

# Assessment of Economic Losses Caused by the Mangrove Degradation: Case study-Fishing community in Puttalam Lagoon

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**Abstract** - Puttalam Lagoon has a rich mangrove ecosystem. The exploitation of such heritage for various reasons has become a threat to the fishing community in terms of economic yield. During 1977-2018, 68-72% of the mangrove species have been depleted, which was negatively impacted to fish productions. Hence, this study focuses to assess the economic fatalities, face by the fishing community. The field study has been carried out to collect primary data, by way of a questionnaire, direct observation, and constructive discussion; following the stratified sampling method. The 91 questionnaires from the six (06) fisheries inspector division, around the lagoon, were filled; which is 1% of the total active fishing population. The secondary data has also been used. The analysis revealed that 64% of people are frequently affected by flooding and 68% by cyclones. Approx. 91% of the Fishermen had an opinion that the seafood production and subsequent income of them have drastically declined, due to the depletion of the mangrove ecosystem. Before the degradation of mangroves, over 80% of Fishermen earned their better income and had remarkable savings for their future needs. Over 80% of fishermen had a good income, but over 90% had low satisfaction level concerning their monthly average expenses, due to the increasing trend of the price for fishing instruments/consumables and cost of living. This shows that depletion of mangroves has a linear relationship with fish production and income. Therefore, the coastal ecosystem of Puttalam Lagoon should be managed, participating relevant stakeholders, implementing existing laws, declaring Puttalam Lagoon as a mangrove protection zone, and promoting secondary income earning source (eco-tourism) to facilitate dwellers to meet future contingency requirements.

**Keywords:** Mangroves, fishing community, lagoon, degradation and re-plantation

## I. INTRODUCTION

Mangroves are coastal species, grown in the inter-tidal region in between sea and land areas of coastal line. This species grows in the tropical and subtropical regions of the world between 30° N and 30° S latitude. Approximately 40% of the mangroves are to be seen in the Asian region, including Sri Lanka. Averages of 0.76-1.2% of mangroves are destroyed annually.

Sri Lankan coastal zone has 15,670 hectares of mangroves land area, along with 20 variety of species from 12 families. According to the "Neganahiru foundation (2020)" more than 50% of Mangrove forest have been destroyed in the past 30 years. Puttalam district, among 14 coastal districts, plays a vital role in the context of the coastal eco-system, along with

the rich mangroves species; since it is both economically and ecologically important.

## II. OBJECTIVES

The major objective is to assess the economic losses of mangrove degradation, faced by the fishing community in Puttalam Lagoon.

1. To examine the common issues, faced by the Fishermen, due to the degradation of mangroves species.
2. To evaluate the economic impacts, faced by the Fishermen, due to the degradation of mangroves species.
3. To provide recommendations to mitigate, such issues to standardize the ecosystem and livelihood patterns of the dwellers of the Puttalam Lagoon area.

## III. LITERATURE REVIEW

Mangroves are one of the forest types located at the confluence of land and sea in the sub-tropical and tropical regions of the world. Mangroves are trees or shrubs that grow best, where the energy of tides and weak coats of beach soil encourage the deposition of fine particles that allow these woody plants to establish roots and grow (Alongi, 2002). The global distribution of mangroves indicates a tropical dominance with major latitudinal limits relating best to major ocean currents and the 20°C seawater isotherm in winter. The latter point underscores the paramount importance of warm temperatures for the existence of mangroves. There are 9 orders, 20 families, 27 genera, and roughly 70 species of mangrove occupying a total estimated area of 181,000 km<sup>2</sup> (Alongi, 2002). Mangroves are mostly distributed in South East Asia. Nearly 33.5% of mangroves are distributed in that area. The most diverse biogeographical regions are in the Indo-West Pacific, Indonesia, Australia, Brazil and Nigeria. Approx. 0.1- 0.2% mangroves are distributed in Sri Lanka (Spalding, Kainuma, & Collins., 2010). In Puttalam lagoon, 3,210 (ha) of mangrove forests are found. 'Kala Oya' estuary, found as mangroves rich area. It is 1,850 (ha) (De silva & De silva, 2006). The distribution of mangroves in Puttalam Lagoon is categorized into two types. Those are

coastal mangrove and estuary mangrove. There are 14 true mangrove species, 29 associated mangroves are identified. Pointedly, huge amounts of mangroves are found in Pallivasalthurai, Thannikuda, Kurigipity, Serakuly, Keerimunthal, Karitheevu, Mandalakuda and Kovilkuda (Coast Conservation Department, 2007). Mangroves have various types of ecological benefits. Mangroves stand as a protective fence for the effect of monsoon cyclone. The root system of mangroves protects from soil erosion in the river estuary. It filters infiltration and provides nutrition to the ecosystem (Salem & Mercer, 2012).

