired labor cost are deducted from gross total income. However, cost of family labor is not monetize (Cavendish, 2002).

In this study, total household income calculated in Sri Lankan Rupees (Exchange rate US\$1 equal to 145 Sri Lankan Rupees (SLRs). Total household income was contributed by 6 income sources as follows;

Total household income = Agricultural income + off farm income+ Livestock income+ Indian gooseberry income + Other NTFPs income

Above 5 income sources were calculated as follows;

Agricultural income = it includes the sum of the income obtained by selling and subsistence use of agricultural crops grown by household in last 12 month. Calculating the income derived from agriculture, the quantity of agriculture production (yield) obtained from household survey was multiply by the local market price of each product. In study community none of the Indian gooseberry collector used hired labor for agriculture activities. Traditional labor sharing method called *Aththama* practice in the study area.

Off farm income = it includes the sum of income gotten in last 12 month from wage labor, income from hiring or renting assets, paid employment such as government and private jobs, pensions, self employment and other non farm businesses. Consider the wage labor in the study area, in dry season some villagers move into the cities to working in construction sectors, Paddy fields and sugarcane plantations. Furthermore, some villagers earn money by working as wage labor in minor agriculture crop plantations established by individuals. The daily wages in different activities are not same. Also it is

vary with gender. Number of working days/Hours and wage rate is used in the calculation of total wage income.

Livestock income = it includes the sum of income gotten in last 12 month from selling livestock products and livestock assets and subsistence use of livestock product.

Indian gooseberry income = it includes sum of income gotten in last 12 month from selling Indian gooseberry fruits plus subsistence use of Indian gooseberry harvested in natural forest. None of harvesters used hired labor for collecting Indian gooseberry. The reported income of Indian gooseberry was estimated by the total number of kilograms and market price of 1 kg.

Other NTFP income = it includes income obtained in last 12 month by selling NTFPs (other than Indian gooseberry fruits) collected from forests and subsistence use of these products. The definition of NTFPs used in this study based on the definition established by FAO. It defines NTFPs as “Goods of biological origin other than wood derived from forest”. other important non timber products in this study area are Firewood, Bee Honey, Roping materials ,Medicinal plants edible products such as Mora (*Dimocarpus longan*),Kahata(*Careya arborea*), thibbatu (*Solanum indicum*).

None of harvesters used hired labor for collecting NTFPs. The reported income of NTFPs was estimated by two ways. The products that have market value were validated by multiplying household extracted quantity and unit market price. But some none timber forest products such as roping materials do not have price in market (Gunatilaka *et al.*, 1993). Price of substitute and willingness to pay were used to measure the value of those products.

3.5 Data analysis methods

Collected data were analyzed by using both descriptive statistic and econometric analysis method. Excel 2010 and STATA version 13 were used to analyze data. Descriptive statistics was use to describe the socio economic profile of the Indian gooseberry collectors such as sex, age, family size, education, level of annual income from different income strata ,occupation in different sectors and household income of the study area.

Econometric analysis method was used for analyze the relationship between the income of Indian gooseberry and household social economic characteristics. Ordinary Least square (OLS) regression model was used to determine the effect of socioeconomic variables on the Indian gooseberry income. Indian gooseberry income is considered as the dependent variable and household socio economic variables such as age of Indian gooseberry collector, education of Indian gooseberry collector , house hold size, distance travelled from home to forest for harvesting Indian gooseberry, experience of Indian gooseberry fruit harvesting, time spent for collection of Indian gooseberry, agricultural land owned by household, water availability for agriculture and total household income

without Indian gooseberry income considered as independent or explanatory variables. Forest lands in Sri Lanka were state owned and almost all the people have equal rights to use forest resources. Therefore a variable such as forest land size is not included in to econometric model.

The definition of the variables included in the model can be stated as

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \mu$$

Where,

Y= Indian gooseberry income

β_0 = Intercept of the model

$\beta_1 \dots \beta_9$ = Estimated coefficient of explanatory variable $X_1 \dots X_9$

X_1 = Age of Indian gooseberry Collector (Years)

X_2 = Education of Indian gooseberry Collector (Years)

X_3 = House hold size (Person)

X_4 = Distance travelled from home to forest for harvesting Indian gooseberry (km)

X_5 = Time spent for collection of Indian gooseberry in 2016 (Days)

X_6 = Experience of Indian gooseberry fruit harvesting (Years)

X_7 = Agricultural land owned by household (Acres)

X_8 = Water availability for Agriculture in 2016 (Months)

X_9 = Total household income without Indian gooseberry income (Sri Lankan Rupees)

μ = Error term

In the case of comparing dependency of Indian gooseberry income among the households with different economic status, the sample was divided in to three income levels based on the total household income without Indian gooseberry income. Those economic status are, Income \leq SLRs 200000 (Low income level), income SLRs 200000 - Rs 400000 (Medium income) and income $>$ Rs 400000 (High income level). The dependency of household on Indian gooseberry harvesting was estimated by calculating the share of Indian gooseberry income to total household income. The difference of the income across different income groups (Low, Medium and high) was analyzed by using one way ANOVA test.

According to the Basavarajappa (2008) likert scale was used to measure the collector's opinion on various constraints of IG harvesting and trading. In this method collectors were asked to weight each problem in terms of agreement or disagreement. The major problems that collectors faced are discussed in group discussion and ranked according to priority by the collectors' responses. Five is the highest weight in the opinion list and one is the lowest weight. The weight named as 1- strongly disagree, 2-disagree, 3- undecided, 4-agree, 5-strongly agree.

4 RESULT AND DISCUSSION

This study accomplishes the first attempt of assessment of the contribution of Indian gooseberry to the household economy of rural livelihood in Sri Lanka. Among the various fruit species found in different parts of the country, Indian gooseberry has a wide range of medicinal and industrial uses. However, within the country the uses of Indian gooseberry as a fruit have not been properly exploited and it has been neglected or underutilized fruit crop in Sri Lanka (Dahanayake, 2015).

4.1 Socio-economic characters of Indian gooseberry collecting households

The information about socio- economic characters of Indian gooseberry collecting household is presented in table 4.1. The average age of Indian gooseberry collector was 45.29 with a minimum of 17 and maximum of 68. Among these harvesters, there were neither females no children under 16 involving in Indian Gooseberry collection: the 100% of respondents were males. Athukorala (2013) in his study on assessing integration of gender perspective in Sri Lankan national forest policy revealed that women participation in forestry related activities are still existed as secondary to the men. In the study sample, average family size of the study community is quite small (3.73) because after the marriage they live independently creating a nuclear family. This can be the reason for the small average family size. These results were Similar to the observation of Hedge (1996) and Basavarajappa(2008), who showed that the reason of small average family size can be the marriage which pushes people leave their parents and live independently by creating nuclear family.

The average education level of Indian gooseberry collectors is 7.51 with minimum 0 and maximum 13 years. With the total 117 collectors, the persons with secondary education or ordinary level education is dominant in the study area (49.6%) followed by primary education holders (46.1%) while Advance level education holders occupied the least percentage (4.3%). The low literacy level was found among the harvester whose age is greater than 50 years old where some of them are not got schooling. The rate of literacy was increased gradually due to the development of infrastructure and government encouragement through awareness program. This confirmed the results from the Grama Niladhari survey done in 2015 where they found considerable increment in the rate of student qualified for the university education compared with the situation in 2009 (Udadumbara DSD,2015).

Average distance travelled for harvesting of Indian gooseberry was 3.14km with minimum 0.5km and maximum 5km. The harvesters are lived adjacent to the forest and they can easily enter to the forest even though forest law prohibited to access and

RESULT AND DISCUSSION

extraction of forest resources in reserved and conservation forest (Forest Conservation Ordinance, 1995). The times spent for collection of Indian gooseberry varies from minimum 1 day to maximum 7 days with the average time of 3.39 days. This time is low comparing with 5.47 days spent by Soliga communities lived in Biligiri Rangan Hills in India collect Indian gooseberry from the forest (Hegde *et.al.*, 1996). The average agriculture land owned by the household is 1.16 Acres, but families in lower income level have a significantly smaller extent of land (0.67 Acres) compared to the households in the middle and higher income level ($P < 0.00005$). Gunatilake *et al.*, (1993) who revealed that villagers living in peripheral area of Knuckles conservation Forest of Sri Lanka have small extent of land that they use for producing part of their daily need.

