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An Assessment of Coastal and Bank fisheries in Mauritius: Analysis of CPFD Trends

[1] R. Soobhug, [2] M.R. Lollchund, [3] K. Boodhoo
[1] Department of Physics, Faculty of Science, University of Mauritius, Réduit 80837, Republic of Mauritius, [2] Department of Physics, Faculty of Science, University of Mauritius, Réduit 80837, Republic of Mauritius, [3] Department of Chemistry, Faculty of Science, University of Mauritius, Réduit 80837, Republic of Mauritius. [1] ritesh.soobhug@gmail.com, [2] r.lollchund@uom.ac.mu, [3] kishore.boodhoo@uom.ac.mu

Abstract— Marine capture fisheries are crucial for food security and economic stability, yet they confront escalating threats from anthropogenic activities and climate change. This study focuses on the coastal and bank fisheries of the Republic of Mauritius, a Small Island Developing State (SIDS) which is highly reliant on fisheries. We analyze a decade of catch data sourced from the Ministry of Blue Economy, Marine Resources, Fisheries, and Shipping, by studying catch composition and trends in Catch Per Fisherman Day (CPFD). Our analysis reveals intriguing patterns in CPFD across different regions. Coastal fisheries exhibit fluctuations in CPFD for various fishing methods, signaling the necessity for adaptive management strategies. In contrast, bank fisheries demonstrate more stable CPFD trends, possibly due to the unique characteristics of these fishing grounds. These findings offer valuable insights for fisheries management and conservation efforts in Mauritius. They emphasize the significance of sustainable practices and adaptive management to safeguard the future of these vital marine resources amidst environmental challenges.

Index Terms —Bank Fisheries, Catch Per Fisherman Day (CPFD), Coastal Fisheries.

I. INTRODUCTION

The Republic of Mauritius encompasses an extensive Exclusive Economic Zone (EEZ) spanning 2.3 million km², which includes a continental shelf of 396,000 km² jointly managed with the Republic of Seychelles and the Chagos region (Fig. 1) [1]. Leveraging this expansive marine domain, the Government of Mauritius envisions to further develop its ocean-based economic activities, with a specific focus on the fisheries industry: coastal and bank fisheries [2].

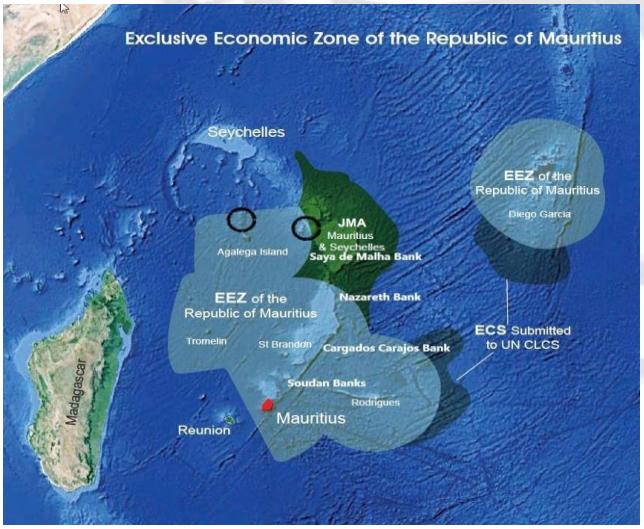

Fig. 1: Google Map showing the Exclusive Economic Zone of the Republic of Mauritius [1].

Coastal fishery activities cover both lagoon and off-lagoon areas, while bank fisheries concentrate on fishing banks such as Albatross, Saya de Malha, Nazareth, Soudan, and lagoon areas of Saint Brandon [3]. Fishermen utilize various fishing gears, including handline, large nets, gillnets, canard nets, hooks and lines, and basket traps in lagoons and off-lagoon areas. Handline and bottom line are predominantly used in bank fisheries. The primary species caught include Serranidae (groupers/vieilles), Siganidae (rabbitfish/ cordonnier), Lethrinidae (emperors/dame berri), Lutjanidae (snappers), Scaridae (parrotfish), Mullidae (goatfish/ rougets), Mugilidae (mullets), Acanthuridae (surgeonfish/ licornes), octopus, and lobsters [4].

