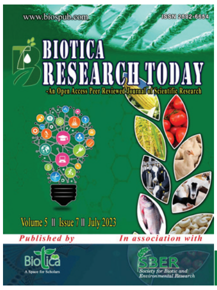

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Article ID: RT1379 **Case Study**

Carbon Emissions from Kerala Reservoirs: An Estimation Study

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Abstract

Reservoirs in Kerala serve a variety of purposes, including fisheries, which can potentially contribute to greenhouse gas (GHG) emissions. This study attempts to estimate methane and carbon dioxide (CO_2) emissions from reservoir fisheries as a precursor for promoting it as sustainable development. The carbon emissions from small, medium and large reservoirs from Kerala were estimated at 314.25, 644.82 and 184.8 tonnes km^{-2}day^{-1}. Despite being conserved, Peechi reservoir alone is a source of 1.2 tonnes of methane km^{-2}day^{-1} and 36 tonnes of carbon dioxide km^{-2}day^{-1}, respectively. GHG emission from Pothundi reservoir can be estimated at 1.089 tonnes km^{-2} of CO_2 eq. and 0.363 tonnes km^{-2} of CH_4. These carbon foot print estimates where less compared to the same from aquaculture ponds and marine fisheries of India. This in turn explains the need for development for reservoir fisheries as it adheres to sustainable development goals.

Keywords: GHG, Kerala, Reservoirs, SDG

Introduction

Reservoirs are artificial structures envisaged and constructed for hydroelectric power generation, water supply, irrigation and fisheries. In India, reservoirs are one of the abodes of inland fish diversity. These reservoirs offer a variety of ecosystem services ranging from provisioning to supporting services. One of the major regulating services offered by reservoirs is climate management and carbon storage. Reservoirs can act as either carbon sinks or sources, depending on factors such as their age, location and climate. The magnitude of carbon burial and greenhouse gas emissions in reservoirs depends on productivity, land use, geology, water body type and watershed morphometric (Phyoe and Wang, 2019). Studies by St. Louis *et al.* (2000) estimated the rate of carbon emission in mg m^{-2}day^{-1} from different bodies of water as in table 1. No serious attempts have been made to estimate greenhouse gas emission from the reservoirs of Kerala. In this scenario, this study attempts to estimate methane and carbon dioxide (CO_2) emissions from reservoir fisheries as a precursor for promoting it as sustainable development.

Methodology

The study used the estimation methodology adopted by St. Louis *et al.* (2000). The area of the reservoirs of Kerala is obtained from (DoF, 2023). The carbon monoxide and methane gas emissions for reservoirs of Kerala is obtained by multiplying the area of reservoirs of Kerala with the respective GHG emission values in mg m^{-2}day^{-1} extracted from St. Louis *et al.* (2000).

Table 1: GHG emissions from waterbodies (St. Louis *et al.*, 2000)

Location	Carbon dioxide	Methane
Lakes	700	9
Temperate reservoirs	1500	20
Tropical reservoirs	3000	100

NB: Unit measured in mg m^{-2}day^{-1}

Article History

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Emissions from Reservoirs in Kerala

Recent surveys in Kerala have identified 51 reservoirs in Kerala (DoF, 2023). Table 2 shows the estimated average GHG emissions from reservoirs in Kerala.

Table 2: GHG emissions from reservoirs in Kerala

Type of Reservoirs	Small	Medium	Large
Number	37	13	1
Area (m^2)	10,47,50,000	21,49,40,000	6,16,00,000
Methane gas emissions estimates (tonnes km^{-2} day^{-1})	10.475	21.494	6.16
Carbon dioxide emissions estimates (tonnes km^{-2} day^{-1})	314.25	644.82	184.8

Case Studies in Relation to Reservoirs of Kerala

Reservoirs in Kerala are not exclusively under the fisheries department. A string of line departments are associated with reservoir management. This forces the fisheries department to undertake fisheries activities in certain reservoirs and to conserve other reservoirs. In this scenario, we can categorise reservoirs in Kerala into 2 categories: one for conservation and the other for fisheries.

