

Importance of indigenous knowledge of Adivasi fisher's communities on production biology of *Monopterus albus* and its effect on their livelihood in northern Bangladesh.

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ABSTRACT

Cuchia (*Monopterus albus*), a delicious, nutritious and favorite fish for Adivasi and South Asian countries people was abundant throughout the Bangladesh. At present this fish is scarcely found in the open water system. The study was conducted in Kokraduba beel surrounding two Adivasi fisher's villages Chitolia and Shampur; district Mymensingh to collect information about ecosystem health of Kokraduba beel, habitat, food and feeding habit and reproductive biology of *cuchia* (*M. albus*) by interviewing Adivasi fisher's indigenous technological knowledge (ITK). Both primary and secondary data were collected by direct interviews to the Adivasi respondents, Department of Fisheries and websites. According to the ITK method of Adivasi fisher's, total production of the Kokraduba beel was recorded 14395.0 kg and 13208.0 kg between the year 2012 and 2013 respectively. About 8.25% production was decreased from 2012 to 2013. According to (78.57-88.01)% fisher's blocked water flow and shallow depth of the beel, expansion of agriculture and aquaculture, use of chemicals, fertilizer and pesticide, infrastructure development and fishing pressure in breeding season were main causes for destruction of natural habitats and reducing production of *M. albus* in Kokraduba beel. Three fishing methods viz. physical (by hand picking), line and traps (bair) were identified in the survey area among which traps catches relatively undersized *M. albus*. According to the ITK method, food and feeding habit, identifying characteristics of male and female, breeding behavior; fecundity and larvae development, mother care, cannibalism were identified and 64.24% Adivasi fisher's recognized that breeding period of *M. albus* was April to mid July. Updated Adivasi's ITK method with science based knowledge on habitat, food and feeding habit, reproductive biology, management of hatchlings, fry and fingerling production, in alternative income generating activities (AIGAs) and developed value chain; will be a new horizon to develop ecosystem health and production of *M. albus* in the Kokraduba beel through community based co-management aspect.

Keywords: Adivasi communities, involvement, ITK, Mud eel, scientific knowledge

Cuchia (*M. albus*), a delicious, nutritious and favorite fish for Adivasi people is usually found in the freshwater of Bangladesh as well in other South Asian countries like Pakistan, India and Nepal (Talwar and Jingran, 1991). Once, indigenous *M. albus* was abundant throughout the Bangladesh, plenty in mud holes in shallow "beels" and 'boro' paddy field particularly in old Sylhet, Mymensingh and Tangail Districts (Rahman, 1989). But presently this fish is hardly found in the open water system. International Union of Conservation of Nature (IUCN), Bangladesh (2000) enlisted *M. albus* as a vulnerable species in the country. But destruction of the natural habitats of this species and climate change by different ways like horizontal expansion of agriculture and aquaculture, destructive fishing methods, use of chemicals, fertilizer and pesticide, infrastructure development etc. and harvesting of this species increased with the increase of population, which is further influenced by the international demand and trade of *M. albus*. Many of poor Adivasi people harvest and sell this species as a full-time or part-time profession. But this species is

threatened now (Diaster, 1990; Chakraborty *et al.*, 2010; Chakraborty and Nur, 2009). Considering the importance of this species in nutritional, economic and biodiversity point of view, its conservation and propagation are considered through fisheries regulation. Studies on the reproductive biology of fish are essential for evaluating the commercial potentialities of its stock, life history, cultural practice and actual management of indigenous fishes (Lagler, 1956; Doha and Hye, 1970). Reproductive potential of a population is one of the basic exigencies to designate the individuals of that population in respect to their gonadal conditions (Jhingran and Verma, 1972). It is very important to assess the yearly breeding cycle of *M. albus* to make success in breeding practice. Knowledge of gonad development and the spawning season of a species allow subsequent studies on spawning frequency of its population, which is very important for its management. The present work was undertaken to find out the food and feeding habit and natural reproductive cycle of both sexes of *M. albus*. In order to increase its production restoring and protecting natural habitats, and development of sustainable harvesting may be a good

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option improving livelihoods of *Adivasi* people are important. Considering the importance of promotion of its production the *Adivasi* Fisheries Project of the Bangladesh Fisheries Research Forum (BFRF) in collaboration with researchers from Department of fisheries (DoF) conducted a study involving with indigenous knowledge of adivasi people through understanding its biology and development of management technique. In order to increase its productivity from natural habitat it is important to get more understanding about the breeding biology, the seasonality in production of *M. cuchia* together with understanding about the habitat and the people involved in its harvest and uses for consumption and sale.

The objective of the study was to investigate the status of aquatic biodiversity of the water body and observe food and feeding habit; production and breeding biology of *M. cuchia* in Kukraduba beel for ethnic (*Adivasi*) communities to preserve the fish from endanger level and further developing their livelihood.

MATERIALS AND METHODS

The current survey was conducted in Kokraduba beel surrounding two *Adivasi* villages Chitolia and Shampur, under Phulpur Upazila district Mymensingh (Fig. 1) to collect information about ecosystem of beel, habitat, food and feeding habit and reproductive biology of *M. cuchia* by interviewing adivasi fisher's indigenous knowledge.