Notably, the Government of Mauritius has instituted a closed season for octopus fishing, prohibiting octopus fishing from 15 August to 15 October and from 15 January to 15 March to preserve and sustain this valuable fishery resource [5]. However, climate change is emerging as a critical concern, potentially causing adverse effects on Mauritian fisheries and marine resources. Rising atmospheric and ocean temperatures contribute to coral reef bleaching, soil and beach erosion, increased drought and flash flood risks, intensification of tropical storms, sea level rise, and biodiversity impacts [3].

The aims and objectives of this study include analyzing trends in Catch Per Fisherman Day (CPFD) across various fishing regions around the island, with a specific focus on coastal and bank fisheries. Through this exploration, we aim to contribute to knowledge and provide insights that can aid in the conservation and sustainable management of these precious marine resources.

II. Data and Method

A. Site Description and Data Sources

For this study, a decade of time series coastal and bank fisheries datasets has been obtained from the Ministry of Blue Economy, Marine Resources, Fisheries, and Shipping. This Ministry records the reported fish catch data from 61 landing stations around the island (see Fig. 2) and categorizes them into three strata (North, East and West).

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Fig. 2: A map of the Island of Mauritius showing the 61 fishing landing stations grouped into three strata (North, East and West).

The dataset spans from 2005 to 2015 and includes reported fish catches from the fishing landing stations. The analysis conducted in this article involves the cumulated catch per strata and aims to provide insights into the trends and sustainability of lagoon-based fishing practices.

B. Catch Per Fisherman Day

We examine the reported catches using the Catch Per Fisherman Day (CPFD) parameter, which is a fundamental metric also known as Catch Per Unit of Effort (CPUE), to assess the productivity of both coastal and bank fisheries [6,7]. CPFD is calculated using Equation (1).

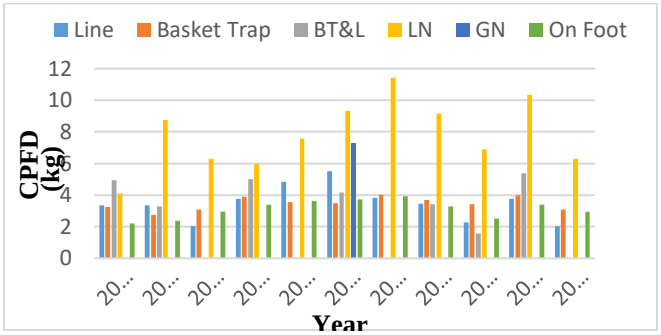
$$\mathbf{CPFD} = \frac{\mathbf{Catch}}{\mathbf{No.\ of\ Fisherman\ Days}} \quad (1)$$

Here, 'Catch' (in kg) refers to catches of fishery products, and 'No. of Fisherman Days' represents the total number of days on which the fishing took place. This parameter serves as a key indicator for evaluating the efficiency and productivity of fishing efforts in both coastal and bank fisheries.

