

## Indigenous hillstream fishing practices in Telangana State, India

Kante Krishna Prasad<sup>a,b,\*</sup> & Chelmala Srinivasulu<sup>b,c,d</sup>

<sup>a</sup>Wildlife Institute of India, Post Box #18, Chandrabani, Dehradun, Uttarakhand 248 001, India

<sup>b</sup>Natural History Museum and Wildlife Biology and Taxonomy Lab, Department of Zoology, University College of Science, Osmania University, Hyderabad, Telangana 500 007, India

<sup>c</sup>Centre for Biodiversity and Conservation Studies, Osmania University, Hyderabad, Telangana 500 007, India

<sup>d</sup>Systematics, Ecology & Conservation Laboratory, Zoo Outreach Organization, No. 12 Thiruvannamalai Nagar, Saravanampatti, Coimbatore 641 035, Tamil Nadu, India

\*E-mail: krishnaprasadwii@gmail.com

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The present study deals with the traditional knowledge of various fishing techniques and practices of tribes and local fishermen in the Telangana State. Field surveys were carried out across the state during the period of 2013 to 2021 and we have documented all hillstream fishing activities by tribes and local fishermen. All hillstream fishing activities were categorized into three categories based on fish-catching methods: poisoning, trapping, and traumatizing. During the study period, we documented a total of 16 piscicidal plant species used by various tribes around the state. Bamboo traps, casting nets, constructing pseudo-littoral zones, hooks, long cloth method, pot/dish trap and stream diversion approaches were all listed as trapping methods. The technique of traumatizing involves hitting with a stone. These are all techniques that facilitate future researchers, fishermen, and aquarium traders to understand the various fishing methods used in the stream water, as well as to catch live fish for scientific studies, aquarium trades, and sustainable use of natural resources. Other recent trends discussed include high-voltage electric fishing, the use of explosives, poisoning with commercial pesticides, and bleaching powder ( $\text{Ca}(\text{OCl})_2$ ) to catch hillstream fish by local fishermen in the state. Indigenous fishing practices can help to establish eco-friendly methods for aquarium fish trading, research, providing a source of income for unemployed youth in remote areas, and maintaining a sustainable utilization of natural resources.

**Keywords:** Ethnobiology, Ichthyotoxic plants, Local fishing methods, Piscicidal plants, Traditional fishing

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India is diversified both in terms of biodiversity and its people. Approximately 700 kinds of tribes are inhabited all over India and most of them are populated in the northeast states followed by the central, northwest, and southern states of the country<sup>1</sup>. Telangana state is one of the southern states of India, having 32 scheduled tribes, and their population accounts for 9% of the total population in the state<sup>1</sup>. Based on their population and cultural trends in the state, tribes were categorized into three main groups namely Adivasi communities, Particularly Vulnerable Tribal Groups, and Dispersed Tribal Groups. The major tribes in the Adivasi communities include the Andh, Gonds, Koya, and Pardhan, while Particularly Vulnerable Tribal Groups are the Chenchus, Kolams, Konda Reddis, and Thoti, and Dispersed Tribal Groups include the Lambada, Yerukala, Nakkala, Kammara, and Yenadi etc. The majority of them are involved in

agriculture and livestock rearing for their livelihood, as well as honey collection, hunting, fishing, bamboo crafts, basketry, and other activities. To lead such a way of life, they had the knowledge gained over generations, which is referred to as traditional knowledge or indigenous knowledge. This knowledge includes biological, geographical, and genealogical that represents human relations to the environment, flora, and fauna<sup>2-6</sup>. Indigenous knowledge can contribute significant information about the native ecosystem and how to manage its natural resources successfully<sup>5</sup>. The study of indigenous knowledge of flora and fauna is known as ethnobiology, and it has attracted a lot of interest in India<sup>3-7</sup>.