Mangrove is an economic and ecological resource. It provides a nursery to birds, fish, crab, shrimp, shells, reptiles, and mammals. It is a recyclable tree resource. Alluvial soil, dirt, nutrition get collected in this area (Alongi, 2002). From the amount of carbon produced by mangroves 9% of carbon is absorbed by herbivores, 16% of carbon is stored in alluvial soil, 40% carbon is destroyed and recycled (Qualls & Bruce, 1992).

The economic value of the fish breeding function of the mangrove forest in Sri Lanka was estimated at US\$ 218 per hectare per year, while the total economic value was estimated at US\$1,229 per hectare per year. On this basis, the fishery value of 1,392.7 ha of Puttalam mangrove was estimated at US\$ 303,609 per annum, while the total economic value of mangrove would be USD 17,116,283 per annum (Department of Fisheries and Aquatic Resources, 2013).

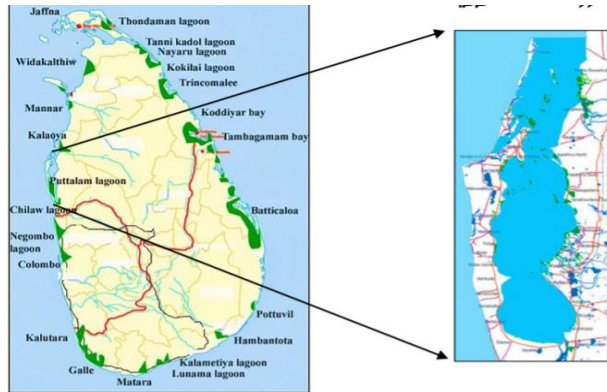
During 1977-2015 in Sri Lanka, 0.08% of mangroves have been destroyed, due to fish farming (Spalding, Kainuma, & Collins, 2010). Preparing herbal medicine, fuelwood, timber, industrial intension, overconsumption, soil miming, agriculture, aquaculture, expansion of ground and tourism are further reasons for the destruction of mangroves (Kaleel & Nijamir, 2017). According to the cost conservation department (2007), the mangroves were destroyed; during 1984-1992 are 44% in the East, 28% in the west (Coast Conservation Department, 2007). In Bangladesh, the coastal craft industry and curb business have gone down, due to the destruction of mangroves and the loss of their occupations (Spalding, Kainuma, & Collins., 2010).

Similarly, a fishing community in the Puttalam lagoon have been highly affected, due to the destruction of mangrove destruction and birds lost their heritage to live, which affected attracting tourist into the area (Kaleel & Nijamir, 2017).

The fish productions have gone down in 1994, amounting to 4kg per hectare. This amount was 1.5 kg in 1997, due to mangroves destruction (Department of Fisheries and Aquatic Resources, 2013). The literature revealed that mangroves destruction and fish production has a direct relationship.

#### IV. LOCATION AND STATUS OF STUDY AREA

Puttalam Lagoon is situated in the North-Western Province of Sri Lanka, between north latitude 7°44' to 8°2' and east longitude 79°48' to 79°49', belongs to three Divisional Secretariats (DS) viz. Kalpitiya, Puttalam and Vanathavillu. The recorded population of the said DS divisions was approximately 242,000 people, together with 49,000 families. The lagoon area covers a land area of 33,000 hectares, with 2,200 ha of mangroves. It receives freshwater from Kala Oya (2.2 m<sup>3</sup>/s) and Mee (Oya 8.1 m<sup>3</sup>/s).



Source: - - www.google.lk/search?q=manroves, (11 January 2019 12:18 PM)

Fig.1 Study area

Mangrove ecosystem losses its area in the recent past, due to the coastal agricultural activities, shrimp and aquaculture, coastal erosion, housing and infrastructure (road development and settlements) development, etc. During 1984-1992, 44% of mangroves have been destroyed in the eastern side of the Puttalam Lagoon and 28% from the west, resulting in an adverse effect to the fishing community by way of flooding, storm, yields, income, and related social issues. In 1977, mangroves were distributed in an area of 4,366 hectares and it has been reduced to 1,640 hectares. This situation has obstructed their daily lifestyle and their future generation too.

