

Harvesting Techniques in Traditional Shrimp Culture

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Harvesting techniques in traditional shrimp culture are diverse and varied depending upon the requirements of each area. The design, the technical details and operational features of the different harvesting methods prevalent in the traditional shrimp culture in Kerala coast have been studied and described in this paper.

Key words: Traditional shrimp culture, harvesting, sluice net, gill net, cast net, drag net.

Methods for harvesting shrimp are diverse and varied depending upon the requirements of each area. Primitive and age old methods like fishing without gear (hand-picking), plunge basket traps and other traditional methods (Gudger, 1952; George *et al.*, 1968) to modern methods like electric nets (Tseng, 1988; Fast, 1991; Agrawal, 1999) and the pump systems (James and James, 1993), are employed for harvesting shrimp in aquaculture. The traditional gear like traps, drag nets, bag nets, cast nets, gill nets and advanced fishing techniques like pump equipped drag net and electric shocker are still in vogue in aquacultural practices for harvesting cultured shrimps around the world. Methods of harvesting cultured shrimp have been described by a few (Kathirvel, 1978; Fast, 1991; Anon, 1999; Stickney, 1994). Cultured shrimp quality is largely related to harvest techniques and post harvest handling. The shrimps must be harvested within a short time period once it has been reared to a sufficient size for marketing. Some factors like the characteristic behavior of the shrimps are to be considered prior to and during harvesting.

The type of harvest is also influenced depending on whether the crop consists of a single cohort or multiple cohorts. Some aquaculturists, employ a technique known as 'thinning' or periodic selective harvesting

of the crop. As and when the shrimp reach market size, they are removed from the system. The selective partial harvest is achieved by using nets with appropriate mesh size which allows the smaller shrimp to escape. Juveniles are added as replacement after each such harvesting. These strategies are used in Japan for the culture of *P. japonicus* (Hirasawa, 1985).

Harvesting methods can be broadly divided into partial harvesting and total harvesting. Different fishing gear and methods are employed depending on the type of harvesting. Partial harvesting may be done after reducing the water level to the maximum possible extent and harvesting the shrimps by using traps, pound nets, gill nets or cast nets and complete or total harvest is usually done with the bag net placed near the sluice gate or by gradual draining of the pond to concentrate the shrimps in the pond canals and catching them using drag net, scoop net or by hand picking (Anon, 1984; Unnithan, 1985).

Various types of indigenous fishing gears of Kerala were reported by many (Hornell, 1938; Bal & Banerjee, 1951; Anon, 1951; Kurien & Sebastian, 1986; Kurup & Samuel, 1985). However, the design details of fishing gears used in aquaculture systems are scanty. An attempt was made through

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this study to broadly group the fishing techniques and document the design details of the different harvesting gears used in traditional shrimp aquaculture systems.

Materials and Methods

A survey with reference to shrimp harvesting systems in aquaculture was conducted in Vypeen in Kerala. The gear survey was conducted following Miyamoto (1962) and the technical specifications and design details of the gear and mode of operation were recorded. Based on the proforma, the dimension details such as general dimensions, material, mesh size, twine size, hanging coefficient, construction details, floats, sinkers were collected, for different types of gear.

Results and Discussion

Based on the study, the different harvesting gears like sluice net, gill net and cast nets observed were grouped taking into

consideration of the size, type of material and method of operation. Handpicking of shrimps by men and women were recorded separately. Table 1 gives the details of different fishing gears in traditional shrimp aquaculture.

Sluice net

Sluice net is a stationary conical shaped filtering device, which is attached to a wooden or metal frame, fitted into a slot on the sluice gate. The nets are fabricated by hand or machine made webbings are used after shaping it by tailoring. The technical specifications of sluice nets are given in Table 2 and the design of a large sluice net is given in Fig. 1. Sluice nets are widely used in the paddy shrimp filtration fields (Panikkar, 1937; Kathirvel, 1978 ; George *et al.*, 1968).

Filtration is carried out for 7-9 days in a fortnight *i.e.*, 3-4 days before or after full moon and new moon days either after dusk or before dawn as the shrimps are very

Table 1. Details of different fishing gears in traditional shrimp aquaculture systems

Gear	Length of unit (m)	Depth of unit (m)	Mesh size (mm)	Material	Coefficient of hanging (E)	Float (material)	Sinker (material)
Gill net	30-50	2-3	28-55	PA (mono filament)	0.5	PVC	Granite/lead
	30-50	2-3	28-32	PA (multi filament)	0.5	PVC	Granite/lead
Cast net stringed	-	2-3.5	20-32	PA (mono filament)	-	-	Granite/lead
	-	2-3.5	20-32	PA (multi filament)	-	-	Granite/lead
Cast net stringless	-	2-2.5	20-32	PA (multi filament)			Granite/lead
Drag net (Large)	50-100	2-2.5	10-12	PA (multi filament)	0.4-0.5	PVC	Lead
	50-100	2-2.5	10-12	PA (multi filament)	0.4-0.5	PVC	Lead
Drag net (Small)	6-10	1-1.5	30-20	HDPE	0.5	PVC	Lead
Sluice net (Large)	-	-	10-15	PA (multi filament)	0.5	PVC	-
Sluice net (Small)	-	-	10-15	HDPE	0.5	PVC	-