表 4-1 调查样本基本特征

Tab 4-1 Socio-economic characteristics of the Indian Gooseberry collecting families

Household characteristic	Mean	Standard deviation	Standard error	Minimum	Maximum
Age of Indian gooseberry collector (Years)	45.50	11.10	1.02	17	68
Education of Indian gooseberry collector(Years)	7.41	3.51	0.32	0	13
House hold size (Person)	3.73	0.94	0.08	2	6
Distance traveled for harvesting Indian gooseberry (km)	3.14	1.09	0.10	0.5	5
Experience of Indian gooseberry harvesting(years)	10.49	4.88	0.45	3	25
Time spent for collecting of Indian gooseberry(Days)	3.39	1.49	0.13	1	7
Agricultural land owned by household(Acres)	1.16	0.85	0.08	0	4
Water availability for Agriculture (Months)	4.85	1.98	0.18	3	9

Source: Primary Data, 2016

4.2 Economic contribution of different income sources

The study community meets their food and income needs from agriculture, off farm activities, livestock rearing, collection of Indian gooseberry and other non timber forest products.

The contribution of different income sources to the total household income is shown in table 4.2. The average total household income of the Indian gooseberry harvester is SLRs.243571.5. As shown in table 4.2, off farm income contributes to the highest share of total income; it is about 53.1% of total household income and comprises both cash and

subsistence income. Agriculture income was the second largest contributor (35.1%) and Indian gooseberry income was the third contributor (10.1%). The average income derived from Indian gooseberry is SLRs18322.81 which almost comes from the sale of Indian gooseberry fruits collected from nearby forest. The people are content for getting money by selling the great quantity of harvested fruits to the village trades and road head retailers. Household consumption of Indian gooseberry fruit is very low. Similar results were observed in the study conducted in India (Shankar *et al.*, 1998) on the extraction of NTFPs in the forest of Biligiri Rangan hills. They found that the tribal families lived in this area obtained a net annual income of Indian Rupees 12240 from selling Indian gooseberry.

表 4-2 不同来源的平均收入与收入占比
Tab 4-2 Average income and income share by different income sources

Income source	Average income (SLRs/Year/ Household)	Standard deviation	Income share (%)
Agriculture income	85496.58	67495	35.1
Livestock income	1590.99	6252	0.6
Off farm income	136279.7	101280	53.1
Indian gooseberry income	18322.81	12933	10.1
Other NTFPs income	1881.35	3534	1.1
Total income	243571.5	120964	100

Source: Primary Data, 2016

Other NTFPs income accounted 1.1% of the total household income on average. The major NTFPs other than the Indian gooseberry that contribute to the household income are fuelwood, bee honey, leafy vegetables and thibbatu (*Solanum indicum*). In addition, *kahata* (*Careya coccinea*), yams, medicinal products, wild Fruits, product of *Caryota urens*, roping materials, mushrooms which are collected in minor quantities. The detail descriptions of other NTFPs are listed in Appendix 2. Figure 4.1 represents the details of different NTFPs (without Indian gooseberry) which contribute to the total NTFPs income. Most of the NTFPs listed in Appendix 2 are non market products and have low rate of return, therefore households pay less attention to collect them. Researchers found that NTFPs extraction may be easily derelict if other more advantageous income sources become available (Howell *et al.*, 2010). The similar pattern was observed in the study community for collection of NTFPs other than Indian gooseberry.

In study area, fuelwood is non- market product mainly used for cooking purposes. Since the fuelwood is the primary source of energy for low income household (Paumgarte

and Shackleton, 2011), the poor families have fewer alternatives. Nearly 60.6% of sample households engaged in collection of fuelwood from nearby forest.

The fuelwood collection is done by the women who organized into small groups with their neighbors. The amount of fuelwood collected from the forest depends on the availability of fuelwood in their home garden. The Contribution of different NTFPs to the total other NTFPs income is shown in figure 4.1. The 16.1% share of income from fuel wood is less value comparing to the value of the 55% contribution in Sothern Ethiopia as reported by Yemiru *et al.*,(2010) and the value reported in Northern Ethiopia where fuel wood account for about 45 % of the forest income(Babulo *et al.*, 2009) .

Proportion of household engaged in collection of different NTFPS Contribution of different NTFPs to total NTFPs income (without I.G)

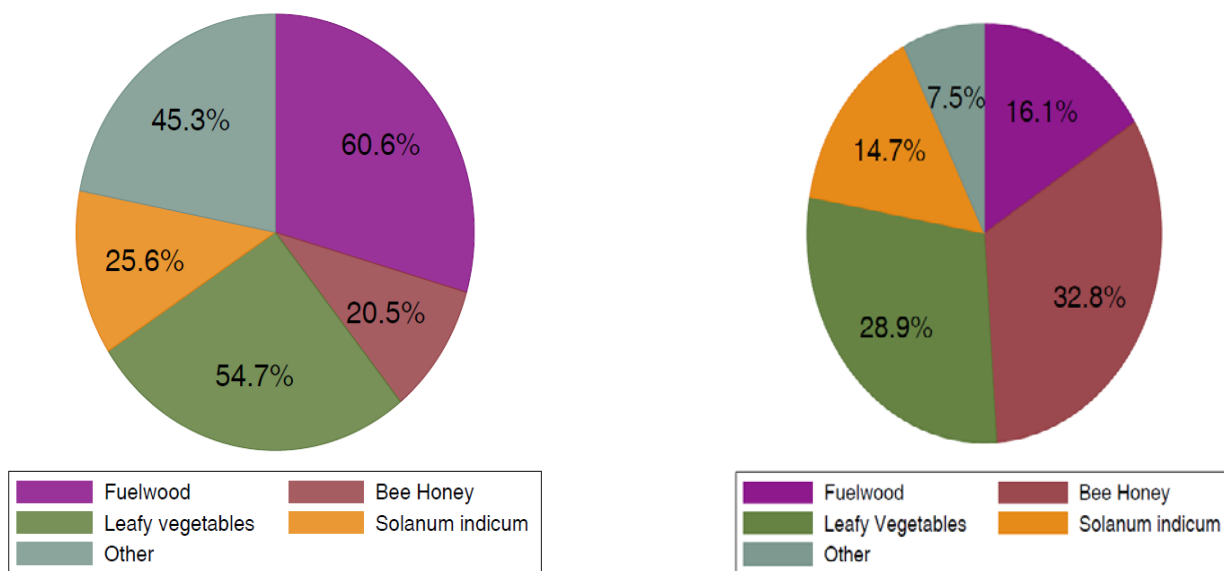


图 4-1 其他非木质林产品（除醋栗外）收入对比
Fig 4-1 Contribution of different NTFPS to the Total Other NTFPs income
 Source: Primary Data, 2016

Apart from fuelwood, most of above NTFPs namely bee honey, *Solanum indicum*, *Careya coccinea*, leafy vegetable and fruits are seasonal in nature. The period from April to August is concerned as the peak season for NTFPs collection. Income share from Bee honey, leafy vegetable, *Solanum indicum* and others are 32.8%, 28.9%, 14.7% and 7.5% respectively. Natural bee honey is available in the study area and has good market. As mentioned by the villagers during the interview, the honey collection is done in dry period by adult male and it is marketed to the nearest city of Ududumbara or Hunnasingiriya where the average price of one bottle of honey (750ml) is around SLRs.800-1000. Nearly 54.7% households in the present study area collect leafy vegetables (Appendix 1).

