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Structural and Operational Aspects of Fishing Traps of Meghalaya, North East India

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Abstract

Fish traps are passive fishing gear which lured the fish either for food or shelter and get trapped through appropriate hard or soft structures. Documentation of these traditional fish trapping methods from the northeastern parts of India is limited. This study attempts to document the traditional fish trapping devices from four districts of Meghalaya with respect to its structure and operation. The depicted survey highlights 11 types of fish traps which were classified into three major categories such as tubular, basket and box traps. Average length of these documented traps ranged from 0.25-1.5 m and mostly operated during monsoon and post-monsoon season in floodplain and low-lying areas like rice fields, ponds, shallow rivers and ditches. Murrels, minnows, barbs, mahseers and catfishes were the dominant fish catch from these gears. Most of the traps were fabricated with bamboo and locally available materials with a life span of more than 2-3 years. Results revealed that *Khnu/Chiap,* is the most popular and efficient trap with a CPUE of 2.5 kg day^{-1} trap^{-1}. Documentation and the knowledge concerning the traditional gears will facilitate to improvise the fishing gears which will ultimately improve the livelihood of fishermen in the northeastern region of India.

Keywords: Passive gears, Bamboo, Catch per unit effort, Meghalaya

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Introduction

The peculiar biogeography and climatic pattern of north eastern states of India makes them biodiversity hotspots of the country. Icthyobiodiversity is not exceptional. Endemic fish species recorded from this region is about 138 which belonged to 54 genera, 18 families and 6 orders. Out of this, 7.97% of the species are in Endangered category of IUCN list *viz., Psilorhynchus* spp., *Schistura* spp., *Ambyceps* spp., *Badis* spp., *Perhia* spp., *Lepidocephalichthys* spp., *Pterocryptis* spp. and *Pilaia* spp (Sarma et al., 2018). Meghalaya is one of the Northeastern states of India located between latitude 25º to 26ºN and longitude 90º to 92º45'E. The state has potential fishery resources and an average annual rainfall of 12000 mm which offer tremendous scope for the development of the fisheries sector of the state. Uneven geographical condition is one of the major constraints for the commercial fisheries sector to develop (Kumar & Lawai, 2017). There are diverse fishing gears like hook and line, gill net, traps, falling gear, lift net, scoop net, surrounding net etc.operated in the state to utilize the potential fishery resources. Among these gears, fishing traps are widely distributed and common in Meghalaya as it can be easily operated in the hilly terrain where other fishing gears are difficult to operate.

Trap fishing is one of the age old fishing methods in Meghalaya as it is a simple passive fishing gear which ensures highly selective fishing. Fishermen of Meghalaya are well experienced and use their traditional knowledge for fish catching and preservation techniques. Fishing traps were developed by the fishermen using their traditional knowledge and experience based on the behavior and size of the target species (Griffiths et al., 2017). Meghalaya has rich source of fish diversity being a part of Indo-burma global diversity hotspot. It consists of 165 fish species distributed in different aquatic ecosystems

that have food, ornamental and sports values (Nath, 2016). Assessment of the abundance of the fish stock was estimated by using the scientific tool CPUE (catch per unit effort). Ghosh & Biswas (2017) studied the CPUE of the fishing gears operated in the oxbow lake ecosystem in Eastern India with respect to the effects on the fish biodiversity. Detailed aspects of fishing with traps and pots have been described by Slack-Smith (2001) and Griffiths et al. (2017). Mohanrajan (1993) gave a detailed description of 13 types of fish trapping devices and methods from the southern part of India. Bamboo is the common locally available material for fish traps in this state. Remesan & Ramachandran (2008) describes six types of fish traps operated in the inland water bodies of Northern kerala. Tynsong & Tiwari (2008) reported an association of ethno-ecological knowledge with fish harvesting practices like traps in Meghalaya. The literature on the traditional fish traps of Meghalaya with respect to its economic viability is limited. This study attempts to document the traditional fish trapping devices from the four districts *viz.,* Ri-bhoi, East Khasi Hills, West Khasi Hills and West Jaintihills of Meghalaya with respect to its operation, structure design and economic efficiency.