Fishing practices have been a part of traditional knowledge in many tribes across the country for a long time<sup>2,3</sup>. Various traditional fishing methods have been reported in India, with the majority of these studies focusing on Northeast India<sup>4,7-11</sup>, followed by North India<sup>3,12</sup>, Central India<sup>13-15</sup>, and South India<sup>5,6,16</sup>.

\*Corresponding author

Many investigators have conducted extensive research only on fish fauna in the Telangana state's reservoirs and Rivers<sup>17-22</sup>, but there have been limited studies on traditional fishing techniques including using piscicidal plants, fishing crafts and gear in the state<sup>5,23,24</sup>. Inadvertently, this indigenous knowledge of fishing practices in the hillstream was not well documented in the state. We aimed to document the indigenous fishing techniques and practices in the state and this traditional knowledge will help to provide important information on native fishing practices and how to effectively manage the natural resources and cultural heritage. This publication will facilitate future researchers, fishermen, and aquarium traders to understand the various fishing methods used in stream water, as well as to catch live fish for scientific studies, aquarium trades, and sustainable use of natural resources.

**Materials and Methods**

**Study area**

Telangana State is located on the Deccan Plateau in the south-central part of Peninsular India, and it

encompasses an area of 112,077 km<sup>2</sup> (Fig. 1). It is bordered on the northwest by Maharashtra, on the east by Chhattisgarh and Odisha, on the southeast by Andhra Pradesh, and on the west by Karnataka. Two major rivers, the Godavari and Krishna, as well as their numerous tributaries, drain the state. The plateau area has an average elevation of 500 m, with greater elevations in the north, west and southwest and sloping down to the east and northeast, where the Eastern Ghats hills converge in a snaking line. The western part of the state is hilly, with heights ranging from 300 to 800 m, and certain locations in the eastern part of the state reach up to 965 m, the highest point in the state<sup>25</sup>. Telangana State has 26,904 Km<sup>2</sup> of notified forest land, which is 24% of the total geographical area of the state and the present scenario of the forest cover in the state is 20,582 Km<sup>2</sup> which is 18.36% of the State's geographical area<sup>26</sup>. The three major forest types found across the state are tropical moist deciduous forests, tropical dry deciduous forests, and tropical thorn forests<sup>27</sup>. The state experienced the mean annual rainfall ranges between 670 mm to 1126 mm and the mean annual temperature varies from 21°C-34°C<sup>25</sup>.

