



Research Note

Stake Net Fishery of Central Kerala – Costs, Returns and Seasonality

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Stake net fishing in Vembanad Lake plays a vital role in the local economy and to food security. The study analysed the cost and return and seasonality of stake net fishery in Vembanad Lake, Kerala, India. It faces significant challenges threatening its sustainability. High-value prawns comprise of 65% of landings from fishery and account for more than 70% of the revenue realisation. The annual net profit is less than Rs.2 lakhs per stake net unit which again is shared among the crew of 3 to 4 members, which is only nominal considering the fishing effort. The average catch during lean months is currently reported to be as low as 9.49 kg per unit. The net present value of stake net fishing unit was computed as Rs.10.26 lakhs. The study points to seasonality in fish landings.

Keywords: Stake net, sustainability, Vembanad lake, seasonality, livelihood, costs and returns

Kerala's fishing industry has been supporting the livelihood of its coastal people, with an estimated number of 10.44 lakh fishers employed in fishing and associated activities. A highly competent community of fishers harness the rich fishery resources, making Kerala a prominent producer and consumer of seafood. Total fish production in Kerala was 8.26 lakh MT during 2021-22 with marine resources contributing 73%. The share of fisheries in the primary sector is 15.19% in the year 2021-2022 (Government of Kerala, 2024). The export of fish and fishery products from Kerala stood at 2.26 lakh tonnes valued at Rs.7662.78 crores in the year 2022-23 (MPEDA, 2024).

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Kerala's fisheries sector is characterized by a wide range of fishing gears and practices tailored to diverse aquatic environments. The overall number of fishers who make a living from the state's inland waters is estimated to be 2.42 lakhs, with the number of active fishers in the inland sector being about fifty thousand (Govt. of Kerala, 2024). Sustainable management practices are essential to ensure the long-term viability of these fisheries.

The backwaters of Central Kerala are rich prawn fishing grounds, conducive for small-scale fisheries all round the year (Ansar et al., 2017; Menon & Raman, 1961). The backwaters are connected extensively through a network of canals forming rich fishing grounds and also to the paddy fields bordering the 'Vembanad Kayal' at about the middle of the chain.

The Stake net fishery in Vembanad Lake is deeply embedded in the region's socio-economic fabric, playing a crucial role in sustaining livelihoods of inland fishers, organised under various *Dheevara* community groups which constitute a small minority. Vembanad wetland system has an area of more than 1512 km² spanning the districts of Alappuzha, Kottayam, and Ernakulam (Kurup, Sebastian, Sankaran, & Rabindranath, 1993). Stake net fishing is intricately linked to the tidal phenomenon facilitated by the lake's unique ecosystem. Fishermen strategically utilize these natural dynamics for their fishing operations.

Built as India's largest mud regulator, the Thannermukkom barrier, a distinctive feature of the lake, serves to prevent tidal action and saltwater incursion into the Kuttanad lowlands. The Thannermukkom barrier, while beneficial for agriculture, poses challenges that necessitate careful environmental management to ensure the long-term health and productivity of the lake's ecosystem and

the viability of stake net fishing as a sustainable practice. The barrier has led to the division of the lake into two distinct ecosystems: one with brackish water and another with freshwater fed by rivers (Kolathayar, Krishnan, & Sitharam, 2021). This ecological partition has both positive and negative effects. It has aided agricultural activities in Kuttanad by maintaining favourable water conditions for cultivation below sea level. It has contributed to ecological issues such as proliferation of Water Hyacinth in the freshwater areas, affecting biodiversity and fisheries.

In essence, stake net fishing in Vembanad Lake not only supports the livelihoods of a significant number of families but also underscores the complex interplay between human activities, ecological management, and socio-economic sustainability. The present study was conducted in Kerala with the objective of analysing the trend and seasonality of catch from stake net fisheries and its economics of operation.

Stake nets are stationary set bag nets, which are placed in running water that filters out prawns and fish that are carried passively by the current and kept by the force of the river. The structure of the stake net unit includes a large vertical wall of netting supported by a line of strong wooden poles placed perpendicular to the flow of water, designed to disrupt the natural swim of the fish and push them. The conical shape of the net protects it from tides and currents in the backwaters and sea (Boopendranath & Hameed, 2010). Stake nets are common in the backwaters of the Astamudi and Vembanad, as well as in areas with strong tidal currents and is known locally as 'oonnivala.' Fishermen practice *pakkashshippu*, an indigenous method of resource conservation that involves limiting fishing effort (Thomas, Archana, & Edwin, 2019). Certain communities use the *Paadu* method to ensure control over fishing effort.