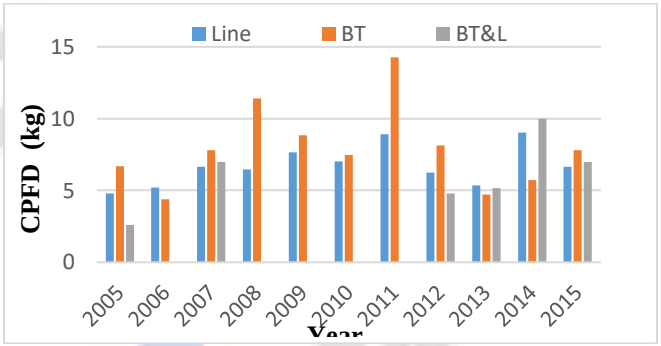
III. RESULTS

A. Coastal Fisheries

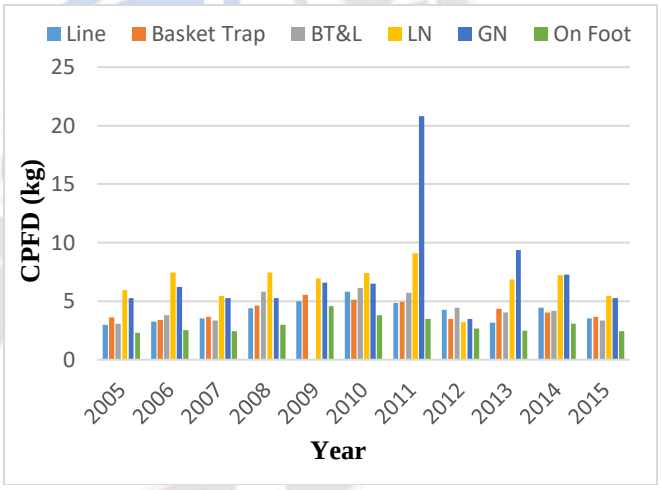
We examined Catch Per Fisherman Day (CPFD) trends for various fishing methods in lagoon areas, including Line, Basket Trap (BT), BT&L (Basket Trap and Line), LN (Large Nets), GN (Gillnets), and On Foot. Fig. 3 illustrates the corresponding Yearly CPFDs Coastal Lagoon Fisheries and the main observations for each graph are summarized in table 1.



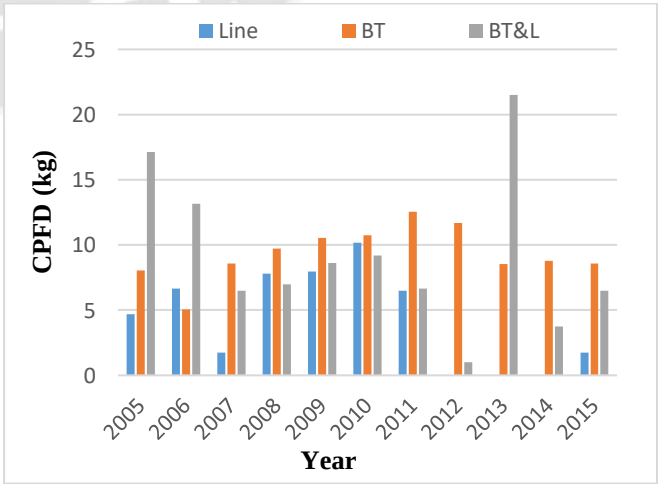
(a) Northern Lagoon.



(b) Northern Outer Lagoon.



(c) Eastern Lagoon.



(d) Eastern Outer Lagoon.

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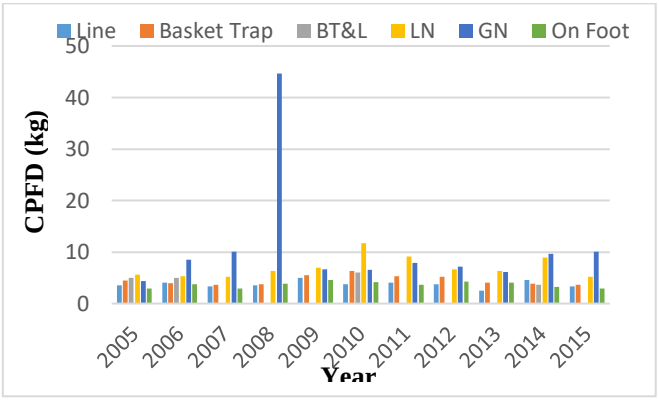
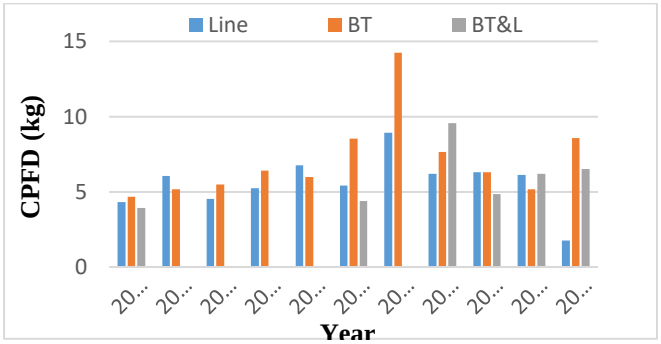