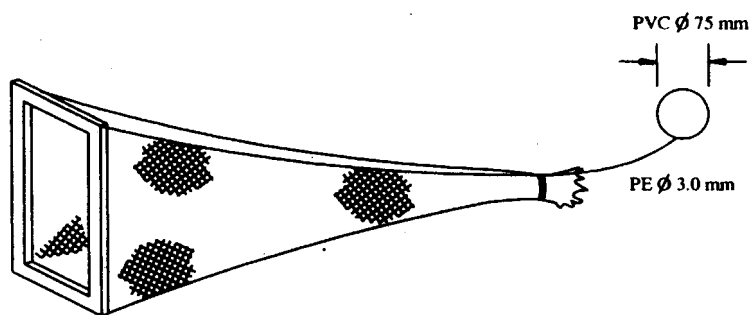
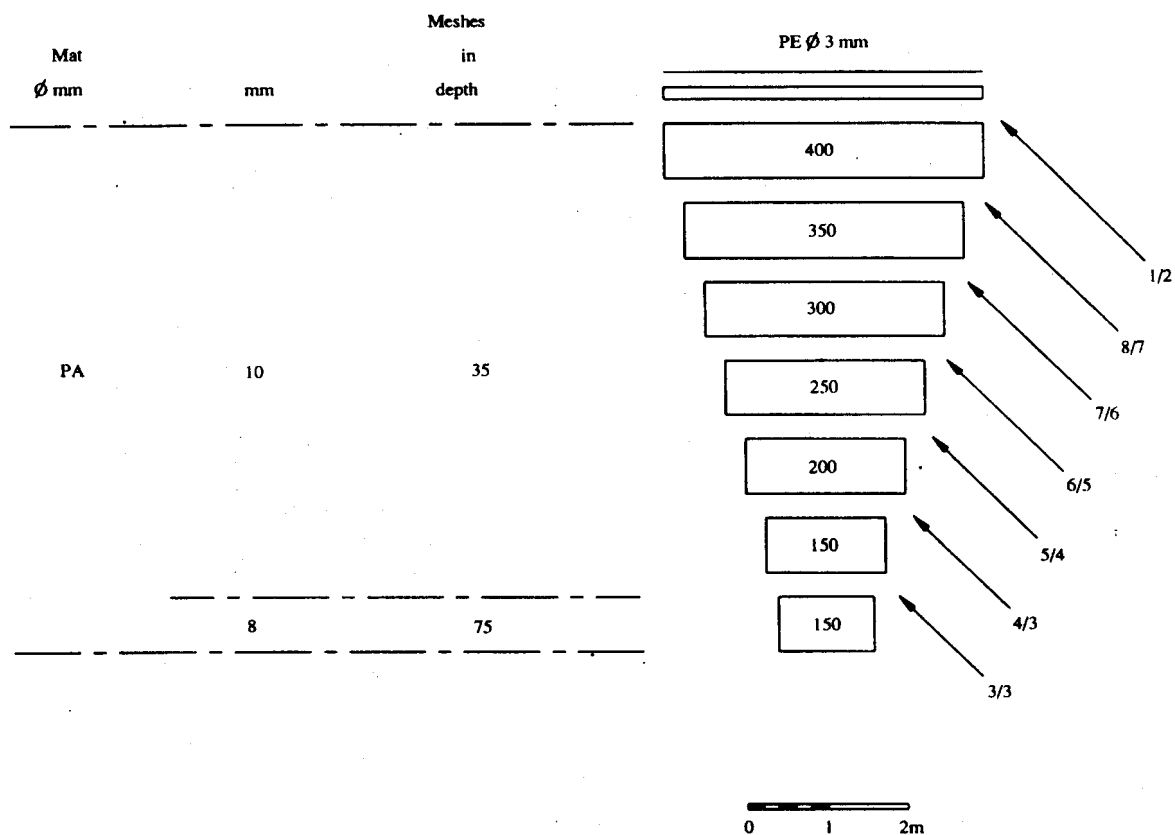


Fig. 1. Design of large sluice net

active during this period. Maximum quantity of incoming spring tide water is kept inside the pond with the help of the shutter planks in the sluice gate. A light is installed near the inner mouth of the sluice gate to attract more shrimps. During low tide when the water starts receding, the sluice net is fixed to the sluice gate and the shutter planks