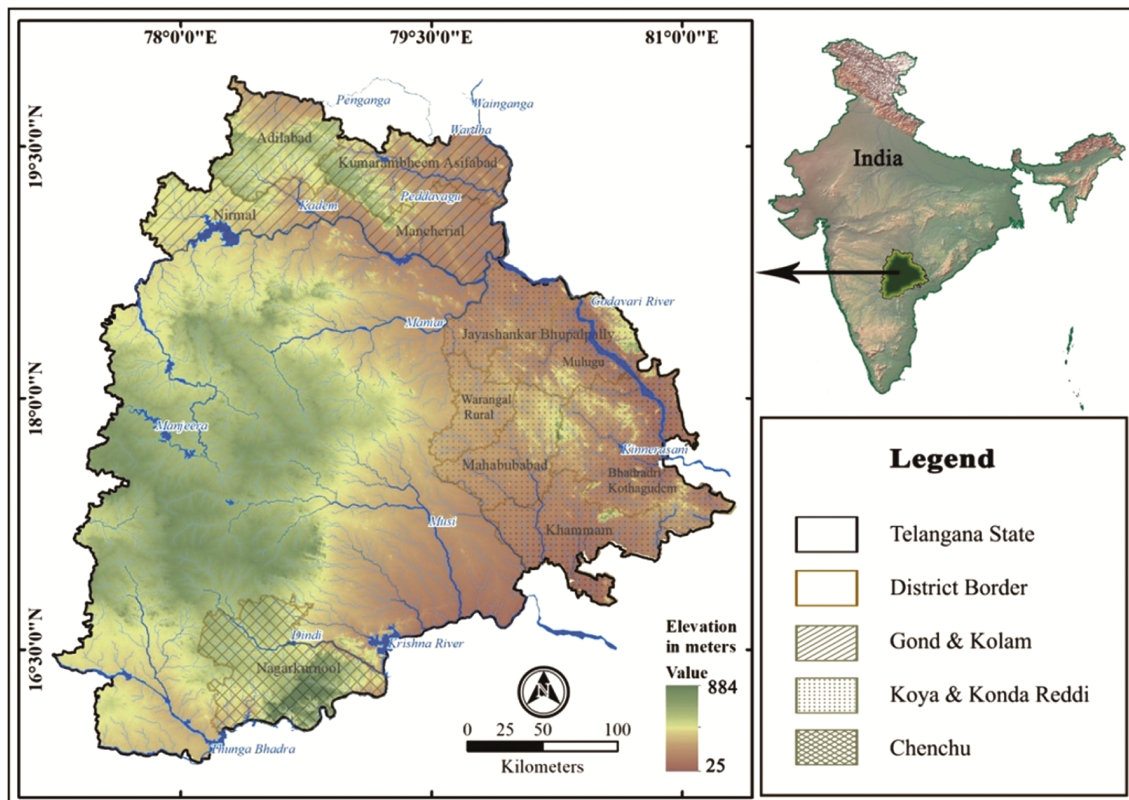


Fig. 1 — Map showing the geographical view of Telangana State, and distribution of major tribes in the state. The dispersed tribal group was found all over the state (ArcGIS v10.8 used for map production)

## Methods

Random field surveys were carried out throughout the Telangana State during the period of 2013 to 2021. We documented all kinds of hillstream fishing activity and techniques used by the tribes and local fishermen in the state who applied their traditional expertise in the stream waters through direct observations in the field. Using the following questionnaire, we interviewed approximately 10-15 individuals from each tribe and local fisherman communities throughout the state to acquire information about traditional fishing techniques. How does their method operate; how many members are required to operate the method; the type of bait used in the trap; the type of fish that they catch in the trap; whether they employ piscicidal plants or not?; How many plants are used as piscicidal; the vernacular name of that plant; which part of the plant is utilized; the mode of use of the piscicidal plant; and other key aspects. All the stream fishing activities in the state were observed, photographed, and documented in the field. Piscicidal plants were photographed and identification followed Pullaiah<sup>28</sup>. In addition, we observed recent fishing trends including electric fishing, the use of explosives, and the poisoning of stream waters with commercial pesticides.

## Results

Majorly, three forms of hillstream fishing activities have been practiced by tribes and local fishermen in the state. They can be categorized as poisoning, trapping, and traumatizing based on the mode of fish catching.

### Poisoning

One of the fishing methods utilized by tribes in the research area involves poisoning fish. Tribes catch hillstream fish by adding extracts from various plant species in the stream waters, which are known as piscicidal plants. Plant poisons have been used by tribes all over the world to catch fish in the stream waters.

#### *Poisoning by piscicidal plants*

Some plant extracts are poisonous to fish and are known as piscicidal plants or ichthyotoxic plants or fish stupefying plants. To add piscicidal plant extractions, shallow water bodies with slow-moving or stationary pools of streams are preferred. Piscicidal plant parts were crushed and mixed in the ditches or pools of the stream water. Fish are affected by the

phytochemical compounds present in piscicidal plants, and their activity is effectively decreased. Fish become stunned and immobile, allowing tribes to easily capture them on the surface of the water. Various tribes have been using several piscicidal plants to catch stream fish in Adilabad, Bhadrachalam, Kothagudem, Kumarambheem Asifabad, Mancherial, Mulugu, Nagarkurnool, Nirmal, Jayashankar Bhupalpally, and Warangal Rural districts of the state were given in the Table 1 (Plate 1).

