Journal of Social Sciences and Humanities Review (JSSHR)
Vol. 3, Issue 3 (175-192)

ISSN: 2279-3933

**Original Article**

# THE USE OF MANGROVES AS A SOURCE OF FIRE WOOD: A SOCIO-ECONOMIC STUDY ON SELECTED MANGROVES IN SOUTHERN SRI LANKA

**W. K. V. Dayalatha[1],S. K. M. Ali**

## Abstract

Mangrove forests are among the world's most productive ecosystems (Kathiresan and Bingham, 2001).This resource has faced depletion and degradation during the last few decades in Sri Lanka. This paper attempts to find the causative factors of depletion and degradation of mangroves in southern Sri Lanka during the twenty-three-year period from 1994 to 2017 and attempts to find the solutions to minimize it. Garaduwa, Mahamodara and Galdoowa lagoon areas and Polwatumodara river mouth area, are included in the study. The study used mixed-methods design forbetter understanding of the research problem.A questionnaire, focus group discussion (FGDs), observations and secondary data was used for this study. Google Earth maps and aerial photographs were used to estimate the mangrove resource use of the four selected mangrove areas.Approximately, 10 percent of the total householders of the study area(384) were consulted to collect primary data by using random sampling.Both quantitative and qualitative methods were used to analyse the collected data, such as GIS mapping and analysis, standard deviation and percentage. The results highlight that the main methods of depletion anddegradation of mangrove are used for firewood, settlements, development activities and conversion for agriculture.Mainly seven species were used for firewood (more than 50% of households).Socio-economic factors such as income, employment, ethnicity, distance to mangrove land,residential area, usage of gas for cooking, education level,and age (mangrove use of fuel) affected the higher use of mangrove resource as a fuel. A large number of householders who responded are still dependent on the wood stove for cooking.The results further reveal that many people collect fuel wood for their daily needs in every day. More than 44% of households do not have gas cookers and as a result, they used mangrove fuel wood as an alternate method for their cooking. Research is needed to reduce the threats and to understand mangrove species better, and to direct conservation initiatives.Alternative resources and methods to avoid the mangrove resource degradation has to be searched.

***Keywords:****Aerial photographs, Depletion, Fire wood, Google Earth, Mangrove,*

[1] Department of Geography, University of Ruhuna-Sri Lanka

wkvdayalatha@yahoo.com

Journal of Social Sciences and Humanities Review (JSSHR)
Vol. 3, Issue 3 (175-192)

ISSN: 2279-3933

Original Article

## INTRODUCTION

Mangroves are salt-tolerant evergreen forests found along sheltered coastlines, shallow-water lagoons, estuaries, river banks in tropical and subtropical countries of the world. They provide an array of ecological services and economic products. Mangrove habitats are reported from 124 countries between 30˚N and 30˚S latitudes (Giesen et al., 2007). However the global mangrove cover has been estimated to be approximately 150,000 $km^2$ (Spalding et al., 2010).

Mangrove plants are broadly classified into two groups, i) true mangroves and ii) mangrove associates (Liang, 2008). True mangrove species only grow in intertidal zones, e.g., *Bruguieragymnorrhiza*, *Avicennia alba* and *Rhizophora mucronata*, whereas mangrove associates can survive in both littoral and terrestrial environments, e.g., *Thespesia populnea*, *Suaedanudiflora and Annona glabra.*

As a result of population growth and rapid urbanization, anthropogenic pressure has been increased throughout the world within the last few decades. Nearly 45 percent of the world's population is estimated to live within 150 km of the coast (Kay and Alder, 2005).Rosenberg (2012) indicated that the world's coastal population increased by 35 percent in 1995. Consequently, heavily populated coastal zones have spurred the widespread clearing of mangroves for coastal development, aquaculture, or resource use (Berger et al., 1999; Greenberg et al., 2006).

Decline in the mangrove cover is reported from many areas worldwide over the last few decades. Few studies (Kathiresan and Bingham, 2001) found that mangrove timber is also widely used to produce charcoal, tannins and resins for dying and tanning of leather, making furniture, bridges, poles for fences, fish cages and traps and, medicines, alcohol, boats and many other products. During the period 1980–2001, the world lost between 19 percent and 35 percent of its total mangrove forest area (Farnsworth et al., 1997; Valiela et al., 2001).

Polidoro (2010) and Valiela et al. (2001) estimates that the 26 percent of mangrove forests in the world are degraded due to over-exploitation for fuel wood and timber production and Upadhyay et al. (2002) has also estimated in India alone, over 40 percent of mangrove area on the western coast has been converted to agriculture and urban development. However, Valiela et al. (2001) further estimates that the loss of mangroves throughout the world may reach up to 60% by 2030. Mangrove forests are continuously declining at a speedy rate (1 to 2% per year), however, at a threatening level in the developing countries where they are found in abundance (Giri et al., 2011). In this regard, many specific human activities at various levels, reduce the area of mangroves (Valiela et al., 2001; Alongi, 2002; Duke et al., 2007).

Arulpragasam (2000) emphasizes that Sri Lanka has a small mangrove cover, and estimated as 6000 ha - 13000 ha and Valiela et al. (2001) stated that less than 10,000hectares of mangroves exist along the coast of Sri Lanka. These most valuable mangrove ecosystems provide an array of economic uses and ecological services. Among them, the productive function of mangroves against the ocean

Original Article

surges attracted higher attention, particularly after the Indian Ocean tsunami in 2004. Even though, after the tsunami, Sri Lanka had launched mangrove planting efforts in different places of Sri Lanka, Kodikara et al. (2017) identified that out of the 1000-1200 ha of coastal lands with planted mangrove seedlings only about 200-220 ha showed successful mangrove restoration. Kodikara et al. (2017) further stated that, the stress created by natural as well as human disturbances has been the main reason for the loss of 80% of planted seedlings.

Mangrove safeguards community lives and properties in coastal areas during storm surges, cyclones and tsunamis. However, irrespective of those uses and services, mangroves are damaged and destroyed at an alarming rate, by various anthropogenic activities such as illegal construction, converting to shrimp farms, water pollution, garbage disposal and mass tourism. Causes of mangrove depletion in Sri Lanka are overexploitation by traditional users than commercial users. The extent of mangrove destruction appeared in the north-western province, due to shrimp cultivation (Senerath and Visvanathan, 2001) and the main environmental impacts of unsustainable shrimp farming have been well documented by traditional users in the Putthalam lagoon area (Bournazel et al., 2015). However, Valiela et al. (2001) mentioned that alarmingly, despite their importance there is little conversation, conservation, and knowledge about their workings, compared to tropical rainforests; they have received far less public, governmental, and conservation attention.