About 68% *Adivasi* people of the Chitolia village and 80% *Adivasi* people of the Shampur village are habituated with *M. cuchia* harvesting. It is noteworthy to mention that Kokraduba beel is used for *M. cuchia* fishing. It is evident from the above mentioned information that Kukraduba beel is still now resourceful for *M. cuchia* fish availability. Considering the above mentioned potentialities, Kukraduba beel is selected as most potential study area for this species.

A set of questionnaire was designed to study the existing ecosystem status of the beel, food and feeding habit and reproductive biology of *M. cuchia*. Primary

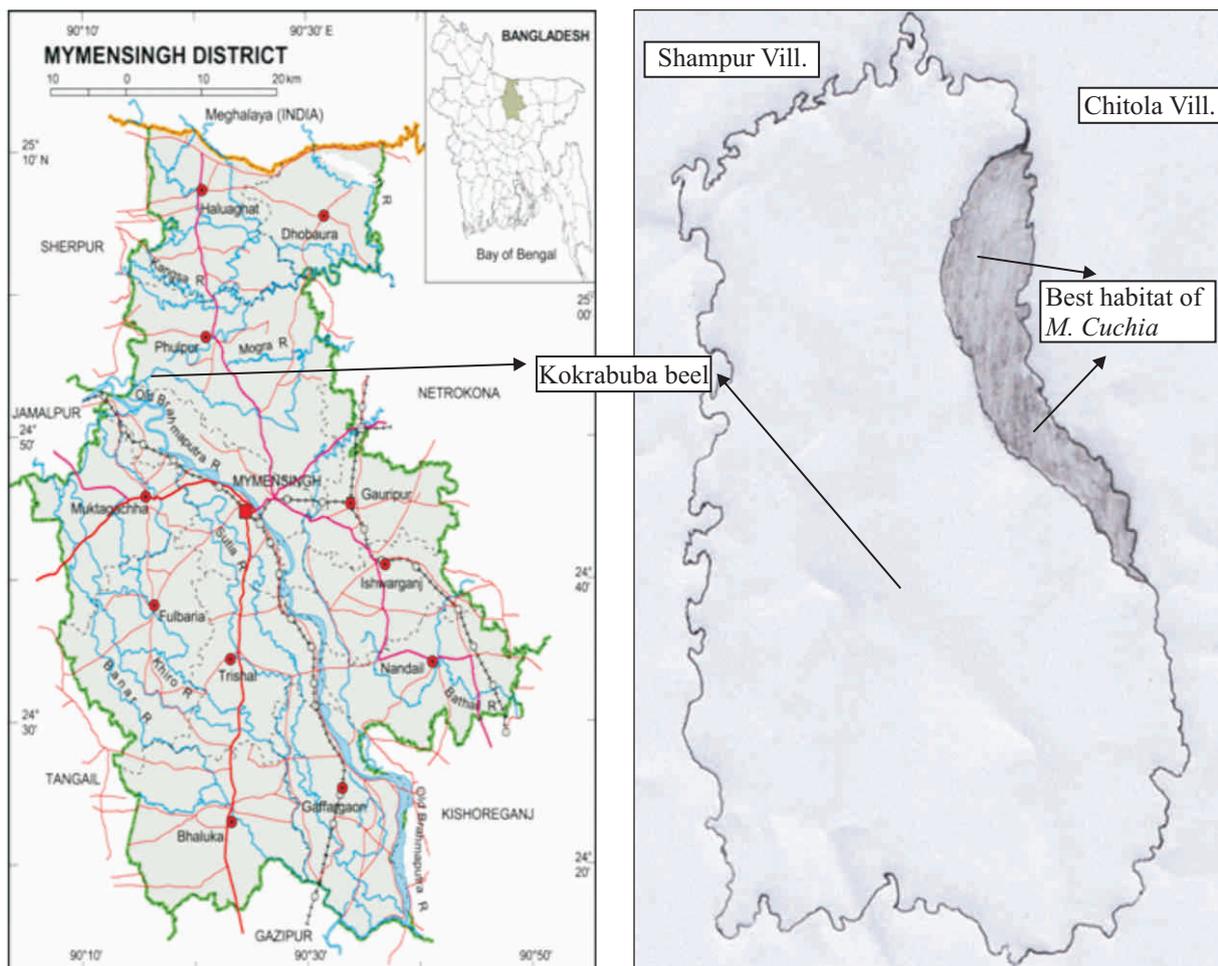


Fig.1: Location of Kokraduba beel.

data was collected by direct interviews to the *Adivasi* respondents. Questions were asked systematically, with framed questionnaire. Necessary explanations about questionnaire were given to the *Adivasi* fishers who were interviewed wherever it was felt necessary. Secondary data were collected mainly from the Department of Fisheries (DoF). Relevant literature has been reviewed and websites were explored to have relevant information. *Adivasi* fishers, transporters and Paikers were also met to get more information about needs and gaps of the production.

The data were analyzed through one way ANOVA using SPSS program to find out whether any significant difference existed among different data (Duncan, 1955; Zar, 1984). Standard deviation in each parameter was calculated and expressed as mean \pm S.D.

