

COMPARATIVE STUDY ON CURRENT FISHING STATUS OF PAALAMEENMADU AND KALLAR BARMOUTHS IN BATTICALOA DISTRICT, SRI LANKA

ABSTRACT

Batticaloa lagoon is one of the productive estuaries on the East coast of Sri Lanka and is connected to the sea at two points, Paalameenmadu and Kallarbarmouths. The entire dynamics of the lagoon is based on the seasonal opening and closing of the above barmouths which influences the fish catch composition in nearby fishing areas. This study collects information on current fishing practices, species composition of the catch, and seasonal catch species composition, the level of awareness on fishing regulation and sustainable fishery using semi-structured questionnaire. Fisheries data were collected from 10 major barmouth fishery landing sites from January to April 2021. 210 respondents were selected using a stratified random sampling technique. A semi-structured questionnaire was used to collect responses after a pre-test and analysed with descriptive statistics method using SPSS. The study revealed that Paalameenmadubarmouth was opened annually and Kallarbarmouth has been closed for the last five years. The most practiced crafts in Paalameenmadu are outboard Fiber Reinforced Plastic boats (OFRP) by 35.26% of fishers and small lagoon canoes by 87.04% fishers in Kallar. A total of seven types of fishing gears are used, among them hook and line, cast net, and dragnet were identified as major fishing gears operated. 30 aquatic species have been recorded in the catch, representing 17 families. Among them, dominant fish families are Scombridae 17.11% and Penaeidae 14.81% in Paalameenmadu. In the Kallar, family Penaeidae 18.75% and Gerreidae 16.32% have been recorded. Barmouth opening is favourable for fishing and 38.57% Penaeidae species were caught during barmouth opening period. Community response that Irregular and early barmouth opening have caused a reduction in fish production which impacts on economic activities. This research stresses and paves the way to sustainable management strategy with further research and stakeholder awareness programmes on lagoon sustainability.

Comment [MOU1]: The status of capture at the two research sites and what differentiates them from each other have not been disclosed.

Keywords: Barmouth fishing, Batticaloa Lagoon fishery, Fishing gear, Seasonal changes

1. INTRODUCTION

Fishing has historically played a key economic role in the island of Sri Lanka. Batticaloa district is one of the coastal areas which provide around 1.5% of the total fish production of the island of Sri Lanka [1,2]. Batticaloa lagoon is one of the estuarine lagoons and the largest coastal water body in the Batticaloa district. It occupies an area of 168km² with 56km long and 14.3% of population in Batticaloa district is depending on fisheries for their income [3,4,5]. Batticaloa lagoon connected to the sea through two bar mouths, known as Palameenmadu and Kallar.[5, 6].

During the rainy season fresh water discharge into the lagoon from seasonal rivers, major and minor irrigation tanks and runoff from adjacent land mass [7]. It leads to rise of water level in the lagoon, when the water level rises under the Kallady Bridge by 0.838 m mean sea level the Palameenmadubarmouth is cut open by Road Development Authority and Koddakallarbarmouth is opened during wet season annually [5,8]. However, both barmouths are opened by human interventions and closed naturally in dry season by accumulation of sand due to wave action and ocean dynamics[5,9].

Barmouth biological and chemical characteristics would directly influence by mixing of lagoon water with marine water[10]. Lagoon does receive freshwater from seasonal rivers, tanks, ponds and other water resources seasonally. This inflow of freshwater and movement of seawater into the lagoon mainly determine the biological diversity, physical characters and the chemical composition of lagoon water[8,11]. Such inflows of water increase nutrients in system which enhance ecological productivity led to booms in fisheries of certain species, high variation of fish assemblages, rich fish biomass and it provides nursery grounds for many marine species. [12].

The primary factors attracting fish to this area are their high production, abundant food sources, diversity on ecosystem and ideal temperature for larval and juvenile growth. This seasonal changes and Movements of fish larvae between lagoons and adjacent seas are critical events influencing livelihoods of the people who are depending on these resources and attracts newcomers also. Sugirtharan[8, 13].