Materials and Methods

Study was conducted during the period from July to December, 2018. Out of the eleven districts of Meghalaya, seven sampling sites from four districts were selected through purposive sampling method based on traditional fishermen populations. The selected sites are Shillong of East Khasi Hills district, Umtru, Umiam and Marngar of Ri-bhoi district, Nongshillong of West Khasi hills district, Umladkhur

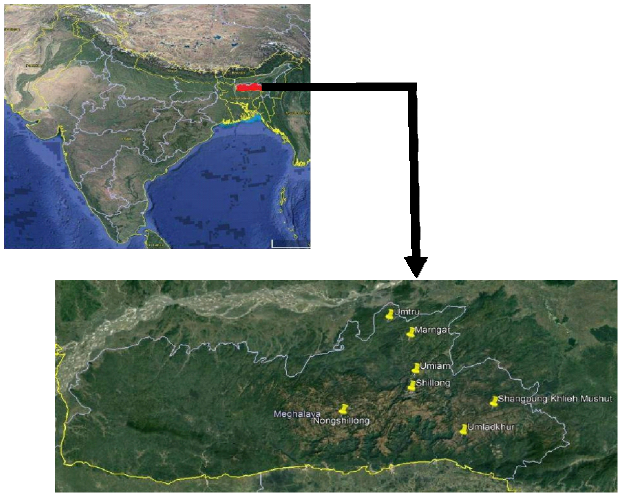

Fig. 1. Map showing selected study area in Meghalaya

and Shangpung Khlieh Mushut of West Jaintihills district (Fig. 1). From each village five experienced fishermen were selected based on snowball sampling technique (Saha et al., 2015).

Information about the indigenous fish trapping devices and methods were collected based on FAO catalogue of small-scale fishing gear design (1975) and classification is based on Slack-Smith (2001) manual of FAO training series (Fig. 2). The traps were measured to nearest millimeter and the designs of the fish trap are drawn directly to the field diary and later on converted into scientific drawings using Corel DRAW software. A structured questionnaire was prepared to get the structural and operational details of fish traps used by the fishermen.

Catch per unit effort (CPUE) for the fish traps is calculated by dividing the mean catch per day to the

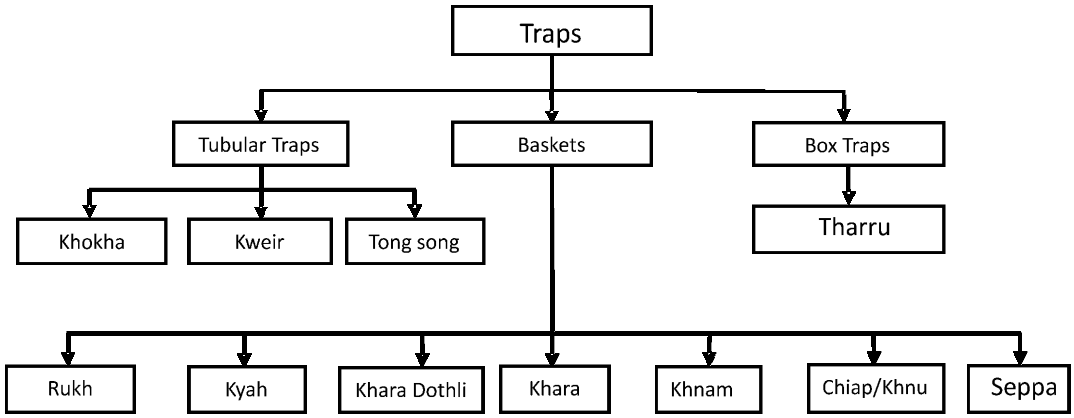

Fig. 2. Classification of fish traps from the study area

mean number of traps operated per fishermen (kg day^{-1} fishing trap^{-1}) for the different species combined (Ghosh & Biswas, 2017)