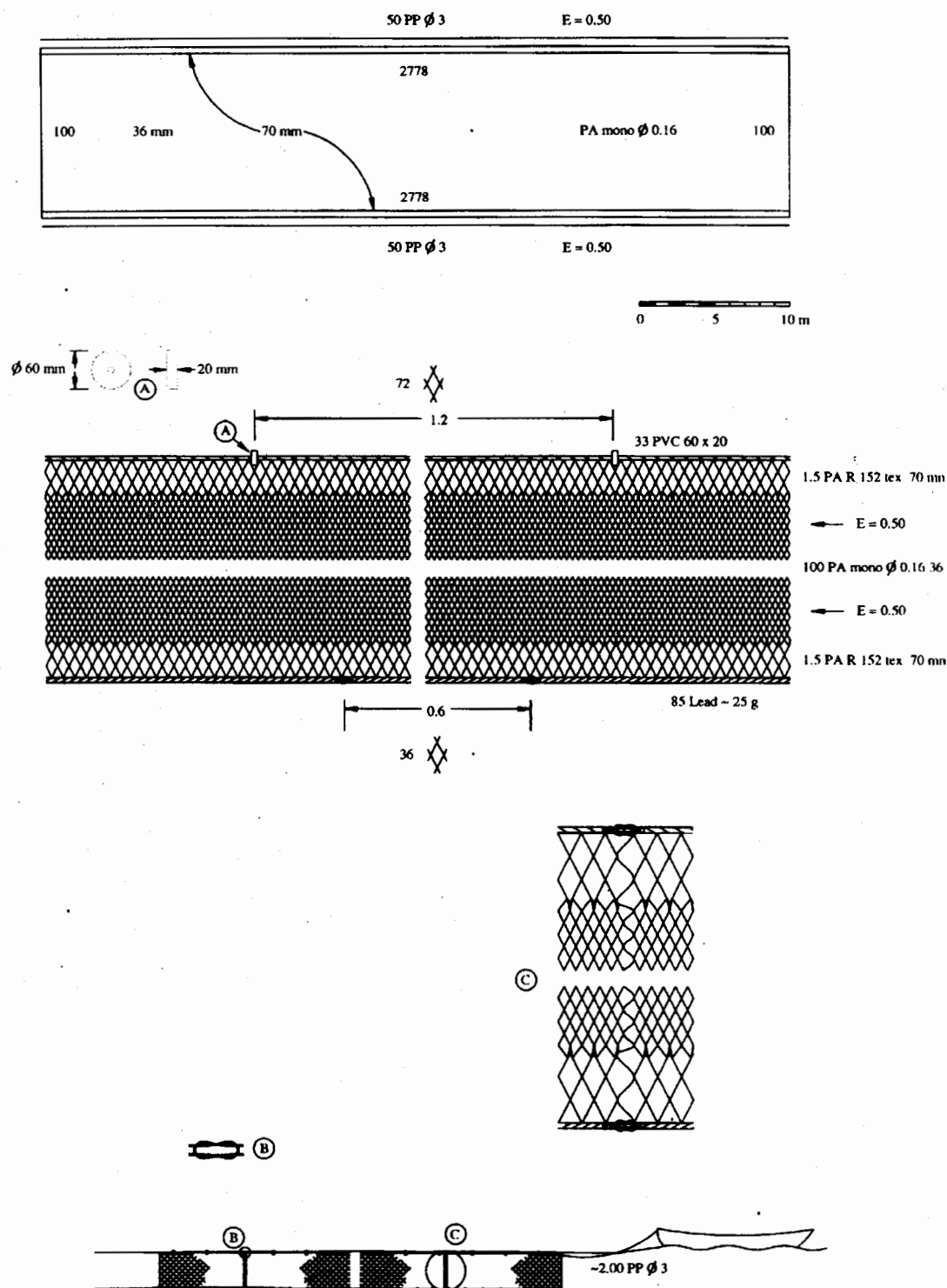
are removed. Water rushes into the net and the shrimps and fishes are filtered. A canoe is kept ready outside the sluice gate and is used for taking the catch from the codend. A float is tied to the codend using a float line for facilitating easy retrieval of codend. Then the sluice gate shutters are closed.

Table 2. Technical specifications of sluice net

	Small sluice net	Large sluice net
Main webbing	Polyamide	Polyethylene
Mesh size (mm)	15-20 mm	20-25 mm
Twine type	Multifilament	Multifilament
Twine specifications	210x1x2	0.75-1.5 mm Ø
Selvedge	210x2x3	1.5-2.0 mm Ø
Depth	3-5 m	5-9 m
Hanging coefficient (E)	0.5	0.5
Codend		
Mesh size (mm)	10 mm	10-12 mm
Twine type	Multifilament	Multifilament
Twine specifications	1.0 mm Ø	1.0 - 1.5 mm Ø
Depth	1.0 m	2-2.5 m
Ropes		
Material	Polypropylene	Polypropylene
Rope mouth region	2.5 - 3.0 mm Ø	2.5 - 6.0 mm Ø
Cod end rope	12 mm Ø	12-20 mm Ø
Float (attached to end of cod end)	Plastic can, float	Spherical PVC float
Float material	Plastic can or PVC	PVC
Floats per unit (No.)	1	1
Float size	100 - 150 mm	200 - 300 mm