Opening and closing barmouth affect the social and economic activities around it[14]. This lagoon provides the majority of the fishing community with their livelihood[6]. Unfortunately, in the recent years timing of opening of barmouth and Improper management of bar mouth mechanism has become more irregular due to various political

influences [15]. Recent anthropogenic activities in the lagoon have adverse impacts in natural system of lagoon environment and this situation threatens the sustainability of fisheries productivity [16]. Therefore, it is essential to the renewal of fisheries resources [17].

There were lack of studies related to analyse both the direct and indirect affects as well as influences of barmouth opening on fishing. This research mainly focuses on study and compare barmouth fishing in both Paalameenmadu and kallarbarmouth area, Batticaloa district. This study aims on Comparison of the fishing techniques and fish catch species composition in the two barmouth areas and identifying fluctuation of seasonal catch composition.

Comment [MOU2]: It is important to emphasise the importance of this research for sustainable management. Or what is the expected contribution of this research

2. METHODOLOGY

2.1 Experimental Location

Batticaloa lagoon located in East coast of Sri Lanka is the third largest estuary and one of the most productive brackish water bodies in Sri Lanka. It is located between 7°24'-7°46' N and 81°35'-81°49' E. The lagoon is about 23 miles (56.8 km) long along meridian axis and its width varies widely 0.5 km to 4 km extending from Kalmunai in the south to Eravur in the north. the lagoon receive freshwater from about 19 fresh water impoundments, 5 major lakes, 8 rivers, numerous irrigational channels and many drainage basins. The lagoon opens to the sea by two points, one at Palameenmadu and the other at Kallar. During the rainy season lagoon is in open communication with the ocean, but in dry season the barmouth is closed by accumulation of sand due to wave action and ocean dynamics.

Comment [MOU3]: I think this research does not fall under experimental research but non-experimental research.

2.2 Data Collection

Ten study sites were selected from near two bar mouth regions. The questionnaire survey was conducted from 21st January 2021 to 21st May 2021 over the wet season to dry seasons with a pre-test. The questionnaire structure consisted multiple response questions, semi structured question and five-point Likert scale method. The data from selected locality collected from key informative interviewees, questionnaire survey and focus group discussion. Stratified random sampling technique was used to select two hundred and ten (210) samples out of 350 active fishermen population for the questionnaire survey.

Comment [MOU4]: It is better to add a map of the research location to make it easier for readers to understand the condition of the research area.

Comment [MOU5]: How many interviewees; how many focus group participants; and why 210 respondents.

2.3 Statistical Analysis

Comment [MOU6]: It is important to mention what variables are being correlated and to whom the formulation refers?

The collected primary data from questionnaires were entered into an Excel sheet and analysed and evaluated mainly by using descriptive statistical techniques, correlation coefficients analysis and univariate & bivariate analysis. Secondary data were collected from the Department of Fisheries and Aquatic Resources Development, journal articles and research reports.

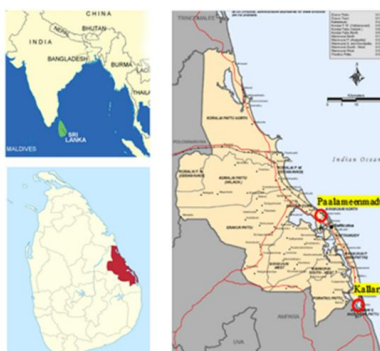


Figure 1 : Map of Study Area

3. RESULTS AND DISCUSSION

3.1 Socio-economic condition of the Batticaloa barmouth fishers

An individual's socio-economic status is a measurement of their standing in society and economy relative to others. It is based on a variety of variables, such as their income, education, employment, family influence, social position, engagement with society, caste, and political influence[18]. General socio-economic characteristics such as gender, age group, marital status, fishing experience, nature of the occupation and monthly income range of fishermen were investigated in the present study[1, 19].