(e) Western Lagoon.



(f) Western Outer Lagoon.

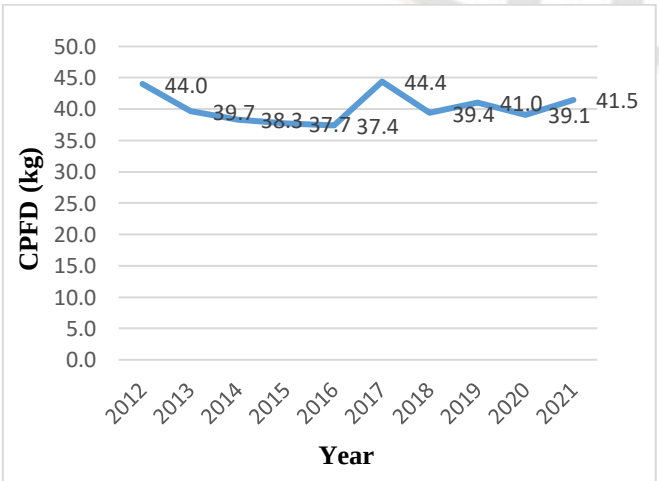
Fig. 3: Yearly Catch Per Fisherman Day (CPFD) (in kg) for Coastal Lagoon Fisheries.

Table I: Summary of results for Coastal Lagoon Fisheries (Fig. 3).

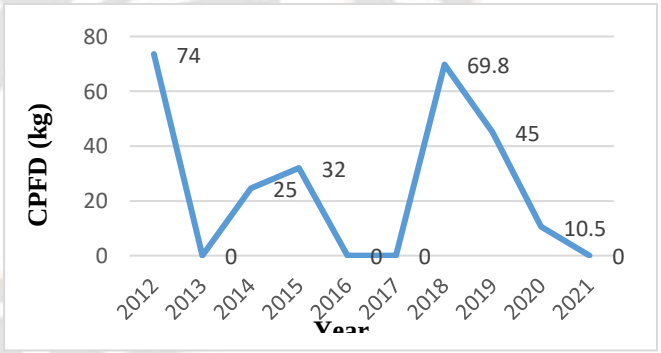
Region	Graph	Main Observation
Northern lagoon	(a)	The CPFD shows a declining trend when comparing the CPFD (14.4 kg) in 2015 to CPFD (17.5 kg) in 2005.
Northern outer lagoon	(b)	A significant decline in CPFD was noted from 2007 to 2010 and 2011 to 2013, with differences of 6.9 kg and 7.9 kg, respectively.
Eastern lagoon	(c)	From 2005 to 2011, a significant increase in CPFD was recorded with 25.5 kg. A sharp decline in CPFD was noted with 27.2 kg between 2011 and 2012.
Eastern outer lagoon	(d)	A sharp decline in CPFD was noted from 2005 to 2007 with a difference of 13 kg. Afterwards, there was a significant increase in CPFD with 13.3 kg, followed by a decrease in CPFD by 17.4 kg.
Western lagoon	(e)	From 2005 to 2008, a significant increase of 36.2 kg in CPFD was observed, followed by a decrease of 39 kg in CPFD for the period 2008 to 2013.
Western outer lagoon	(f)	From 2005 to 2007, a slight decrease of 2.9 kg in CPFD was observed, followed by a notable increase of 13.4 kg in CPFD for the period 2007 to 2012.