Many scientific studieshave widely reported losses of mangrove resource in Sri Lanka from many human activities. Deepthi (2010) has identified the increase in human activities such as illegal felling, encroachment and clearing for infrastructural development, landfilling for housing development, cutting for firewood and converting to other uses have caused serious pressure on the mangrove environment. Karunatilake (2003) mentions that mangroves in Sri Lanka are one of the most abused ecosystems in the country, in the recent past, there was an abrupt decline in the forest cover especially in Puttalam and Kalpitiya lagoon areas. Jayasinghe and De Silva (1992)indicate that approximately 34 percent of mangrove forests of the Puttalam - Kalpitiya area were converted to industrial shrimp farms.

Giri et al. (2008) emphasizes that mangrove forests of Sri Lanka have declinedbythe rateof 0.08% per yearduring the 30 year period from 1975–2005. However, Bournazel (2014) has shown that, the mangrove cover of Puttalam lagoon, has been reduced from 1085.55ha (23% of the country's mangrove cover) 633.28ha (17% of the country's mangrove cover) during the twenty year period from 1992 to 2012.

Dahdouh-Guebas et al. (2000) further examined that the mangrove forest in Sri Lanka has declined rapidly due to many anthropogenic causes and the floral composition of mangrove forests in Sri Lanka has also decreased at a rapid rate during the last few decades, possibly leading to the local extinction of some rare species.

Journal of Social Sciences and Humanities Review (JSSHR)
Vol. 3, Issue 3 (175-192)
© Author(s) September 2018
ISSN: 2279-3933

Original Article

Various anthropogenic activities are taking place in mangrove forests in Sri Lanka, however, many studies (Dahdouh-Guebaset al., 2000; Satyanarayana et al., 2013) have identified small scale cutting of mangroves for fuel wood and small-scaletimber requirements is the most common practice under anthropogenic activities in Sri Lankan mangrove areas. Extensive damage has been caused by the conversion of large mangrove areas to other uses, such as shrimp farms, tourists hotels and settlements.

Numerous studies have revealed that mangrove forests in Sri Lanka have declined rapidly due to many anthropogenic causes during the last few decades; among them small scale cutting for firewood and timber requirement of dwellers is taking place as a practice common to all mangroves whilst large scale conversion for prawn farms and tourist hotels is taking place in some of the mangroves.

## RESEARCH PROBLEM

The depletion and degradation of mangroves have affected directly and indirectly the livelihood of the people and survival of the associated wildlife.Therefore, the conservation of this valuable resource is needed for the well-being of future generations and other dependent living beings. In that attempt, it is necessary to find out the acute threats which affect seriously the mangrove resource depletion and degradation in the coastal area. Then it is important to generate awareness among coastal inhabitants regarding beneficial aspects of mangroves and hence, the need of their conservation. At the same time, it is required to implement a proper management strategy with regular monitoring process, to protect these habitats from further destruction.

The main objective of this study was to find the causative factors and quantity of the depletion and degradation of mangroves in southern Sri Lanka during the twenty four year period from 1994 to 2017. The specific objective was to study the contribution of mangrove species for the fuel wood supply for the households; the species used as fuel wood, their preference by people, and quantities used were studied with particular attention on whether it affectsthe declining of mangrove areas in the study area.

## MATERIALS AND METHODS

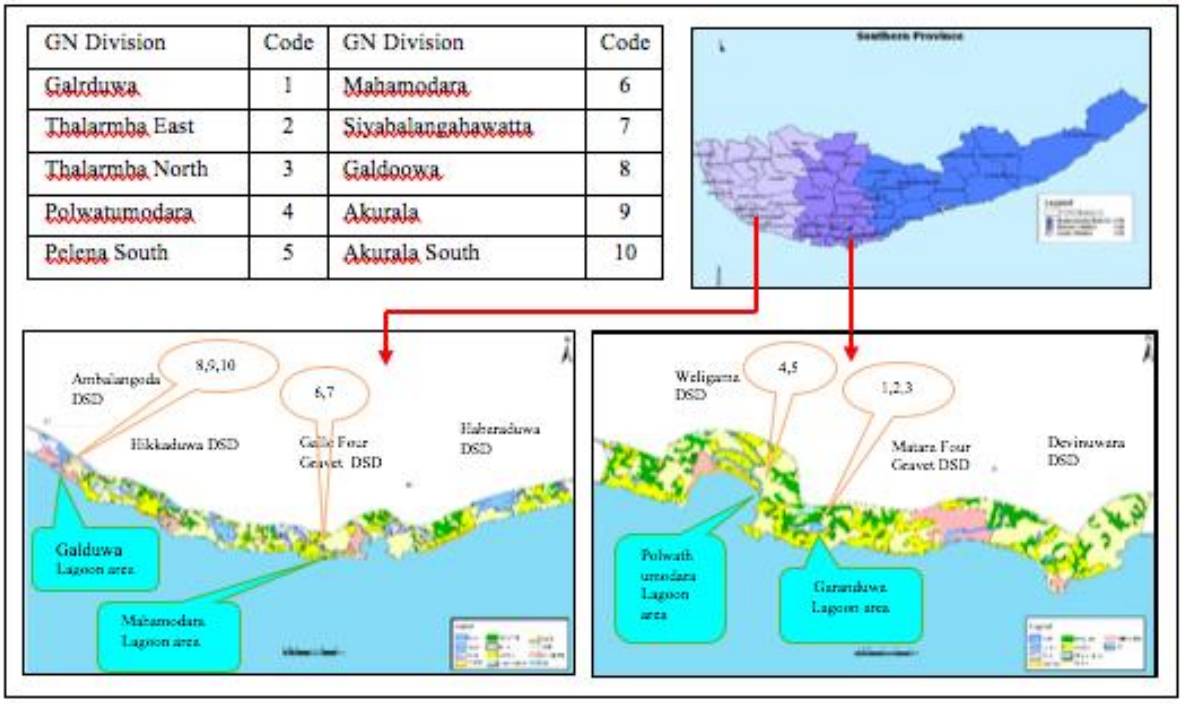
The study area is located in the Southern coastal belt between $05^0$ 56` and $06^0$ 11`N latitude and $80^0$ 3` and $80^0$ 29`E longitude (Figure 1).

Journal of Social Sciences and Humanities Review (JSSHR)
Vol. 3, Issue 3 (175-192)

ISSN: 2279-3933

**Original Article**

Figure 1: Map of Southern province of Sri Lanka showing the four mangrove ecosystems and associated GramaNiladari Divisions selected in the study area




Source: Dayalatha, 2014

Sampling survey was carried out using a structured questionnaire, based on a simple random sample design (Khan, 2008). Three hundred and eighty four (384) households living in ten GramaNiladari Divisions (Garaduwa, Thalarmba East, Thalarmba North, Polwatumodara, Pelena South, Mahamodara, Siyabalangahawatta, Galdoowa, Akurala and Akurala South) surrounding the mangrove areas were selected for the research. Further, the study was carried out using Focus Group Discussion (FGDs), and Observation method. The sample size represented 10 percent of the total number of households (4172) (DCS, 2012).