Reservoir fisheries in Kerala are a traditional sector without any motorised crafts. The LCA (Life Cycle Assessment) of fishing in these reservoirs encompasses mainly the pre-harvest phase which mainly constitutes the carbon emission associated with fishing inventories. Since the marketing of the harvested fishes are done in the landing centres nearby, the emissions due to marketing are negligible. System boundary was drawn to understand the processes (Jha *et al.*, 2021) of input and output in reservoir fisheries of Kerala (Figure 1).

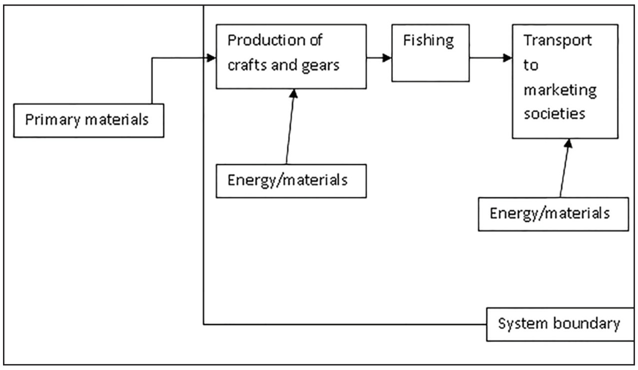

Figure 1: System boundary of reservoir fisheries of Kerala

Conserved Reservoirs

Peechi reservoir is a reservoir in which the forest department is the main stakeholder. Fishing activities only are allowed in this reservoir. This reservoir built across the Manali River in Thrissur district of Kerala state has a catchment area of nearly 3,200 acres (1,300 ha). Fishermen use gillnets of around 3 kg of different mesh sizes ranging from 30 mm to 180 mm and wooden boats of 12 ft length for fishing. This tropical reservoir alone is a source of 1.2 tonnes of methane km^{-2} day^{-1} and 36 tonnes of carbon-dioxide km^{-2} day^{-1}, respectively. Since only small-scale fishing is done here and landings are marketed through co-operative societies which are at a walkable distance from the reservoir, GHG emissions will be very low compared to culture-based reservoirs. Studies by Jha *et al.* (2021) found that the wooden boats emit 0.211 kg CO_2 eq. kg^{-1} of the functional unit.

Fisheries Reservoirs

Pothundi reservoir situated in the Palakkad district of Kerala extends over 363 ha of area. Reservoir fishing is well-developed in this reservoir. Fishermen use 4-5 kg of mono-filament gill-net (30-200 mm mesh size) and FRP (Fibre rein-forced plastic sheathed wooden boats) for fishing. Studies by Jha *et al.* (2021) found that for producing 1 kg of FRP, 4.97 (~5.0) kg C are emitted. Hence GHG emission from Pothundi reservoir can be estimated at 10.89 tonnes km^{-2} of CO_2 eq. and 0.363 tonnes km^{-2} of CH_4.

The reservoir fisheries which are emerging in Kerala can be considered organic and more environmental friendly. The carbon footprint to harvest 1 kg of fish from aquaculture ponds and marine fisheries of India was reported at 0.614±0.593 CO_2 eq. kg $fish^{-1}$ and 1.312 CO_2 eq. tonne $fish^{-1}$. This is very high when compared to reservoirs.

Conclusion

The present study highlights that reservoir fisheries of Kerala emit only 10.475 km^{-2} day^{-1} of GHG compared to marine fisheries. The LCA of fishing in reservoirs encompasses the pre-harvest phase, including the construction of fishing vessels, gear and accessories. The marketing of harvested fishes done in nearby landing centres reduces the emissions. The current investigation thus emphasizes the effective utilization of reservoir fisheries as it ensures reduced GHG emissions from freshwater ecosystems (sustainable development goal 6).

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