Table 3. Technical specifications of shrimp gill nets

	PA multifilament	PA monofilament
Main webbing		
Mesh size (mm)	24 - 34	34-55
Twine type	PA multifilament	PA monofilament
Twine specifications	210x1x2 - 21x1x3	0.16 - 0.20 Ø
No of meshes in depth	80- 100	50-60
Hanging coefficient (E)	0.5-0.53	0.5
No of meshes in length/unit	2000-3000	1500-2000
Hung length (m)	28-50	25-55
Hung depth (m)	2-3	2-3
Selvedge		
Mesh size (mm)	60-70	70-100
Twine type	PA multifilament	PA multifilament
Twine specifications	210x2x3	210x4x3
No of meshes in depth	2	0.5-1
Ropes		
Material	Polypropylene	Polypropylene
Head rope dia (mm)	4-6	4-6
Foot rope dia (mm)	4-8	4-8
Floats and sinkers		
Float material	PVC	PVC
Floats per unit (No.)	40-50	30-40
Float size (mm)	50x10	60x20
Sinker material	Lead	Lead
Sinkers per unit (No.)	60-80	60-80
Sinker weight (g)	25	25



Gill nets

Gill nets are passive fishing gear and the fish gets gilled, wedged or entangled. In the case of shrimps, they are enmeshed in the net. Gill net locally called *Loop vala*, (Kurup and Samuel, 1983, 1985; Pauly, 1991),

Kandali vala (Hornell, 1925, 1938) and *Kara vala* (Pauly, 1991) are operated for harvesting the shrimps in the culture farms. Chemeen vala (Kurien and Sebastian, 1986; George and Brandt, 1975; Pauly, 1991; Thomas, 2001) are used extensively in the shrimp culture farms.

The technical specifications of the gill nets are given in Table. 3. and the design of a monofilament gill net is given in Fig. 2.

Gill nets with mesh size ranging from 24-36 mm are generally used to harvest *Fenneropenaeus indicus* and are locally known as *naran vala* whereas larger mesh size of 36 mm onwards are used to harvest *P. monodon* and are locally known as *kara vala*. The present study indicated that gill nets are widely used in large traditional farms of Kerala. The gill nets operated in the aquaculture farms are similar in design to those used in the backwaters of Kerala.

Gill nets are operated as bottom drift by one or two persons from a wooden canoe of 4-6 m LOA. The net is drifted for about 30 min to an hour. While hauling the net, both the head rope and foot rope are held together and are taken into the boat gradually by one person while the other manaeoeuvers the canoe. Coconut leaves or pieces of webbing

are placed inside the canoe to prevent the shrimps from jumping back to the pond.

Cast nets

Cast nets or falling nets, as the name implies are thrown over the water surface where catch is expected. It is perhaps the oldest and the simplest method for partial harvest in aquaculture systems. Two types of cast nets (stringed and stringless) types are operated in the aquaculture systems. The technical specifications of cast nets are given in Table. 4. and the design details are given in Fig. 3. Use of cast nets in aquaculture farms has been reported by (Kathirvel, 1978; Unnithan, 1985; Purushan, 1995; SEAFDEC, 1986; and Agrawal, 1999). Fast (1991) observed that in aquaculture, cast netting was not very efficient in terms of kg harvested per man hour, but it could be cost effective where labour is inexpensive. Coconut wastes are used to attract the shrimp before the net is cast from boats (Suseelan, 1975).

Table 4. Technical specifications of shrimp cast nets

Main webbing	Multifilament	Monofilament
Mesh size (mm)	20 - 32	20-32
Material	PA multifilament	PA monofilament
Twine specifications	210x1x2 , 210x1x3	0.16, 0.20, 0.23 Ø
Length (m)	2.5-3	3-5
No of meshes in top	150-175	175-275
No of meshes in bottom	1500-2500	2000-3000
Bottom radius (m)	2-2.5	2.5 - 4
Selvedge		
Mesh size (mm)	30-40	30-40
Material	PA multifilament	PA multifilament
Twine specifications	210x1x3 210x2x3 210x6x3	210x2x3 210x6x3 210x9x3
Ropes		
Main rope		
Material	PP multifilament	PP multifilament
Twine size (mm)	4 Ø	4 Ø
Foot rope (double)		
Material	PA multifilament	PA multifilament
Twine size	210x4x3	210x6x3
Sinkers		
Material	Lead	Lead
Shape	Spindle	Spindle
No. per unit	60-80	60-80
Weight (g)	20	20-25