The study reveals that all the respondents were males and about 96.19% of respondents belonged to married category.

The figure 2 shows that the majority of respondents (44.76%) belong to the category of age between 41 – 50 years. Then 42.86% of represent fishermen who are in age above 50 years group, 6.19% of respondents belonged to the category of between 31-40, 4.76% and 1.43% represent fishermen who are in age between 21-30 and below 20 years respectively.

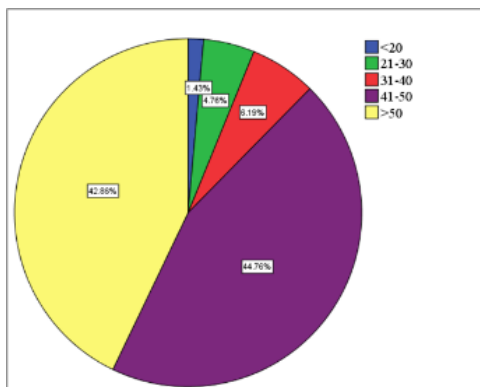


Figure 2: Age group distribution of the studied fishermen

The majority of respondents (89%) fall in more than ten years of experience, while 5.71%, 3.81 % and nearly 2% of the respondents are with fishing experience of 6-10 years, 1-5 years and below one year of experience respectively (figure 3). It was found that 96.2% of respondents belonged to the category of full-time and the rest are part-time.

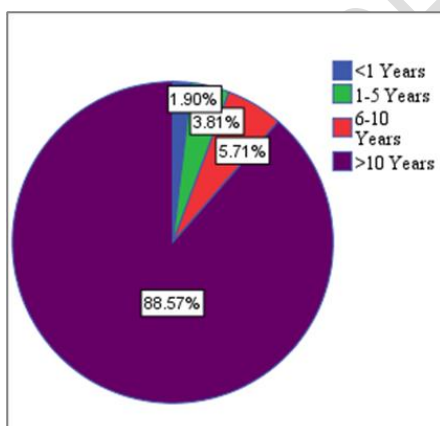
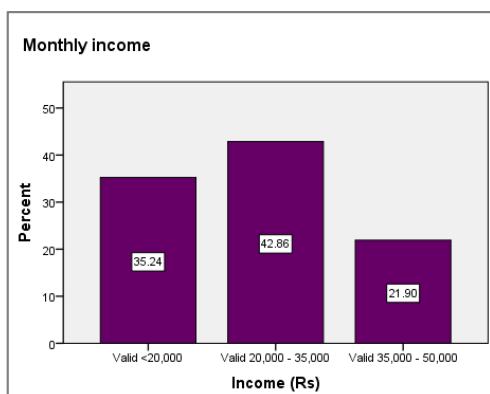


Figure 3: Experience level of the studied fishermen



The figure 2 shows that at the current study, monthly income range of fishermen in the selected landing sites revealed that 42.86% of the respondents belonged to the category of monthly income between Rs. 20,000 to Rs. 35,000. Also, 35.24% and 21.90% of the respondent's income were within the range of below Rs. 20,000 and between Rs. 35,000 to Rs. 50,000 respectively.

3.2 Relationship between the socio-economic characteristics

The strength of the relationship between two variables evaluated and compared by Pearson correlation coefficient analysis. The relationship between the socioeconomic characteristics of fishermen, independent variables such as age and fishing experience has a strong positive relationship with monthly income while number of fishing gears has a weak positive relationship with monthly income.

Table 1: Relationship between the socio-economic characteristics

Monthly Income (Rs)	Age (Years)	Experience (Years)	No of fishing gear
Pearson Correlation	.654**	.557**	.123
Sig. (2-tailed)	.000	.000	.076
N	210	210	210
Relationship strength	strong positive relationship	strong positive relationship	weak positive relationship

The study conducted by [20] stated that, number of fishing gear is one of the, determinants of fishing income which positively influencing fishing income. [21] revealed that, fishermen's income were broadly influence by socioeconomic characteristics. These results are on par with the above statements.