RESULTS AND DISCUSSION

Location of the *cuchia* habitat

There are 30 *Adivasi* households in Chitolia and 38 *Adivasi* household in Shampur village. Total 42 member of the community were interviewed. According to the harvesting statistics of *M. cuchia* in different year, about 90.48% fisher's thought that *M. cuchia* was found very

poorly in northern west side, 92.86% said that north eastern side was the best habitat of this species, 90.48% believed that second highest habitat was north western and 88.10% said that this species was harvested very poorly in south eastern side of the beel (Table 1).

Rich characteristics of *M. cuchia* habitat in Kokraduba beel

Locations of *M. cuchia* habitat in Kokraduba beel were identified according to the indigenous technical knowledge of *Adivasi* fisher's. About 24.0% agreed that this species liked shallow and swampy area for habitat, 27.0% said that plenty in mud-holes was found in the north eastern area, 26.0% said that feed availability like as tadpole, small fish, small insect, earthworm were available in that area and 35.0% agreed that less aquaculture pressure was found south eastern side of the beel (Fig. 2).

Causes of reducing ecosystem health of the beel

About five reasons were identified to reduce ecosystem health of the beel for *M. cuchia* species. About 21.0% *Adivasi* fisher's thought that domestic migratory route of this species was blocked, 20.0% believed that depth of the beel became deeper to

Table 1: Location of *M. cuchia* habitat in the Kokraduba beel.

Location	Response of Adivasi Fisher's		Total(n=42)	Percentage(%)	Remarks
	Chitolia	Shampur			
North western	30	08	38.0 \pm 14.02	90.48	Poor habitat
North eastern	30	09	39.0 \pm 14.85	92.86	Best habitat
South western	29	09	38.0 \pm 14.42	90.48	2 nd habitat
South eastern	29	08	37.0 \pm 13.88	88.10	Very poor habitat

Table 2: Harvesting methods of *M. cuchia* in Kokraduba beel.

Fishing methods	Involvement of Adivasi fisher's		Total (n=42)	Percentage (%)	Cumulative	Community involved (%)
	Chitolia	Shampur				
Physical (By hand)	05	02	07.0 \pm 2.83	16.67	16.67	Adivasi 100%
Line (Angling)	22	06	28.0 \pm 12.02	66.66	83.33	Adivasi 100%
Trapping (Bair)	05	02	07.0 \pm 2.83	16.67	100	Adivasi 50% Muslim 50%

Table 3: Important characteristics of *M. cuchia* responded by Adivasi fisher's in the surveyed area.

Characteristics	Response of Fisher's		Total (n=42)	Percentage (%)	Remarks
	Chitolia	Shampur			
Hiding under crevices, floating weeds and mud	28	07	35.0 \pm 14.86	83.33	Adivasi fisher's had good knowledge
Nocturnal and hibernation	27	09	36.0 \pm 12.72	85.71	and trap user's had
Both	29	08	37.0 \pm 14.85	88.01	poor knowledge.

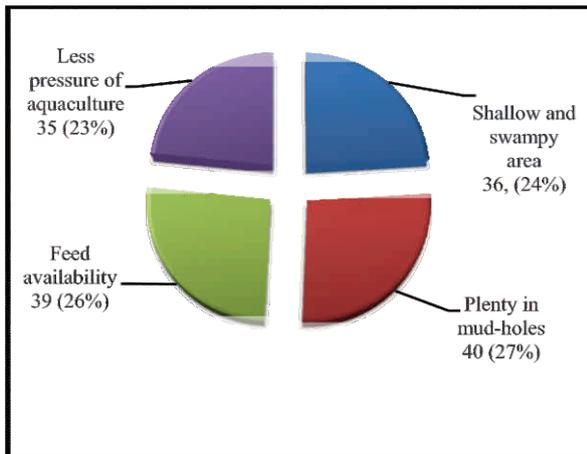


Fig. 2 : Characteristics of *M. cuchia* habitat in Kokraduba beel.

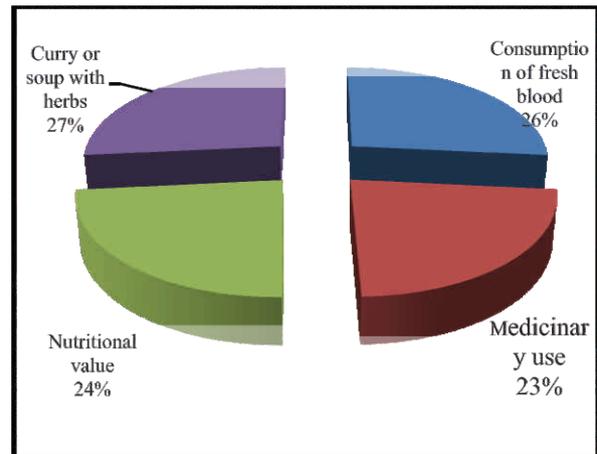


Fig. 4: Food value of *M. cuchia*.