This study used mixed methods design for data collection, analysing and integrating for data. It has started with the quantitative data collection method with the questionnaire survey, conducted with 384 household respondents which were drawn by a multi-stage random sampling method, to be followed by a qualitative data collection involving detailed exploration through FGDs, and observations. Four FGDs were organized in four study areas with 08 or 09 group members. Mangrove wood users are mainly householders' wives in the house, so, information on mangrove usage was collected from them.

Aerial photographs of the study area taken in 1994 with a scale of 1: 20,000 and navigation of the Google Earth maps of the Earth in 2017 were used for mapping the mangrove cover. (In this task, the year of 1983 Aerial photographs was used only for the Polwatumodara area at Weligama, because 1994 Aerial photographs were not available for and comparison of changes of the mangrove cover. Hence the ideas and details were taken from Grama Niladhari, older persons, and coastal householders).

Journal of Social Sciences and Humanities Review (JSSHR)
Vol. 3, Issue 3 (175-192)
© Author(s) September 2018
ISSN: 2279-3933

Original Article

Both sets of aerial photographs and Google Earth maps were scanned and digitized using Arc GIS 10.1 (Esri, USA) to subsequently identify the temporal change of mangrove coverage and thereafter maps were made by using Arc GIS 10.1 method and calculated by percentages.

The quantitative methods used in collecting data to assess the factors affecting depletion and degradation of mangroves. Qualitative methods, on the other hand, allowed to understand the explanations of "why" and 'how' the phenomena occur in the depletion and degradation of mangroves. Mixed methods were used to analyse collected data and quantitative analysis was done in terms of frequencies and cross tabulations. The qualitative data were analysed by thematic analysis and the results were used to fulfil the findings originated from the quantitative analysis. The results of qualitative analysis, on mangrove resource depletion and degradation factors were used to strengthen and improve the reality of final results relevant to informal utilization and destruction of mangroves.

The mangrove species used for fuel wood were identified and their preference as well as quantities (as a percentage of the total amount of fire wood use) was studied using secondary data.Google Earth maps and aerial photographs were used for understanding the land use of the four selected mangrove areas.Information obtainedduring the survey was analysed using SPSS v. 13 and produced the frequency tables and clustered column charts.

## RESULTS

### Demographic information

The variations in the population of the study area are shown in Table 1 and it showed an increasing trend in many GN divisions whilst decreasing trends in a few areas.

Table 1: Changes of population in the study area from 1981 to 2012

| GN Division | 1981 | 2001 | 2012 | Changes from to 1981-2012 |
|---|---|---|---|---|
| Garanduwa | 558 | 966 | 1189 | +631 |
| Thala Aramba East | 577 | 693 | 674 | +97 |
| ThalAramba North | 670 | 1111 | 1748 | +1078 |
| Polwathumodara | 1008 | 1114 | 1152 | +144 |
| Pelena South | 1109 | 1601 | 1190 | +81 |
| Mahamodara | 1943 | 2562 | 1447 | -496 |
| Siyambalangahawatta | 1541 | 2263 | 2220 | +679 |
| Galdoowa | 787 | 724 | 764 | -23 |
| Akurala S: | 391 | 585 | 301 | -90 |
| Akurala | 577 | 856 | 900 | +323 |

Source: Department of Census and Statistics, 1981, 2001, 2012

Journal of Social Sciences and Humanities Review (JSSHR)
Vol. 3, Issue 3 (175-192)

ISSN: 2279-3933

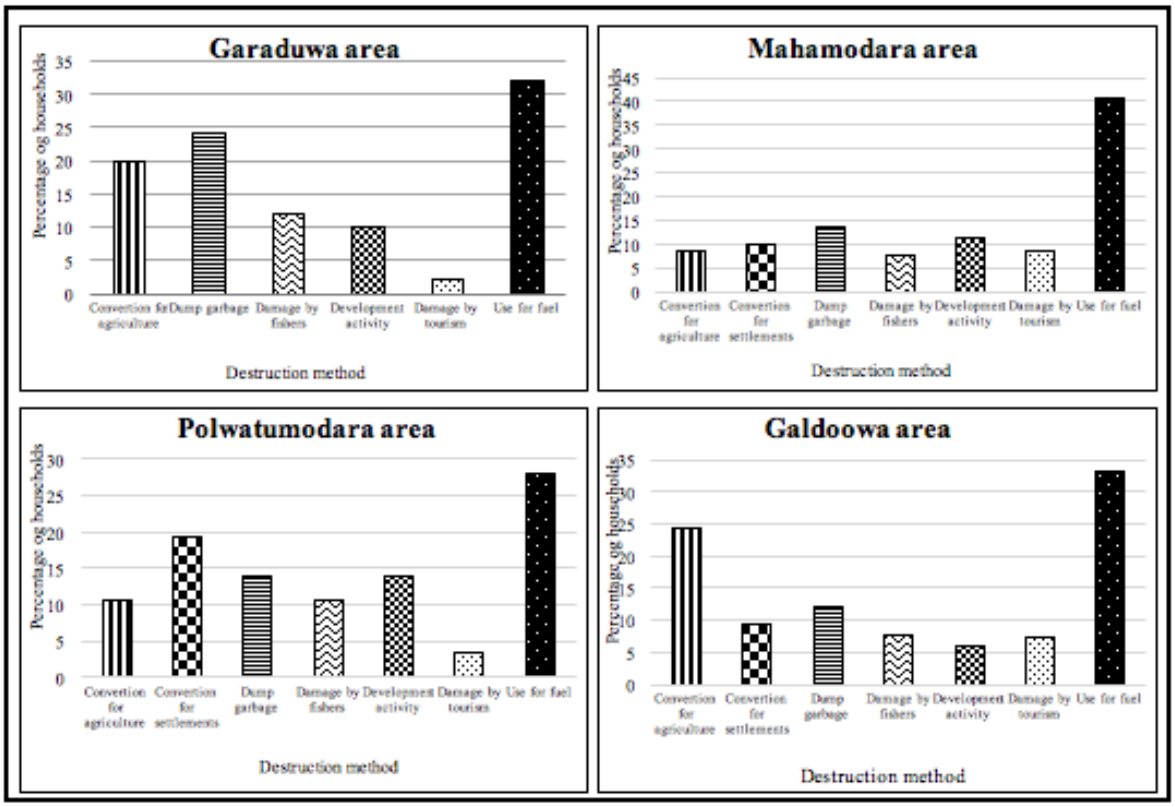
Original Article

## Factors affecting the mangrove destruction

Figure 2 shows that the cutting of fuel wood is the most prominent reason for mangrove destruction in all the four areas studied. Conversions for agriculture, settlements, and garbage dumping are the second most important factor depletion and degradation of mangrove forests. Other factors such as tourism, development activities and fishing activities have low impact on mangrove forests.