3.3 Current fishery status of barmouth Batticaloa

The main aim of this objective is to get a detailed idea about the different types of fishing practices and catch species composition in the selected landing sites and consequence of barmouth opening on fishing.

Comment [MOU7]: Why not calculate its sustainability status in the two study areas for comparison?

3.3.1 Fishing regions of Paalameenmadu and Kallarbarmouth fishermen

Multiple Response analysis on fishing regions in Paalameenmadu reveals majority of (34.84%) percentage of fishermen actively involving in bar mouth area and 33.0% of fishermen coastal sea for fishing. About 27.6% and nearly 5% of respondents belonged to lagoon and the mangrove fishing respectively.

Since the Kallar bar mouth closed for past five years, 89.0% of the fishermen depend on lagoon for fishing. Then coastal sea and mangrove fishing in equal level in percentage 5.56%.

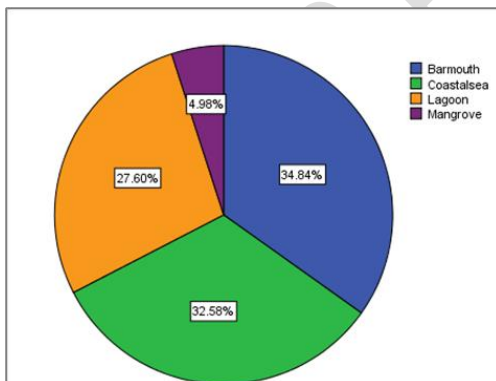


Figure 5: fishing regions of Paalameenmadu fishermen

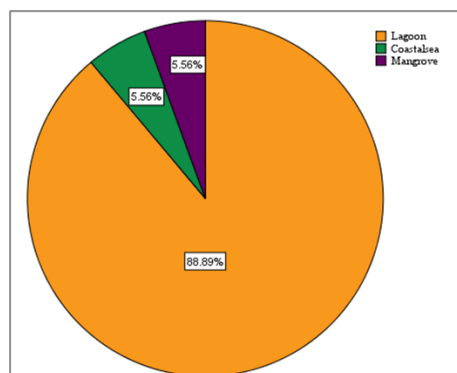


Figure 6: fishing regions of Paalameenmadu fishermen

3.3.2 Fishing craft operated in Paalameenmadu and Kallarbarmouth

In Paalameenmadu study area, several type of fishing craft mostly used for fishing various means such as Outboard Fiber Reinforced Plastic Boat (35.26%), small lagoon canoe (32.05%), Inboard Day Boat (17.31%), and not used vessels for fishing (15.38%). As far as the fishing activities in the Paalameenmadu barmouth mainly by Outboard Fiber Reinforced Plastic Boat.

More than $\frac{3}{4}$ of respondents used small lagoon canoe for fishing in Kallar barmouth landing sites and it represents 87.04% of the sample. Then 7.41% of respondents used Outboard Fiber Reinforced Plastic Boat and 5.56% of respondents did not use vessel for fishing.

3.3.3 Fishing gear operated in Paalameenmadu and Kallar barmouth

According to the survey, hook and line, cast net, drag net, gill net, cage, drift net and stake net were identified as major seven fishing gears operated in the study sites. 27.30% of Paalameenmadu fishermen used hook and line and 22.37% of fishermen used cast net for fishing. Equal percentage 9.54% of respondents use gillnet and cage. Also, minimum number of respondents used drift net and stake net.

Thus, in Kallar bar mouth region more than half of all fishermen used cast net for fishing, which is 58.23%. The 31.65% of fishermen used Raalvalai fishery or stakenet, 6.33% of respondents used hook and lines and 3.80% of respondents used cage for fishing. Since they used a variety of gears, then the gear selection at the time depended on fishing location and season.