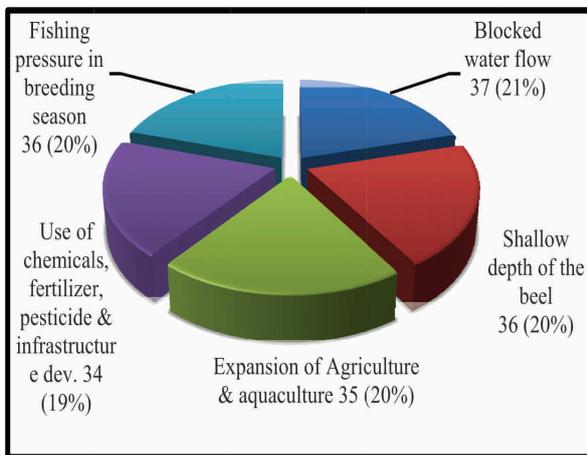


Fig. 3: Causes of destruction of the natural habitats and production of *M. cuchia* in Kokraduba beel.

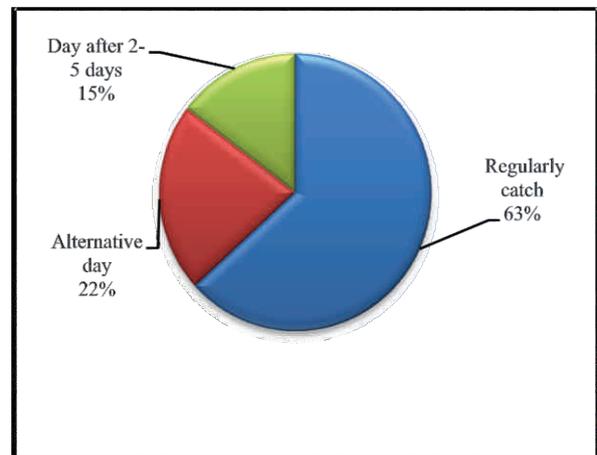


Fig. 5: Number of *Adivasi* fisher's involvement in *M. cuchia* fishing in kokraduba beel.

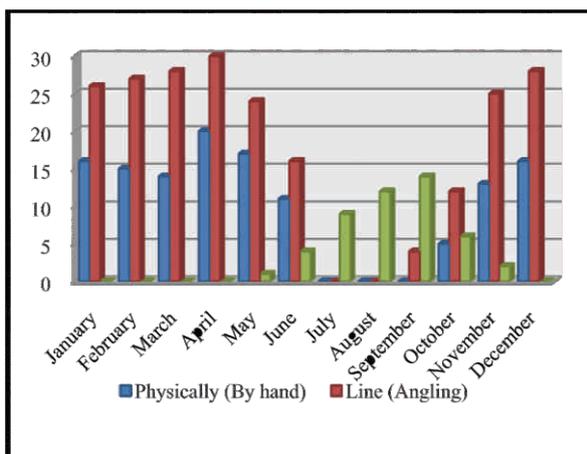


Fig. 6: Fisher's harvested *M. cuchia* by different methods in Kokraduba beel.

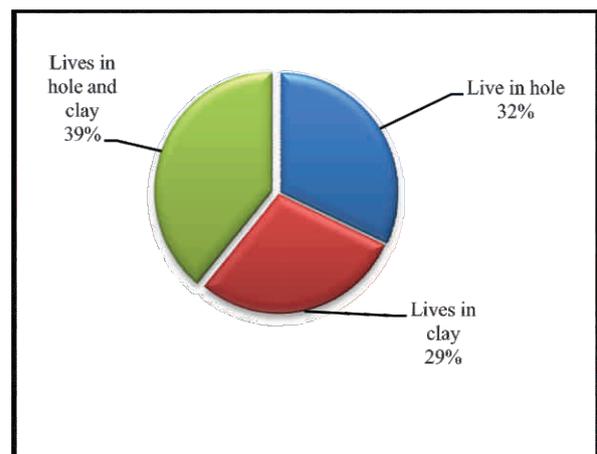


Fig. 7: Different habitat of *M. cuchia* according to the indigenous knowledge of *Adivasi* fisher's.

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Fig. 8: Physically by hand



Fig. 9: Line method



Fig. 10: Trap method

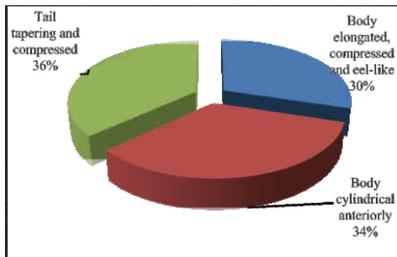


Fig. 11: Size and shape of *M. cuchia* identified according to ITK method.

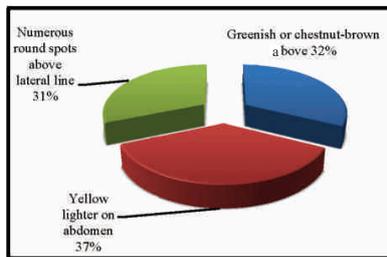


Fig. 12: Colour of *M. cuchia* identified according to the ITK method.

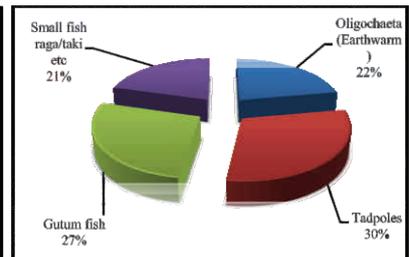


Fig. 13: Feed items used in line (angling) method.