#### V. METHODOLOGY

The qualitative and quantitative approaches were deployed to carry out the field study. The field study has been carried out to collect primary data, by way of a questionnaire, direct observation, interviews, and constructive discussion and followed the stratified sampling method.

Out of 9,100 highly operative fishermen, 91 Fishermen, from 6-fisheries inspector division around the lagoon, were incorporated for this study, following the stratified sampling methods. The secondary data from multiple statistic reports, previous researches, books, and magazines have also been used. The collected data were analyzed, using the appropriate descriptive and statistical techniques. Quantitative data are presented by way of tables, bar graphs and maps. Data

obtained from various sources are analyzed with MS-Excel and Arc GIS 10.1.

## VI. ANALYSIS OF RESULTS

According to the analysis, 64.84% of Fishermen reported that the frequent flooding hinders their daily lifestyle (migration to the inland area) and lowering daily income too.

Also, they said that they have to bear additional costs to shift their residences and to pay rent for a new home.

The IUCN report (2010) reveals that lagoon areas with high water levels have been permanently flooded from the recent past, due to the impact of the initial waves, where mangroves were largely cleared.

Further, they have to face multiple health issues; along with sea level rising, saltwater mixing with drinking water (increases the salinity level of drinking water) and scarcity of Potable water, etc. The below figures reveal that the mangroves degraded areas are highly affected by flooding.

Moreover, 68% of the occupants, along with their boats, ferries, fishing nets, and fishing harbor have been affected by the cyclone, resulting in economic losses.

Moreover, highly mangroves depleted areas, such as Serakuliya, Thirukkapallama, Aanakutty, Navakkady and Seguvantheevu, are mostly affected by the storm.

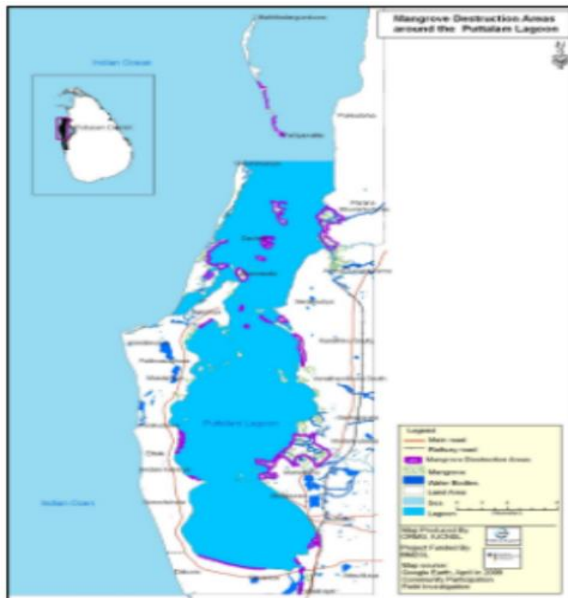


Fig.2 Mangrove degraded area in Puttalam lagoon

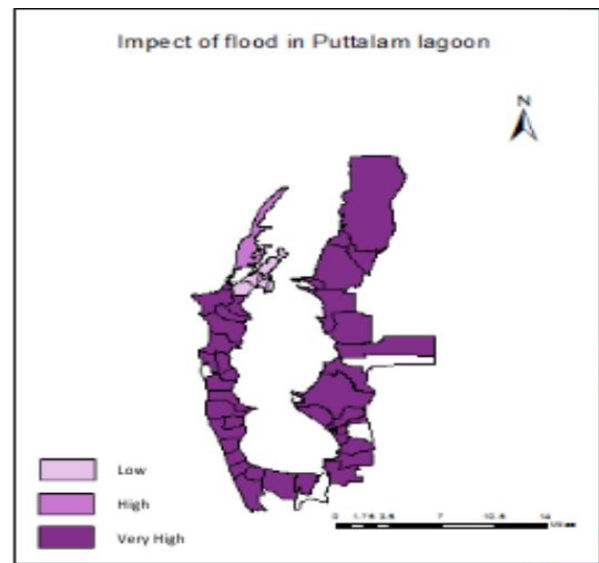


Fig.3 Flooding area in Puttalam lagoon

Accordingly, 91.21% of fishermen say seafood production has been declined in the recent past.