### Trapping

Trappings are devices or enclosures used to catch or keep fish, usually by allowing the fish to enter but not escape. Bamboo traps, casting nets, constructing pseudo-littoral zones, hooks, long cloth method, pot/dish trap, and stream diversion method were among the several trapping techniques utilized to capture fish from the state's stream waters.



Plate 1 — a) *Aegle marmelos*, b) *Calotropis gigantea*, c) *Cassia fistula*, d) *Gloriosa superba*, e) *Jatropha gossypifolia*, f) *Plumbago zeylanica*, g) Seeds of *Strychnos nux-vomica* and h) *Wrightia tinctoria*

**A Bamboo traps**

To collect stream fish, different kinds of bamboo stick traps are utilized. These are seen and being used by tribes and local fishermen in Adilabad, Bhadradi Kothagudem, Khammam, Kumarambheem Asifabad, Mancherial, Medak, Mahabubabad, Nagarkurnool, Nalgonda, Nirmal, and Warangal Rural district of Telangana. During the study period, we recorded three varieties of bamboo traps, which are described below.

**i. Box type bamboo trap**

A rectangular-shaped box was made up of bamboo sticks as shown in the figure (Plate 2a). A bicuspid non-returning unidirectional longitudinal valve allows the fish to enter the box but prevents them from escaping. These traps are used in the knee-deep water to capture snakehead fish, eel fish, and other fish in the stream waters. This kind of trap is often used by tribes and local fishermen throughout the state.

Table 1 — List of piscicidal plants and practicing tribe of Telangana State.

Botanical name	Vernacular name	Family	Type	Using part of the plant	Using Tribe	Method
<i>Aegle marmelos</i> (L.) Corrêa	Maredu	Rutaceae	Tree	Stem Bark	Chenchu, Gond, Kolam, Konda Reddis & Koya	Grind the bark and mix it in the stream water
<i>Balanites aegyptiaca</i> (L.) Delile	Gara	Zygophyllaceae	Tree	Fruit and Stem Bark	Gond, Gutti-Koya, Dispersed tribe (Yerukala) & Koya	Grind the bark and fruit and mix it in the stream water
<i>Calotropis gigantea</i> (L.) Dryand	Jilledu	Apocynaceae	Shrub	Root	Chenchu, Gond, Konda Reddis & Koya	Grind the root and mix it in the stream water
<i>Cassia fistula</i> L.	Rela chettu	Leguminosae	Tree	Stem Bark	Chenchu, Gond & Koya	Grind the bark and mix it in the stream water
<i>Catunaregam spinosa</i> (Thunb.) Tirveng.	Manga	Rubiaceae	Tree	Fruit	Gutti-Koya & Koya	Crush and grind the fruit and mix it in the stream water
<i>Chloroxylon swietenia</i> DC.	Bilugu	Rutaceae	Tree	Stem bark	Gutti-Koya & Koya	Grind the bark and mix it in the stream water
<i>Gloriosa superba</i> L.	Nabhi/Edlenka poolu	Colchicaceae	Herb	Tuber	Gond, Gutti-Koya, Kolam & Koya	Grind the tuber and mix it in the stream water
<i>Holoptelea integrifolia</i> Planch.	Nemali nara	Ulmaceae	Tree	Leaves and stem bark	Gond, Konda Reddis & Koya	Grinding the leaves and bark and mix it in the stream water
<i>Jatropha gossypifolia</i> L.	Adavi aamudam	Euphorbiaceae	Shrub	Fruit	Dispersed tribe (Yerukala)	Crush and grind the fruit and mix it in the stream water
<i>Madhuca longifolia</i> var. <i>latifolia</i> (Roxb.) A. Chev.	Ippa-chettu	Sapotaceae	Tree	Seed	Chenchu, Gond, Kolam, Konda Reddis & Koya	Oil cake boiled in the water after extraction of oil from seeds, and the boiled water was mixed in the stream water
<i>Plumbago zeylanica</i> L.	Chitra moolam	Plumbaginaceae	Herb	Root	Gond & Kolam	Grind the root and mix it in the stream water
<i>Pongamia pinnata</i> (L.) Pierre	Kaanuga	Fabaceae	Tree	Seed	Chenchu, Gond & Kolam	Grind the seeds and mix them in the stream water
<i>Strychnos nux-vomica</i> L.	Vishamusti	Loganiaceae	Tree	Seed	Chenchu, Gond, Gutti-Koya & Koya	Crush the seeds and mix them in the stream water flow
<i>Strychnos potatorum</i> L. f.	Chilla ginja chettu	Loganiaceae	Tree	Seed	Gond, Gutti-Koya & Koya	Grind the seeds and mix them in the stream water
<i>Ventilago denticulata</i> Willd.	Dantaaku	Rhamnaceae	Climber	Stem bark	Gond & Kolam	Grind the bark and mix it in the stream water
<i>Wrightia tinctoria</i> R. Br.	Kodise pala	Apocynaceae	Tree	Stem bark	Gutti-Koya & Koya	Grind the bark and mix it in the stream water