This obtained results are in agreement with [11], who observed that, main fishing techniques such as drawnet, gillnet, cast net and hook and line at Batticaloa lagoon. Thus, these findings are in line with the same.

3.4 Species composition

About 30 aquatic species have been recorded in the both Paalameenmadu and Kallar locality which include 17 families. Freshwater, brackish, fresh-brackish, and marine-brackish migratory species were among the fish species recorded.

Table 2: List of species composition Paalameenmadu and Kallar locality

No	Scientific name	Common name (English)	Common name (Tamil)
----	-----------------	--------------------------	------------------------

Family: Ambassidae		
1. <i>Ambassisgymnocephalus</i>	Bald glassy	Selunthal
Family: Anabantidae		
2. <i>Anabustestudineus</i>	Climbing bass	Panayan
Family: Ariidae		
3. <i>Arius sp</i>	Catfish	Keluthi
Family: Belonidae		
4. <i>Belone belone</i>	Garfish	Mural
Family: Carangidae		
5. <i>Caranxmelampygus</i>	Bluefin trevally	Paarai
6. <i>Carangoidesmalabaricus</i>	Malabar trevally	Kannadipaarai
7. <i>Caranxsansun</i>	Yellow-fin trevally	Manchalpaarai
Family: Carcharhinidae		
8. <i>Scoliodonpalasorrah</i>	Grey dog shark	Paal surah
Family: Channidae		
9. <i>Channa striata</i>	Mudfish, snakehead murrel	Viral
Family: Cichlidae		
10. <i>Oreochromis mossambicus</i>	Tilapia	Golden
11. <i>Tilapia niloticus</i>	Tilapia	Selvan
12. <i>Etroplussuratensis</i>	Pearl spot	Seththal
Family: Clupeidae		
13. <i>Escualosa elongate</i>	Slender white sardine	Vella sudai
14. <i>Sprattus Sprattus</i>	Sprats	Netholi
15. <i>Nematalosasp</i>	Hair back	Koimeen
16. <i>Amblygaster sirm</i>	Spotted sardinella	Keerimeen
Family: Gerreidae		
17. <i>Gerreomorphasetifer</i>	Black striped silver biddy	Thirali

Family: Mugilidae		
18. <i>Mugil cephalus</i>	Mullet	Manalai
Family: Penaeidae		
19. <i>Metapenaeus monoceros</i>	Speckled shrimp	Koonieraal
20. <i>Penaeus indicus</i>	Indian white shrimp	Vella eraal
21. <i>Penaeus monodon</i>	Giant tiger prawn	Karueraal
Family: Portunidae		
22. <i>Portunus pelagicus</i>	Blue swimming crab	Neela nandu
23. <i>Scylla serrata</i>	Mangrove crab	Peru nandu
Family: Siganidae		
24. <i>Siganus javus</i>	Streaked spine foot	Oora
25. <i>Siganus oramin</i>	White spotted Spine foot	Oddi
Family: Sillaginidae		
26. <i>Sillago sihama</i>	Silver Whiting	Kilakkan
Family: Triacanthidae		
27. <i>Triacanthus biaculeatus</i>	Short-nosed tripod fish	Tholi
Family: Scombridae		
28. <i>Thunnus albacares</i>	Yellowfin tuna	Kilawala
29. <i>Rastrelliger kanagurta</i>	Indian mackerel	Kumbala
30. <i>Thunnus obesus</i>	Bigeye tuna	Arukkula