Results and Discussion

A general survey on the fishing traps in the four districts of Meghalaya showed its potential fishery resources and fishing methods that are based on the physiography, habitat and ecology of the state which is reflected in the design of the fishing traps that vary widely compared to the fish traps of other northeastern parts (Table 1). The fish traps of Meghalaya were classified into three types tubular traps, baskets and box traps based on the manual of Slack-Smith (2001) shown below

1. Tubular traps: These are funnel-shaped traps without any non-returnable device and are closed at the smaller end (Gabriel et al., 2005). A bamboo piece is used which is splitted for the entry of fish and ends with a bamboo node.

***a. Khokha*:** This is a tubular fish trap made with a single piece of bamboo (1-2 m in length) with one end split opened and other end closed with the bamboo node. Mouth is kept open with of iron ring of 0.1-0.2m diameter (Fig. 3). The front upper part of these traps is cut open to increase the catch rate.

Table 1. Traps and targeted species

Local Name	Material	Length (m)	Mouth opening (m)	Longevity (Years)	Area of operation	Targeted species
Khokha	Bamboo	1-2	0.1-0.2	4-5	Paddy Field	*Heteropneustus fossils, Puntius* spp., *Clarius batruchus* etc.
Kwier	Bamboo	0.7-0.8	0.2-0.3	4-5	Paddy Field	Fingerling sized fishes; eg. *Channa* spp., *Danio* spp., *Garra* spp., *Tor* spp. etc.
Tong song	Nylon-Mosquito net	0.5	0.12	1	Paddy Field	*Puntius* spp., *Danio* spp., *Labeo* spp., *Channa* spp., etc.
Rukh	Bamboo	0.26-0.30	0.09	4-5	Paddy Field	*Garra* spp., *Danio* spp., *Puntius* spp., *Channa* spp., *Cyrinus carpio*etc.
Kyah	Bamboo	0.35-0.40	0.13-0.15	4-5	Paddy Field	*Channa* spp., *Danio* spp., *Labeo* sppetc
KharaDothli	Bamboo	0.25-0.40	0.08-0.17	4-5	Paddy Field	*Channa* spp., *Puntius* spp. and small miscellaneous fishes
Khara	Bamboo	0.26-0.30	0.16-0.18	4-5	Rivers	*Neolissochilus hexagonolepis, Heteropneustus fossils, Clarius* spp., *Channa* spp. etc.
Khnam	Bamboo	0.5-0.6	0.1-0.2	4-5	River	*Heteropneustus fossils, Neolissochilus hexagonolepis, Labeo* spp., *Cyrpinus carpio, Tor* spp. etc.
Khnu	Bamboo	0.3-0.4	0.1-0.2	2-3	River	*Labeo* spp., *Channa* spp., *Neolissochilus hexagonolepis, Puntius* spp., *Danio* spp. etc.
Seppa	Bamboo	1-2	0.7-0.1	4-5	Paddy Field	*Neolissochilus hexagonolepis, Heteropneustus fossils, Clarius* spp., *Channa* spp., etc.
Tharru	Iron mesh net	0.3	0.04	2-3	River	*Tor* spp., *Cyprinus carpio, Clarius* spp., *Channa* spp., Labeo spp., *Garra* spp., etc.