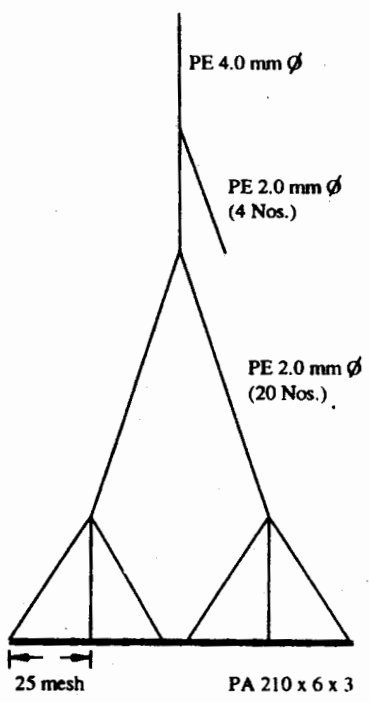
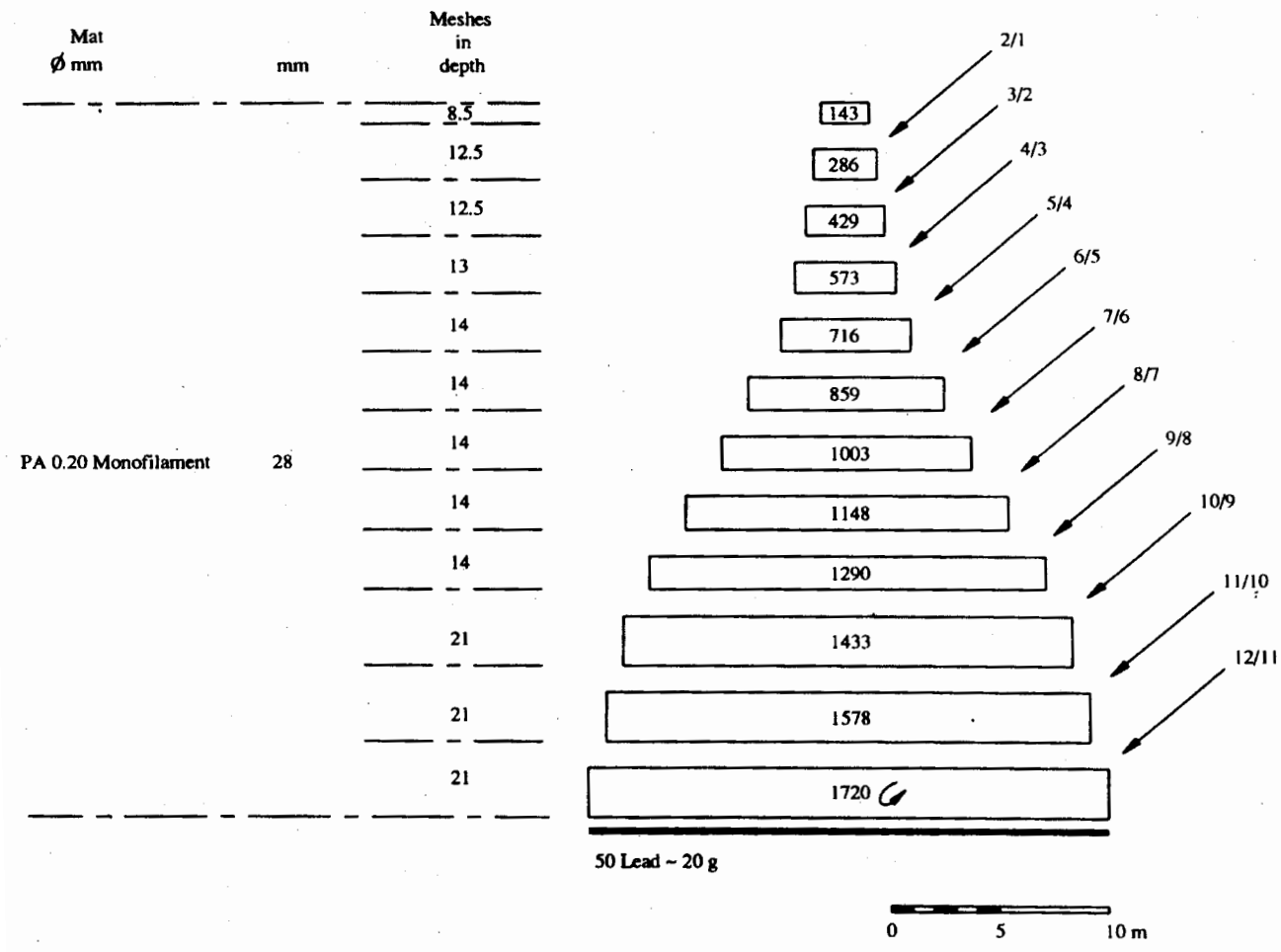


Fig. 3. Design of shrimp cast net (stringed)