3.4.1 Catch species composition from Paalameenmadu

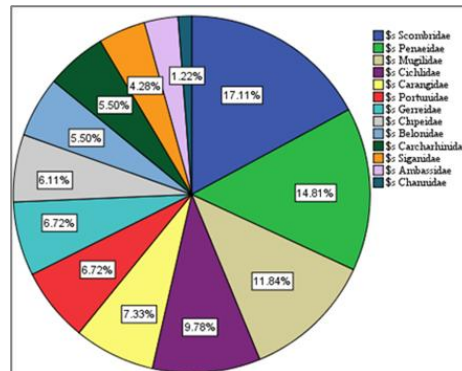


Figure 7: Catch species composition from Paalameenmadu

Figure 7 shown that belongs to 13 families species caught in Paalameenmadubarmouth landing sites. Among them dominant fish families are Scombridae 17.11% and Penaeidae 14.81% and 11.84% of Mugilidae species caught and it accounted that highest percentage of Scombridae species caught compared to the other species. Less than 10% of Cichlidae, Carangidae, Portunidae, Gerreidae, Clupeidae, Belonidae, Carcharhinidae, Siganidae, Ambassidae and Channidae were caught in Paalameenmadubarmouth landing sites.

3.4.2 Catch species composition from Kallar

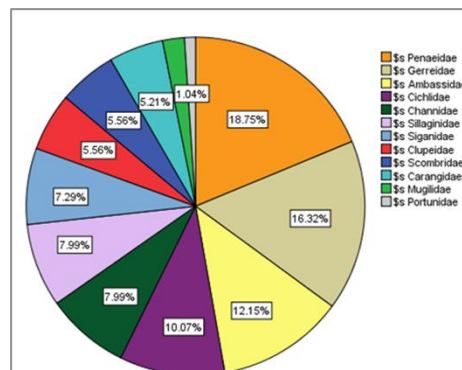


Figure 8: Catch species composition from Kallar

Figure 8 shown that in Kallarbarbarmouth landing sites belongs to 12 family's species caught and highest percentage of Penaeidaespecies caught which was 18.75%. In particular speckled shrimp caught in high amount at Kallar fishing grounds. Also 16.32% of Gerreidae species,

12.15% of Ambassidae species, 10.07% of Cichlidae species caught at this barmouth. Family Channidae, Sillaginidae, Siganidae, Clupeidae, Scombridae, Carangidae, Mugilidae and Portunidae species were caught less than 10% in the Kallarbarmouth landing sites. Hence, both catch species composition revealed that considerably high amount of Penaeidae species caught in the both barmouth related fishing regions.

3.5 Barmouth opening and species composition

3.5.1 Advantages of barmouth opening in fishing

Barmouth opening is favourable for fishing community with regards to High catch, seasonal species catch composition and easy of transport to coastal sea. Among them seasonal species catch more advantageous for fishermen.

Table 3: Advantages of barmouth opening in fishing

Advantages	Frequency	Valid Percent	Cumulative Percent
Easy of transport	69	32.9	32.9
Seasonal species catch	81	38.6	71.4
High catch	60	28.6	100.0
Total	210	100.0	

3.5.2 The catch species composition during the Paalameenmadubarmouth opening period

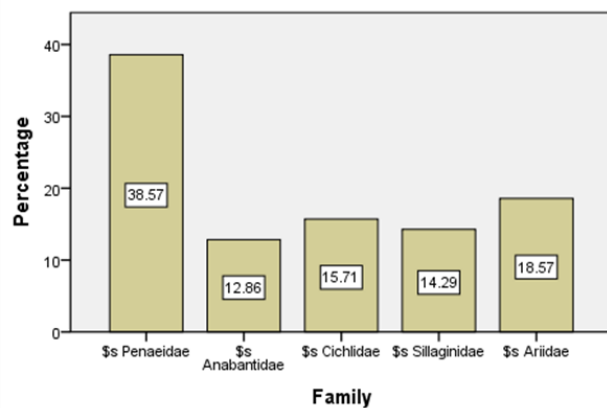


Figure 9: Seasonal catch species composition

Paalameenmadubarmouth opening between December to January and closed between August to September. Thus, Kallarbarmouth closed for last five years. Figure 9 showed that the highest percentage of family Penaeidae species were caught 38.57% during Paalameenmadubarmouth opening period and the exotic species includes family Ariidae, Cichlidae, Sillaginidae and Anabantidae high catch during the bar mouth opening season.