### ii. Cone-shaped bamboo trap

A circular cone-shaped bamboo trap was employed to catch hillstream fish (Plate 2b). A bamboo-stick-based unidirectional valve around the entrance allows the fish to enter but stops them from escaping. The opening or mouth of the trap was placed against the water current of the streams. The unidirectional valve holds the fish in the trap while allowing them to enter with the flow of water. All tribes and local fishermen in the state employ cone-shaped traps.

### iii. Frame-type trap

In shallow water streams, frame-type traps are employed to catch tiny fish. As illustrated in the image (Plate 2c), these traps are left in the streams overnight. Generally, thorn shrubs are planted on the frame to prevent caught fish from escaping. The fish that have been trapped on the bamboo frame are

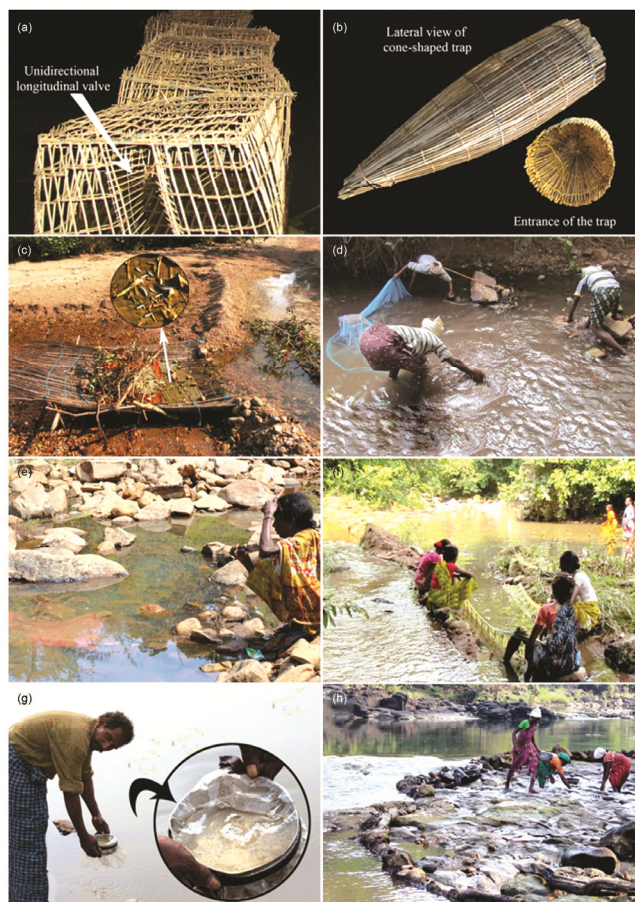


Plate 2 — a) Box-type bamboo traps arranged in a stream, b) Cone-type bamboo trap, c) Frame-type bamboo trap (trapped fishes are shown in a circle), d) Hillstream fishing using mosquito net, e) Constructing pseudo-littoral zone on a cloth, f) Long cloth method, g) Pot/dish trap (dish trap is shown in the circle) and h) Stream diversion.

gathered the next day. Only the Gond and Kolam tribes were known to deploy this form of trap in Kumarambheem Asifabad district.

