Increasing Human Population and its Impacts on Fish Resources Degradation in the Southern Coastal Area in Sri Lanka

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Introduction

The fisheries sector is an important part in the Sri Lankan economy. Out of the 15 fisheries Districts, Galle and Matara together contribute 21 percent to the total marine fish production of the country.As a result of population growth, demand and competition for natural resources growing rapidly. Thus, the largest number of people have been joined to fishery in Sri Lanka. Lalith (2014) indicates that in Sri Lanka coastal fish production has been growing and has reported 165 246 MT in 1980 and it increased 278,850 MT in 2014. Also, few studies (Samaranayake, 2003; Plan 2012) found that coastal fisheries in Sri Lanka are afflicted by a number of anthropogenic threats; the major ones are over exploitation of resources, the use of destructive fishing practices.The one main reason is over fishing development of more amenities in the fish industry (Floyd. 2011; Watson *et al.* 2012) and an increased demand for fish have led to overfishing, as a result, causing several marine species to become extinct or endangered. As this phenomenon, this study was focused to investigate the fish resource degradation due to the population increase, in Matara and Galle Districts in the Southern coastal area.

Research Problem

The coastal districts in Sri Lanka had a population of 8,189,961 in 1981 and 11,707,636 in 2012 (Department of Census and Statistics, 2015). Population has increased 42.95 percent within this period. Population densities of these coastal areas have increased from 457 to 658 persons per square kilometer in Galle District and from 517 to 641 persons per square kilometer in Matara District from 1981 to 2012 (Department of Census and Statistics, 2012). As a result of coastal population growth, the number of fishers, fishing families, facilities and use of fish resources aregoing higher.The study investigatesthe impact of population growth on the fish resource degradation in the southern coastal region from Devinuwara (Matara District) to Ambalangoda (Galle District) from 1981 to 2012.

Objectives

The main objective of the study is to examine the impact of human population increase on the degradation of the coastal fish resources in the southern coastal region. Another objective is to understand the reasons for the fish resource degradation.

Theoretical Considerations and Empirical Evidence

Although, some theories were developed in relation to the population increase and resources, this study used Ehrlich's (1968) population theory, because itcontained three major elements: a rapid rate of change, a limit of some sort, and delays in perceiving the limit. He argued that environmental impacts (I) are the result of three variables: population (P); affluence (A); and technology (T), as follows:

IPAT (Impact) = **P**opulation x **A**ffluence x **T**echnology

The World Commission on Environment and Development presents the Brundtland Report (1987) was released by the United Nations. Entitled "Our Common Future". The document addressed the degradation of environmental resources and outlined the effects that such deterioration would have on social and economic growth in world populations.

This study is used these theories and concepts to success the main aim of the study, which is according to the human impacts fish resource degradation.

Methodology

Mixed methodological approach, Focus Group Discussion (FGD) and comparative cross sectional research design has been used in this study. Main analysis based on the data was drawn from Department of Fisheries and aquatic resources, 1980 to 2015, while key informant interviews have been used to collect quantitative primary data. The study area was consisted two main districts, and seven DS Divisions (Ambalangoda, Hikkaduwa, Galle Four Gravet and Habaraduwa, Weligama, Matara Four Gravet and Dewinuwara DS Divisions) and it included 313 coastal GN Divisions. Out of the total GN division of each DS division, 25 percent sample was selected. Then, out of the total number of household units in the selected GN Divisions 10 percent sample was selected. Apart from the basic analysis, Pearson's correlation coefficient has been used to analysis the time-based increase of the active fishers and fish production and presenting the socio-economic data has been used descriptive analysis with tables, charts and graphs.

Key Findings

Using Fishing Crafts and Fishing Methods

Beach shine, Gill nettingand Handlinesare the most common fishing gears used in Southern Sri Lanka. Table 1 shows the using fishing craft by fishers. Majority of fishers (38.38 percent) used fiber glass reinforced plastic boats (FRP).