Among the Penaeidae species Indian white shrimp, giant tiger prawn and speckled shrimp were the most abundant species. Hence, in that barmouth opening season, most of the fresh water fish species come to the barmouth region with the seasonal fresh water inputs, so due to that, the fresh fish such as family Ariidae, Cichlidae, Sillaginidae and Anabantidae catch increases.

GajabaEllepola, [2014] revealed that, During the rainy season, when there was a greater inflow of freshwater from streams, a variety of freshwater species were generally observed in lagoon [22]. Harris and Vinobaba, stated that there was little variation in species composition and high species richness in Paalameenmadu with respect to seasons [23]. The availability and composition of aquatic resources, along with the livelihoods of the people who depend on them, are all influenced by variations in the salinity of the lagoon water [11].

These obtained findings are in line with findings by GajabaEllepola[22] and Harris and Vinobaba[24].

4. Conclusions

This study reveals that bar mouth opening season is most favourable for fishing activities. Higher amount of flower prawn and tiger prawn catch during bar mouth opening season has been recorded. The survey, it was found that a total of 12 types of fishing gears and 10 types of fishing crafts used in Batticaloa bar mouth region. A total number of 30 species were identified in the landing site during the study period.

Moreover, the lack of government involvement to restrict the banned fishing practices and unregistered fishing boats also a major constraint to local fishermen. It helps State Government agencies in terms of monitoring, evaluation and reporting consequence of annual barmouth opening. It is expected that the study finding will help to improve the management system of the Batticaloa lagoon and bar mouth area and also it will support to obtain the attention of the government to implement an optimum management strategy.

Comment [MOU8]: There is no record of a conclusion regarding the status of the capture fishery, whether it continues or not.

5. Recommendation

I would recommend the major and minor irrigation tanks have to be dug properly to increase the water capacity which can prevent early flooding and irregular barmouth opening. It would be great if coordination between fishing community and advisory committee such as government departments, NGOs and other agencies can be improved in order to improve the quality of service.

6. References

1. Jeyarajah S, Santhirasegaram S. SocioEconomicFactorsInfluencing Marine Small Scale Fishers Income in the Batticaloa District of Sri Lanka. The International Journal of Humanities & Social Studies. 2015;3(1):75–79.
2. Green Tech Consultants. An assessment of the change in shoreline location along the coast of the Eastern Province of Sri Lanka, using remote sensing technology. Revised Final Report. North East Coastal Community Development Project (NECCDEP). 2009;Pp. 49
3. Santharooban S, Manobavan M. Evaluating the impact of an improperly designed bridge across Batticaloa Lagoon. In Water Professional's Day Symposium. 2005.
4. NARA. Socio – Economic and Marketing Research Division National Aquatic Resources Research and Development Agency Content. 2015.
5. Thayananth S, Santharooban S, Manobavan M, Fernando G. W. A. R. Modelling the influence of Unnichchai irrigation tank on the Batticaloa lagoon. 2008;20(January), pp. 326–335.
6. Sugirtharan M, Pathmarajah S, Mowjood M I M. Spatial and temporal dynamics of water quality in Batticaloa lagoon in Sri Lanka. Tropical Agricultural Research. 2017;28(03): 281. Available: 10.4038/tar.v28i3.8232.
7. Kjerfve B. Coastal lagoons. In Elsevier oceanography series. 1994;Vol. 60:1-8.
8. Muthucumaran S, Pathmarajah S, Mowjood M I M. Vertical variation of Salinity, Electrical Conductivity Temperature and pH of Batticaloa Lagoon. International Journal of Applied and Physical Sciences. 2015;1(2): 36-41.
9. Harris J M, Vinobaba P, Deepananda KHMA. Ichthyofauna Diversity of Batticaloa Lagoon, Sri Lanka and Needs for Their Conservation. 2013;02(02):25–33.
10. Suzuki MS, Figueiredo RO, Castro SC, Silva CF, Pereira EA, Silva JA, Aragon, GT. Sand bar opening in a coastal lagoon (Iquipari) in the northern region of Rio de Janeiro State: hydrological and hydrochemical changes. Brazilian Journal of Biology. 2002;62:51-62.
11. Sugirtharan M, Pathmarajah S, Mowjood M IM. Variation of salinity in Batticaloa lagoon in Sri Lanka during wet season. Tropical Agricultural Research. 2014; 25 (3):403 – 411.
12. Oliva- Paterna FJ, Andreu A, Miñano P A, Verdiell D, Egea A, De Maya JA, Torralva M. Y- O- Y fish species richness in the littoral shallows of the meso- saline coastal lagoon (Mar Menor, Mediterranean coast of the Iberian Peninsula). Journal of Applied