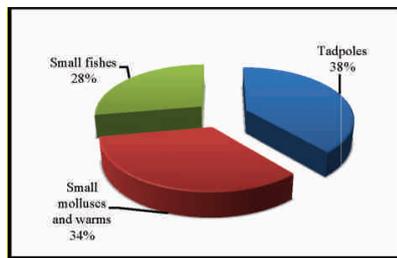


Fig. 14: Food and feeding habit of *M. cuchia*.

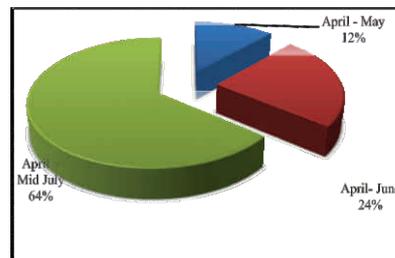


Fig. 15: Knowledge profile on breeding period of *M. cuchia* according to ITK method.



Fig. 16: Stocking live *M. cuchia* for marketing.



Fig. 17: Drying method of *M. cuchia* prepared by Advasi fisher.

shallower, 20.0% said that expansion of agriculture and aquaculture was liable, 35.0% said that use of chemicals, fertilizer, pesticide and infrastructure development directly affected habitat and health of water body and 20.0% said that increasing fishing pressure in breeding season were other causes for destruction of natural habitat of Kokraduba beel (Fig.3).

Food value of *M. cuchia*

About 26.0% *Adivasi* fisher's of study area told that consumption of fresh blood of *M. cuchia* cures weakness, anemia and asthma and 23.0% thought this fish is used as a medicine which cured pain and regenerate blood in human body, 24.0% fisher's said that it has high caloric and protein value and finally, 27.0% said that curry or soup of *M. cuchia* flesh with herbs cured anemia, piles and diabetes (Fig. 4).

Involvement of *Adivasi* fisher's in harvesting

From interviewing with *Adivasi* fisher's, it was found that about 63.0% *Adivasi* fisher's of Chitolia and Shampur village harvested *M. cuchia* regularly, 22.0% fisher's were involved to harvest alternative day and finally, 15.0% harvested day after two to five days in Kokraduba beel (Fig. 5).

Fishing methods and fishing period

From the discussion of the two *Adivasi* village's community, three methods of *M. cuchia* harvesting were identified. About 16.67% *Adivasi* fisher's harvested *M. cuchia* by physical (by hand picking) method, 66.66% *Adivasi* fisher's harvested by hook and line (angling) and 16.67% fisher's harvested *M. cuchia* by trapping (bair), respectively (Table 2). Information was found in the surveyed area that about 100% *Adivasi* fisher's were involved in physical and line methods. But about 50% *Adivasi* and 50% non-*Adivasi* community's people were involved in trap method. From the figure 6, it is recorded that fisher's did not catch this species by physical method between the months of July and September, by line between July and August and by trap between December and May.

Habitat of *M. Cuchia*

On the basis of indigenous technological knowledge of *Adivasi* fisher's *M. cuchia* preferred to live in holes, clay and both hole and clay. About 32.0% *Adivasi* fisher's responded that this species favored to live in hole from the months of January to December, 29.0% answered that this species preferred to live in clay from October to March in a year and 39.0% reported that this species liked to live in both hole and clay from January to December (Fig. 7).

Other characteristics

From the survey of 42 *Adivasi* fisher's, about 83.33% agreed that *M. cuchia* had been liked to hide under crevices, floating weeds and mud. About 85.71% reported that this species was nocturnal and had been gone to hibernation. About 88.01% said that this species was habituated with both characteristics (Table 3). *Adivasi* fisher's had good knowledge on hiding, nocturnal and hibernation. On the other way, trap user's had shallow knowledge about these characteristics.

Size and weight

About 28 *Adivasi* fisher's reported that the size of *M. cuchia* was identified 46.86±5.01 cm and 352.44±117.97g by physically (by hand picking), 49.11±4.34 cm and 392.22±86.71 g by line (angling) and 32.59±6.13cm and 163.33±93.20g by trap (bair), respectively (Table 4). About 100% *Adivasi* fisher's were involved in physical and line methods. But about 50% non-*Adivasi* community's people were involved in trap method. They harvest under size fishes also by trap method.

Total catch

According to the indigenous technological knowledge of *Adivasi* fisher's total production of the Kokraduba beel was recorded 14395.0 kg and 13208.0 kg between the year 2012 and 2013 respectively (Table 5). About 1187 kg (8.25%) production was decreased between 2012 and 2013. About 75% *Adivasi* responded that regular harvesting of *M. cuchia* was recorded 5.3 kg and 4.6 kg by physically by hand (Fig.8), 97.5% answered that regular catch was 17.1 kg and 15.4 kg by line method (Fig.9) and 95% fisher's reported that regular catch was 106.2 kg and 24.68 kg by trap method (Fig. 10) between the year of 2012 and 2013. About 139 traps were regularly used to catch this species where 50% non-*Adivasi* communities' people were involved.

Size and shape of *M. cuchia*

Among the surveyed 42 *Adivasi* fisher's, about 30.0% discussed that the body size of *M. cuchia* was elongated, compressed and eel-like. About 34.0% reported that the body of this species was cylindrical anteriorly and 36.0% said that this species had tail tapering and compressed (Fig. 11).