Table 2. Illustration of the fishing traps CPUE and Mean ± SD

Traps	CPUE	Mean ± SD
Khokha	0.28	0.91 ± 0.34
Kweir	0.6	1.41 ± 0.49
Tongsong	0.5	0.56 ± 0.11
Rukh	0.38	1.25 ± 0.41
Kyah	0.5	0.58 ± 0.28
KharaDothli	0.41	1.25 ± 0.50
Khara	1.5	1.75 ± 0.50
Khnam	2.2	1.83 ±0.50
Chiap/Khnu	2.5	4.00 ± 0.80
Seppa	2.5	0.83 ± 0.70
Tharru	1.85	2.16± 0.65

Table 3. CPUE and catch of classified traps in Meghalaya

Traps	CPUE (kg/day/trap)	Catch(kg/day/fisherman) Mean ± SD
Tubular	0.46	0.97 ± 0.32
Basket	1.43	1.64 ± 0.55
Box	1.85	2.17 ± 0.65

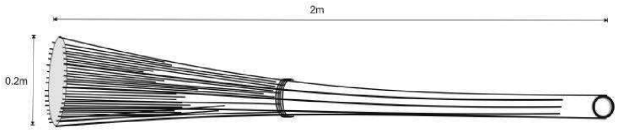

Fig. 3. *Khokha trap*

These traps are fixed in the embankments of the paddy fields during monsoon season (June - October). Remesan & Ramachandran (2008) describes a filter trap that are set against the receding current in shallow rivulets and rice (pokkali) fields of Kerala. During post-monsoon season, *Khokha* is fixed in seasonal streams where fish migrate downstream and get trapped (Tysong & Tiwari, 2008). Species trapped in these devices were *Heteropneustus fossilis*, *Puntius* spp., *Mystus* spp. and *Clarius* spp. CPUE is 0.28 kg/day/trap (Table 2).

***b. Kweir*:** *Kweir* is a funnel shaped trap which has a posterior length of 0.7-0.8m. The mouth has a diameter of 0.2-0.3m which are made circular by weaving bamboo strips (Fig 4). It is similar to the fishing trap of Assam which is locally called as *Hufa* operated during rainy season in low-lying paddy fields (Baruah et al., 2013). *Kweir* is a popular trap in West Khasi Hills district of Meghalaya and are operated in the streams, lakes and canals of about 0.6-0.9 m depth. *Channa* spp., *Danio* spp., *Garra* spp., and *Tor* spp. are the most commonly caught fishes in the device. It is placed in series against the water current for 2-3 days. This gear is normally operated in the pre-monsoon season. CPUE is 0.6 kg/day/trap (Table 2).

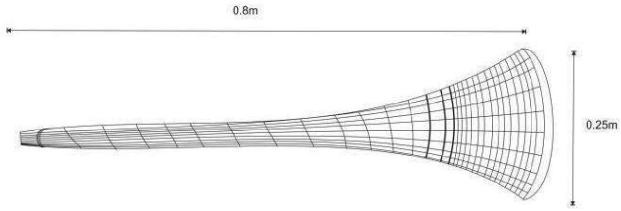

Fig. 4. *Kweir* trap

***c. Tong song*:** It is a trap made of mosquito net and the mouth is kept open by a fixed metallic ring. The mosquito net is stitched together and closed at the end. This trap is used in slow running water (Fig. 5). It has a length of 0.5m and mouth diameter of 0.12m. It is fixed in small canals to catch small *Puntius* spp. CPUE is 0.5 kg/day/trap (Table 2).

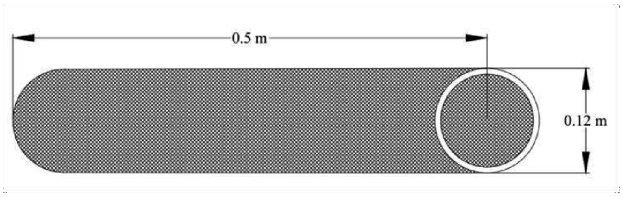

Fig 5. *Tongsong* trap

2. Baskets: These are three-dimensional structures where the catch chamber is completely closed except for the entrance secured by a non-returnable device. Bamboo is the common material for the fabrication of these fishing gears which made them light and transportable (Nedelec, 1975).

a. *Rukh*: This is a conical shaped filter trap. A small bamboo woven non-returnable funnel called *Ka Shit* is kept inside the *Rukh* (Tynsong & Tiwari, 2008). The posterior part tapers towards the end closed with the interwinding bamboo strips. Length of these traps varies from 0.26-0.30 m and diameter of mouth opening is of 0.09 m approx. Size of the funnel varies from 0.11-0.12 m in length (Fig. 6). This type of trap is operated during July-October

specially to catch *Garra lissorhynchus* in small streams. CPUE is 0.38 kg/day/trap (Table 2).