The majority of respondent harvest leafy vegetables for immediate consumption and sell few species in nearest city. They eat leafy vegetables as part of their meal in a form of curry, fried or salad. Furthermore, *Dregea volubilis* and *Amaranthus viridis* were common potentially domesticable leafy vegetable reported by the collectors. Leafy vegetables mainly harvested from forest are allowed to grow in backyards with other food plants even though they are considered weeds (Badimo *et al.*, 2015). Livestock income is the least contributor to the household income (0.6%) because the villagers do not take livestock as a source of income (Gunatilake *et al.* 1993). The livestock recorded in study area are buffalos, cattle and poultry. The few villagers rear cattle for milk and poultry for eggs and they sold their products to road head traders or village traders. All the villagers do not take milk from buffalos. People rear buffalos for supplying draft power in harrowing. During the *maha* season (November - February) when paddy cultivation starts, the buffalos kept in the village. Later they are drive away to the forest for freely grazing until the starting of next cultivation.

The result of this study about total NTFPs income (Indian gooseberry and Other NTFPs) is similar to the study conducted in Knuckles National wildness area in Sri Lanka (Gunatilake *et al.* 1993) reported that average annual income generated by NTFPs Accounted for 16.2% of the total household income. Similarly, Misbahuzzaman and Smith-hall (2015) found that contribution of forest related income was low (11.59%) than agriculture income (77.02%). A study in Cambodia (Ra and Sasaki, 2013) depicted that income from forest resources contributed to 12-34% of the total income of the three communities in Kampot, Kampong Spoeu and Kampong Thom province in Cambodia. Also this study reported that forest resources income depends on seasonality and forest location.

However this result is relatively low in comparing to other international studies. Study by Leßmeister *et al.*, (2016) in south –eastern Burkina Faso, estimated that NTFPs contributed 45% to the household economy and second largest share of the household income. Another research by Foppes and Ketphanh (1997) in 28 villages in Lao PDR revealed that NTFPs provide on average 55% of family cash income.

4.3 Indian gooseberry income among different income groups

Approximately 55 families in our sample community were accounted in to poor income level, followed by 50 families of medium income level and 12 were high income level. Our results on total household income show that Indian gooseberry harvesting is the third livelihood strategy after the off farm and agriculture income in study area. In terms of mean value, the income from Indian gooseberry is higher in the group of people with the low income level (Table 4.3). The percentage contribution of Indian gooseberry to the total

income in the low income house hold is about 16.4% while it is about 5.2% in the medium income level. The households with higher income level received lowest income from Indian gooseberry accounting 2.1% of the total household income but they received greater portion (66.4%) from off farm income sources such as government/private jobs and private off farm business. Therefore, those households do not depend on Indian gooseberry much as low income level. The contribution of forest products explained declining trend as other income increases, indicating higher economic role played by the forest product among low income families (Gunatilake *et al.*, 1993).

In this study area middle income level household get higher income share from agriculture (37.7%) and livestock. They intensively manage livestock (poultry) and cultivate pepper, one of the highly valuable condiments in local and international market. Previous research findings have shown contradictory results for the relationship between dependency of NTFPs and Income groups. Our results are contrary to the finding of Leßmeister *et al.*, (2016).

表 4-3 不同收入水平的年平均收入和收入份额
Tab 4-3 Mean annual income and income share of different income levels

Income Source	Low income Level (n=55)		Medium Income level (n=50)		High Income Level (n=12)	
	Mean (SLRs)	Mean Percentage contribution (%)	Mean (SLRs)	Mean Percentage contribution (%)	Mean (SLRs)	Mean Percentage contribution (%)
Agricultural income**	50107	33.8	108136	37.7	153369	30.7
Livestock income	393	0.2	2973	1	1320	0.3
Off farm income**	71882	47.8	159781	55.7	333514	66.4
Indian gooseberry income*	23436	16.4	14550	5.2	10607	2.1
Other NTFPs income	2505	1.8	1115	0.4	2212	0.4

Significant difference between three groups (F test)

Source: Primary Data, 2016

*P<0.05

**P<0.00005

They found that medium and high income level households received highest absolute income from NTFPs than lower income group because of restricted access to parklands and fallows.

Similarly, Hogarth *et al.*, (2013) found that higher income household used greater quantity of forest product and derived higher absolute income from forest than lower income household. But, the results of this study are supported by the findings of Quang and Noriko (2008) in Vietnam and Khosravi *et al.*, (2016) in Iran. They observed that better off (Medium and High income group) household had less share of income from forest resources than poor (low Income) household. Because better off household get more share of income from off-forest sources. Moreover, results of one way ANOVA trot out that the differences of Indian gooseberry income among three income levels are statistically significant. In fact, Bonferroni comparison test explained that Indian gooseberry income of low income household is significantly higher than that of the high income level household.

4.4 Socio-economic factors affecting Indian gooseberry dependency

There are many studies conducted in different countries to find out the effect of various socio-economic factors on household's NTFPs income (Hogarth *et al.*, 2013; Leßmeister *et al.*, 2016; Quang and Anh, 2006; Yemiru *et al.*, 2010). Result of OLS regression is shown in table 4.4.

表 4-4 关于印度醋栗收入的回归分析

Tab 4-4 OLS regression of Indian Gooseberry income by socio-economic variables

Variables	Estimated coefficients	Standard errors	t statistic	P>[t]
Age of Indian gooseberry collector (Years)	-57.11992	94.94017	-0.60	0.549
Education of Indian gooseberry collector(Years)	-273.4267	310.9402	-0.88	0.381
House hold size (Person)	211.5878	877.2041	0.24	0.810
Distance travelled to harvesting Indian gooseberry (km)	-72.3950	776.0958	-0.09	0.926
Experience of Indian gooseberry harvesting(years)	231.6988	185.4049	1.25	0.214
Time spent for collection of Indian gooseberry(Days)	4580.521	716.2674	6.39	0.000
Agricultural land owned by household(Acres)*	-2405.518	1431.251	-1.68	0.096
Water availability for Agriculture (Months)*	-1173.123	649.0948	-1.81	0.074
Total Income without Indian gooseberry income (SLRs)	.0019248	.0082532	0.23	0.816
Constant	12465.93	8697.319	1.43	0.155

n = 117, R²= 0.6100, adj.R²= 0.5772, F =18.60, Prob>F = 0.0000,*p<0.1

Source: Primary Data, 2016

This model shows that there is 61% ($R^2=0.6100$) of variance in Indian gooseberry income (dependent variable) by all tested independent variables.

The results of regression analysis shows that there are no significant different between age, education years, house hold size, distance travelled to harvesting, harvesting experience and total Income without Indian gooseberry income. Age of Indian gooseberry collector was negatively correlated to the Indian gooseberry income. This denotes that older rural people are negatively associated with Indian gooseberry harvesting and obtain low income than younger people because younger people have relatively higher physical strength to harvest Indian gooseberry. Moreover, education level of the Indian gooseberry collector has negative correlation on the Indian gooseberry income as collectors with higher level of educational qualification are less likely to involve in harvesting these fruits. Higher level of education opens up the possibility for government and privet jobs. This the case of some well-educated families where the net profit from extraction of NTFPs is decreased due to the lowest opportunity cost of time spent to extraction (Adhikari *et al.*, 2004; Khosravi *et al.*, 2016). Therefore, lower levels of education cause unstable economic situation which leads poor households to collect Indian gooseberry and other forest resources for bumping up household income. The similar results were observed in Zambia, (Mulenga *et al.*, 2011) where the share of NTFPs income in total household income was negatively correlated with education and age of NTFPs collector. In China, total forest income of household correlated negatively with age of household head but positively correlated with education of household head (Hogarth *et al.*, 2013).

Among the other independent variable the time spent for collection of Indian gooseberry is significantly and positively correlated with the Indian gooseberry income. This is defined by the fact that the harvesters spent more time in forest collecting the fruits, the more they get a great quantity to sell, so the more their income from fruits will become high. This result is similar to the finding of Basavarajappa (2008) in India. In addition, the result has shown that distance travelled to harvesting Indian gooseberry has the negative correlation on the Indian gooseberry dependency but it is not statistically significant. Households living near by the forest area are more willing to collect Indian gooseberry from reserved and conservation forest than those who living far away due to high accessibility and low difficulties in transporting of harvested fruits, often used by headload. Adhikari (2003) reported that the household in forest fringe have secure access to extract NTFPs even though forest law and regulation hindered it. Similarly a study by Saifullah *et al.*, (2016) revealed that location is crucial factor for earning from NTFPs because people living in the nearby forest have more easy access to forest.