Body colour

Colour of *M. cuchia* was identified by ITK knowledge of *Adivasi* fisher's. About 32.0% of *Adivasi* fisher's described that the color of this species was greenish or chestnut-brown above, 37.0% explained the color of this species was yellow lighter on the

Table 4: Length and weight of *M. cuchia* recorded according to the Adivasi fisher's response.

Fishing methods	Length(cm)	Weight(g)	Responded fisher's	Percentage(%)	Remarks
Physically (By hand picking)	46.86±5.01 (36.0-52.2)	352.44±117.97 (150.0-450.20)	28	70	Involved 100% Adivasi
Line (Angling)	49.11±4.34 (40.0-53.4)	392.22±86.71 (200.0-500.0)	26	65	Involved 100% Adivasi
Trap (Bair)	32.59±6.13 (25.0-48.0)	163.33±93.20 (50.0-350.0)	32	80	Involved 50% non-Adivasi

Table 5: Catch statistics of *M. cuchia* in Kokraduba beel according to the ITK knowledge of fisher's.

Fishing methods	Total production (2012)		Total production (2013)		Responded fisher's	Percentage (%)	Remarks
	Daily catches (kg)	Total harvested (kg)	Daily catches (kg)	Total harvested(kg)			
Physical (By hand picking)	5.3±.04	1012.0±6.82	4.6±.04	966.0±5.66	30	75.0	Decreased production in 2013 and
Line (Angling)	17.1±2.82	3782.0±9.55	15.4±1.02	3234.0±10.42	39	97.5	Regular recorded
Trapping (Bair)	106.2±8.25	9601.0±12.46	105.6±10.08	9008.0±13.22	38	95.0	traps is 139.
Total	14395.0		13208.0				

Table 6: Knowledge profile of male and female characteristics of *M. cuchia* fish.

Individual Characters	No. of fisher's responded		Total fisher's (n=42)	Percentage (%)	Remarks
	Chitolia	Shampur			
Male Abdomen: Round, not very soft to touch; Vent: slightly elongated and reddish; Tail: Narrow; Body colour: Prominent, bright and brownish	20	07	27.0±9.19	64.28	35.72% had less idea.
Female Abdomen: Soft, round, bulging out belly; Vent: Round, flesh and pinkish; Tail: flattened; Body colour: Comparatively dull.	22	08	30.0±9.90	71.43	28.57% had less idea.

Table 7: Knowledge profile on aggressive behavior in breeding season of *M. cuchia*.

Types of behavior	No. of fisher's responded		Total fisher's (n=42)	Percentage (%)	Remarks
	Chitolia	Shampur			
Aggressor	28	07	35.0±14.84	83.33	80% adivasi fisher's
Bitten	30	08	38.0±15.85	90.48	showed biting spot in their hand.

Table 8: Knowledge profile of fecundity and larvae of *M. cuchia* fish.

Types of knowledge	Character	No. of fisher's responded		Total fisher's (n=42)	Percentage (%)	Remarks
		Chitolia	Shampur			
Fecundity	Body wt. 250-500 gno. of egg: 400-950 Adhesive characteristic.	17	06	23.0±7.78	54.76	Shallow knowledge on fecundity & larvae
Larvae	Black and brownish thread or hair like, found in hole.	16	05	21.0±7.22	50.00	

Table 9: Mother care, carnivore and cannibalism characteristics of *M. cuchia* according to ITK.

Characteristics	No. of fisher's responded		Total fisher's (n=42)	Percentage (%)	Remarks
	Chitolia	Shampur			
Mother care	28	09	37.0±13.43	88.10	Male take part in no care
Carnivore	29	09	38.0±14.14	90.48	-
Cannibalism	28	08	36.0±13.88	84.71	Male attack the larvae to take it as a feed

abdomen and 31.0% *Adivasi* fisher's expressed that numerous round spots on the body above the lateral line on the *M. cuchia* was found (Fig. 12).

Bait information in line (angling) system

Angling is the most technical method to harvest *M. cuchia*. This species preferred to take oligochaeta (Earthworm), Tadpoles, gutum fish, small raga/taki etc as bait. About 22.0% of *M. cuchia* fisher's responded that this species preferred to feed oligochaeta (earth worm) as bait, 30.0% fisher's said that tadpole was the most preferable bait in line method and 27.0% fisher's believed that gutum fish was second choice of bait and 21.0% stated that this species also preferred small raga/taki fish etc as bait (Fig. 13).

Food and feeding habit of *M. cuchia*

Among the surveyed 42 *Adivasi* fisher's, about 38.0% responded that first choosing feed of *M. cuchia* was tadpoles. About 34.0% reported that second choosing feed was small molluscs and warms, and 28.0% said that *M. cuchia* also liked small fishes as a feed (Fig. 14). The response by the *Adivasi* fishers' of Kokraduba beel revealed that *M. cuchia* is a carnivore *i.e.* identified cannibalism characteristics.