### B. Casting nets

Fishing nets have been regularly utilized to catch fish in the streams across the state. Tribes and local fishermen caught fish in the streams using traditional cast nets and mosquito nets (Plate 2d).

### C. Constructing pseudo-littoral zone

Generally, tribes will construct a false littoral zone at the stream's bottom using pebbles, small stones, and aquatic plants on a long, wide fabric (Plate 2e). This arrangement will take some time to attract the fish. The fishermen grip the corners of the fabric and lift the entire setup from the stream once there are enough fish in the arrangement. Bottom feeders, stone loaches and other small fishes are trapped and collected in this method. This method was noticed and practiced by the Chenchu tribes in the Nagarkurnool district.

### D. Hook technique

A well-known technique for catching stream fish. The tip of an iron-made hook is tied with a fish line (polythene thread) and attached to a long bamboo stick with a bait (earthworms/rice barn, etc). It's a skilful technique for catching fish. Tribes and local fishermen use this strategy all around the state.

### E. Long cloth method

A long cloth (often a saree) is draped over the stream's water current, and the stream is channelled to reduce water inflow as illustrated in the figure (Plate 2f). Along with the rerouted water current, fish will be trapped in the cloth. This procedure necessitates a significant amount of manpower. The Gond and Kolam tribes in the Nirmal and Mancherial districts use this methodology.

### F. Pot/Dish trap

In this method, a pot or dish was employed to trap stream fish. Rice bran flour or boiled rice is used as bait and placed at the bottom of the pot/dish. The pot/dish was covered with polythene or cloth, and tied at the mouth of the pot, a hole was made enough for the fish to enter (Plate 2g). This pot/dish is then placed in the stream overnight and the fish are trapped which are attracted by the bait in the pot and trapped fishes are collected the next morning. This type of trap is used by tribes in Kumarambheem Asifabad, Nagarkurnool, and Nalgonda districts.

### G. Stream diversions

Generally, stream diversion is carried out by 10-20 individuals (Plate 2h). Fishermen select a ditch or pool area in the stream where there will be plenty of fish around. The stream will be channelled to reduce water inflow and make a barrage around the selected pool with the pebbles, boulders, and clay soil in the stream. Water will be pulled out of the pool by manpower and the fish that could not escape from the pool will be collected. Stream diversion is a way of catching hillstream fish used by the Gond and Kolam tribes in remote areas of Adilabad, Nirmal, Mancherial, and Kumarambheem Asifabad districts.

### 3. Traumatizing

Traumatizing is a method of capturing hillstream fish in the state. This approach paralyzes, stuns, and traumatizes the fish by hitting them with stones to capture them. Hitting with stone is thought to have been prehistoric man's first long-range weapon<sup>2</sup>, and it is still used for fishing in the state's tribe community.

#### Hitting with stone

Throwing a stone at a fish from a distance is the simplest way to traumatize it. The fish will be stunned and might be caught by hand if the fishermen are skilled enough to hit it with a stone. This was observed in the tribal community that resides in the areas of the Adilabad, Kumarambheem Asifabad, Mancherial, and Nagarkurnool districts of Telangana State.

### Discussion

A wide variety of bamboo traps and other stream fishing techniques were enormously used in Northeast states of India compared to Telangana State<sup>8-10,30</sup>. Hillstream fishing practices were common phenomena in northeast states which comprise hills and mountains, which form 65% of its territory and they had massive bodies of freshwater in the form of rivers and canals, as well as flood plains, and wetlands which provide enough opportunities for fisherman to use various types of fishing traps<sup>4</sup>. However, some trapping methods were identical across the country, while others were unique to the state, such as stream diversion, frame-type traps, and the use of various piscicidal plants.