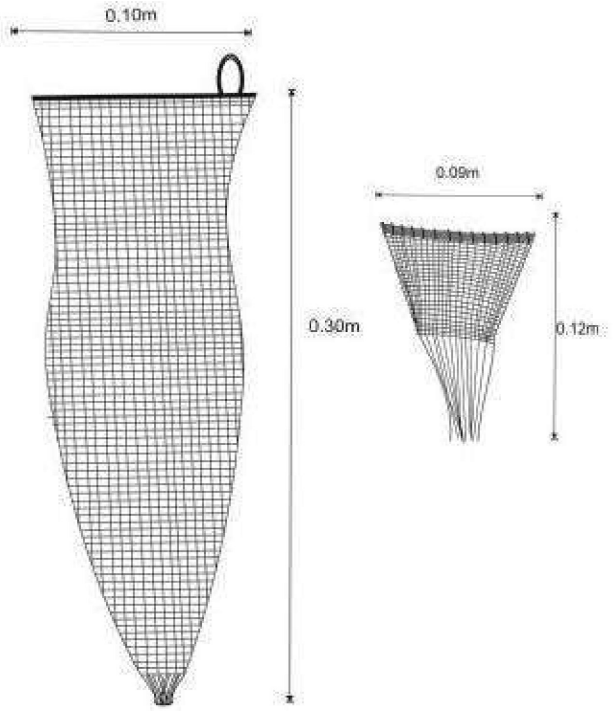

Fig 6. Diagram of *Rukh* and *Ka shit*

b. *Kyah*: This trap resembles the *Rukh,* but posterior end is square-shaped by thick bamboo sticks which is kept elongated for bottom support. Length of the trap is 0.38-0.40 m and mouth opening diameter is 0.13-0.15 m. *Ka shit* length is 0.10-0.12 m (Fig. 7). It is operated in lakes and canals to catch *Channa* spp., *Danio* spp., *Labeo* spp. etc. during pre-monsoon and monsoon season. CPUE is 0.5 kg/day/trap (Table 2).

c. *KharaDothli*: The trap is named after the most targeted species *Channa*, whose local name is *Dothli*. This trap resembles *Rukh* but the posterior end which is round in shape. The bamboo strips are woven tightly on anterior part and posterior part woven with a small gap to filter water. Length varies from 0.25-0.40 m and mouth diameter 0.08-0.17 m according to target species size (Fig. 8). It can be easily operated in canals and shallow rivers during monsoon seasons. CPUE is 0.41 kg/day/trap (Table 2).

d. *Khara*: The shape of the trap is like a pot woven by bamboo strips. The mouth is made in the shape of funnel for placing the *Ka shit.* Base of the pot is square-shape of 0.09 m side length which increase