Table 1: Some Technical Characteristics of Coastal Fishing Crafts Used by Southern Fishers (Percent)

Key characteristics	Craft category	Paru	Oru	Vallam	Theppam	MTRB boat	FRP boat	3 ½ ton boat
	No. of Craft	11	18	45	59	75	185	89
	%	2.28	3.73	9.34	12.24	15.56	38.38	18.47
Length ft		20-24	>24	15-19	10-14	17-23	15-29	28-34
Crew size	7-8	2	2	2	2	2-3	2-3	4-5
Fishing gear used		Beach shine	Drift Gillnet, Handlines	Drift Gillnet	Drift Gillnet	Drift Gillnet	Drift Gillnet	Gillnet, Handlines

Source: Field Survey - 2015

Coastal fishers use different fishing methods. The most common method was cast net and karamal dal (See Table 2). Smaller number of fishermen (7.5 percent) use harmful fishing methods and instruments such as dynamite/ cyanide fishing, light course and Moxy net.

Table 2: Fishers Using Fishing Methods by Fishing Place (Percent)

Fishing methods	Number of fishers	%
Trawl net	163	33.82
Catch with net (Cast and karamal Dal)	212	43.98
Rod	62	12.86
Dynamite/ Cyanide	12	2.49
Light course	09	1.87
Moxy net	14	2.91
Stilt	10	2.07
Total	482	100.0

Source: Field Survey - 2015

Table 3: Average Monthly Income – Expenses of Coastal Fishers

Income& expenditure(Rs)	Number of fishers	%	Number of fishers	%
5,000>	3	0.62	5	1.04
5,000-9,999	59	12.24	66	13.69
10,000-19,999	161	33.40	157	32.57

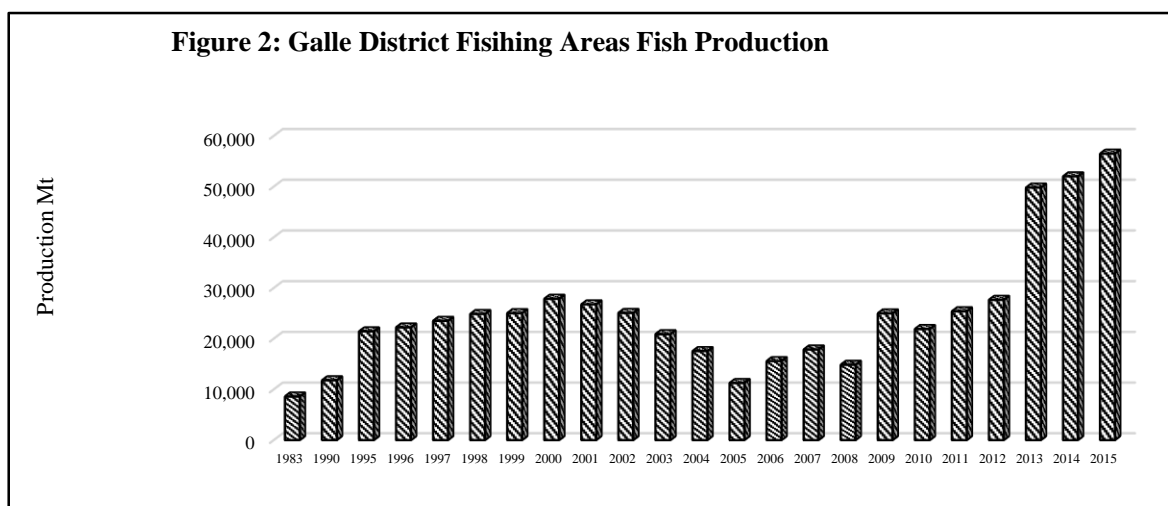|				
20,000-29,999	144	29.88	167	34.64
30,000-49,999	92	19.09	73	15.15
50,000<	23	4.77	14	2.91
Total	482	100.00	482	100.00

Source: Field Survey - 2015

As indicated Table 3 the study reveals that majority of fishers' expenditure exceeded more than their monthly income. By this reveal that coastal fishing people are living with poor condition.

