

Ethnobotanical uses of piscicidal plants for fishing by the Bodo Tribes of Kokrajhar, Assam

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Abstract

Application of piscicidal plants in fishing is an age-old traditional method used by many communities around the world including the Bodo tribes of Assam in Northeast India. These methods are simple, ecofriendly and effective for catching fish or to eradicate unwanted weed fish from a culture system. Proper identification and documentation of these knowledge are important for their preservation and development of novel techniques based on such knowledge. The present study aims to evaluate the ethnobotanical use of plants by the Bodo tribes in Kokrajhar, Assam for fishing. Eight villages in 3 subdivisions of the Kokrajhar district were surveyed during February, 2021 to January, 2022. A total of 9 plants belonging to 7 family and 9 genera were recorded in the study. Three species were recorded from family Fabaceae, while Rubiaceae, Theaceae, Polygonaceae, Moringaceae, Costaceae and Asteraceae recorded 1 species each. The most frequently reported method of application was to grind the plants into a paste and apply directly. Use of piscicidal plants in fishing can be an ecofriendly alternative for harmful synthetic chemicals used in aquaculture. Further studies to identify the active ingredients, optimal dosage and other possible applications are recommended for efficient utilization and commercial exploitation of the identified plants.

Key words : Ethnobotanical, Piscicidal plants, Bodo Tribes, Kokrajhar, Ichthyotoxic.

Northeast India is one of the world's top six biodiversity hotspots¹³ blessed with healthy vegetation and natural resources. The region is home to several ethnic tribal groups whose livelihood depends on the forest and natural resources like fishes. A variety of

indigenous techniques are traditionally used for capturing fish. One such technique is the use of piscicidal plants to induce sedation or for stupefying fishes or sometimes killing the fish. Plants naturally contains variety of phytochemicals which have wide application. Many

studies have identified such bioactive ingredients in different solvent-based extracts of many plant species. The extracts of the plants when toxic to fish are referred to as piscicides¹². The piscicidal plants are known to contain various bioactive compounds known as alkaloids such as pyrethrum, diosgenin, nicotine, saponins, ryania, tannins, rotenone, akaummine, coumerin and resin^{1,38}, and these were reported to be toxic to fish and aquatic organisms at higher concentrations^{2,28}.

The use of the piscicidal plants for fishing is reported in various countries like Nepal¹⁶, Eastern Himalayan Region of Nepal²¹, Thailand⁸, Southwestern Nigeria¹², *etc.* In India, this practice is reported from various states and ethnic groups *viz.*, Madurai district of Tamil Nadu¹⁴, Gond tribe of Kawal Wildlife Sanctuary in Andhra Pradesh²⁴ and Mendha village of Gadchiroli district in Maharashtra¹⁹, tribes of Nicobar Island³¹ and tribal people of Panchakot hills at Purulia in West Bengal³⁰. Reports are also available from Kasaragod district of Kerala²⁹. Bokolial and Nath⁶ reported piscicidal plants from various regions of Northeast India. In Assam, few reports are available on the piscicidal plants and their uses. Some of these studies are associated with the Hill Tiwas of Assam³⁷, Karbi Anglong district of Assam¹⁷, and the use of ichthyotoxic plants for catching *M. cuchia* in Goalpara district of Assam³. To the best knowledge of the authors, there are no studies till date reported on the use of piscicidal plants of the Bodo tribes of Kokrajhar, Assam.

The Bodos are the single largest plain tribal groups in the Northeast India, and they are largely confined to the Bodoland Territorial

Region (B.T.R) in Assam³³. Regarded as the early settlers of Assam²⁵, the Bodos are the prominent inhabitant among all the different tribes inhabiting the Kokrajhar district²⁶. The region is endowed with natural biodiversity of ichthyofauna⁷ including coldwater fishes⁵, ornamental fish species⁴, ethnomedicinal plants³² and wild edible vegetables²⁶. Fish and fisheries occupy an important part of diet, culture and traditions of the Bodos here. Among the various traditional methods of fishing, the Bodos also use some plant species for their piscicidal activity. Documentation of this rich indigenous knowledge is important for the sustainable utilization and conservation of the biological resources¹⁴. Piscicidal plants are preferred over harmful synthetic chemicals because they are ecofriendly, easily available, cheap, biodegradable to nutrients and less harmful for non-target organisms. Therefore, the present study aims to identify and study the mode of application of the different piscicidal plants used by the Bodo tribes of Kokrajhar district, Assam for fishing.