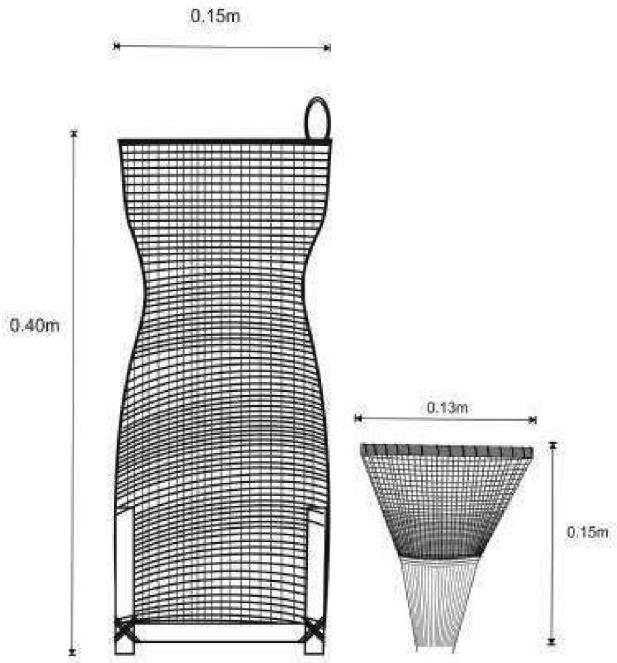

Fig. 7. *Kyah* and *Ka shit* trap

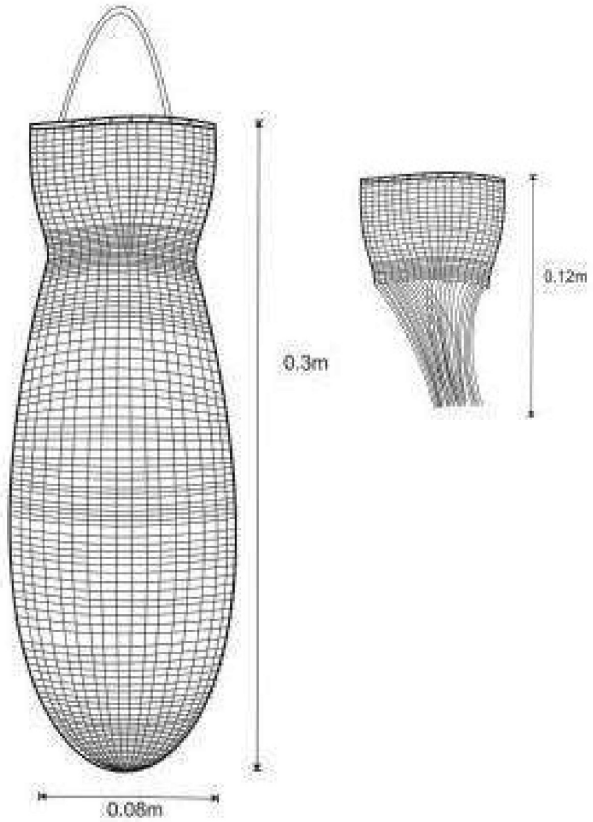

Fig. 8. *KharaDothli* and *Ka shit* traps

the surface area to catch more fish. Length is 0.26-0.30 m and mouth diameter 0.16-0.18 m (Fig. 9). It is operated in paddy fields and rivers to catch *Neolissochilus hexagonolepis* and *Labeo* spp. *Dong*, an urn shaped trap seen in Dawki river of Meghalaya (Nath, 2016). CPUE is 1.5 kg/day/trap (Table 2).

