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Energy Analysis of the Stake Net Operations, in Vembanad Lake, Kerala, India

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Stake nets are fixed conical bag nets operated in the shallow waters and estuaries where the tidal currents are strong. The mouth of the net is kept open against the current by means of stakes driven to the bottom. Fish production and energy requirement in the traditional stake net operations, in Vembanadu lake, Kerala, India are discussed in this paper. Stake nets are primarily targeted at prawns, which drift with the tidal currents. Mean catch per year per stake net was estimated as 0.41 t and mean number of fishing days in a year was 210. Metapenaeus dobsoni formed the dominant component of the catch consisting 92.4%, followed by M. monoceros (6.0%) and Penaeus indicus (1.6%). Energy inputs in the stake net system has been estimated at 2.13 GJ. Fishing gear and stakes constituted 95% of the gross energy requirement (GER) the balance being contributed by the traditional plank canoe used for carrying the gear and catch. GER was estimated at 5.19 GJ.t fish^{-1} which was quite high for a stationary passively operated gear. The high GER value of this passively operated, non-motorised gear system is due to the low magnitude of landings by this gear. Energy efficiency ratio obtained was 0.65 and energy intensity value was 1.54.

Keywords : Stake net, fish production, gross energy requirement, Vembanad lake

The stake net is a form of stow net, operated in different parts of the world, in the artisanal sector (Brandt, 1984). Nedlec (1982) and Hameed & Boopendranath (2000) have grouped them as stow nets under the category of traps along with fyke nets and other trapping devices. Stake nets are passively operated stationary fishing gear. The principle of operation is filtration. The organisms which drift with the tidal current enter the net set against the current, and are filtered and retained in the codend.

Stake nets constitute one of the most important gear categories used for brackish water fishing in the Kerala state and elsewhere in India (Pillai & Gopalakrishnan, 1984; Kurien & Sebastian, 1986; Hridayanathan et al., 1990; Rao, et al., 1993; Parulekar & Achuthankutty, 1993; Thomas et al., 2007; Thomas et al., 2008a; 2008b). In the Vembanad backwaters, stake nets are widely operated in areas where the tidal currents are strong, particularly in the downstream regions. Total number of stake nets in operation in the backwaters of Kerala, has been reported to be 9200 in 1984 and their number rose to 12900 during 1987-90 (Sanjeevaghosh, 1993). The stake net is known as oonni vala in vernacular. Based on a survey, during 1988-89, Kurup et al. (1993) reported that stake nets ranked first in terms of the gear-wise landings, contributing 53.1% of the annual landings from the Vembanad lake. In this paper, a detailed description of the design, structure and operation of the stake nets in vogue in Kumbalam (Ernakulam Dist.), is given along with the results of energy analysis of the fishing system.

Materials and Methods

Energy analysis of selected fish harvesting systems and determination of Gross

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Energy Requirement per tonne of fish landed (GER.t fish^{-1}), Energy Ratio and Energy Intensity, were carried out following the methodology and conventions recommended by IFIAS (International Federation of Institutes for Advanced Study) (1975) and other authors (Edwardson, 1976; Mittal & Dhawan, 1988; EMC, 1991; Boopendranath, 2000; Boopendranath & Hameed, 2009).

Sources of energy inputs for construction of traditional crafts were collected from traditional craft builders of Chellanam (Ernakulam Dist.), as per the structured Schedule prepared for the purpose. Useful life-time of traditional crafts, was assumed to be 10 years for energy amortisation purposes. Data on design details and rigging of fishing gears were obtained by a survey of fishing gears, as per a structured Schedule prepared for the purpose. Useful life-time of fishing gears estimated for amortisation purposes was one year for stake nets.

Data on fish production were collected during 1997-98 from different landing points located in Kumbalam, according to a pre-fixed sampling schedule. Data on fishing operations were collected by discussions with the operators as per a structured Schedule prepared for the purpose and short onboard visits. Sample size and sampling frequency were 2.9% (6 units) and every three days, respectively.

Results and Discussion

Stake net fishing system consists of two components. The stake nets themselves which are set against the tidal current in the fishing area and the traditional two-men canoe used for collecting the catch at the end of each operation and for maintaining the gear.