There is a significant negative correlation between dependent variable and Agriculture land owned by household ($p<0.1$) Agricultural land is most noticeable factor

that determines the dependency of study community on Indian gooseberry and other forest product.

In line with other studies Leßmeister *et al.*,(2016) observed that NTFPs dependency in rural household was significantly decreased with increasing farm land. In Ethiopia, the relative income from forest was negatively correlated with crop land (Yemiru *et al.*, 2010). Looking the water availability in study area, it can be seen in minimum 3 month and maximum 9 month with average of 4.85 month. The water availability is highly affected to the agriculture crop production. Due to the lack of water, in some villages' agriculture crop production restricted to only one season (*Maha* season). Therefore water availability for agriculture has significant negative correlation ($p < 0.1$) between Indian gooseberry income. The results of this study similar to the finding of Kalaba *et al.*, (2009) they found that limited rain fall results to poor harvest and food insecurity in rural Zambia which results to high dependency on indigenous fruit trees and forest resources.

4.5 Problems Linked to Indian Gooseberry harvesting and Trade

This part attempts to discuss the main issues of Indian gooseberry collection and factors affecting to the livelihood of Indian gooseberry collectors. The entire sample of respondents of the DSD was interviewed about the problems faced in harvesting and trading of Indian gooseberry.

表 4-5 调查样本对于各影响因素的认同情况

Tab 4-5 Collectors opinion on problem by priority

Problem according to the priority by the collectors	Percentage result of Collectors Opinion				
	1	2	3	4	5
	(%)	(%)	(%)	(%)	(%)
Restrictive forestry legislation	0	0	0	18.8	81.2
Lack of trees	1.8	6.8	0	39.3	52.1
Lack of knowledge on forest law and regulations (eg. Permit)	14.5	12	5.9	18.8	48.7
Tree Die back	5.1	11.9	9.4	31.7	41.9
Inappropriate harvesting technique	9.4	7.7	35.9	20.5	26.5
Price fluctuation	7.6	15.4	8.5	27.3	41.0
Forest fire	11.7	24.8	1.7	24.8	36.7
Threaten by forest Officer	24.8	29.1	0	26.5	19.6
Other	27.3	41.0	0	11.1	20.5

Note: 1- Strongly Disagree, 2- Disagree, 3- Undecided, 4- Agree, 5- Strongly agree

Source: Primary Data, 2016

4.5.1 Restrictive forestry legislation and Lack of Policy

Almost all respondent (Table 4.5) were answered that restrictive forestry legislation was the main problem of harvesting of Indian gooseberry with 81.2 % of collectors who strongly agreed. This is due to restriction of forest department which is seen in forest conservation ordinance. According to the forest conservation ordinance, in conservation forest areas extraction of forest product is prohibited and in reserved forests, the extraction of NTFPs products is permitted (Permit issued by authorized officer of FD. In other state forest and village forests, the NTFPs extraction is controlled by the forest and wildlife department. In these two types of forest limited collection of medicinal plant, fuel wood and fodder is granted to local people, but granting of these rights is at the pleasure of particular department officers. These legislation causes to non-development of this sector (Liyanaarachchi, 2004).

Since early 2000, more than 400 ha of forest land in the study area were declared as reserved forest. According to the section 3(2) in forest ordinance, the Conservator General of Forest shall prepare a management plan for reserved forest, in a manner as may be prescribed for the purpose of conservation of bio diversity, soil and water, for the preservation of its unique ecosystem, and protection of genetic resources and habitat of rare and endemic species of flora and fauna. But the economic importance of these forests to the rural community has been ignored. Moreover, forestry policies do not give adequate consideration of the goods and services that can provide a well being of rural people (Liyanaarachchi, 2004). FD has been adopted forest policies and regulations which are designed to limit the extraction rather than encourage of extraction and sale of NTFPs. Unfortunately, this has promoted the illegal extraction of Indian gooseberry and other NTFPs from the reserved forest.

4.5.2 Lack of knowledge on forest law and regulations (eg. Permit)

With regard to the lack of knowledge on forest laws and regulation, 48.7 % of the collectors were strongly agreed this is the problem that they face. They clearly said that they face problem in getting the forest product extraction permit and implementation of the ordinance. Most of the NTFPs products are regulated by legislations and permits. Permits are issued on an annual or short-term basis. Fees needed in issuing forest products extraction permit have been published in the gazette extraordinary 1600/18 of May 06, 2009, by the ministry of Environment and renewable energy and conservator of forest. According to that, permit fee for extraction of 100 seeds of Indian gooseberry is SLRs 80.00. Illegal extraction of Indian gooseberry without having a permit would be guilty of an offence and be liable on conviction to imprisonment or to a fine.

Similar results were observed in Kodagu district of Karnataka in India. A study done by Basavarajappa (2008) found that 42.9% of the tribal respondents do not have knowledge about forest policies and laws due to higher illiterate rate of tribal community.

4.5.3 Trees die back

Regarding to the tree die back, some collectors responded that “we observed many trees with parasitic plants; these parasitic plants reduce the vigor and productivity of Indian gooseberry trees and after several years those trees will begin to dying from affected part of the tree (Especially from Branches)”. Therefore 41.9% of the collectors indicate that this was a high risk. The findings are supported by the Shankar *et al.*, (1998). They reported that two common parasitic plants namely *Taxillus tomentosus* and *Dendrophthoe falcate* are affected to the vigor and productivity of Indian gooseberry tree. But, they do not estimate the extent to which these parasitic plants affect the trees.

For the dying of canopies of forest trees called canopy dieback. Scientist found several reasons for tree dieback including Pest and diseases, bark damage by samburs (*Cerus unicolor*), acid rain, soil nutrient imbalance and soil toxicity. Dieback of Tropical Upper Montane Rain Forests has become a severe environmental problem in Sri Lanka (Ranasinghe *et al.*, 2009). But, species dieback in tropical mixed evergreen forest has been not highlights yet. Unfortunately, in recent years the FD has not been conducted any research and there is a lack of update information on the cause of tree die back.

4.5.4 Lack of trees

The forest degradation also entails a loss of species abundance and distribution. By the far majority (52.1%) of collectors indicate (strongly agreed) that Indian gooseberry trees are lack in availability. They mentioned that the fruits have become scanty, especially in open forest adjacent to the village. Collectors also indicate that the distance which collectors have to travel to extract IG has increased overtime. The alteration in forest system by reduction of forest cover and extent, and scarcity of different species has counteracted on livelihood of rural people who are highly depend on forests (Kalaba *et al.*, 2009)

The practice of slash and burn in *Chena* cultivation is known for contributing to vast losses of forest cover in this area. Department of forest conservation have been conducted reforestation and enrichment planting program in study area by using timber oriented plant species such as *Eucalyptus spp*, *Pterocarpus marsupium*, *Chuckrassia velutina*, *Termunalia arjuna*, *Vitex altiasime* and *Michelia champaca* . Also, few fruit crops with higher timber value were planted in enrichment plantations mixed with other species (eg: *Artocarpus heterophyllus*, *Tamarindus indica*). But, the department has not been interested to plant Indian gooseberry in large scale. Due to the request of community based organization in Bambarabedda village, 5 ha of IG plantation were established in year 2013 even though this is not sufficient to satisfy the demand of Indian Gooseberry.

4.5.5 Inappropriate Harvesting technique

Results showed that IG collectors in the study area used different types of harvesting techniques. Mainly, harvesting is done by climbing the trees and picking up fruit to the poly sack bags. In addition to that, some of them knocking the fruit down with stick and then gather the fruits in beneath the tree. Also some harvesters climb the tree and cut off branches bearing fruits, then they separate fruits on the ground and gathered them. This result supports the finding of in Bilagiri Rangan hills in India. Authors revealed that the Soligas, an indigenous tribal lived in this area extract *Amla* (IG) as group activity, all group members enter to the forest in morning and separated in to families. The male members in family harvest the fruit by climbing tree while other members of family collect the fruit on lop off branches (Shankar *et al.*, 1998). This poor harvesting methods cause unsustainable production.