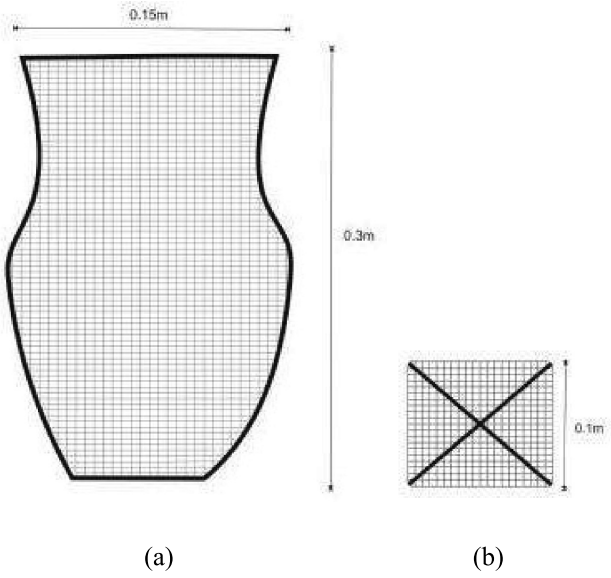

Fig. 9. *Khara* – (a) Pot and (b) Bottom view of *Khara trap*

e. *Khnam*: *Khnam* is made up by cutting a bamboo pole of length 0.5-0.6 m which ends with a bamboo node. The bamboo is split in thick strips tied with thin iron wires and mouth is interwoven tightly by bamboo strips of diameter 0.1-0.2 m. *Ka shit* length varies from 0.20-0.23 m (Fig. 10). *Khnam* is operated in all seasons but the peak season is during post-monsoon from October to November that targets the fish species mainly *Heteropneustus fossils*. CPUE is 2.2 kg/day/trap (Table 2).

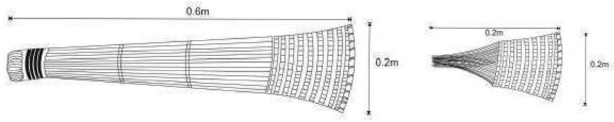

Fig. 10. *Khnam* and *Ka shit* traps

f. *Chiap*/*Khnu*: *Chiap* is a cylindrical-shaped trap interwoven tightly by bamboo strips. Mouth opening at the base (0.1-0.2 m diameter) is fitted with *Ka shit* to prevent the escapement of the fish caught and collected from the loose end at the top by untying the strips which otherwise is kept tied when it is in operation. Length of *Khnu* varies from 0.3-0.4m based on the species size (Fig. 11). Dried fish, orange peel and earthworm are used as bait. These are operated in shallow water current streams and canals. Fishes like *Garra* spp., *Danio* spp., *Neolissochilus hexagonolepis, Tor* spp. and common carp are caught in the trap during pre-monsoon and monsoon season. *Ubhoti* and *Doo* are similar structures seen in rivers and beels of assam (Pravin et al., 2011). CPUE is 2.5 kg/day/trap (Table 2).

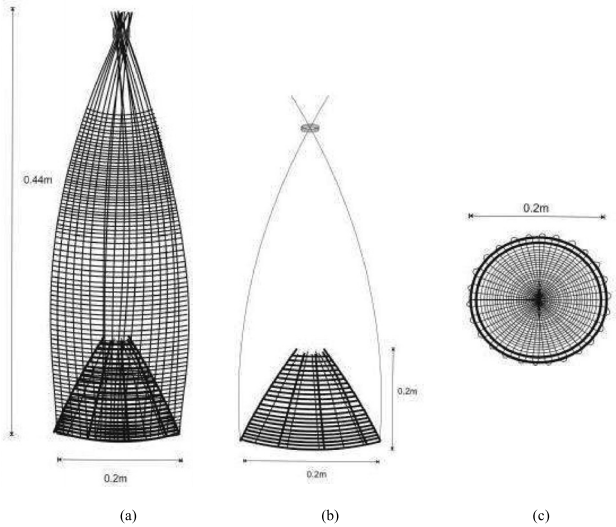

Fig. 11. *Khnu/Chiap* – (a) *Khnu/Chiap* (b) Interwind *Ka shit* (c) Bottom view of *Khnu/Chiap* traps

g. *Seppa*: *Seppa* is a spindle shaped trap made by weaving split-bamboo strips with cane (Pravin et al., 2011). The trap length varies from 1-2 m with maximum girth of 0.2-0.25 m (Fig. 12). Generally, it has two windows of trapezoid shape in the middle of 0.1 m in length placed 0.1 m apart. It is extensively used in inundated paddy fields during monsoon season. Main catch from the gear comprise of *Channa* spp., *Puntius* spp., *Heteropneustus fossilis, Clarius batrachus,* etc. with a CPUE of 2.5 kg/day/trap (Table 2).