The Table 2 and Figure 3 shows the variation in mangrove covers of the four study sites over the 23 year period from 1994-2017. It shows that, except in Garanduwa lagoon, all the other three mangroves were seriously affected and the cover has been reduced by a higher percentage during the23 year period considered.

Figure 2: Contribution of different factors for the depletion and degradation of Mangrove forests



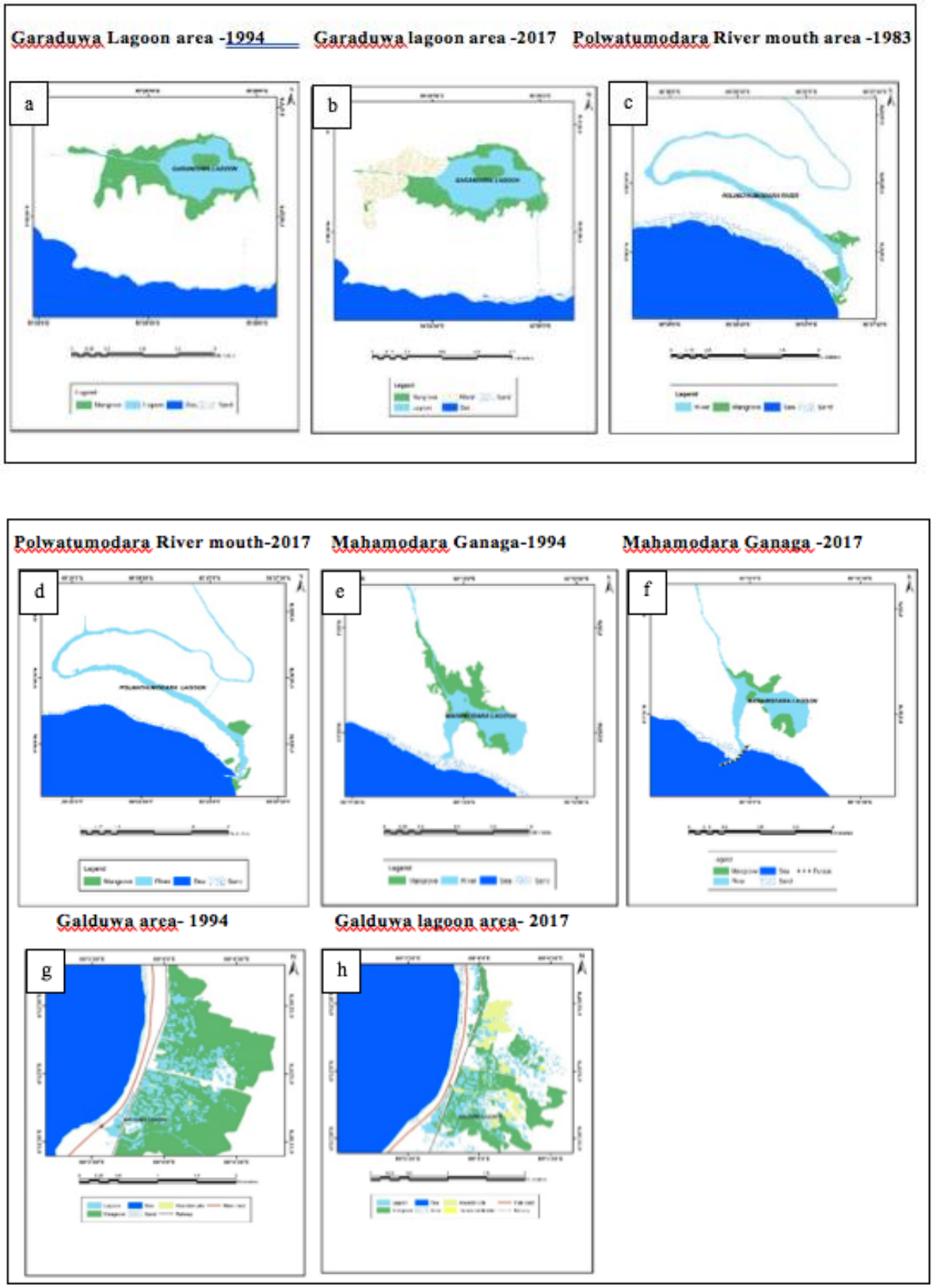

Source: Field Survey, 2014

Journal of Social Sciences and Humanities Review (JSSHR)
Vol. 3, Issue 3 (175-192)

ISSN: 2279-3933

**Original Article**

Figure 3: Variation of the mangrove cover of the four study sites over the 23 year period from 1994 – 2017, a & b, Garanduwa lagoon, c & d, Polwatumodara River mouth area, e & f, MahamodaraGanaga, g & h, Galduwa lagoon area



Journal of Social Sciences and Humanities Review (JSSHR)
Vol. 3, Issue 3 (175-192)
© Author(s) September 2018
ISSN: 2279-3933

Original Article

According to the Figure 03; a-h, there was a considerable deduction of mangrove resource of Mahamodra lagoon area (Figure 03; e and f) compared with other regions (Table 2).

Table 2: Mangrove coverage of the selected coastal areas from 1994 to 2017

| Mangrove location | Mangroves coverage | | |
|---|---|---|---|
| | 1994 | 2017 | Percentage changes from 1994 to 2017 |
| | Hectare | Hectare | |
| Garaduwa lagoon area | 32.87 | 32.23 | -1.94 |
| Polwatumodara River mouth area | 12.76 | 8.31 | -34.83 |
| Mahmodara lagoon area | 15.47 | 6.55 | -57.65 |
| Galduwa lagoon area | 53.76 | 27.18 | -49.43 |

Source: Dayalatha, 2017

## Socio - economic status of mangroves users as a fuel wood

Coastal people have been using mangrove for several purposes (36%) such as an edible plant, agriculture, boat making, mask making and fishing material.Among them, it is mostly used as firewood (44.5%) for preparing their daily meal. Further, 19.5% of people don't use mangroves as a source of firewood. Their income level was over Rs. 40,000 and they have grade 12-13 education level.Many of them engagedin private and government sector jobs and living in the far away from mangrove land (more than1km).