The results present in table 2.3 revealed that 35.9% of the collectors had opinion that they were undecided or unable to decide as they do not have enough knowledge about the proper harvesting technique. On the contrary 26.5% of the collectors strongly agreed this was problem. They said that cutting off of fruiting branches will reduce the future production drastically, although lop off of branches can be expected to increase susceptibility to pest and disease attack. They also opined that, from the collectors this is done by only few collectors who come from other villages.

It is a confessed economics fact that demand creates supply. As demand for IG is increasing, harvesting of IG will also increasing. Due to high demand, most harvester pluck fruits early in the season, and encourage the cutting of branches with both mature and unripe fruits. Also, fruits are harvested without considering the reproduction of the species. This can be responsible for low yield or even plant destruction. When fruits are harvested in immature stage, they are highly subjected to shriveling and mechanical damage which lead to the shorter shelf life (Kader, 1999).

4.5.6 Price fluctuation

Indian gooseberry is wild seasonal tree which depends on different environmental factors for naturally growth that makes its productivity unpredictable. Therefore, market for Indian gooseberry fruit is relatively complex compared to agriculture products. Its prices also vary from one village to the next, across the different locations, access to market, existence of trade network (village seller, road head seller) as well as over time. Regarding to the price fluctuation, the collectors responded that middle men get two times more income than them. Therefore 41.0% of collectors indicate that, high risk of price fluctuation while 27.3% of the collectors agreed it. Similar results were observed in Peru (RuizPerez and Arnold, 1996). The Study found that forest dwellers sell their product less than 5 % of market price.

Also this was supported by the result of Hegde *et al.*, (1996) in India. They found that, due to the poorly developed marketing channel the prices of different NTFPs gain from the point of collection varies from 50% in *Magalibery* to as high as 25% in *Soapnut*.

IG collectors have no organization to regulate the trade of Indian gooseberry as they do not possess fix price (minimum price) for the fruits they have been harvested. As a consequence of this, collectors at the family level adapted to sell their product to convenient buyer cope up with available facilities (e.g. access to local market). These make people pay little attention to the income from Indian gooseberry.

4.5.7 Forest Fire

Forest fires in Sri Lanka occur mainly in grasslands and forest plantations. In every year, Sri Lanka loses roughly about 500 hectares of forest land by forest fire. In 1999 it was 417 ha (FAO, 2002). In the central highlands risk of fire is often high in dry season due to topography and low humidity. Every year forest fire destroys the considerable forest resources in central highlands of Sri Lanka. It includes both timber and non timber forest products. But quantitative information is not available. The study area is highly susceptible for forest fires due to the prolonged dry period (within six months). Almost all forest fires in this area human origin. Negligence or carelessness is the main causes for that. According to the data of range forest office, the grass lands in Knuckles world heritage site, open forests and exotic pine plantation are usually prone to fire. Most of the IG trees were distributed in grass lands and open forests. Mature Indian gooseberry trees are resistant to the fire, but periodical forest fire affected to seedlings, root system of the mature trees, although areal parts are burn. This leads to reduce the production. Therefore 36.7% of responded strongly agreed this was problem while 24.8% of collectors had the opinion that, they were agreed this was a problem. On the other hand almost 24.8% of the collectors had the opinion that, they disagree or they cannot say that forest fire is problem. Presumably, the reason for this is most of the forest fires are surface fires and do not attack to the canopy of tree. According to the respondent, the fire makes only stress for tree and doesn't destroy the mature tree.

4.5.8 Threaten by forest Officer

Because of seemingly less harmful to natural ecosystem, forest officers themselves are less concerned about the Indian gooseberry collection than illegal felling and hunting. Also collection of IG is done on an individual basis in irregular manner. Therefore the ability of being caught by the forest officers for this type of offences is considerably low. This is the reason why 29.1% of the collectors in the study area were disagreed this was a problem. This result is in line with the finding of Senaratne *et al.* (2003). They found that gathering and delivery of edible NTFPs from Sinharaja conservation forest is done on small scale and irregular basis. Hence, penalties by the authorities for such cases are very low. But this study is opposite to the findings of Basavarajappa (2008). He stated that

47.3% of the total tribal households in Kodagu district of Karnataka in India agreed that, they have high risk of being punished by the officers in Forest Department of India. On the contrary, 26.5% of the collectors agreed threaten by forest officer was a problem and 19.6% of them strongly agreed for it. They said that, high potential of being detected by the forest officers, when they enter to reserved forest and conservation forest. They were caught and fined if they enter to the reserved forest and conservation forest without having extraction permit. This brings out collectors life in to difficult stage, as IG collection is part of their household income. But collectors also stated that, the forest officers don't caught them dispensable excepting they have real reasons committed during harvesting of IG.

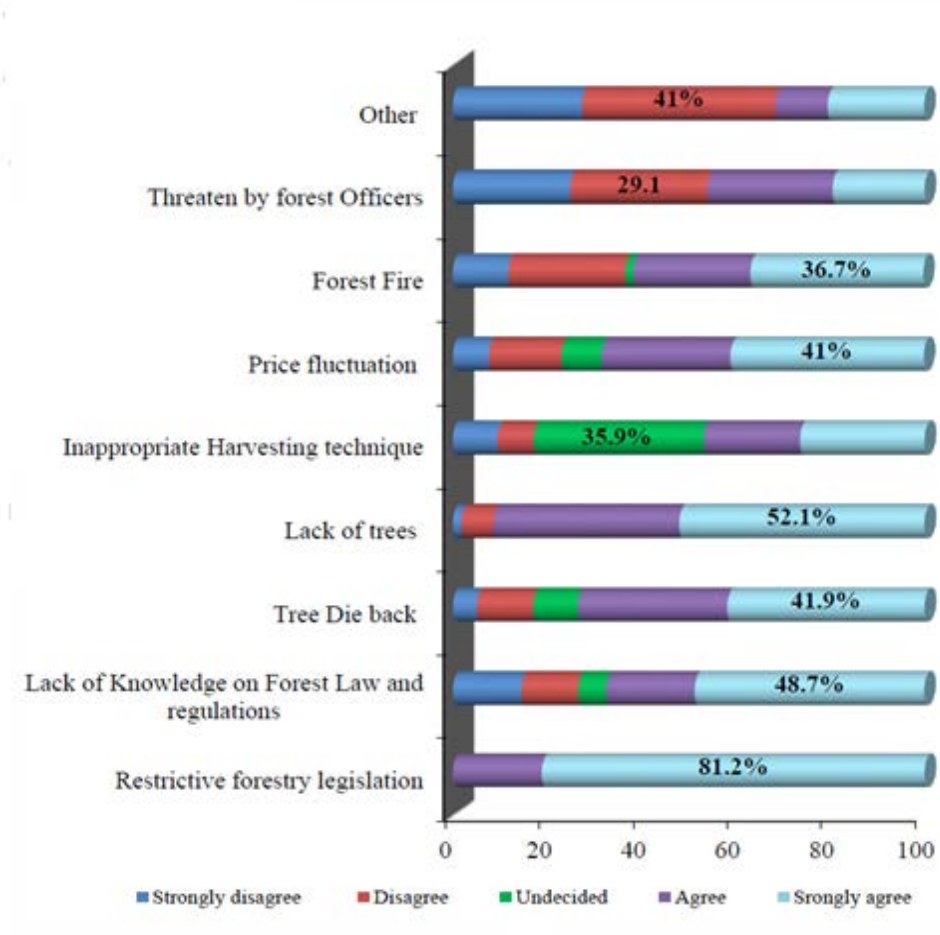


图 4-2 被调查对象的观点
 Fig 4-2 The opinion of Indian Gooseberry collectors
 Source: Primary Data, 2016

The results presented in figure 4.2 revealed that the restrictive forestry legislation is the foremost constraint which collectors faced during harvesting. This is given top priority by collectors. Lack of trees, lack of knowledge on forest law and regulations, tree die back, price fluctuation and forest fire are other most severe constraints faced by the collectors. Results revealed that greater proportion of collectors do not have better understanding about the inappropriate harvesting technique. Even though collectors decide that threaten by forest officers as a problem; majority of the collectors disagree for that.