B. Bank Fisheries

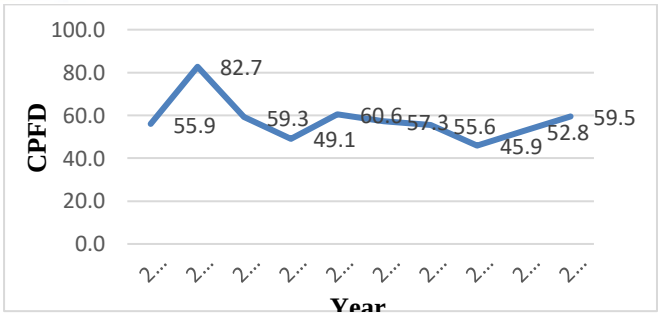
For bank fisheries, the primary fishing gears are handline, bottom line, longline and basket trap. Fig. 4 displays the yearly trends of CPFDs for Bank Fisheries, and the corresponding main observations are summarized in table 2. For the shallow water species of Saint Brandon, CPFD has not been analyzed as the data for fisherman days is unknown. Only catch data has been used for analysis.



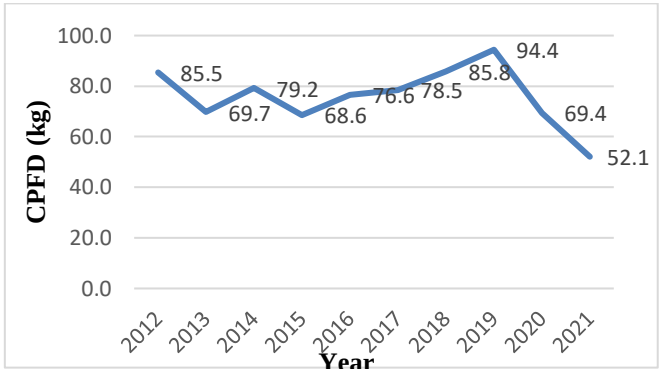
(a) Albatross - Shallow water species.



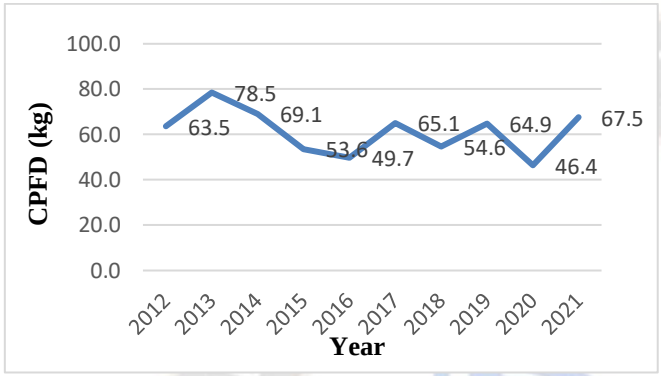
(b) Albatross - Deep water species.



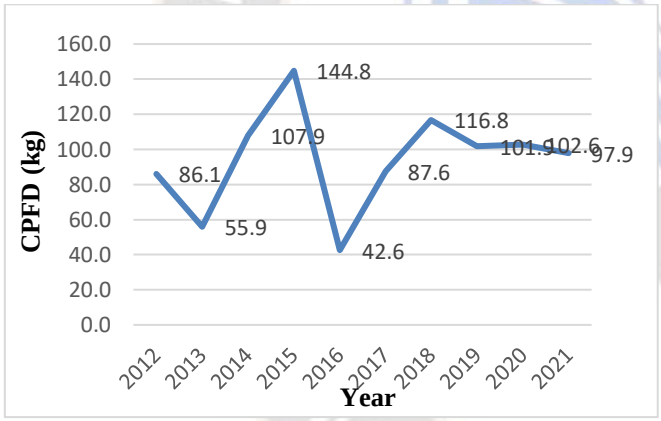
(c) Nazareth - Shallow water species.