- Ichthyology.2006; 22(3):235-237.
13. Perera GL, EiichiFurusato,Amarasekara GP,Priyadarshana T, Tanaka N. CurrentstatusofSalinitystratificationofRekawaLagoon, Sri Lanka. Special session on Sustainable Earth. SLJCR 2013.
 14. Blaber S J M, Cyrus D P, Albaret J J, Ching C V, Day J W, Elliott M, SilvertW. Effectsoffishing on thestructureandfunctioningofestuarineandnearshoreecosystems. iCES Journal of marine Science. 2000; 57(3): 590-602.
 15. NECCDEP. (2010). Batticaloa Lagoon Special Area Management Plan "BL SAM". Final. Pp. 125. January 2010. Eastern Province Integrated Coastal Resources Management Plan (EP ICRMP) 2010-2013. The Green Blue Sunrise Plan. Anzdec Ltd., Resource Development Consultants. ADB LOAN 2027 SRI (SF): North East Coastal Community Development Project (NECCDEP).
 16. HarrisJ, VinobabaP.SeasonalinfluenceofwaterqualityofBatticaloaLagoon, Sri lanka on fishandplanktonabundance. International Journal of Environmental Sciences. 2012; 3(1):371–385. Available: doi: 10.6088/ijes.2012030131035.
 17. Able KW. A re-examinationoffishestuarinedependence: Evidenceforconnectivitybetweenestuarineandoceanhabitats. Estuarine, CoastalandShelf Science. 2005;64(1):5–17.
 18. Shobiya P, Sivashanthini K, SutharshinyS,Gunaalan, K.Impacts oftheThondaimanaru Barrage Construction on Socio – Economic Status ofFishing Communities in ThondaimanaruLagoon, Jaffna, Sri Lanka. Vingnanam Journal of Science. 2019;14 (1):27-31.
 19. Sugirtharan M, Pathmaraja S, Mowjood I M M. Climatechangeawarenessandperceptionamongthecommunityresidingnearbyare asofBatticaloalagoon in Srilanka.2019;13(2):55–68.
 20. ZellaAdili Y, Antonia M. Determinantsinfluencingfishingincometothe coastalhouseholdsof Indian Ocean. Oceanography&Fisheries Open Access Journal. 2017;4(3):85-91.
 21. Al JabriOM AR, CollinsR, Sun X, OmezzineA, BelwalR. Determinantsofsmall-scalefishermen'sincomeonOman'sBatinah Coast. 2013.
 22. Ellepola G, Ranawana K B, Harischandra S.Utilizationoffisheryresources in the Panama lagoon ,AmparaDistrict , Sri Lanka. International journaloffisheriesandaquaticstudies. 2014;1(5):32–37.
 23. Harris J M,VinobabaP.‘ImpactofWater Quality on SpeciesCompositionandSeasonalFluctuationof Planktons ofBatticaloalagoon, Sri Lanka. Ecosystem&Ecography. 2012;2(4): 117-122.
 24. HarrisJ M,Vinobaba, P.Assessment thepresentstatusofBatticaloaLagoon, Sri Lanka bymeansofwaterquality, fishdiversityindicesandpollutionindicatingplanktons. J Biodivers EndangerSpecies. 2013; 1(105):2.