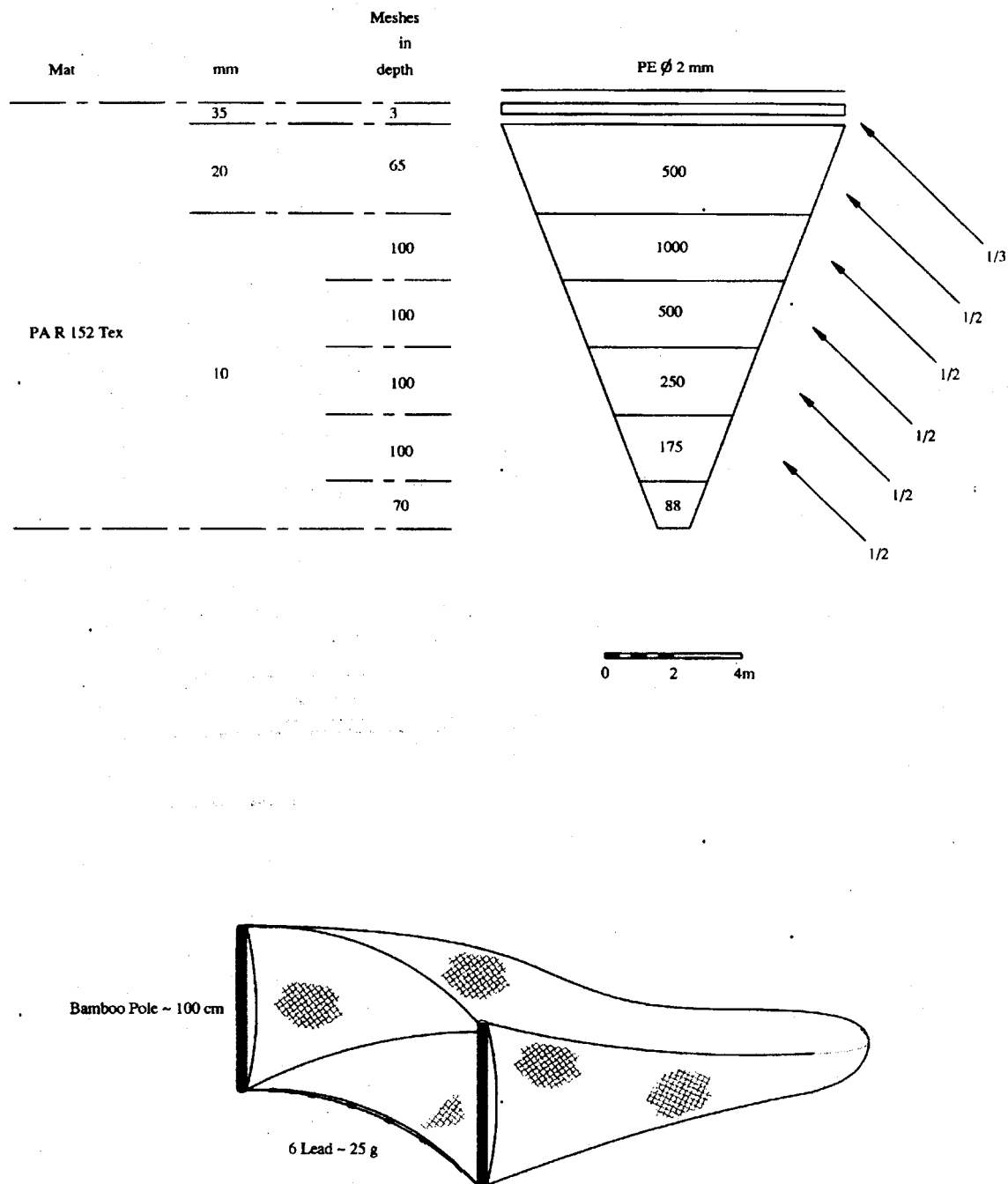


Fig. 4. Design of drag net

Few cast nets are constructed using a combination of monofilament and multifilament material. The cast nets used for harvesting *P. monodon* is called *Kara veesu vala* and for *F. indicus* is called *Naran veesu vala*. The main difference between them being the size of mesh. 26–30 mm mesh size are

popular for *F. indicus* and larger mesh size of 30–50 mm are used for *P. monodon*. The present study shows that cast nets are very popular among the aquaculture farmers and are widely used in all the farms. The design specifications do not vary much and are very much similar to the cast nets operated in the

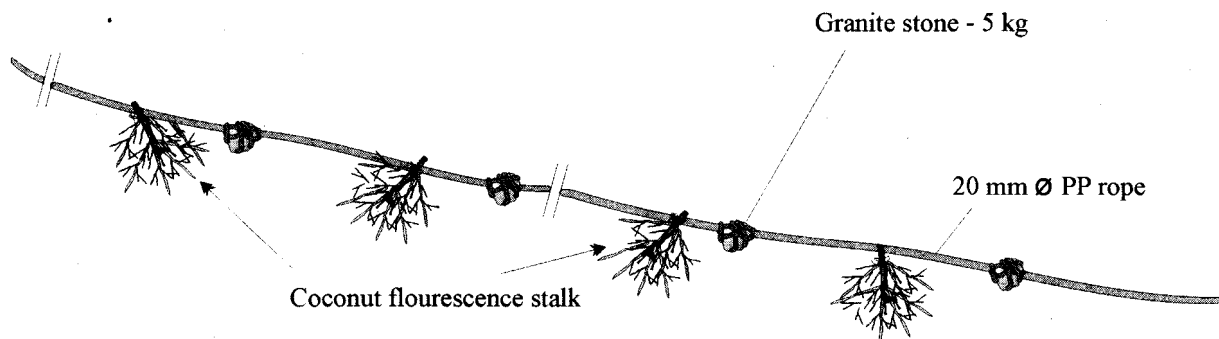


Fig. 5 (a). Arrangement of coconut fluorescence stalk and granite stones for harvesting shrimps