The stake net is a conical bag net made of several cylindrical sections of the netting, diminishing in diameter progressively from the mouth to the codend. Variation in the structure and construction of stake nets operated in the backwaters of Kerala, has been reported by Hridayanathan, et al. (1990), Pauly (1991), Hridayanathan & Pauly (1993) and Thomas et al. (2007). Construction features and size have also been changed over a period of time and the designs operated in the area during the period of observation differed in certain aspects from the description given earlier by Hridayanathan, et al. (1990), Pauly (1991), and Hridayanathan & Pauly (1993). The design of stake nets operated in the Kumbalam area of the backwater system is given Fig. 1. Polyamide netting is used for the construction of the gear. The mesh size decreased from mouth to codend. The mesh size varied from 200 to 60 mm in the three front sections and from 18 to 12 mm in the following sections up to codend. The mesh size of the codend was 10 mm. Twine size in the corresponding sections varied from R635tex for 200 mm meshes, R235tex for 100 mm meshes and R155tex for the rest of the netting. Polypropylene ropes of 10 mm dia were used as framing ropes. The length of the upper and the lower frame ropes was 4.5 m each and that of the side frame ropes was 9.0 m each. Loops were provided at the four corners to facilitate bunching of a few meshes in the adjacent pieces of netting and for tying to the stakes. About 12.0 kg of webbing and 1.4 kg of polypropylene rope were used in the construction of the gear. Mouth area of the gear was 40.5 m^2.

Traditional non-motorised canoes are used by fishermen for installation of the stakes, setting the gear and for routine functions of tending the gear and collection of catch. Canoes of size 5.5 to 7.6 m, manned by 2-3 fishermen, are used for operations. Propulsion is by manual paddling.

Prior to the operations, stakes are installed in the fishing ground where tidal currents are strong. Usually, areca nut tree trunks are used as stakes. In addition to the main stakes, auxiliary stakes of smaller diameter obliquely placed as props are tied to the main stake for additional strength.