Fish Production and Excessive Fishing

Figure 1: Matara District Fisihing Areas Fish Production
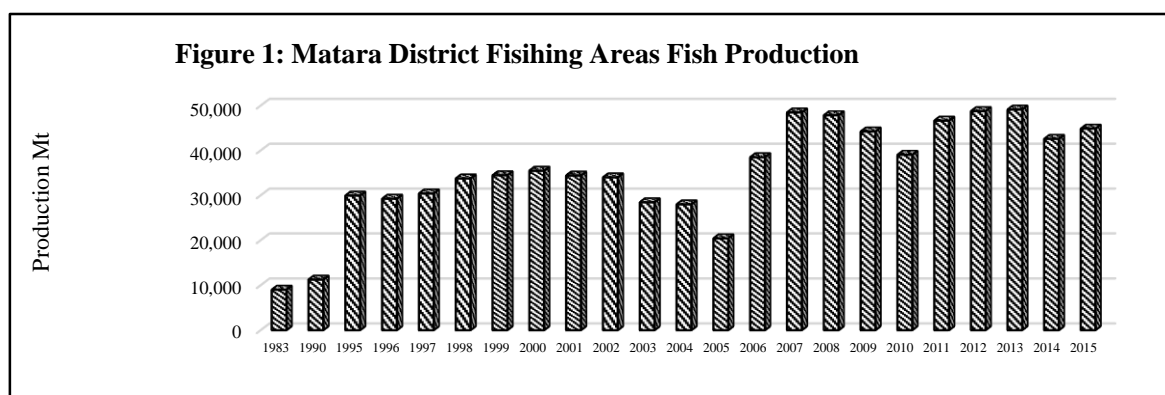
Source: Fisheries office, Matara - 2016

Figure 2: Galle District Fisihing Areas Fish Production

Source: Fisheries office, Galle - 2016

In Matara and Galle fisheries Districts total fish production from 1983 to 2015 has been increased (see Figure 1 and 2). This has mostly been due to the rapid increase of new vessels with modern technology. Due to the increasing production reveal that both Districts have an excessive fish harvest.

Increase of Fishing Population

Since the 1980s, Matara and Galle districts fishing families' population have been increased. It increased by 223 percent in Matara district from 1980 to 2015 and by 258 percent in Galle district of the same period.
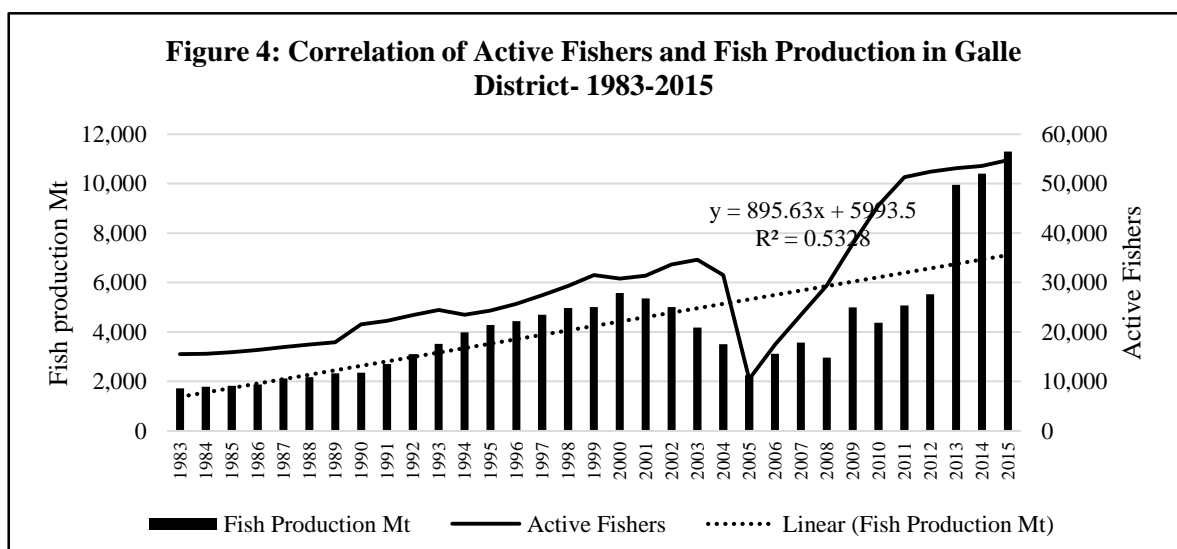
Relationship between the Increase of Fish Production and Active Fishers