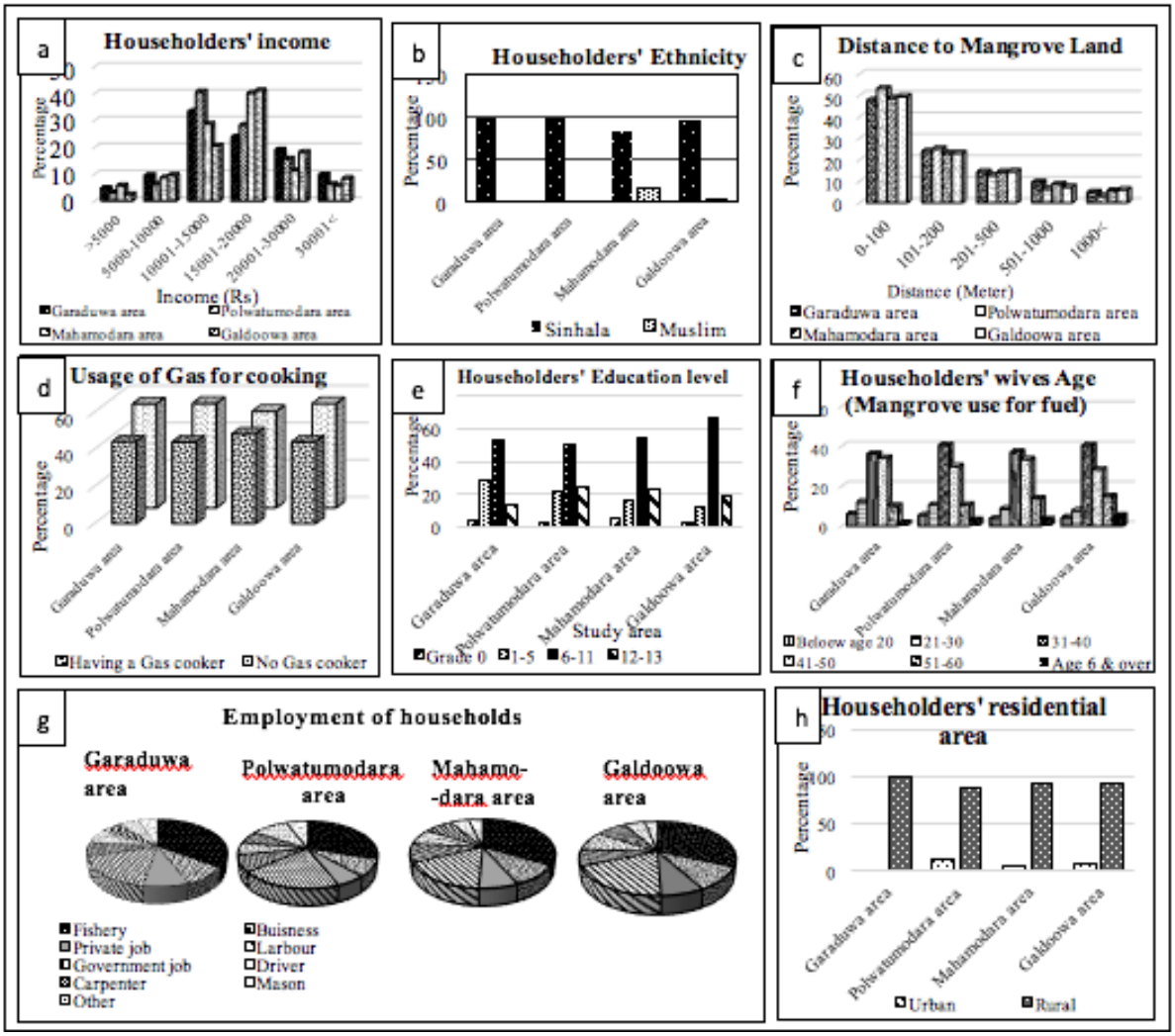
The study investigates the socio-economic status of the coastal householders,who use the mangroves as fuel. Results show that, some socio-economic factors such as income, ethnicity, distance to mangrove land,usage of gas for cooking, employment, education level,age and residential area, mainly affected mangrove use as a fuel (Figure 4; a-h).

Journal of Social Sciences and Humanities Review (JSSHR)
Vol. 3, Issue 3 (175-192)

ISSN: 2279-3933

**Original Article**

Figure 4 (a-h): The socio-economic status of the householders using mangrove wood as a fuel, by percentage. (a).Householders' income, (b) Householders' Ethnicity (c) Distance to Mangrove Land, (d) Usage of Gas for cooking (e) Householders' Education level (f) Householders' wives Age (Mangrove use for fuel) (g) Employment of households (h) Householders' residential area




Source: Field Survey, 2014

Figure 4; a-h show that householders' have very low socio economic status, the majority of the householders' income level was between Rs. 10,000-20,000. Many mangrove fuel users were Sinhalese. According to the distance from the mangrove land, many householders' (between 44% - 58%) were living very close to the mangrove area (100m), and they used mangroves higher than those who lived further away from the mangroves. More than 46% of households do not have gas cookers and as a result, they used mangrove fuel wood as an alternate method for their cooking. More than 50% of households' educated, they passed grade 6-11 education level (figure 4-e). Many users were included in the age range 31-40 years.

As a major occupation, more than 50% of the respondents in each area were engaged

Original Article

in the fishery or labour. However, almost all the people in these two categories were engaged in an additional occupation due to the low income of the main occupation, due to its seasonal variation (mainly fishery). In some families, women were engaged in income generating activities, as the income earned by the head of the family was not enough even for the basic needs of the family. Some of these activities were the selling of *Sonneratiacaseolaris* (Kirala) fruits on the market or popular place and preparing dry fish for earning money. Almost all the households in Garaduwa area lived in rural surroundings and in the other areas the majority of households lived in rural areas except a few households.

**Utilization of mangroves**

Even today, coastal people, mainly use mangrove species for different needs. However, in general, the mangrove areas are under heavy movement, especially in cutting, clearing and degrading. From the discussionwith respondents and through observations, Table 3 shows the dominant mangrovespecies of these areas.

Table 3: Mangrove species found in the study area

| Vernacular name(s) in Sinhala) | Scientific Names | Garaduwa area | Polwatumo dara area | Mahamo dara area | Galdoowa area |
|---|---|---|---|---|---|
| Thelakiriya | *Excoecariaagallocha*(M) | ✓ | | ✓ | |
| Kadol | *Aegicerascorniiculatum*(M) | ✓ | ✓ | ✓ | ✓ |
| Ela kadol | *Bruguierasexangula*(M) | ✓ | ✓ | ✓ | ✓ |
| Kirala | *Sonneratiacaseolaris*(M) | ✓ | ✓ | ✓ | ✓ |
| Well Kaduru | *Cerberaodollam*(M-A) | ✓ | ✓ | ✓ | ✓ |
| Diya danga | *Dolichandronespathacea*(M-A) | ✓ | | ✓ | ✓ |
| Suriya | *Thespesia populnea*(M-A) | ✓ | ✓ | ✓ | ✓ |
| Karan | *Acrostichumaureum*(M-A) | ✓ | ✓ | ✓ | ✓ |
| Ginpol | *NypaFruticans*(M) | | ✓ | | |
| Mahakadol | *Rhizophora apiculata*(M) | ✓ | ✓ | ✓ | ✓ |
| Atuna | *HeritieralittoralisDryand*(M) | | | ✓ | |
| Mutti Gas | *Xylocarpusgranatum*(M) | | ✓ | | |
| KatuIkiri | *Acanthus ilicifolius*(M-A) | ✓ | | ✓ | ✓ |
| Bariya | *Lumnitzeraracemasa*(M) | | | ✓ | |
| Punkanda | *Ceriopstagal* | | | ✓ | |

Mangrove (M) Mangrove Associate (M-A) Source: Field Survey, 2014

Of these mangrove species, Kirala and Mal Kadol were categorized as very common, true mangrove plant species in Sri Lanka (Silva and Silva, 1998). Gin Pol was categorized as common and endangered mangrove plant species (Ministry of Education, 2012).