Knowledge about breeding of *M. cuchia*

According to the indigenous knowledge of *Adivasi* fisher's, Fig. 15 shows the knowledge profile on breeding period of *M. cuchia*. About 12.0% fisher's said that April to May was the breeding period, 24.0% said that April to June was peak breeding period and 64.0% recommended that April to mid July was natural breeding period in Kokraduba beel. But they have no ability to protect breeding ground of *M. cuchia* between the months of April to mid July.

Knowledge about male and female of *M. cuchia*

Table 6 shows the knowledge about male and female of *M. cuchia*. About 64.28% *Adivasi* fisher's had knowledge on male characteristics of *M. cuchia*. According to them abdomen was round, not very soft to touch. Vent was slightly elongated and reddish in colour. Tail was narrow. Body colour was prominent, bright and brownish. Rest of 35.72% had less idea on male characteristics. About 71.43% fisher's had good knowledge about female characteristics of *M. cuchia*. They said that abdomen was soft, round and bulging out belly. Vent was round, flesh and pinkish. Tail was flattened. Body colour was comparatively dull. About 28.57% *Adivasi* fisher's had less knowledge on female characteristics (Table 6).

Knowledge about breeding behavior

Adivasi fisher's had good idea on breeding behavior. About 83.33% *Adivasi* fisher's agreed that mother *M. cuchia* was an aggressor after ovulation and 90.48% reported that *M. cuchia* had bitten characteristics during breeding season (Table 7).

Knowledge about fecundity and larvae of *M. cuchia*

From the table 8, it was found that about 54.76% *Adivasi* fisher's had knowledge about fecundity of *M. cuchia* and rest of other had no idea on it and about 50.0% fisher's had an idea of larvae of *M. cuchia* and rest of other had no idea.

Characteristics of mother care, carnivore and cannibalism of *M. cuchia* according to ITK

Different characteristics of mother care, carnivore and cannibalism of *M. cuchia* was recorded in the survey area according to ITK method. About 88.10% *Adivasi* fisher's reported that *M. cuchia* had only mother care, 90.48% said that *M. cuchia* was carnivore and 84.71% said that fish had cannibalism characteristics (Table 9). Generally, *M. cuchia* took their larvae in its mouth during attacking of enemies. But when female did not take all the larvae in its mouth at a time, the male attacked the larvae and take it as a feed.

Marketing and processing method of *M. cuchia*

Adivasi fisher's had a good knowledge on marketing and processing of *M. cuchia*. About 26.0% fisher's said that it was easy to stocked live *M. cuchia* for 1-3 month from harvester to consumer due to air breathing characteristic (Fig. 15), 23.0% said that *M. cuchia* was dried for a long term preservation (Fig. 16), 24.0% reported that *Adivasi* people liked to *M. cuchia* as a fry with rice and 27.0% pointed that they liked to take *M. cuchia* as curry with rice.

Adivasi fisher's have indigenous technological knowledge (ITK) regarding destruction of natural habitats of Kokraduba beel. According to ITK method north eastern side of the beel was identified as a best habitat of *M. cuchia*. Shallow and swampy area, plenty in mud-holes, available of food items as like as tadpole, small fish, earthworm and molluscs was found in that area. Less agriculture and aquaculture pressure was also found south eastern side of the beel (Jyotish et al. 2013). On the basis of these characteristics a rich habitat of *M. cuchia* is identified in the south eastern area of Kokraduba beel. *Adivasi* fisher's had knowledge regarding destruction of natural habitats of Kokraduba beel. Maximum *Adivasi* fisher's thought that blocked

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water flow, shallow depth, expansion of agriculture and aquaculture, use of chemicals, fertilizer pesticide and infrastructure development and fishing pressure were main reasons for destruction of natural habitat of the beel which is agreed by Jyotish *et al.*, 2013.

Adivasi fisher's had a good knowledge on food value of *M. cuchia*. According to the indigenous knowledge of *Adivasi* fisher's direct consumption of fresh blood cured weakness, anemia and asthma which is agreed by Saika and Ahmed, 2012. This fish was used as a pain killer, blood regenerator and nutrient contents. The average protein content per 100 gm of raw flesh was 18.7 gm, while the concentrations of other nutrients were 0.8 gm fats, 2.4 gm carbohydrate and 185 mg calcium and caloric value of eel flesh was 303Kcal per 100gm (www.mcgill.ca; Nasar, 1970). Curry or soup of flesh prepared with certain herbs cured anemia, piles and diabetes (Saika and Ahmed, 2012; Chakravarty and Kalita, 2012).

There were different causes of reducing ecosystem health of the beel. *Advasi* fisher's thought that domestic migratory route of *M. cuchia* was blocked, depth of the beel became deeper to shallower, expansion of agriculture and aquaculture, use of chemicals, fertilizer, pesticide and infrastructure development, increasing fishing pressure were main causes for destruction of natural habitat of Kokraduba beel, which is agreed by Chakraborty, 2011; Hussain and Hossain, 1999 and Disaster, 1990. *Adivasi* fisher's practiced to catch this fish regularly, alternative day and day after two to five days.