4.5.9 Other

The other factors including lack of transport facilities, lack of education on processing, conflict of collectors are not much of a problem for many collectors as mentioned by 41.0% of the collectors (Figure 4.2). On the other hand, 20.5% of the collectors who were highly depend on forest land strongly agreed conflict of collectors and lack of transport facilities were an important problem. This is because collectors who don't have more access to other income sources will be able to fulfill their livelihood requirements from the Indian gooseberry, so they have conflict with other harvesters to extract higher amount. On the other hand, 20.5% of the collectors who were highly depend on forest land strongly agreed conflict of collectors and lack of transport facilities were an important problem. This is because collectors who don't have more access to other income sources will be able to fulfill their livelihood requirements from the Indian gooseberry, so they have conflict with other harvesters to extract higher amount.

The results indicated that, none of the collectors involved in the processing of Indian gooseberry. They sell fresh fruits to village sellers or road head sellers. Because of little support was paid to the Indian gooseberry and NTFPs, the level of knowledge on the processing of Indian gooseberry is quite inadequate. Methodologies and technologies on processing and value addition of Indian gooseberry are not available in village level.

5 CONCLUTIONS AND RECOMMENDATION

5.1 Conclusions

Since antiquity, Indian gooseberry fruit has been extensively used in Sri Lankan traditional system of medicine; it is now comprehensively trade in local market due to its high demand as natural antioxidant. Tropical savanna and dry mixed evergreen forests in Sri Lanka are home for Indian gooseberry trees. Indian gooseberry fruits are playing vital role in rural household income and sustain the livelihood of communities living adjacent to the forest. Extraction of Indian gooseberry is one of the alternative income sources for rural poor and landless families in dry and intermediate zone in Sri Lanka.

In this situation, the present study is conducted to assess the contribution of Indian gooseberry to income and livelihood of the rural community, and also to identify the major problems of Indian gooseberry harvesting and trading in the Udadumbara Divisional Secretariat Division of Sri Lanka.

This study recognized that income from Indian gooseberry is clearly important alternative income source in the study area. The study found that Indian gooseberry income contributes 10.1% of the total household income on average. It was the third largest share after the off farm income (53.1%) and agriculture income (35.1%).

Although this study found that low income level household relies more on Indian gooseberry than high income level households. As mentioned by Indian gooseberry contribution, 16.4% for the income of the low income level and 2.1% for the high income level. In the survey area, low income families are generally poor farmers with the small piece of land and suffering of water scarcity. They depend on non timber forest products particularly Indian gooseberry for their daily needs. Therefore, Indian gooseberry collection was an integral part of the livelihood of the poor households.

This study also found that agricultural land owned by household and water availability for agriculture is statistically significant and negatively correlated with the Indian gooseberry income. This realized that local households less dependent on forest resources if they have enough assets and resources for farming. As anticipated, income from Indian gooseberry have a negative correlation with the collector's age and education, while time spent for collecting influence positively on the Indian gooseberry income. However, house hold size, distance traveled for harvesting, harvesting experience has no significant effect on Indian gooseberry income.

The study examined the major constraints of Indian gooseberry harvesting and trade. Finding concluded that the restrictive forestry legislation was the major constraint faced by the collectors. With the objective of conservation of natural resources and indigenous fauna and flora, the forest conservation ordinance limited the rights of forest

dwellers for extraction of NTFPs from the conservation forest and reserved forest. In addition, the collectors also faced to the problems such as lack of trees, lack of knowledge on forest law and regulations, tree die back, inappropriate harvesting technique, price fluctuation, forest fire and threaten by the forest officers. Moreover, almost all the respondents in the household survey are mentioned that the Indian gooseberry trees are under vulnerability and reduction in their availability than before. Also they answered that there were no any management activities to control the harvesting.

It is mandatory to mention that the reduction of Indian gooseberry trees has negative effect on rural families which are highly dependent on Indian gooseberry. Also, excessive utilization and inappropriate harvesting have significant environment impact. Therefore, as a rightful owner, the FD and other stakeholders should take into account to find the way how to increase the productivity of Indian gooseberry and reduce the over exploitation and misuse.

Few studies have been conducted on socio-economic contribution of NTFPs in Sri Lanka. However, any studies have not yet been conducted on economic contribution Indian gooseberry. Therefore, further studies are needed on Indian gooseberry production, processing and marketing. Findings of this study could be used as scientific guidance for decision makers to set up appropriate policies to enhance social and ecological welfare.

5.2 Recommendations

Following recommendations are set up from this study;

1. In this study area Indian gooseberry extraction provides considerable income to the forest dwellers. But, fruit scarcity also reported due to forest fire, over exploitation and inappropriate harvesting and tree die back .This destabilizes the Indian gooseberry based income. Therefore, there should be scientific forest management system with strict monitoring process. Moreover, effective programs should be run over to educate local communities about sustainable use of Indian gooseberry and forest fire prevention.

2. Collectors harvest Indian gooseberry as an individual basis. They do not organize as a group for harvesting and trade. The middle men (village trader) have monopoly over the Indian gooseberry trade. Despite its importance, price of IG is fluctuating from place to place. Hence, collectors couldn't get fixed and satisfied price for their product. Therefore co-operative formation should be initiated. Community based forest management is a meaningful step for both conservation of forest resources and enhancing the rural livelihood. Community based organization (CBO) should be established with forest dwellers, and manage the harvesting and trading collaboration with forest department and CBO.

3. Reduction of the availability of trees is reported in the study area due to decline of forest cover. Forest department should be established Indian gooseberry plantation or mixed plantation (Incorporated with other species) in degraded forest land through community forestry program /social forestry program by involving forest dwellers

4. Domestication of Indian gooseberry trees with grafted seedlings should be promoted to cutoff the complete dependency on the forest resources. Also, the government should provide facilities to develop high quality, genetically improved planting materials to improve the production system.

5. Collectors should encourage to value addition of Indian gooseberry as an income generating activity. Skill oriented training on Indian gooseberry processing (value addition) and marketing should be conducted by FD and Department of Agriculture.

6. Scientific studies should be conducted to examine the direct and indirect impact of Indian gooseberry extraction on forest resources and ecosystem. Upon this, collectors have to be educated on sustainable ways of extracting Indian gooseberry.

7. The forest laws and regulations have been prevented the harvesting of NTFPs including Indian gooseberry from conservation and reserved forests. This restrictive forest legislation may relegate forest dwellers towards livelihood dispossession, in such cases; the government should pay attention to find the alternative sources of income for local communities outside the reserved forest. And also, existing rules and regulations should be re formulated in a way that betterment of both environment and economic aspects.

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APPENDIX I

HOUSE HOLD SURVEY QUESTIONNAIRE

“Analysis on influencing factors of the income of Indian Gooseberry (*Phyllanthus emblica*) collectors in Udadumbara Divisional Secretariat Division of Sri Lanka”

A short introduction:

My name is **E.M.B.P.Ekanayake** a Master student in School of Economic and Management studies at **Beijing Forestry University, China**. This survey seeks to explore socio economic features of your area and the income obtain from the natural forest. Your contribution will help me to find out economic contribution of Indian gooseberry (Nelli) to house hold economy of your area.

Instruction:

DATE:

- a) *Write all the answers in given space*
- b) *Write X for filling answer in box*

DIVISIONAL SECRETARIAT:

VILLAGE NAME:HOUSEHOLD NO:

ADDRESS:

I.GENERAL INFORMATION ABOUT RESPONDENT

1.1 Name:

1.2 Age:

1.3 Gender: Male Female

1.4 Education qualification: a) Illiterate b) Primary (1-5 years)

c) Ordinary level (6-10years) d) Advance Level (11-13years)

e) University (more than 13 years)

1.5 Occupation: a) Agriculture (Crops)

b) Livestock

c) Labour /Working

d) Service (Public/Private)

e) Own business

f) Other (specify).....

II. GENERAL INFORMATION ABOUT HOUSEHOLD

2.1 Name of Household head:.....

2.2 Age of Household head:.....

2.3 Gender of Household head: Male Female

2.4 Education level of Household head: a) Illiterate b) Primary (1-5 years)

c) Ordinary level (6-10years) d) Advance Level (11-13years)

e) University (more than 13 years) f) other (specify in Years).....