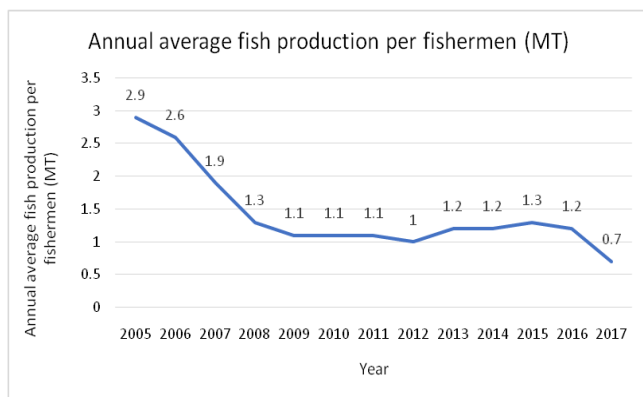
It was observed that some species of fish, such as *Plotosus caninus*, *Epinephelus lanceolatus*, and *Drepanopunctate* are gradually become extinct species, compare to the previous decades.

The following table-1 shows the statistical information on per capita annual average fish production, from 2005 to 2017.

TABLE I FISH PRODUCTION IN PUTTALAM LAGOON AREA

Year	Annual average fish production per fishermen (MT)
2005	2.9
2006	2.6
2007	1.9
2008	1.3
2009	1.1
2010	1.1
2011	1.1
2012	1.0
2013	1.2
2014	1.2
2015	1.3
2016	1.2
2017	0.7

Source: Prepared, based on the statistical information extracted from the Fisheries Department, 2018

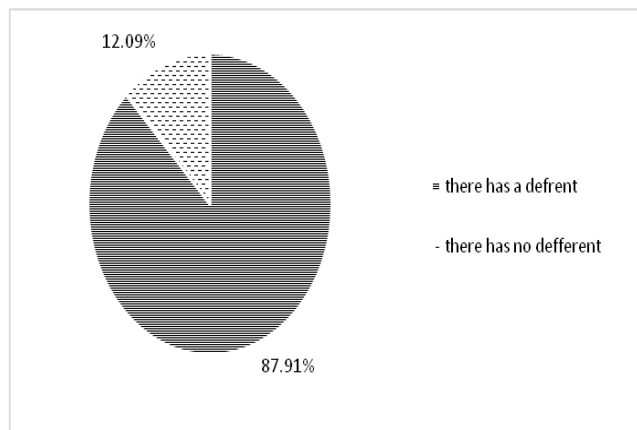


Source: Prepared, based on the statistical information extracted from the Fisheries Department, 2018

Fig.4 Annual average fish production per fishermen( MT)

According to above figure-4, the fish production was 2.9 MT per fishermen in 2005. It was decreased as 2.6 MT per person in 2006. This was further decreased in 2007 and 2008 as 1.9 and 1.3 respectively. However, this situation has changed, after 2009 and shows an almost equal trend like a spasmodic shape. The amount shows a huge drop in 2017 than previous years. The mangrove destruction and the drop in fishing production falls parallel, under same periods. The Fishermen occupied in this area revealed that their income level has been declined and expenditures have been gone-

up, which lead to a drastic decrease in their savings. Accordingly, the following pie chart (figure-5) reflects that the 87.91% of the respondents said, after mangrove degradation, the gap between income and expenditure have become wider day by day and saving being narrowed. Similarly, 12% of Fishermen reported that there are no significant changes between income and expenditure.



Source: Field study, 2018.

Fig.5 Comparison of income and expenditure after mangrove degradation

This study further analysed the income, expenses and savings with their satisfactory level

TABLE II COMPARISON OF SATISFACTION LEVEL OF OCCUPANTS (%)

Variables	Satisfaction level- prior to mangrove degradation (%)					Satisfaction level-after mangrove degradation (%)				
	Very high	High	Good	Low	Very low	Very high	High	Good	Low	Very low
Income (per month)	12.09	37.36	40.66	7.69	2.2	24.18	41.76	25.27	6.59	2.2
Expenditure (per month)	8.79	42.86	39.56	8.79	0	0	0	20.88	34.07	45.05
Savings (per month)	12.09	39.56	46.15	2.2	0	0	0	3.3	21.98	41.76

Source: Field study, 2018.