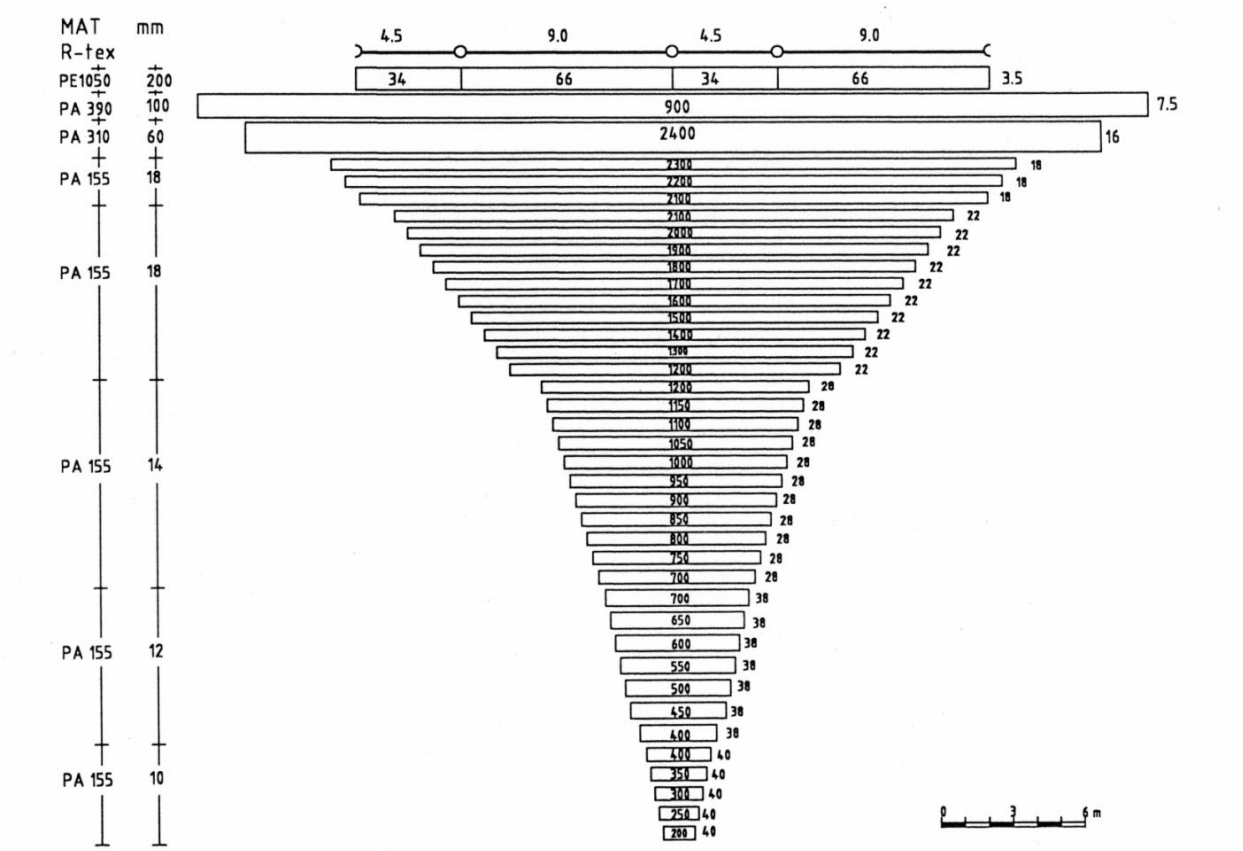

Fig. 1. Design of stake net

The stakes are installed in series at a distance of 4.5 m, to facilitate the operation of a number of nets. The installation of the stakes is done by six or seven fishermen working from two canoes, as described by Pauly (1991).

The net is set at the onset of ebb tide. Before setting the gear, codend is closed by tying the end with codend rope, which is loosely tethered to one of the stakes. A float is usually tied to the end joining the codend. The loops in the lower frame rope are attached first to the main stakes by a rope and pushed down using a forked pole. The other end of this rope is used for attaching the loop in the upper frame rope to the stake. When the net is to be hauled up, the lower loops are lifted up by pulling the ropes used for tying and as it comes up, the upper loops are untied. The net is then hauled into the canoe manually and brought to the shore. The hauling is done when the tide begins to slacken towards the end of the ebb tide.

The fishing season is continuous in the area of operations. Two fishing periods of 10 days each, known as thakkom in vernacular, occur in a lunar month. The first fishing period begins 2 or 3 days before the new moon and lasts 2 to 3 days thereafter. The second fishing period falls around the occurrence of full moon period. The nets are operated twice a day during these periods, first in the forenoon and then in the afternoon.

Stake nets are primarily targeted at prawns, which drift with the tidal currents. Mean catch per year per stake net was estimated as 0.41 t and mean number of fishing days in a year was 210. Best catches were obtained during January-May, with catch rates ranging from 2.90 to 4.74 kg.stake

net^{-1}.day^{-1}, followed by July, September and December (1.16 - 2.22 kg.stake net^{-1}.day^{-1}), while the catches were negligible or absent during the months of August, October and November (Fig. 2). Metapenaeus dobsoni formed the dominant component of the catch consisting 92.4%, followed by M. monoceros (6.0%) and Penaeus indicus (1.6%).