2.5 Number of members in Household: Male:..... Female:.....

2.6 Maximum education attained by the adult (person over 18 years old) in the household

Name	Relationship to Household head	Education qualification (in Years)

III. INCOME OF HOUSEHOLD

3.1 What is the most important activity for your household income? (Please put "X" to your answer)

a) Agriculture (Crops)

b) Livestock

c) Labour /Working

d) Service (Public / Private)

e) Own business

f) Indian gooseberry collection and trade

g) Other NTFP collection and trade

h) Other (specify).....

3.2 Does your household get subsidies from government (*Samurdhi*)?

Yes No

3.3 If yes, what is the amount of monthly subsidies (SLRs)?.....

3.4 What is the total extent of the land that your household owns (Ha)?.....

3.5 Do you cultivate any land? Yes No

3.6 If yes, what is the extent of the land (ha)?.....

3.7 who is the owner of cultivated land?

- a) Your family
- b) Other private owner
- c) State

3.8 What is the name of the crops that you cultivate?

.....

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.....

3.9 Income obtained from Cultivation

Type of crop	Cultivated area(Ac)	Total Production (kg)	Home Consumption (Kg)	Sale (Kg)	Price per Kg/unit	Income per year (SLRs)

3.10 Expenditure for Cultivation

Type of crop	Wage for hired labor per day (SLRs)	No of man days	Total wage for hired labor (SLRS)	Input cost (SLRs)				Total cost (SLRs)
				Planting materials/ seeds	fertilizer	Pesticide /herbicides	Other	

3.11 What are other sources of income? (Please put “X” to your answer)

- a) Livestock
- b) Labour /Working
- c) Service (Public / Private)
- d) Own business
- e) Other(specify)

3.12 Income obtained from Livestock

Type of Livestock	Number of Animal	Total Production (Its/kg)	Home Consumption (Its/Kg)	Sale (Kg)	Price per Kg/unit	Income per year (SLRs)

IV. NONE TIMBER FOREST PRODUCT (NTFP) INCOME

4.1 Do you collect NTFPs from forest? Yes No

4.2 If yes, can you give the name of products?

.....

4.3 If you collect NTFPs, Income obtained from NTFP

Species	Uses	Amount collected / season (Kg/unit)	Frequency of collection/ season	Frequency of collection per year	Home Consumption (Kg/unit)	Sale (Kg/unit)	Price per Kg/unit	Income per year (SLRs)

V. INDIAN GOOSBERRY COLLECTION

5.1 Do you collect Indian gooseberry (Nelli) from forest? Yes No

5.2 If yes, what amount do you collect during the harvesting season (kg)?.....

5.3 During the harvesting season of Indian gooseberry (Nelli), how many times per season do you go to forest to collect them?.....

5.4. What is the distance from your home to forest (km)?.....

5.5 Number of hours of collection /day?.....

5.6 How harvesting and collection of Indian gooseberry (Nelli) are carried out ?

5.7 What is the cost of Collection per once (Rs)?

5.8 Do you collect Indian gooseberry (Nelli) in individual basis? Yes No

5.9. If yes, Why?

(a) Livelihood problem (b) Conflict

(c)Other(specify).....

5.10. In which type of forest do you collect Indian gooseberry

An assessment of contribution of Indian Gooseberry (*Phyllanthus emblica*) to Household Income and
Livelihood in Udadumbara Divisional Secretariat Division of Sri Lanka

(a) Conservation Forest (b) Reserved Forest (c) Other State Forest

5.11 Are there any management systems for Indian gooseberry (Nelli) harvesting and collection? Yes No

5.12 If yes, what are those management systems?

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.....

5.13. Do you have permit to collect Indian gooseberry from forest? Yes No

5.14 Are there sufficient Indian gooseberry (Nelli) in the forest? Yes No

5.15 Are there any barriers in collecting Indian gooseberry (Nelli)? Yes No

5.16 If yes, what are they?.....

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VI. INDIAN GOOSEBERRY MARKETING

6.1. What is the main purpose for collecting Indian gooseberry (Nelli)

- a) Personal use/ household consumption
- b) Sale purpose
- c) Medicine purpose
- d) Others (specify)

6.2 If consumption purpose, how much Indian gooseberry (Nelli) do you keep for home consumption during harvesting season (Kg)?

6.3 If sale purpose, how much Indian gooseberry (Nelli) do you sell during harvesting season(Kg)?

6.4 To whom do you sell?

- a) Directly sell to consumer
- b) Village traders
- c) Road head traders
- d) Other (specify).....

6.5. What is the cost of transportation to the market site (Rs)?.....

6.6 What is the selling price of 1kg of Indian gooseberry (Nelli) ?.....

6.7 Is the price you mentioned above satisfactory? Yes No

6.8 If no, how much price do you expect per 1 kg?

6.9 What is the annual income you gain from selling Indian Gooseberry (Rs)?

6.10 Are there any conflicts regarding Marketing? Yes No

6.11. If yes, what are the Problems that you encounter while marketing the Indian gooseberry?

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VII.COLLECTORS OPINION FOR PROBLEM ENCOUNTERED WITH INDIAN GOOSEBERRY COLLECTION AND MARKETING

Problem According to the priority by the collectors	Priority basis Ranking				
	1-Strongly Disagree	2-Disagree	3- Undesired	4-Agree	5- Strongly agree
Restrictive forestry legislation					
Lack of Knowledge on Forest Law and regulations (eg. Permit)					
Tree Die back					
Inappropriate Harvesting technique					
Price fluctuation					
Forest Fire					
Less productive trees					
Threaten by forest Officer					
Other					

VIII. SUSTAINABLE INDIAN GOOSE BERRY COLLECTION

8.1. How long have you collected Indian gooseberry in forest (year/months)?.....

8.2. Before you started to go to forest to collect Indian gooseberry, how was the quantity collected comparing to the present s quantity you get (kg)?.....

8.3 Do you really want your future generation to continue collecting Indian gooseberry?

Yes No

8.4 Do you wish to continue collecting Indian gooseberry if you get any alternative means which can improve your livelihood and increase your household income?

Yes No

8.5. If yes, why do you wish to continue?

a) High income b) Medicine and nutritious value

c) High quantity available d) Other (Specify).....

8.6. Are the available government forestry policies suitable for collecting Indian gooseberry?

Yes No

8.7 What do you suggest for sustainable future of Indian gooseberry harvesting (collection)?

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APPENDIX II

List of non timber forest products in Udadumbara Divisional Secretariat Division

Common Name	Scientific name	Use part	Uses
<i>Anguna Kola</i>	<i>Dregea volubilis</i>	Leaves	Vegetable
<i>Ankenda</i>	<i>Acronychia pedunculata</i>	Bark	Medicine
<i>Bin Kohomba</i>	<i>Munronia pinnata</i>	Whole plant	Medicine
Bamboo	<i>Ochlandra stridula</i>	Culm	Handicraft
<i>Bo mee</i>	<i>Litsea glutinosa</i>	Bark	Medicine
<i>Bol Pana</i>	<i>Glycosmis pentaphylla</i>	Whole plant	Green Manure
<i>Heen bowitiya</i>	<i>Osbeckia octandra</i>	Leaves	medicine
<i>Bulu</i>	<i>Terminalia bellerica</i>	Fruit	Medicine
<i>Dawul Kurundu</i>	<i>Cinnamomum tamala</i>	Leaves	Culinary use
<i>Damunu</i>	<i>Gerwia damine</i>	Bark	Roping Material
<i>Koora kola</i>	<i>Amaranthus viridis</i>	Leaves	Vegetable
<i>Hevan Pan</i>	<i>Cyperus pangorei</i>	Stem	Handicraft
<i>Kahata</i>	<i>Careya coccinea</i>	Flower	Vegetable
<i>Kaku kamberiya</i>	<i>Solanum nigrum</i>	Leaves	Vegetable
<i>Kala wel</i>	<i>Derris scandens</i>	Vine	Roping material
<i>Kappetiya</i>	<i>Crotalaria retusa</i>	Whole plant	Green Manure
<i>Karanda</i>	<i>Pongamia pinnata</i>	Leaves,pod	Medicine,Pesticide
<i>Karamba</i>	<i>Carissa caranda</i>	Fruit	Edible fruit
<i>Karapincha</i>	<i>Murraya koenigii</i>	Leaves	Condiment
<i>Karawala kebilla</i>	<i>Antidesma thwaitesianum</i>	Fruit	Edible fruit
<i>Katu ala</i>	<i>Dioscorea spp</i>	Tuber	Diet