Stake nets are operated in accordance with the moon phase as the moon cycle has a strong impact on prawn behavior, abundance, and migration. Fishers operate stake nets during the full moon and new moon phases of each lunar month, for 6-8 days duration in each phase. The limitation of stake net operations to the lunar phase guarantees natural resource conservation through the management of fishing efforts (Thomas et al., 2019). However, this sector is plagued by issues like the catch of

undersized fish, pollution, resource depletion, invasive weed menace and conflicts that challenge the very sustainability of the fishery.

The paper outlines the trends in fish landing, seasonality, cost of operation and revenue from stake net fishing carried out at Vembanad lake.

A sample of 200 stake net fishing units operating in Ernakulam and Alappuzha were studied for their catch trend using secondary data.

Both primary and secondary data was collected from stake net fishing units. A cross-sectional survey of stake net fishermen operating in Edakochi, Perumpadappu and Aroor was carried out using a structured schedule. Primary data on costs and returns of stake net fishing units operating in Vembanad lake were collected from 30 fishermen in the year 2019 and was used for economic analysis. Secondary data was collected covering 55 stake net units in Edakochi, 5 units from Perumpadappu and 140 units in Aroor region spanning across Alappuzha and Ernakulam for the period 2017 to 2021. The stake net units were selected on the basis of continuous data availability to study the seasonal variation in the landings. The sample size was proportional to total units operating in each study area. The data was collected from the records maintained at fishermen Societies namely, *Dheevara Vamshodhaya Sabha* at Perumpadappu, *Jnanodaya Sabha* at Edakochi and *Ezhupunna Ulnadan Matsya Thozhilali Vikasana Kshema Sahakarna Sangam*, Aroor. The Societies maintain record of daily landings from registered stake net units which could be utilised for compiling the timeseries data required to carry out the study. Aroor, located in Alappuzha district is the major epicentre of stake net fishery. These three active fishermen societies boast themselves with more than a thousand members on their roll. The secondary data were then computerized and subjected to analysis. Besides descriptive statistics, seasonal decomposition and economic analysis has been carried out.

Financial analyses were used to assess the financial viability, stability and profitability of the stake net fishing operations. Under the annual fixed cost, the annual cost for depreciation was calculated based on 12 years, interest on capital, maintenance of gear & stake poles were included. The methodology used for financial analyses were Net Present Value (NPV), Benefit Cost Ratio (BCR), and Internal Rate of Returns (IRR) and details are given below:

The NPV is difference between the discounted present value of future benefits and the discounted present value of future costs.

$$\text{Net Present Value (NPV)} = \sum_{t=0}^n \frac{B_t - C_t}{(1 + r)^t}$$

When the present value of benefits is divided by present value of costs we get BC Ratio.

$$\text{Benefit/Cost Ratio (BCR)} = \frac{\sum_{t=0}^n \frac{B_t}{(1 + r)^t}}{\sum_{t=0}^n \frac{C_t}{(1 + r)^t}}$$

The discount rate at which the NPV becomes "0" is called the Internal Rate of Return (IRR).

$$\sum_{t=0}^n \frac{B_t - C_t}{(1 + \text{IRR})^t} = 0$$

Where, r = the interest rate (cost of financing the project)

Here,

B_t = Benefits at time t

C_t = Costs at time t

r = Discount rate

t = Time period (from 0 to n)

n = Total number of time periods

The seasonal trend analysis of stake net catch was analysed using *stl* routine in R, which is based on LOESS regression, a nonparametric technique that uses local weighted regression to fit a smooth curve through points in a scatter plot. LOESS curves can reveal trends and cycles in data that might be difficult to model with a parametric curve (Cleveland & Devlin, 1988). STL is a filtering procedure for decomposing a time series into trend, seasonal and remainder components (Cleveland, Cleveland, McRae, & Terpenning, 1990). The analysis was carried out using R package (version 4.2.3)

Suppose $x_i, y_i, i=1,2,\dots,n$ are measurement of an independent and dependent variable respectively. The LOESS regression curve $\widehat{g}(x)$ is a smoothing of y given x that can be computed for any value of x along the scale of the independent variable. The data for the years 2017 to 2021 was used.

The license to operate stake nets in Vembanad lake is issued by the respective Panchayats, the validity of which is one year and has to be renewed. Fishing using a stake net always depends on tidal current locally called *thakkam*. Stake net fishing is confined to 4 to 5 hours in a day and the fishers need to follow *thakkam* timings which involves working in odd hours like midnight to early morning to fish in the water. The number of fishing days in a month varies according to season and the maximum is upto ten days. The income of the fisherman also varies according to season ($p < 0.05$) and depends upon the catch volume. Three prawn species dominate the fishery: Thelly (*Metapenaeus dobsoni*), Choodan (*Metapenaeus monoceros*), and Naran (*Fenneropenaeus indicus*) the landings of which abundantly occur during the December - March period (Nandakumar, 2004). The landing centre price per kg realized for Thelly, Choodan and Naran prawn varieties range from Rs.100 - 125, Rs.150 - 200 and Rs.250 - 300 respectively and it could be observed that 70% of the revenue realized is from the landing of these prawns.