The destruction is caused by man either by awareness or by unawareness of values of mangroves, but certainly ignoring the consequence of the loss. The study was aimed at examining the ways of present utilization of different mangrove species (Table 4).

Journal of Social Sciences and Humanities Review (JSSHR)
Vol. 3, Issue 3 (175-192)
© Author(s) September 2018
ISSN: 2279-3933

**Original Article**

Table 4: Characteristics of true mangrove and associate mangrove species utilization in study areas

| Way of present utilize | Utilize species | Utilization (%) | | | |
|---|---|---|---|---|---|
| | Species names | Garaduwa area | Polwatumodara area | Mahamodara area | Galdoowa area |
| Fuel wood | Thelakiriya[1],Kadol[2], Ela kadol[3], Kirala[4], Well kaduru[5], Diya danga[6], Suriya[7] | 50 | 54.4 | 48.1 | 55.1 |
| Edible Plant | Kirala[4], Karan[8] | 16 | 12.3 | 14.8 | 15.8 |
| Roofing | Ginpol[9] | - | 1.7 | 2.5 | 1.1 |
| Fruit Juice | Kirala[4] | 14 | 8.8 | 9.9 | 9.7 |
| Medicine | Suriya[7] | - | - | 1.2 | 1.1 |
| Vegetable | Karan[8] | 10 | 10.5 | 8.6 | 8.6 |
| Construction material | Maha kadol[10], Thelakeeriya[1], Atuna[11] | - | 5.3 | 4.9 | 1.4 |
| Fishing materials | Kirala[4], kadol[2], Punkanda[12] | 2 | 3.5 | 1.3 | 2.0 |
| Agriculture | Maha kadol[10], Ela kadol[3], Kadol[2] | 4 | 1.8 | 2.5 | 1.5 |
| Household Item | Well Kaduru[5] | 2 | - | 2.5 | 1.5 |
| Decoration | Ginpol[9] | - | 1.7 | 2.5 | 1.1 |
| Bee keeping | Kirala[4], Maha kadol[10] | 2 | - | 1.2 | 1.1 |
| Total | | 100 | 100 | 100 | 100 |

(Scientific names of above mangrove species:*Excoecaria agallocha1*[1], *Aegiceras corniiculatum*[2], *Bruguiera sexangua*[3], *Sonneratia caseolaris*[4], *Cerbera odollam*[5], *Dolichandrone spathacea*[6],*Thespesia populnea*[7], *Acrostichum aureum*[8], *Nypa Fruticans*[9], *Rhizophora apiculata*[10],*Heritieralittoralis Dryand*[11], *Ceriops tagal*[12]

Source: Field Survey, 2014

Results disclose that among the different ways of present utilization, the majority of householdsused many mangrove species as fuel, such asKadol (*Rhizophora apiculata*), Ela Kadol (*Rhizophora mucronata*), Thelakiriya (*Excoecariaagallocha*), WellKduru (*Cerberaodollam*), Diya danga, (*Dolichandronespathacea*) and Suriya (*Thespesia populnea*).Kirala (*Sonneratiacaseolaris)*and Karan *(Acrostichumaureum)*were used as an edible plant.

Roughly, these people were collected 3kg of fuel wood per day. To understand the acuteness of fuel wood collection, the study investigates the frequency of fuel wood collection and the quantity, whether it was every day or once in two days and so on (Table 5).

Journal of Social Sciences and Humanities Review (JSSHR)
Vol. 3, Issue 3 (175-192)
© Author(s) September 2018
ISSN: 2279-3933

Original Article

Table 5: Total amount of mangrove fuel wood collectionby frequency of collection of fuel wood

| Frequency of collection of 3kg of fuel wood | Number of householders | Amount of fuel wood (Kg) | Total (kg) |
|---|---|---|---|
| GARANDUWA | | | |
| Every day | 4 | 12 | |
| Once in two days | 3 | 9 | |
| Once in three days | 2 | 6 | |
| Once in week | 2 | 6 | |
| Once in two weeks | 1 | 3 | |
| Purchase for money * | 9 | 0 | |
| **Estimated total from Garanduwa** | 21 | 36 | 102 |
| POLWATHUMODARA | | | |
| Every day | 5 | 15 | |
| Once in two days | 4 | 12 | |
| Once in three days | 3 | 9 | |
| Once in week | 4 | 12 | |
| Once in two weeks | 2 | 6 | |
| Purchase for money | 14 | 0 | |
| **Estimated total from Polwathumodara** | 32 | 54 | 210 |
| MAHAMODARA | | | |
| Every day | 5 | 15 | |
| Once in two days | 4 | 12 | |
| Once in three days | 3 | 9 | |
| Once in week | 4 | 12 | |
| Once in two weeks | 4 | 12 | |
| Purchase for money | 15 | 0 | |
| **Estimated total from Mahamodara** | 35 | 60 | 246 |
| GALDUWA | | | |
| Every day | 7 | 21 | |
| Once in two days | 6 | 18 | |
| Once in three days | 6 | 18 | |
| Once in week | 5 | 15 | |
| Once in two weeks | 4 | 12 | |
| Purchase for money | 55 | 0 | |
| **Estimated total from Galduwa** | 83 | 84 | 486 |

Source: Field Survey, 2014 *Daily wait of fuel wood collection by the respondent

Journal of Social Sciences and Humanities Review (JSSHR)
Vol. 3, Issue 3 (175-192)
© Author(s) September 2018
ISSN: 2279-3933

Original Article

Table 6: Quantification of firewood collection from four mangroves

| Study area | Value of Standard Deviation (SD) |
|---|---|
| Garanduwa | 4.24 |
| Polwathumodara | 5.3 |
| Mahamodara | 5.2 |
| Galduwa | 7.5 |

Source: Field Survey, 2014

Table 5 revealed that the majority of the households collect 3kg of fuel wood every day and amount of collection fuel wood were higher than in the other periods. Further, a considerable number of households in each area say that they have no fuel wood for collection and they purchased for money.

Table 6 shows the Standard Deviationvalue of firewood collection from four mangroves. According to the Standard Deviationvalue, Galduwa area represents higher SD value than in the other areas.The results reveal that many people collect fuel wood for their daily needs in every day.

## DISCUSSION

According to the information gathered in the Garaduwa, Mahmodaraand Galduwalagoon areas and Polwatumodara River mouth area as well as by direct observation, numerous human activities have caused a reduction of the mangrove cover in the four sites.