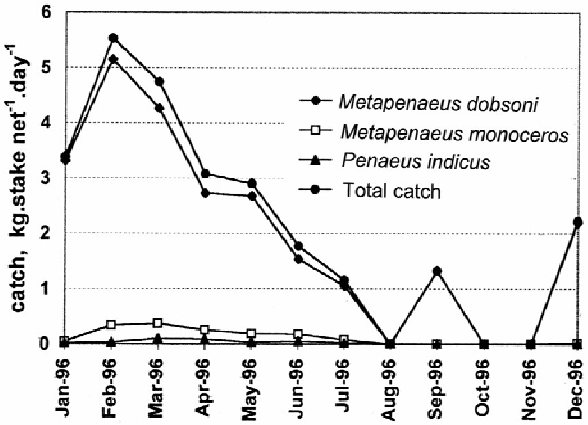

Fig. 2. Mean catch per day of stake nets

Energy analysis of fishing systems have been reported by Edwardson (1976), Watanabe & Uchida (1984), Endal (1989), Boopendranath (2000), Tyedmers (2004), Boopendranath & Hameed (2009) and others. Gross Energy Requirement (GER) is the sum of all non-renewable energy resources consumed in making available a good or service. GER is a measure of intensity of non-renewable resource use. It reflects the amount of depletion of earth's inherited store of non-renewable energy in order to create and make available a good or service (Slesser, 1988). Renewable energies and human energy are not included in the GER. In this study, GER in the fish harvesting system up to the point of landing is estimated. Energy inputs in the stake net system has been estimated at 2.13 GJ (Fig. 3; Table 1). Fishing gear and stakes constituted 95 % of the GER and the balance being contributed by the traditional plank canoe used for carrying the gear and catch (Fig. 4). GER was estimated to be 5.19 GJ.t fish^{-1} which was quite high for a stationary passively operated gear. The high GER value of a passively operated, non-motorised gear system like stake net is due to the low magnitude of landings by this gear. However, the catch is constituted by high unit value components, making the operations economically viable.

Table 1. Results of energy analysis of stake net operation

Item	GJ	Annual GER, GJ
Operational energy requirement	nil	
Fishing gear		
Ropes	0.738	
Netting	0.082	
Stakes	1.200	
Subtotal	2.020	2.02
Vessel	1.09	0.11
Total		2.13

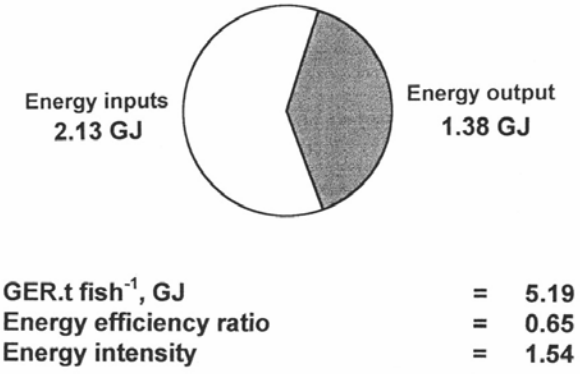

Fig. 3. Results of energy analysis of stake net operations

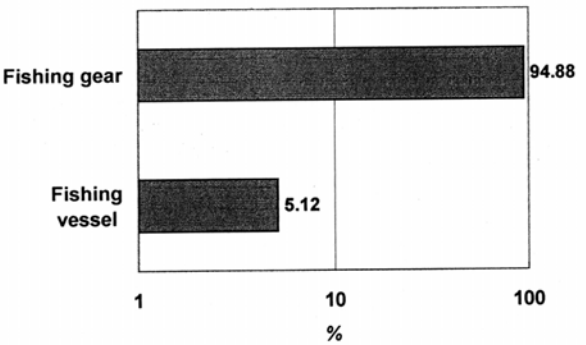

Fig. 4. Percentage contribution of energy inputs to GER of stake net operations

Energy ratio or Energy efficiency ratio is the ratio between metabolizable energy produced and the amount of non-renewable energy consumed (energy output / energy input). It is generally used in the analysis of food production systems (Slesser, 1988; EMC, 1991). Energy intensity is the amount of energy required to create a unit of output energy (energy input / energy output). It is the reciprocal of energy ratio and is equal to GER expressed in terms of output energy (Slesser, 1988; EMC, 1991). Energy efficiency ratio obtained was 0.65 while energy inten- sity value was 1.54.

Boopendranath & Hameed (2009) has determined GER per tonne of fish landed by non-motorised gill netting operations as 0.61. GER value per tonne of fish landed by stake net operations (5.19 GJ) was higher than non-motorised gill netting operations by a factor of 8.5. The predominance of juveniles in the stake net landings has been reported by Mammen (1984), Kurup et al. George et al. (1998), (1993), Thomas et al. (1999), Vijayan et al. (2000), Thomas et al. 2007) and others. The stake net operations in the Vembanad lake need to be strictly regulated in view of the high GER of the stake net operations and predominance of juveniles in the landings.

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