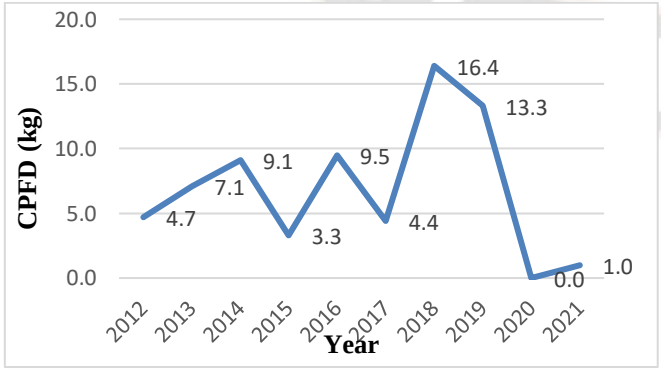
(d) Nazareth - Deep water species.



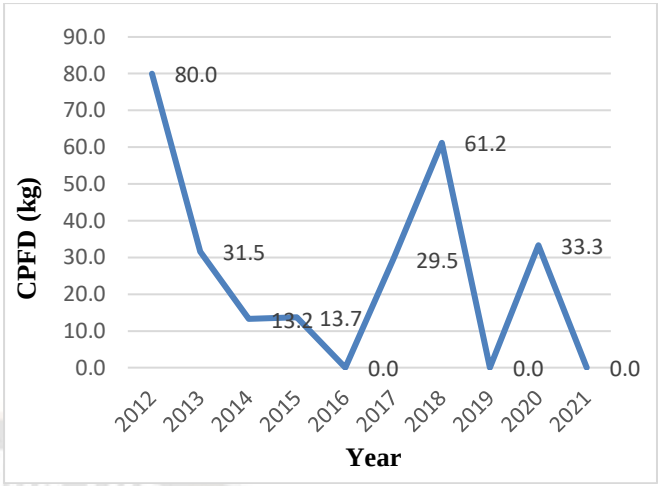
(e) Saya de Malha - Shallow water species.



(f) Saya de Malha - Deep water species.

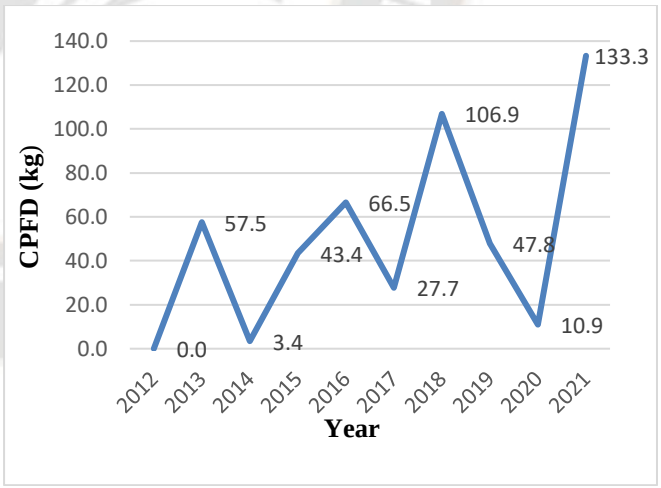


(g) Soudan - Shallow water species.



(h) Soudan - Deep water species.

(i) Saint Brandon - Shallow water species



(j) Saint Brandon - Deep water species.

Fig. 4: Yearly trends of Catch Per Fisherman Day (CPFD) (in kg) for Bank Fisheries and yearly trend of Catch (in kg) for Saint Brandon Shallow Water Species (Fig. 4(i)).

Table II: Summary of results for Bank Fisheries (Fig. 4).