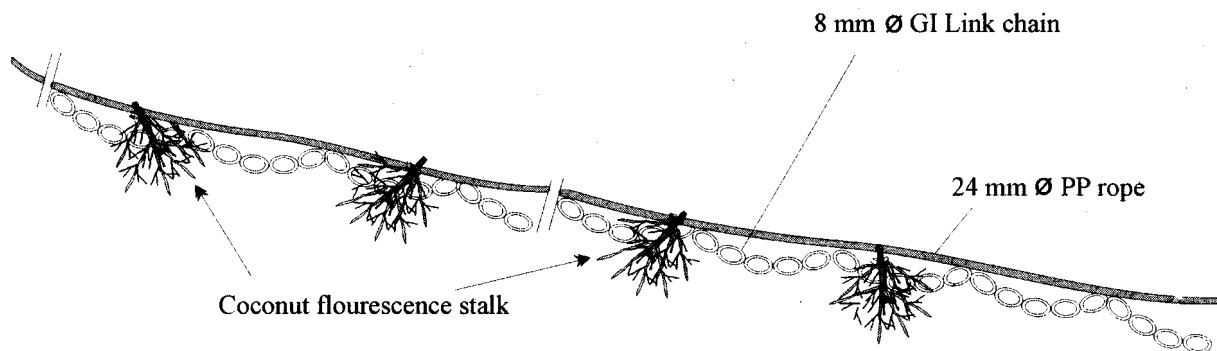


Fig. 5 (b). Arrangement of coconut fluorescence stalk and link chains for harvesting shrimps

sea except that the size of the net used in the marine sector is bigger.

Usually two persons are associated with the operation of the gear. The gear is cast by one man and the other helps in collecting the catch and clearing the net from debris before the next throw. The net remains immersed in water for two to three minutes and is then slowly hauled up. When it is hauled in, the weights converge towards one another and the catch is trapped. The catch entangled in the net are removed and kept in a basket.

Seine nets

Seine nets are also used for either partial or final harvest of shrimp from aquaculture ponds. The level of water inside

the pond is lowered before seining. Seining is more successful when the water level is lowered so that the shrimp are confined to the canals (Menasveta and Higuchi, 1983; Anon, 1984; Unnithan, 1985).

PA knotted or knotless webbing of twine size of 210x2x3 – 210x6x3 with mesh size of 10 mm is used for the main piece. A half mesh selvedge made of twine size 210x9x3 with mesh size 60 mm is given. PP rope of 24 mm diameter is used for the head rope and foot rope. The sinker and floats are attached using a PP rope of 3 mm diameter. The hanging coefficient provided is generally 0.5. The length is usually about one and half times the width of the pond and the depth about two to three times the depth of the

pond. PVC floats, of diameter 50 mm and thickness 20 mm are fixed on the head rope at an interval of 30 cm. Lead sinker each weighing approximately 100 g is fixed on the foot rope at 1m interval.

The water level in the pond is lowered and the drag net is dragged slowly from one end of the pond to the other end. Eight to ten persons are required for the operation. The foot rope touches the bottom of the pond when the net is dragged. One or two persons follow the net from behind to clear the entanglement of the gear with the bottom mud. Both ends of the net are brought closer and the catch is collected with the help of scoop net and later picked by hand. However, seining is not a preferred method as mud and detritus are often mixed with the shrimp and often the shrimps are damaged. The unevenness of the pond bottom also makes seining difficult in most shrimp farms.

Drag net

Small drag net commonly known as *Vadi vala* or *Koruvalai* (Fig.4) is also popular for harvesting shrimps in the aquaculture farms among the shrimp farmers in Kerala. Use of this net in the shallow backwaters has been reported (Ramamurthy and Muthu, 1969 and Kurien and Sebastian, 1986). This net is bag shaped and has a fixed mouth opening of about 4x1 m and is about 6 m long. Wooden sticks or bamboo poles of 1.2 m are fixed on both ends of the webbing for holding, pulling and keeping the mouth of the net open. The main webbing is either made of knotted or knotless PA multifilament or PP twisted monofilament of size 210x1x2 or 0.75-1.0 mm diameter with a mesh size of 20 mm in the fore part decreasing to 10 mm in the hind part. Selvedge of three meshes depth of 35 mm is provided for mounting the main webbing to a PE twine of 3.0 mm diameter which is attached to the bamboo pole.

Three persons are required to operate the net. Two persons hold the bamboo poles

and drag the net along the bottom of the pond. The third person helps in collecting the shrimps after the net reaches the shore. The operation is repeated several times covering the whole area of the pond. This net is used in the final harvesting operations.

Aerial traps

This is a fishing technique based on the shrimp's reflex action to physical stimulation and is being used for harvesting the shrimps in perennial aquaculture farms in Kerala. They are locally known as *Pachil Changadom* or *Changala Pachil*. It is an interesting method for capturing shrimps. Use of this method in shallow waters in canals and backwaters and large aquaculture ponds has been reported by Panikkar (1937); Hornell (1938); Gopinath (1953); Job and Pantulu (1953); Kurien and Sebastian (1986) and George (1991). The shrimps, when disturbed, jump by reflex action and this habit is exploited for this type of fishing. It is also known as *Pran-Junkhar* or *Pachil* locally.

Two medium size canoes are tilted towards inside and connected with bamboo poles at the anterior and posterior extremities. The distance between the two canoes is 1 m. Weights are kept inside the canoe so that the edges will be very near to the water surface. A long heavy iron chain is attached to the bows of the two canoes and is dragged along the bottom. The middle region of the chain lies in the water touching the ground. The boats are moved forward by means of poles or oars. When the chain disturbs the bottom, the shrimps jump out of the water and fall into the canoes. Inside the canoe twigs and leaves are kept to prevent the escape of shrimps landing inside the canoes. It is usually operated at night. To attract the shrimps a kerosene lamp is also placed in the boat. This practice is not so popular nowadays and is rarely seen.