Specially, in the west, east and south-eastern areas of the Polwatumodarariver mouth now consist of more housing units, and in the south area shows built hotel, but in 1990s there was abundant coverage of mangroves (12.76ha). Before twenty three years, the Mahamodara lagoon related areahas 15.47ha of mangrove cover, now this area remains6.55ha. The main cause was direct and indirect anthropogenic impacts such as cut for fuel wood, large abandoned stone-pits, built hotels and houses. Galduwa lagoon related area, in 1990s, there was 53.76ha of mangroves,however, after 1990s, inland coral mining caused more severely removing the mangroves. As a result, many lime pits with water are remaining. Even today this area remains 27.18ha of mangroves. Although, the reduction of mangrove cover in the Garanduwa lagoon area between the period 1994 to 2017 shows the low scale (-1.94ha), actual man-made activities such as human settlements, vegetable cultivation and used many human needs such as brickfield, fuel wood collection, taking poles and wood depletion and degradation of mangroves have occurred, surrounding area. With the population increase, many mangroves are used for their needs, and as a result the mangrove reserve has been reduced.

The results show that households living in the coastal area truly need mangrove resources for their daily cooking and other

Journal of Social Sciences and Humanities Review (JSSHR)
Vol. 3, Issue 3 (175-192)

ISSN: 2279-3933

Original Article

activities (see Figure 2 and 4; a-h). Some socio-economic factors strongly affect the loss and degradation of mangrove resources. The poor families living with low income levels (Rs. 10000 - 15000) in the coastal area (see Figure 4-a) collected large quantities of fuel wood from mangroves, because these woodsis easily burnt. Furthermore, short distance to the mangrove area (42% - 58% households lived within 100m), nothing a gas cooker (56% of households), more than 80% of households completely rural and engage in hardly working employment (50%- 52% of households engage fishery and labour) strongly influenced to mangrove usage.

Mangrove species possess a high amount oftannins and this wood is used in making keels or oar of boat production (Mitra, 2013) because low insect damage and they can be used for a long period. Some fishing, people in the Mahamodara area use *Ceriopstagal*(Punkanda species) for boat making. Also, it is strong and suitable for use in water. Furthermore, it is used for colouring fishing nets of fishery people. However, fishers living in the mangrove areas (Garaduwa and Mahamodara lagoon area) use mangroves highly for other purposes besides these usages.

Mangrove species are highly lost in degradation through ignorance and unawareness of the coastal people. According to FGD, more than 50% of people have known very few mangrove species (5 and or 6 species). At the same time, mangrove areas get damaged by unplanned, non - scientific constructions and illegal land filling (Garaduwa area andMahamodara area).

As a result of persisting human activities in the mangrove forest areas, it faced severe threats recently, the major reason being the increase in population. New houses and hotels have been built in these areas. Such constructions were easily observed while the survey was being conducted in the study area.

Coastal householders living on mangrove lands, clear the remaining land closer to them for extension purposes and cultivation. Low income people of Garaduwa and Mahamodaraareas cut down mangrove species to take sticks for brooms and sweepers. In Focus Discussion Groups, people expressed that it was the way they earned an income. However, the majority of households in each area cut mangroves for mainly fuel wood and also other needs. Some people living in Garaduwa and Galdoowa areas use *Cerberamanghas*(Well Kaduru) for making masks.

Furthermore, some people living in the semi urban and rural areas (Powatumodara river mouth and Garaduwa lagoon areas) dump garbage in mangrove lands as a habit, and as a result water column in the lagoon area get polluted. The Tsunami in 2004 has resulted population decrease in coastal areas, because many people died and some others evacuated and settled in other areas. However, population increase in the study areas, has negatively affected mangrove resources as evidenced by a decrease of mangrove cover as inGaranduwa and Polatumodara area.

## SUMMARY AND CONCLUTION

Compared to other coastal resources, mangrove resources has received a great

Original Article

deal of attention from both amateur and scientific researchers. Even though, mangrove have been often used for the collection of fuel wood, a source of subsistence and other needs for coastal populations, wood removal is definitely the main cause of loss. This study discloses that the study areas represent a change of the population from 1981 to 2012 census period, except in a few areas. Among the various methods that affect the destruction of mangroves were fuel wood collection and use for settlement. This situation is further confirmed change in aerial extent relevant to the period and the Mahamodra lagoon area represented more reduction than in other areas (Dayalatha, 2017). According to the socio-economic factors low income, proximity to mangrove land,lessusage of gas for cooking, employment status, education level,age and rural living, mainly affect mangrove use as a fuel.

Present utilization of different mangrove species, many true mangrove species such as*Excoecariaagallocha, Bruguierasexangua, Sonneratiacaseolaris, Cerberaodollam, Dolichandronespathacea,Thespesia populnea*were used for fuel wood of the coastal people. More than 40% of households collected 3 Kg of fuel wood every day for their daily needs of the house. Due to these reasons, depletion and degradation of mangroves are causing serious by human impacts.

The study findings disclose that there is an urgent need for such evaluation in order to elucidate lessons on what works, where and under what conditions. Recently, government and non-government organizations in Sri Lanka have been taken efforts for replanting mangroves (Kodikara et al. 2017). Further, Seto et al (2007) points out, mangrove extent has remained relatively stable through replanting efforts rather than from the prevention of loss or degradation. Therefore, replanting projects must be initiated to improve the mangrove forest in the Southern coastal area by the Government, NGOs and environmental well-wishers.

Although, laws and regulations enacted by the government aimed to protect mangroves, they are undermined by the people. To reduce the threats, to understand mangrove species better, usage, and losses and to direct conservation initiative's research are needed. Alternative resources and methods to stop the mangrove resource degradation need to be introduced.

## REFERENCES

Alongi, D. M. (2002) Present State and Future of the World's Mangrove Forests. Environ Conservation. 29: pp 331-349.

Arulpragasam, K. D. (2000) Introduction. In: Cooray, P.G., Abeywickrama, B.A., Amarasinghe, M., Arulpragasam, K. D., Dias, P., Watson, M., Wijesinghe, L.C.A.de S, ed. 1991. Natural Resources of Sri Lanka 2000. The National Science Foundation, Colombo, Sri Lanka. pp1-7.

Berger, U.; Glaser, M.; Koch, B.; Krause, G.; Lara, R.; Saint-Paul, U.; Schories, D. and Wolff, M. (1999) An integrated approach to mangrove dynamics and management. Journal of Coastal Conservation, vol. 5, no.2 pp 125-134.

Bournazel, J. (2014) Mapping coastal landscapes in Sri Lanka - Report –icoast. Available at:<Available at:

Original Article

https://ecometrica.com/assets/report_remote_sensing_new.pd>

Bournazel, J.; Marappullige, P.K.; Jayatissa, L.P.; Viergever, K.; Morel, V. and Huxham, M. (2015) The impacts of shrimp farming on land-use and carbon storage around Puttalam Lagoon, Sri Lanka. Ocean & Coastal Management 113 (2015) pp 18 - 28.