Among the all fishing practices in the state, some traditional methods such as casting nets, bamboo traps, stream diversions, long cloth method, pseudo-littoral zone method, and pot/dish traps, will allow to capture of live fish, while others do not support to

catch live fish. Both researchers and fishermen can use these techniques to capture live fish for research purposes as well as acquire fish for the aquarium trade. The collection of live fish is significant for scientific investigations for the reason that the fish may be the least photographed creatures owing in part to the difficulty of watching them in the wild compared to birds, amphibians, reptiles, and mammals<sup>29</sup>. Visual documentation plays an important role in taxonomical studies such as their natural colours, morphometric and meristic characteristics. Incorporating this traditional knowledge into scientific research can help to empower and improve tribes and local fishermen communities. They can contribute important insight into the local ecosystem and how to manage its natural resources successfully. If these conventional methods were improvised, fish capture would increase and might be employed in aquarium trades, providing employment for locals.

For all traditional methods, the average catch size was low (approximately less than 10 kg), and the size of the catch varied according to the method. These fishing techniques were exclusively employed to capture fish for daily consumption. The majority of the fish collected in traditional traps belonged to the Cyprinidae family, followed by Danionidae, Bagridae, Cichlidae, Nemacheilidae, and Channidae. Of which, *Amblypharyngodon mola* (Mola Carplet), *Channa punctata* (Spotted Snakehead), *C. striata* (Striped Snakehead), *Clarias magur* (Magur), *Heteropneustes fossilis* (Stinging Catfish), *Macrogathus pancalus* (Barred Spiny Eel), *Ompok bimaculatus* (Butter Catfish), *Salmostoma bacaila* (Large Razorbelly Minnow), and *Systomus sarana* (Olive Barb) etc. had the high economic value and remain species such as *Glossogobius giuris* (Tank goby), *Garra mullya* (Sucker Fish), *Pethia ticto* (Ticto Barb), *P. conchoni* (Rosy Barb), *Puntius chola* (Swamp Barb), *P. sophore* (Pool Barb), *Rasbora daniconius* (Slender Rasbora), and *Opsarius bendelisis* (Hamilton's Baril) etc. had very low economic value in the market.

Piscicidal plant parts were crushed and mixed in the selected pool or stagnant water bodies in the streams. The piscicides will take approximately 20 to 30 min to have an effect on fish, and fish activity will gradually become paralysed in the water. We noticed that the effect of piscicidal plant extraction mostly covers pools in the stream that are 1-2 m deep, 5-8 m in diameter, and a duration of 40-60 min (depending on its saturation rate with upstream water). Apart

from that, we noticed no fish became paralyzed in the water as a result of the saturation of the plant extraction with upstream water and seepage. In this poisoning procedure, the fish catch would be based on the abundance of fish in the selected pool or stagnant water body. Tribes use this tradition exclusively for daily consumption, not for subsistence. Using piscicidal plants to poison fish has long been a tradition among numerous tribes across the country<sup>2</sup>. Piscicidal plants contain alkaloids, resin, tannins, saponins, nicotine, and diosgenin. These secondary metabolites are toxic to fish in large amounts and cause them to become paralyzed in a short period of time. Unlike synthetic chemical pesticides, plant piscicidal are believed to be more eco-friendly because they are biodegradable and leave no residues in the environment<sup>4</sup>.

We noticed that all the tribes in the state employ piscicidal plants to poison fish, but local fishermen use bleaching and commercial pesticides to poison fish instead of piscicidal plants. Local fishermen use these poisoned tactics in remote locations where there is a lack of electricity. While being interviewed, all of the tribes agreed that plant piscicides have no effect on the flavor or quality of the fish whereas local fishermen also stated that using commercial pesticides has a greater effect on the fish flavor than bleaching.