Region	Species	Graph	Main Observation
Albatross	Shallow water	(a)	From 2012 to 2016, the CPFD has decreased from 44.0 kg to 37.4 kg. An increase of 7 kg in CPFD was observed from 2016 to 2017.
	Deep water	(b)	The CPFD is zero for 2013, 2016, 2017 and 2021 as there was no fishing activity. In 2012, the CPFD was 74 kg, followed by a decline with 25 kg in 2014 and a slight increase with 32 kg in 2015.
Nazareth	Shallow water	(c)	From 2012 to 2013, the CPFD has shown a considerable increase with 26.8 kg. A decrease of 33.6 kg in CPFD was observed from 2013 to 2015. The CPFD has shown a declining trend from 2016 to 2019 with differences of 3.3 kg between 2016 to 2017 and 9.7 kg between 2018 and 2019.
	Deep water	(d)	Between 2014 to 2019, the CPFD has considerably increased from 79.2 kg to 94.4 kg. From 2019 to 2021, the CPFD has significantly decreased with a difference of 42.3 kg.
Saya de Malha	Shallow water	(e)	Between 2013 and 2016, a significant decrease was found with 28.8 kg. The CPFD was then more or less unstable showing ascending and descending trends between 2016 and 2020.
	Deep water	(f)	A decrease of 30.2 kg, 102.2 kg and 18.9 kg was noted for the period 2012-2013, 2015-2016 and 2018-2021. However, an increase of 88.9 kg and 74.2 kg was recorded for the period 2013-2015 and 2016-2018.
Soudan	Shallow water	(g)	A decrease of 5.8 kg, 5.1 kg, 3.1 kg and 13.3 kg was noted for the period 2014-2015, 2016-2017, 2018-2019 and 2019-2020. An increase of 4.4 kg, 6.2 kg and 12 kg was found for the period 2012-2014, 2015-2016 and 2017-2018.
	Deep water	(h)	For the period 2012-2016, 2018-2019 and 2020-2021, a declining trend of CPFD was observed while the CPFD was increased during the period 2016-2018 and 2019-2020.
Saint Brandon	Shallow water	(i)	Between 2012 and 2019, fish catch has shown a significant increasing trend. A decline in fish catch was then observed from 2019 to 2021.
	Deep water	(j)	Highest CPFD was recorded in 2021 and 2018 with 133.3 kg and 106.9 kg respectively while the lowest CPFD was recorded in 2014 and 2019 with 3.4 kg and 10.9 kg respectively. A notable decline in CPFD was observed between 2018 and 2020 with a difference of 96 kg.

IV. DISCUSSION

The present study marks an initial attempt to understand the dynamics of fishing activities in both coastal and bank fisheries, with a specific emphasis on the Catch Per Fisherman Day (CPFD). Several factors have the potential to influence CPFD, including fishing techniques [2] and factors affecting targeted organisms, such as water temperature, substrate size, and the presence of predators [6].

Fishermen typically operate with multiple gears to target diverse species. CPFD serves as an indicator of the effort and inputs required by fishermen to catch fish. Higher CPFD values are assumed to be associated with fishing grounds abundant in fish [2]. Different fishing gears exhibit diverse CPFD trends. Line fishing and on-foot fishing methods seem to maintain relatively stable catch rates over the years, suggesting that these approaches may be less susceptible to external factors or regulatory changes. Conversely, methods like Basket Trap (BT), BT&L, large net, and gillnet fishing show more variable CPFD trends, hinting at potential sensitivity to environmental shifts or alterations in fishing practices.

In spite of the management initiatives by the Government of Mauritius, there is an observable declining trend in CPFD for some banks and lagoon areas, indicating potential risks to fisheries resources. Comprehensive scientific studies are thus imperative to establish the intricate links between CPFD and oceanic and climatic factors. This insight is crucial for informed and sustainable fisheries management in the region.

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