Department of Census and Statistics (1984) Summary information of the Census of Population and Housing 1981, Department of Census and Statistics, Colombo, Sri Lanka.

Department of Census and Statistics (2002) Summary information of the Census of Population and Housing 2001, Department of Census and Statistics, Colombo, Sri Lanka.

Department of Census and Statistics (2015) Summary information of the Census of Population and Housing 2012, Ministry of Policy Planning and Economic Affairs, 'SankyanaMandiraya', 306/71, Polduwa road, Battaramulla.

Duke, N.C.; Meynecke, J.O.; Dittmann, S.; Ellison, A.M.; Anger, K.; Berger, U.,……&Koedam, N. (2007) World without mangroves? Science, 317(5834): pp 41-42.

Deepthi, W. (2010) Chapter 15, Coastal ecosystems and climate vulnerability in Sri Lanka. In S. Rajib, Juan M. P. J. J. Pereira (ed.) Climate Change Adaptation and Disaster Risk Reduction: An Asian Perspective, Community, Environment and Disaster Risk Management, Volume 5, Emerald Group Publishing Limited, pp 307-326.

Dahdouh-Guebas, F.; Verheyden, A.; De Genst, W.; Hettiarachchi, S. and Koedam, N. (2000) Four decade vegetation dynamics in Sri Lankan mangroves as detected from sequential aerial photography: a case study in Galle. Bulletin of Marine Science, vol. 67, no.2. pp 741-759.

Farnsworth, E. J.; Ellison, A. M.; (1997) The Global Conservation Status of Mangrove, Royal Swedish Academy of Science, Ambio, vol. 26 no. 6, pp 328-334.

Giesen, W.; Wulffraat, S.; Zieren, M.; Scholten, L.; (2007) Mangrove Guidebook for Southeast Asia.FAO Regional Officer for Asia and the Pacific, Bangkok, Thailand.

Giri, C.; Ochieng, E.; Tieszen, L.L.; Zhu, Z.; Singh, A. et al. (2011) Status and distribution of mangrove forests of the world using earth observation satellite data. Blackwell Publishing Ltd, USA, Global Ecology and Biogeography. 20: pp 154-159.

Giri, C.; Zhu, Z.; Tieszen, L.L.; Singh, A.; Gillette, S.; and Kelmelis, J.A. (2008) Mangrove forest distributions and dynamics (1975–2005) of the tsunami-affected region of Asia. Journal of Biogeography, 35(3), pp 519-528.

Greenberg, R.; Maldonado, J.E.; Droege, S.; and Mcdonald, M.V. (2006) Tidal Marshes: Home for the few and the highly selected, terrestrial vertebrates of Tidal Marshes: Evolution, Ecology, and Conservation, Studies in Avian Biology, No. 32. pp5-7.

Original Article

Jayasinghe, J.M.P.K and De Silva, J.S. (1992) Prawn farm development and present land use pattern in coastal areas of Sri Lanka. In: Proceedings of International Symposium on Ecology and Landscape Management in Sri Lanka, Eardelen, W, C. Pereu, N. Ishwaran& C. M. MaddumaBandara (eds), Margraf Scientific Books Weikersheim: pp 341-350.

Karunathilake, K.M.B.C. (2003) Status of mangroves in Sri Lanka. Journal of coastal development, vol. 7, no. 1, pp5-9.

Kathiresan, K. and Bingham, B.L. (2001) Biology of Mangroves and Mangrove Ecosystems, Advances in marine biology, Academic Press, vol. 40: 81-251 p36.

Kay, R. and Alder, J. (2005) Coastal Planning and Management. London, Rutledge. pp. 1-5. Available at: <www.crcnetbase.com/doi/pdf/10.4324/9780203010174.fmatt>.

Khan, J.A. (2008) Research Methodology. A. P. H. Publishing Corporation. New Delhi. pp. 75-96.

Kodikara, K. A. S.; Muherjee, M.; Jayatissa, L.P.; Dahdouh-Guebas, F.; Koedam, N. (2017) Have Mangrove Restoration Projects Worked? An in-depth Study in Sri Lanka.Restoration Ecology, Vol. 25, No. 05, pp 705-716.

Liang. S.; Zhou, R.; Dong, S.S.; Shi SH. (2008) Adaptation to salinity in Mangroves: Implication on the evolution of salt-tolerance. SP Sci China Press, China. Chinese Sci Bull 53: pp 1708-1715.

Ministry of Education (MOE) and the National Red List of Sri Lanka (2012) "Conservation status of the fauna and flora", Ministry of Environment, Colombo, Sri Lanka, pp 476.

Mitra, A. (2013). Sensitivity of mangrove ecosystem to changing climate India: Springer.
Vol. 62, pp. 143-157.

Polidoro, B. A.; Carpenter, K.E.; Collins, L.; Duke, N.C.; Ellison, A.M.; Ellison, J.C.; Farnsworth, E.J.; Fernando, E.S.; Kathiresan, K.; Koedam, N.E.; Livingstone, S. R.; Miyagi, T.; Moore, G.E [ ... ], Hong Yong, J.W. (2010) The Loss of Species: Mangrove Extinction Risk and Geographic Areas of Global Concern. PLoS ONE 5(4): e10095.

Rosenberg, M. (2012) "Current World Population." Thought Co, Sep. 28, 2017, Available at: <www.thoughtco.com/current-world-population-1435270>.

Satyanarayana, B.; Mulder, S.; Jayatissa, L.P.; and Dahdouh-Guebas, F. (2013) Are the mangroves in the Galle-Unawatuna area (Sri Lanka) at risk? A social-ecological approach involving local stakeholders for a better conservation policy. Ocean & coastal management, 71, pp225-237.

Senarath, U. and Visvanathan, C. (2001) Environmental issues in brackish water shrimp aquaculture in Sri Lanka. Environmental Management. 27: pp 335-348.

Seto, K.C.; Fragkias, M. (2107) Mangrove conversion and aquaculture development in Vietnam: A remote sensing-based approach for evaluating the Ramsar Convention on Wetlands. Glob. Environ. Chang. 2007, 17, pp 486–500.

Original Article

Silva, M. D. and Silva, P. K. (1998) "Status, diversity and conservation of the mangrove forests of Sri Lanka", Journal of South Asian National History, 3(1): pp 79-102.

Spalding, M.; Kainuma, M.; Collins, L. (2010) World Mangrove Atlas, Routledge, UK.

Upadhyay, V.P.; Ranjan, R.; and Singh, J.S. (2002) Human-mangrove conflicts: The way out. Current Science, 83(11), pp1328-1336.

Valiela, I.; Bowen, J.L., York, J.K. (2001) Mangrove forests: One of One of the world's threatened major tropical environment. Bioscience, 2001, 51, pp807–815.