We recorded a total of 16 piscicidal plant species that are being used by tribes in the state. Of which, 12 piscicidal plant species were recorded from the Gond & Koya tribe followed by Gutti-Koya (7 sp.), Chenchu & Kolam (each tribe 6 sp.), Konda Reddis (4 sp.), and Yerukala (2 sp.). Murthy *et al.*<sup>4</sup> listed 25 piscicidal plant species used by the Gond tribe and we recorded three more species (*Aegle marmelos*, *Chloroxylon swietenia* and *Jatropha gossypifolia*) in addition to the list. Reddy & Rao<sup>23</sup> noted the stem bark of *Balanites aegyptiaca* used as piscicidal and we noticed the fruit and stem bark both used as fish poison. We found less piscicidal plant species than Murthy *et al.*<sup>4</sup>, because the tribes do not want to reveal the piscicidal plant species to outsiders. More studies are needed to document these plant piscicides which aid in the development of potential fish-catching phytochemical agents in aquaculture practice.

Furthermore, local fishermen in the state use high-voltage electric power (220v–240v; 50 Hertz) and dynamites to harvest hillstream fish. They also use bleaching powder ( $\text{Ca}(\text{OCl})_2$ ) and small amounts of commercial pesticides (such as Chlorpyrifos and

Monochrotophos) to poison the fish, similar to piscicidal plant poisoning. This was noticed in the Adilabad, Nirmal, Mancherial and Medak districts of the state. Poisoning with industrial chemicals and commercial pesticides, traumatizing with explosives, and high-voltage electrocution are all extremely dangerous procedures that affect the stream habitat by destroying other organisms in the stream. Industrial chemicals, commercial pesticides, and explosives can harm micro and macro aquatic flora and fauna as well as pollute the stream water, alter the pH of water, inducing chemical oxygen demand (COD) in the riverine environment and bio-magnification in the aquatic food chain. Fish captured using these dangerous fishing practices jeopardize the health of fish consumers. High-voltage electric fishing is a hazardous way of fishing for both anglers and other wildlife in the stream. Electrocution with high voltage paralyses not only fish fauna in the stream but also other aquatic invertebrates, amphibians, reptiles, birds and mammals. This causes an imbalance in the riparian ecology in future. We suggest that the Government should conduct awareness programs among the local fishermen and tribes to prevent practicing hazardous stream fishing methods and implement activities to protect stream diversity.

Despite the fact that Telangana has a smaller tribal population than the northeastern regions, the state protects its culture and way of life. We need to document all indigenous knowledge of the tribes before their culture is extinct in the state. Indigenous fishing practices can help to establish eco-friendly methods for aquarium fish trading, research, providing a source of income for unemployed youth in remote areas, and maintaining a sustainable utilization of natural resources.

## Conclusions

The hillstream fishing activities in Telangana state are divided into three categories based on fish-catching methods: poisoning, trapping, and traumatizing. There are a total of 16 piscicidal plant species used by various tribes in the state for poisoning. The trapping method includes bamboo traps, casting nets, constructing pseudo-littoral zones, hooks, the long cloth method, pot/dish traps, and stream diversion approaches. Traumatizing involves hitting a fish with a stone from a distance. Recent fishing trends in Telangana state also include high-voltage electric fishing, the use of explosives,

poisoning with commercial pesticides, and bleaching powder ( $\text{Ca}(\text{OCl})_2$ ) to catch hillstream fish by local fishermen. It is suggested that the government should conduct awareness programs among the local fishermen and tribes to prevent the practice of hazardous stream fishing methods and implement activities to protect stream diversity.

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### Conflict of Interest

We declare that there is no competing or conflict of interest with respect to the publication of this manuscript.

### Author Contributions

KP and CS conceptualized, and designed the study; KP conducted the field surveys, interviewed the tribe and local fishermen, and collected the data. KP did primary data analysis and wrote the primary draft of the manuscript and finalized the manuscript; CS supervised the overall activities and finalized the manuscript.

### Prior Informed Consent

Informed consent has been secured from all individuals to share data, including photographs as and when necessary.

### Data Availability

Data will be made available on request.

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