The costs and returns of stake net fishing units operating in Vembanad lake were collected from 30 fishermen for the year 2019 (Table 1). The items of capital cost included the expenses for stake poles, gears (nets), canoe, engine, light, ropes and baskets. The total capital investment towards a stake net unit is Rs.1.69 lakhs of which 39% was incurred towards the stake poles which get fixed across the waterbody. The fisherman spends 23% for purchase of gear. The total annual operating cost per stake net unit was Rs.5.03 lakhs. An average bank rate of 10% was taken as the opportunity cost of capital. The average gross revenue amounts to Rs.7.70 lakhs per fishing unit and Benefit Cost Ratio was computed at 1.31. An amount of Rs.175 is paid labour charges during fishing operations. Activities of women in this fishery is limited to sorting the landed fish into baskets and are paid Rs.60 to 100 depending on number of hours of work.

Table 1 indicates that the bulk of the revenue was realized from shrimps with an average annual net profit of Rs.1.84 lakhs. Stake net fish catch was sold through a well-laid marketing system through the fish markets located in the proximity of the landing centres. The fishermen's welfare Societies aided these small-scale fishers in facilitating the auctioning of fish. The major buyers are peeling shed owners and the common public. It noted there was

no direct purchase of this by any company, though it is highly desired by the auctioneers. The auctioneers get a monthly salary from their parent societies for the work undertaken. The fishermen welfare Societies are well established with sound financial status to carry out welfare activities among the community offering financial loan to the members, which include both fishermen and elder members of their families. Societies usually charge a 5% commission from the fishing units for trading fish in the market. The fishermen societies distribute bonus to the tune of 1% to 3.5% during festivals. Fixed deposits are encouraged among the members

Table 1. Economics of stake net operated by artisanal fishers along the Vembanad backwaters (2019)

Sl. No.	Particulars	Cost & Returns (Rs.)
I	Investment	
	Stake pole (Fixed)	66,400
	Gear erecting pole light	4,000
	Canoe (Fibre/wooden)	33,000
	Engine (2HP)	22,000
	Gear	38,500
	Misc. (Basket, utensils etc)	5,000
	Total investment	1,68,900
II	Annual fixed cost	
	Depreciation	11,000
	Interest on fixed capital	16,890
	Gear maintenance	38,500
	Stake pole maintenance	16,600
	Total annual fixed cost	82,990
III	Annual variable cost	
	Labour	4,40,000
	Fuel	13,200
	Tax	4,000
	Interest on working capital	45,720
	Total annual operational cost	5,02,920
IV	Total annual cost	5,85,910
V	Returns	
	Shrimps	6,60,000
	small fishes	1,10,000
	Gross Revenue	7,70,000
VI	Annual net profit	1,84,090
VII	Benefit cost ratio (BCR)	1.31
VIII	Net Present Value (NPV)	10,26,776
IX	Internal Rate of Return (IRR)	109%

and the current interest rate (year) is competitive at the rate of 6.5% per annum. The Fishermen Welfare Society provides financial aid to SHGs amounting to Rs.6 to 7 lakhs for a group and Rs.30,000 to Rs.40,000 for individuals. The role of these societies as a facilitator and certifiers in terms of fishermen ID cards is vital as they also promote the Kerala Government's accident insurance policies for the benefit of fishermen. Apart from these, the society also runs *Chitty*, which is a combination of a recurring deposit and loan for its members.

The stake net fishery thrives on the huge landings of prawns constituting 65% of the quantity amounting to 78% of the revenue realised annually. The proximity of the fish processing hub in Alleppey and Ernakulam to the stake net landing centres favour the disposal of the catch at competitive prices. Juveniles of the three prawn species contributed substantially to the catch (Nandakumar, 2004). The average catch per trip varied from 9.49 kg to 17.25 kg with good fish catch realised during December to May prior to the monsoon season (Table 2).

A seasonal trend decomposition procedure (STL) based on LOESS was adopted to find out whether the stake net fish landings exhibit seasonality and trend in landings over the years 2017 to 2021 (Fig. 1). The data graphed in the top panel is the original month wise timeseries data recorded from 200 stake net fishing units recorded for five consecutive years from 2017. Seasonality was seen from the graph

Table 2. Fish landings from stake net fishery (2021)

Month	Number of fishing units covered	Average catch per unit (kg)
January	325	17.25
February	214	16.41
March	106	16.23
April	147	13.47
May	381	15.03
June	324	11.27
July	274	10.60
August	144	9.49
September	176	12.52
October	234	10.94
November	153	13.27
December	419	15.88

below with peaks during certain months repeated over the years. From the 3rd panel it is seen that fish landings from stake net also have a trend which is exhibited as occasional troughs in certain years. The year 2019 seems to have recorded bulk landings which was also true from the data. Landings of high value species is seasonal and aids in balancing the low catch during lean months.