An assessment of contribution of Indian Gooseberry (*Phyllanthus emblica*) to Household Income and Livelihood in Udadumbara Divisional Secretariat Division of Sri Lanka

<i>Kithul</i>	<i>Caryota urenus</i>	Sap	Produce Various edible products
<i>Koon</i>	<i>Schleichera trijuga</i>	Fruit	Edible fruit
<i>Kowakka</i>	<i>Coccinia grandis L.</i>	Leaves	Vegetable
<i>Madu</i>	<i>Cycas circinalis</i>	Seed	Dessert
<i>Mee</i>	<i>Madhuca longifolia</i>	Fruit	Medicine, edible oil
<i>Mora</i>	<i>Euphoria longan</i>	Fruit	Edible fruit
<i>Naththasooriya</i>	<i>Tithonia diversifolia</i>	Whole Plant	Green Manure
<i>Nika</i>	<i>Vitex negundo</i>	Leaves	Medicine
<i>Nelli</i>	<i>Phyllanthas emblica</i>	Fruit	Edible fruit Medicine
<i>Pawatta</i>	<i>Pavetta indica</i>	Leaves	Medicine
<i>Pera</i>	<i>Psidium guajava</i>	Fruit	Edible fruit
<i>Polpala</i>	<i>Aerva lanata</i>	Whole plant	Medicine
<i>Rattan</i>	<i>Calamus spp</i>	Stem	Handicraft
<i>Thora kola</i>	<i>Cassia tora</i>	Leaves	Vegetable
<i>Thumba pala</i>	<i>Mormordica dioicia</i>	Leaves	Vegetable
<i>Thumba karawila</i>	<i>Momordica dioica</i>	Fruit	Vegetable
<i>Tibbatu</i>	<i>Solanum indicum</i>	Fruit	Vegetable
<i>Titta wel</i>	<i>Anamirta coculus</i>	Vine	Roping material
<i>Wel penela</i>	<i>Cardiopsernum halicacabum</i>	Leaves	Vegetable
<i>Wetakeiya</i>	<i>Pandanus spp</i>	Leaves	Handicraft

Other

Bee honey	Medicine
Fire wood	Fuel
Mushroom	Food item

Sticks Supporting for agriculture crops

APPENDIX III
SOME PHOTOGRAPHS



Indian Gooseberry trees with parasitic plant attack



I.G Plantation established by Range Forest Office, Hunnasgiriya



Data Collection

PROFILE

Ekanayake Mudiyansele Buddhika Piumali Ekanayake (艾卡) is a Master Student in School of Economics and Management at Beijing Forestry University in China.

Ekanayake was born in Kandy City, Central highlands of Sri Lanka on 20 June 1981. She graduated from Pushpadana Girls' College in Kandy City and from Rajarata University in Sri Lanka with Bachelor of Science in Agriculture with second Class upper. In 2009, she joined the department of Forest as a Range Forest Officer and through this department, she was enrolled in the Sri Lanka Forestry Institute and completed two years diploma in the field of forestry. Since 2015, she has been enrolled in the School of Economics and Management at Beijing Forestry University where she is currently in her final step of completing Master Degree in Forestry Economic and Management.

During her studies, she has been energetic active girl in both studies and sports. In College, she was a school prefect, member of cadet platoon, member of debate team and member of swimming team. In same time, she was working as an announcer of children program broadcasted by Radio Cooperation in Sri Lanka. During her Bachelor's program, she completed the research titled with "Effect of Degree of Bran Removal on storage behavior of Parboiled Rice" whose abstract was published in Journal of Rajarata University in 2008. In 2012 during her study in the Forestry Institute, she completed a research on "Orchids diversity in Dotalugala Man and Biosphere Reserved in Sri Lanka". In 2012, she also joined a research conducted by +REDD program namely Carbon estimation on mangrove forest in Sri Lanka. During her work, she participated in different international and national level workshop related to the forestry, biodiversity, organic farming and forest law and regulations. During her master program, she published one paper which is entitled "Forest Policy for Sustainability of Sri Lanka's Forest" and one manuscript with the title of "An assessment of contribution of Indian gooseberry (*Phyllanthus emblica*) to Household Income in Udumbara Divisional Secretariat of Sri Lanka" that was submitted to the journal. In addition, she participated in different workshops and seminars conducted by Beijing Forestry University with the support and sponsorship of Asia Pacific Network for sustainable Forest Management and Rehabilitation (APFNet), International Union of Forest Research Organizations (IUFRO) and Chinese Academy of Forestry.

SUPERVISOR PROFILE

米锋，女，回族，1976年7月出生，山东泰安人，中共党员，博士学位，北京林业大学副教授，硕士研究生导师。

主要从事林业经济管理和林业技术经济方面的科学研究和教学工作，主讲的课程包括本科生课程“林业技术经济学”、“项目管理”和研究生课程“项目管理理论与实践”等。作为副主编参与编写《（林业）技术经济学》、《项目管理》等教材，并作为主编、副主编编写了《中国林业技术经济理论与实践（2008）》、《中国林业经济论坛论文集 I》等书，出版专著《森林资源损失计量研究》。主持完成《项目管理》课程案例及实战式教学模式改革研究与实践项目，参与完成“林业技术经济学”精品课程建设项目等。指导硕士研究生 20 余名。

主持完成和正在进行的课题包括：国家社会科学基金项目一般项目“西部地区生态减贫与林木生物质能源产业协同发展研究”、教育部人文社会科学研究项目青年基金项目“林木生物质能源产业链优化路径研究”、北京林业大学新进教师科研启动基金项目“北京市森林生态安全评价指标体系框架的研建”、北京林业大学科技创新计划项目“北京市园林绿化废弃物资源化再利用产业发展政策研究”、“基于最优控制的森林资源价值动态计量方法及应用研究”和“林木生物质能源产业链发展模式研究”、欧盟中欧合作项目“成型生物质能源及其炉具产业推广政策研究——城乡居民生活用能研究”、北京市园林绿化局科研项目“森林资源损失鉴定标准研究”。参与完成和正在进行的课题包括：国家自然科学基金青年科学基金项目“新企业绿色创业导向的驱动因素和绩效转化机制研究”、教育部人文社会科学研究青年基金项目“基于绿色技术转移的企业社会创业路径选择与可持续发展研究”、欧盟中欧合作项“BENWOOD-Coordination And Eco-Efficient Short Rotation Forestry In CDM/JI

Countries”、北京市科委项目“北京市园林绿化废弃物资源利用产业规划与布局”、国家林业局十二五规划项目“林业产业发展战略与重点领域研究”、国家林业局林业科学技术研究项目“林业生态安全指数研究”、北京市园林绿化局科研项目“北京地区森林资源损失计量研究”和“北京市山区生态林补偿机制的理论与实践”、北京市水务局科研项目“北京城市绿化中水资源合理配置研究”。其中：“北京地区森林资源损失计量研究”课题获梁希林业科学技术奖二等奖、“北京市山区生态林补偿机制的理论与实践”课题获北京市园林绿化科技进步奖二等奖，科研论文《北京地区林木损失额的价值计量研究——有关古树名木科学文化价值损失额计量方法的探讨》获首届梁希青年论文大奖赛二等奖以及全国博士生学术论坛优秀论文一等奖、《林木生态价值损失额计量方法研究》获第四届梁希青年论文大奖赛二等奖、《北京市林木资源损失的评估计量》获中国科协学术年会优秀论文一等奖、《森林生态效益评价的研究进展》获《北京林业大学学报》优秀论文奖、《园林绿化废弃物再利用产业发展现状及展望——以北京市为例》获第八届中国林业经济论坛论文三等奖。

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