Fish production as well as active fishers were timely increased in the coastal fishery. This figure clearly represents since the after 1990s. For understanding the relationship, the increase of active fishers and the increase of fish production, used the Pearson's correlation coefficient test. The Figure 3 and 4present the correlation of these two variables.
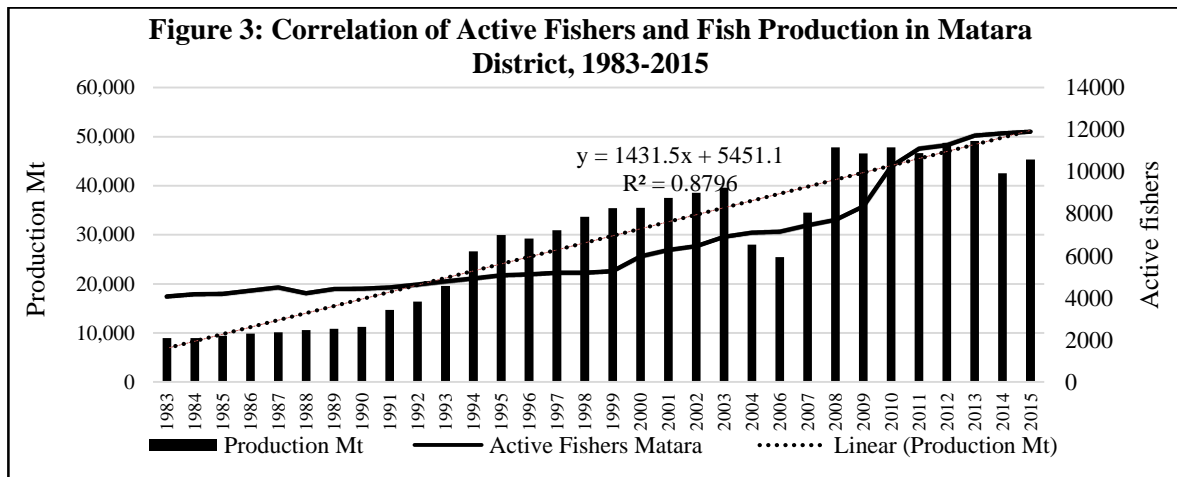
Figure 3: Correlation of Active Fishers and Fish Production in Matara District, 1983-2015

$y = 1431.5x + 5451.1$
$R^2 = 0.8796$

Source: Department of Fisheries and aquatic resources - 2016

Correlation coefficient value is $R^2 = 0.8796$. This indicates that there is positive relationship between theincrease of fish production and increase of active fishers in Matara District.

Figure 4: Correlation of Active Fishers and Fish Production in Galle District- 1983-2015

$y = 895.63x + 5993.5$
$R^2 = 0.5328$

Source: Department of Fisheries and aquatic resources - 2016

Correlation coefficient value is R² = 0.5328. Due to the result, there is positive relationship between theincrease of fish production and increase of active fishers in Galle District. According to the above analysis, make clear idea, large amount of fish resources has been caught from the sea by the fishers since the long period.

The total fish catch has been changed due to the nature of the sea, during the Warakan (May/October) and Haraya (November/April) seasons. Recent decades, fishers engaging the fishery on both seasons. As in understanding the study, the one main reason for the high fish catch was well developed fishing facilities and technology. Wijeratne et al. (2001) revel that inboard and outboard motors were issued to replace existing ones and to mechanize traditional craft.

Trends of Fish Yield

For the decrease of fish yield is affected over exploitation of fish resources, throw away destroyed fish in by-catch and over harvest and for the increase of fish yield are affected developed fishing technologies, advancement of knowledge of fishers, growth of facilities. Due to the fishers' experiences, half of the fishers say that 50 percent of fish yield has beendecreased and, 23.7 percent of fishers say that by 75 percent of fish yield have been decreased in the recent decades. The study shows thatusing bad fishing methods such as dynamite and light course method affected for decreasing the fish yield.In the study, 38.5 percent of fishers haveagreed with this.

Conclusion

As concern the degradation of fish resources due to human population increase, there were considerable depletion of fish resources in the past few decades. In the recent time, many fishers engage in the fish industry throughout the year, especially in the near shore coastal area. They do not concern the fishing season and using the high level technology, instruments and other facilities, as a result they caught large fish harvest.For the decrease of fish yield is affected several reasons such as over exploitation of fish resources, throw away destroyed fish in bycatch, and these activities severe further by some reasons such as developed fishing technologies, advancement of knowledge of fishers, growth of facilities such as instruments, boats, developed communication, and aware of the regular weather forecast. To avoid the fish resources needed to stop the Bycatch fishery, because this method is cause for loss of biological diversity and changes in ecosystem stability and banded the use of harmful nets such as Moxy nets, bottom-set nets course nets, surukku nets and Lila nets. Further, a policy framework should develop for access and allocation of fishery resources and conservation of coastal fishery resources.

Keywords: By-Catch; Over Exploitation; Moxy Net; Post-Harvest; Southern Coast

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