The stake net fishery in Vembanad Lake operates under a traditional community-based resource management system, primarily governed by the *paadu* rotation system. The *paadu* rotation system

grants permission to eligible members of specific communities to fish in designated areas for defined periods (Thomas et al., 2019). This system is recognized for its success in managing fishing effort in small-scale fisheries worldwide. It ensures that fishing pressure remains within sustainable limits by controlling the number of fishing units operating at any given time (Jayawardane & Perera, 2003). The lunar phase-based fishing pattern complements the *paadu* system, further regulating fishing activities based on natural cycles. Initially, when stake net fishing consisted of only legally permitted units, the *paadu* method was carefully observed and extremely effective. Traditionally, *paadu* rights for stake net fishing are inherited through the paternal line (patrilineal). However, in cases where there are no male heirs, daughters or widows may inherit the fishing unit and license. Due to the physical demands of stake net fishing, which involves heavy labour, women often lease the fishing units to male counterparts within the community if they are unable to manage it themselves. Women often participate in fish collection and marketing activities.

Stake net fishing is currently prevalent in the major backwaters and brackish water bodies of Kerala and has a long and rich heritage of small-scale fishing, providing livelihood security to fisherfolk. Though the fishery seems to be economically sustainable, several aspects need urgent attention for a long-term sustainability. The annual net profit is less than Rs.2 lakhs per stake net unit which again will be shared among the crew members and is only nominal considering the fishing effort. Since the fishery has strong seasonality, the average catch during lean months is currently reported to be as low as 9.49 kg per unit. Introducing interventions like cage fish culture could help, leading to higher yields and consequently generate more income for fishers involved in the Stake net fishery. Effective governance, community participation, and monitoring will be essential for achieving the goals of sustainability and protect the lake for future generations.

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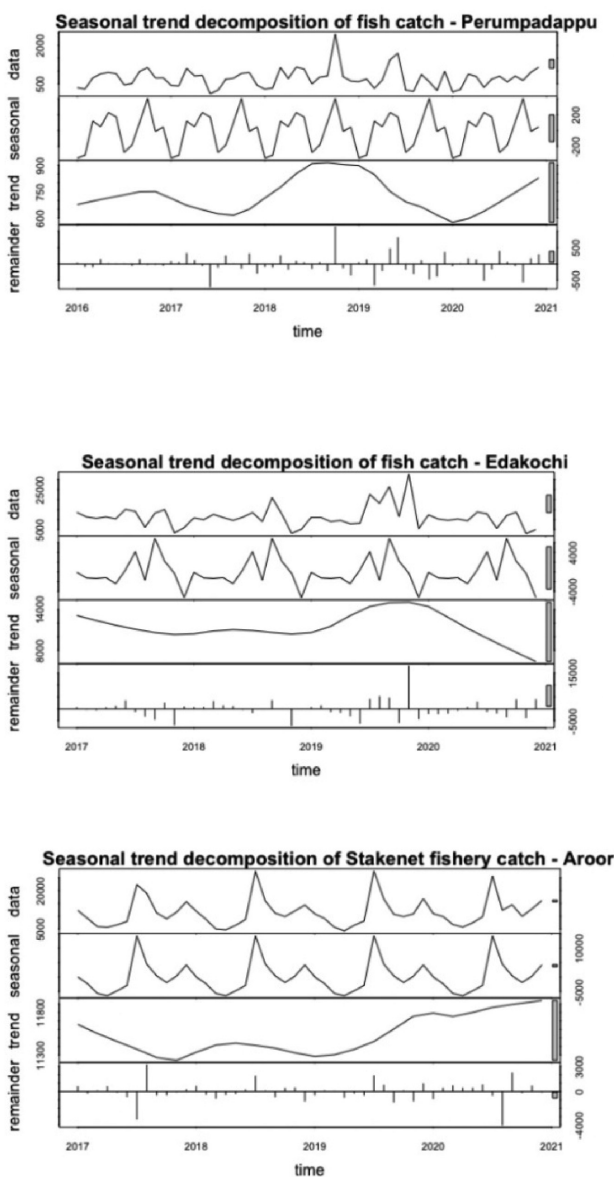


Fig. 1. Seasonal trend decomposition of stake net fish catch (2017 to 2021) from Vembanad lake

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