Hand Picking

Harvesting of shrimps using bare hands has been observed in all the shrimp farms.

It is the simplest form of fishing since ancient times and commonly seen in the estuaries and backwaters of Asian countries (Gudger, 1952). It is also carried out in the paddy fields and shallow beaches in India (George *et al.*, 1968; Pai *et al.*, 1982; Unnithan, 1985). It is locally called as *Thappal*. It was observed that practice of hand picking of shrimps and other fishes was mainly dominated by skilled fisherwomen.

The operation starts early in the morning and continues till evening. The level of water in the pond is usually reduced to the minimum possible extent. The fishers stand in a row at one end of the pond and gradually move towards the opposite end of the pond covering the entire stretch. They again return and also move in the pond in a zig zag motion to cover maximum area of bottom of the pond. The bottom of the pond is searched by the fishers with the feet or hands for any fish or prawn. As they advance, any shrimp or fish that are felt by the foot are taken by hand. The catch is collected in a floating pot, which is carried along with them. This type of fishing method is locally called *Kalakippiditham*, *Chavuttuppiditham*, *Thappiyedukkal* and *Veetiyedukkal* in Kerala (Kurup *et al.*, 1993).

Other methods

Kolanjil katti vala

This method is mostly seen in the northern parts of Kerala. Coconut florescence stalk locally called *Kolanjil* are tied to a 20 mm diameter PP rope of length 20-30 m and is fixed at an interval of about 1 m. A granite stone weighing about 5 kg is fixed in between or galvanized iron chain links are tied as shown in Fig. 5 (a & b). The ropes at each end of the tackle is held and dragged from one end of the pond to the other end by 5-6 persons. Operation is usually done only after lowering the water level and is used in the final harvest. During dragging the weights attached to the rope keeps the whole gear system submerged under water and the uneven sharp edges of the *Kolanjil*

disturbs the pond bottom. Any shrimp buried in the mud is forced to come out and move towards the bank. The shrimps are harvested using a cast net or scoop net or by hand picking. Similar version of operation is also being carried out in seasonal shrimp farms in Vypeen and are locally known as *Kodha pottikunu* or *changla vala*. Instead of granite stones, 10 mm diameter GI chains are used and tied along the rope. The method of operation is the same.

Stupefying

Insecticides, pesticides or chemicals are usually used in shrimp aquaculture farms in Kerala for harvesting the shrimps. It is carried out in the final stages of harvesting in most of the seasonal shrimp aquaculture farms. As poisoning is an illegal practice (Anon, 1980), it is done secretly during night. This practice is mostly carried out in the leased ponds as a last resort to capture all the shrimps available in the farm before completion of the lease period.

Benzene hexachloride (BHC) powder is mixed with other insecticides and sand. This mixture is added into the pond carefully as overdose may kill all the shrimps and fish in the pond. This mixture is distributed evenly in the water near the pond edges opposite to the sluice gate at night keeping the level of the water as low as possible. The shrimps avoid the poisoned areas and try to move in the opposite direction towards the sluice gate. At high tide, freshwater is allowed inside and all the shrimps rush towards the sluice gate. When the tide recedes the sluice gate is opened and the shrimps escape from the uncomfortable environment and are trapped in the sluice net. This procedure is repeated with a higher dosage of chemicals on the next day. This has been found very effective for *E. indicus* as they seem to be more sensitive and most of them move out of the pond. But *P. monodon* is not easily flushed out and has to be harvested using cast nets and hand picking.

Warming of water

During the final stages of harvesting the water level inside the pond is kept at a bare minimum level and is allowed to get heated naturally by the sun. As the water level is low the water gets warmed and the shrimps are forced to move towards deeper areas of the pond where it is comparatively cooler. During high tide, water enters inside through the sluice gate and the shrimps move towards the entrance which is much cooler. They are caught in the sluice net when the tide recedes again. This practice is being carried out by most of the seasonal farmers as the depth of the pond is usually low as compared to the perennial farms. This technique is repeatedly done during the end of the season to harvest as many shrimps as possible.

Species specific behaviour is an important consideration when selecting a harvest method. Some species like *P. monodon* and *F. indicus* do not always run readily with the drain water and may either strand or burrow into the bottom. Harvesting of ponds is easier when they are constructed in regular shape, with properly sloped banks, proper depth, easy access by vehicles, large drain lines that allow rapid and complete emptying and the incorporation of a harvest basin near the drain. Many ponds lack one or more of these features. The use of canals within the ponds create faster water currents at the termination of the drain harvest, as well as much reduced bottom areas where the shrimps are likely to remain.

Different harvesting techniques are used for harvest of shrimps from filtration farms. Operation of sluice net is the most common practice used for harvesting shrimps from these farms. Gill net and cast net are used periodically in the perennial farms where as it is used only during the final phase of harvesting in seasonal farms. Other methods like hand picking, warming of the water, use of chemicals, draining of water etc., are carried out at the end of the lease period.

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