According to the above Table II, the fishermen's satisfaction level in relation to their income, expenditure and savings have been analysed, comparing the status prior to and after the mangrove degradations. 40.66% of inhabitants' satisfactory level was "good" with regard to their income, prior to mangrove degradation; whereas 42.86% dwellers had 'high' satisfactory level in terms of their expenditure. Hence, 39.56% and 46.15% had "high and good" satisfactory level respectively in terms of their savings.

In contrast, 41.76% and 25.27% of inhabitants had "high and good" satisfactory level respectively with regard to their income, after the mangrove degradation; whereas 20.88% dwellers had 'good' satisfactory level in terms of their expenditure. Hence, the satisfactory level in terms of their savings was "very low, i.e. 41.76%".

Generally, the fishermen received a good monthly income and had better satisfactions, prior to the degradation of mangrove ecosystem and "very low" satisfactions after the depletion of mangroves. Similarly, the fishermen's satisfactory level on their monthly expenses was good, prior to mangrove degradation and very low after the mangrove degradation. The status of all variables, income, expenses and savings, showed a negative status, prior to and after the mangrove depletion. Further study found that most of the fishermen, who had narrow gap between income and expenditure (high income and lowest expenses), are still continuing their fishing activities for an average of more than last 20 years. Such dwellers stated that the large number of fish varieties were produced at the low cost in the initial stage and earned good income and had a better satisfactory level on their income and expenses. The lower cost for basic fishing instruments and use of large numbers of ferry had

become a reason for such low expenses and good income in initial stage. They caught more fish varieties in short distance from the shore, which consume low fuel and oil. At present, the prices of engine oil for boats and refurbishment cost for damaged fishing net has been increased. The price of ferry oil, which uses for deep shore fishing activities, has been also gone-up, than the earlier. In the recent past, they caught fish varieties in the short distance from the seashore, due to the mangrove cover, such as white mangrove (*Avicennia marina*), tall-stilt mangrove (*Rizophora apiculata*) and Asiatic mangrove (*Rizophora mucronate*); which provide protection for marine fish and provide ideal site for reproduction. These types of species are mostly destroyed for various reasons in this study area. Thereby, it has affected reproduction of fish and shrimp. Hence, the fishermen, at present, involve in offshore fishing activities.

## VII. RECOMMENDATIONS

The result of this study found that mangrove degradation of Puttalam Lagoon is a major reason economic drawback of fishing community of the area. There is a positive relationship between mangrove degradation and economic changes of dwellers. It has also affected to seafood production negatively, leading to multiple economic consequences to dwellers. Hence, it is required immediate and viable measures to control the continuous process of mangrove degradation in the Puttalam lagoon; by way of public awareness programme, re-plantation of mangroves, strong implementation of existing laws and declaration of Puttalam lagoon as mangrove protection zone. Currently, the five (5) mangrove intense area in Puttalam lagoon have been identified as protected area by the Coast Conservation Department, as per the gazette notification no.1152.13 dated 10.04.2002; which should be extended to other areas too. Further, it is required to promote secondary economic activities (handicraft products, home gardening and self-employment for women *etc.*), among the fishing population for the purpose contingency and stabilize their economic status during the period, when fish production has come down.

Similarly, the existing public awareness programmes and re-plantation on mangrove protection especially in the Kalpitya, Palakuda and Kandakuly area should be extended to other area too. Providing the secondary income earning activities to fishermen can prevent the illegal mangrove destruction of the area. Introduce the eco-tourism based on mangrove environment is an additional avenue for income generation. These activities can protect the mangrove environment to earn economic benefit.

## VIII. CONCLUSION

The Mangroves degradations have a positive correlation with dwellers income, savings and other economic gain. The frequent flooding, cyclone and sea erosion *etc.* are other consequences, faced by the dwellers. Such consequences

finally ended-up with health issues among the occupants. The seafood productions have been declined, due to the destruction of mangrove cover. Hence, the mangrove degradation should be properly managed and controlled. The recommendations of this study should be converted into productive action plans and should be implemented with careful monitoring and management processes.

## IX. ACKNOWLEDGEMENT

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