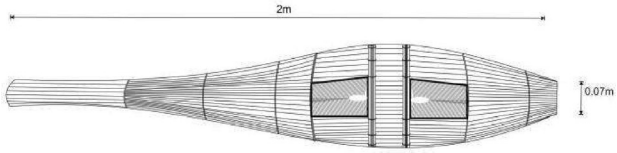

Fig. 12. Diagram of *Seppa* trap

3. Box traps: These are rectangular flat box made of iron netting.

***a. Tharru*:** This is a box shaped trap made up of netting wire with a mesh size of 2 mm. Circular

holes of diameter 0.04-0.06 m are provided on all the three sides of the trap except in the opening lid to collect the catch. On the two elongated side of the trap it has four round hole and one hole on the opposite side of the opening lid. There is square mesh door on the upper side of the trap to keep the bait like worms and bread. Size of *Tharru* is 0.3x0.2x0.1 m (Fig 13). It is operated in streams fixed by a bamboo pole. Species caught are *Channa spp., Puntius* spp. and some other miscellaneous fish. Some authors reported these trap as *Synduk jar* or *Ruh pdem* with a catch rate of 1-5 kg/pot/day (Nath, 2016). CPUE of *Tharru* is 1.85 kg/day/trap (Table 2 and 3).

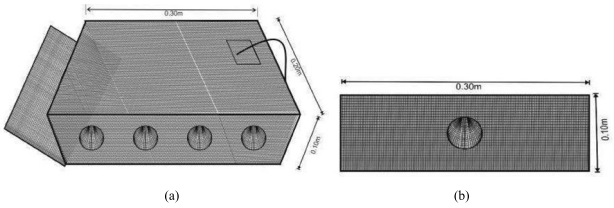

Fig. 13. *Tharru* trap (a) Side view (b) Posterior view

Trap fishing is a dominant fishing technique employed mostly during monsoon and post-monsoon. Fish traps during monsoon season are widely used in the inundated paddy field and post-monsoon in the streams and rivers. *Khokha* and *Seppa* are the most popular traps used in the paddy fields belonging to the category of Tubular traps and Basket traps. *Khnam*, *Tharru* and larger forms basket traps are used in rivers. These traditional fish traps are selective in nature as their design is based on the size of the fish available in that operational area. For example, *Rukh* is designed to catch *Gara* spp. and *Khara Dothli* which is fabricated to catch *Channa* spp. and also the name is after the *Channa* spp. locally known as Dothli. A particular feature of Meghalaya traditional fish traps is the use of funnel-like part of the pot known as *Ka shit* which can be removed and placed in the pot. Thus, the traditional fish traps are made up from bamboo which are available and also economical for the fishermen. Lifespan of the traditional fish traps are longer than 2-3 years because the fish traps when not being operated are kept in smoke that increases its strength. Operation of these traditional fishing traps are carried out by the male member of the family who is also responsible for fabrication of the fish traps and the female member help them by selling the catch in nearby market.

Khnu/*Chiap* and *Seppa* has the highest and *Khokha* has the lowest CPUE among the eleven traditional fish traps but are observed in most of the sample area. Based on CPUE, *Khnu*/*Chiap* is the most popular and efficient traditional fish traps of Khasi and Jaintia hills of Meghalaya. CPUE was studied on the investigated fish traps of described dimensions which may vary for similar traps with different dimensions. These are placed in different location of the operational site so that there is no place of escapement of fish. This increases the probability of catching fish for the fishermen by the end of the day.

Nowadays, fish traps made up of plastic bottles are seen operated in the shallow streams which may cause harmful effects not only to the environment but also to the organisms in the inland water bodies. Hence, biodegradable and environment friendly materials of fishing gears should be recommended for fishing practices. Plant-based fish poison, explosives and other destructive fishing methods are also practiced that has caused over-exploitation of fishes in Meghalaya (Nath, 2016). Hence the village headmen has taken appropriate measures and decision for the fishing practices operated in the nearby waterbodies which is abide by every members of the village. There is a scope of modernization to increase the efficiency of the traps and to meet the growing demands of fish of Meghalaya state. The documentation of the traditional traps will also help to secure and protect their indigenous knowledge and skills of the fishermen in Meghalaya.

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