Poor *Advasi* fisher's caught *M. cuchia* regularly, which is supported by Kaliata *et al.*, 2010. Fisher's harvested *M. cuchia* whole the year by Physical (By hand picking), Line (Angling) and Trapping (Bair) methods. About 50% non-*Adivasi* people's were involved in trapping method and they always practiced to harvest all type of fish including under size *M. cuchia* (Gurumayam and Choudhury, 2009; Dutta and Bhattacharjya, 2008; Kakati and Marak, 2002)

Habitat of *M. cuchia* was identified by indigenous knowledge of *Adivasi* fisher's. Among the surveyed about 83.33% agreed that *M. cuchia* was hidden under crevices, floating weeds, stone, mud, etc., which is agreed by (Jyotish *et al.* 2013). The stakeholder of the area reported that *M. cuchia* was nocturnal and went to hibernation winter (Jyotish *et al.*, 2013).

About 28 *Adivasi* fisher's of Chitolia and Shampur village reported that the size of *M. cuchia* was harvested

352.44±117.97g by physical method, 392.22±86.71 g by line method and 163.33±93.20g by trapping method, respectively. They harvested under size fishes by trapping method. Total catch of Kokraduba beel was recorded 14395.0 kg and 13208.0 kg between the year 2012 and 2013 respectively which is agreed by Chakraborty *et al.* 2010. About 139 traps were regularly used to catch *M. cuchia* where 50% non-*Adivasi* communities' peoples were involved. Under size of *M. cuchia* was harvested by trapping method (Jyotish *et al.*, 2013).

Adivasi fisher's had good idea about colour, size and shape of *M. cuchia*. Among the surveyed *Adivasi* fisher's, it was found that the color of the *M. cuchia* was greenish or chestnut-brown above, yellow lighter on the abdomen and numerous round spots on the body above the lateral line. The body size of *M. cuchia* was elongated, compressed and eel-like or cylindrical anteriorly and tail tapering and compressed which is agreed by Jayaram, 1981 and Bhiyan, 1964.

Bait items of line identified according to the response of *Adivasi* fisher's. The hook was tied with a synthetic twine to a float mode of twig. Earthworm, small fish, insect, tadpole *etc* were used as bait to lure the fish. The baited hook inserted in holes with the help of a thin bamboo stick and a dropping movement of float indicated hooking of fish. The fisher pulled out the fish from the hole, which is supported by Jyotish *et al.*, 2013; Bhattacharjya *et al.*, 2004 and Sarma, 2001.

It was noted from the surveyed area that the *Adivasi* households who had in particularly involved in *M. cuchia* harvesting could be given required time to harvest *M. cuchia* from Kokraduba beel (Chakraborty *et al.*, 2010). In such cases dependency on *M. cuchia* harvesting became obvious, that affected the natural stocking of this species in the Kokraduba beel. *Adivasi* fisher's had a good knowledge on food items. Among the surveyed area, *Adivasi* people's responded that first choosing feed was tadpoles, second choosing feed was small molluscs and warms, and then small fishes as a feed (Jyotish *et al.*, 2013).

Knowledge on breeding of *M. cuchia* fish was identified by indigenous knowledge of *Adivasi* fisher's in the survey area, which is a vital part of natural resource management. The breeding period was identified from April to mid July which is supported by Banerjee *et al.*, 1981. Fisher's had indigenous knowledge on breeding behavior of this species fish and also good knowledge to identify on male and female

characteristics of *M. cuchia*, which is a vital part of breeding package (Faruque et al., 2013). About 54.76% Adivasi fisher's had knowledge about fecundity of *M. cuchia* and rest of other had no idea on it which is very much similar study of Chakraborty et al., 2013.

Fisher's had ITK knowledge on mother care of *M. cuchia* fish, which is an important part for survivality of *M. cuchia* population. Because male attracts the larvae at that time and caught the larvae to take it as a feed which is agreed by Nasar, 1989.

Fisher's had knowledge on processing of *M. cuchia*. It is easy to stock live *M. cuchia* for a certain period because of its air breathing characteristic. Dry fish is a long term preservative method. So, *M. cuchia* processing method including value chain is to be developed intensively by ITK method of Adivasi fisher's and science based knowledge.

The ecosystem health of the Kokraduba beel for *M. cuchia* habitat was destructed by blocked water flow, shallow depth, expansion of agriculture and aquaculture, use of chemicals, fertilizer pesticide and infrastructure development. Fishing pressure was increased for local and international demand and trade. Limited technical know-how, poor monitoring and support, absence of legal framework, destruction of breeding ground and over fishing was negatively affected the growth and production of *M. cuchia*. Updated Adivasi's ITK method with science based knowledge on habitat, food and feeding habit, reproductive biology, in alternative income generating activities (AIGAs) and developed value chain will be a new horizon to develop ecosystem health and production of *M. cuchia* in the Kukraduba beel through community based co-management aspect.

The following recommendations are suggested depending on the findings of the present study:

1. Ecosystem health of the beel should be developed through co-management;
2. Use of chemicals, fertilizer and pesticide in agriculture land should be limited;
3. A methodology on natural breeding, embryonic and larval development, should be developed;
4. Ban on harvesting of *M. cuchia* and other small fish during breeding period between April and mid July and restricted to catch under size *M. cuchia* and
5. More study should be needed on habitat, food and feeding habit, reproductive biology, production, alternative income generating activities (AIGAs)

and developed value chain of *M. cuchia* to update Adivasi's ITK method with science based knowledge.

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