Study area :

The study was conducted during the February 2021 to January 2022 in three subdivisions of the Kokrajhar district of Assam, North East India. These subdivisions were Kokrajhar, Gossaigaon and Parbatjhora. The Kokrajhar district is the headquarter of the Bodoland Territorial Region (B.T.R) in Assam and lies in between 89° 46' E to 90° 38' E longitudes and 26° 19' N to 26° 54' N latitudes. The study sites include the 8 villages *viz.* Borshijhora Part 1, Borshijhora Part 2, Bagmara, Lawdanga, Middle Kalugaon, Takampur FV, Kachugaon FV and Kazigaon. Out of these 8

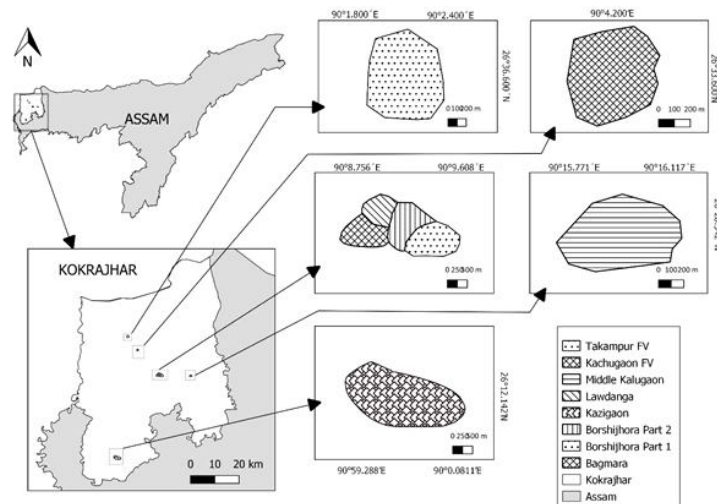


Fig. 1. Map of the study area showing the 8 villages viz. Borshijhora Part 1, Borshijhora Part 2, Bagmara, Lawdanga, Middle Kalugaon, Takampur FV, Kachugaon FV and Kazigaon in Kokrajhar district of Assam, India.

villages, 4 villages viz., Borshijhora Part 1, Borshijhora Part 2, Lawdanga and Bagmara are located in the Dotoma Tehsil of the Kokrajhar subdivision of the Kokrajhar district, while Middle Kalugaon is located in the Kokrajhar Tehsil of the Kokrajhar subdivision of the Kokrajhar district. Two villages (Takampur FV and Kachugaon FV) are located in the Kachugaon Tehsil of the Gossaigaon subdivision of the Kokrajhar district and one village (Kazigaon) is located in the Debitola Tehsil of the Parbatjhora subdivision of the Kokrajhar district of Assam.

The primary information was collected from the respondents by personal interviews and semi-structured questionnaires. The respondents belong to the Bodo tribes engaged in fishing and allied activities in the study area. A total of 200 respondents participated in the study. Detailed information regarding the ichthyotoxic plants, the parts used, mode of

application and effect on fish were collected from each respondent. The pictures of all the plant species recorded were taken for documentation and reference. The piscicidal plants were arranged and grouped following Murthy *et al.*²⁴. Samples of all plant species recorded were collected, preserved as herbarium and submitted to the Bodoland University Botanical Herbarium (BUBH), Kokrajhar for identification, authentication generation of Accession No. and future reference.

A total of 9 different plant species belonging to 7 families and 9 genera were found in the study which were used for their ichthyotoxic properties by the Bodo tribal fishers. Among all the species, 3 were from family Fabaceae while 1 species each were recorded from the families Rubiaceae, Theaceae, Polygonaceae, Moringaceae, Costaceae and Asteraceae. The different ichthyotoxic plant species recorded are described in detail as follows.

Table-1. List of Piscicidal Plants Used by the Bodo Tribes of Kokrajhar, Assam, India recorded in the study

Sl No.	Botanical Name	Family	Local Name	Place of Collection	Habit	Parts used	Accession No.
1	<i>Derris elliptica</i> (Wall.) Benth.	Fabaceae	<i>Ruk Rwda</i> or <i>Ruk Biphang</i>	Takampur	Scandent Shrub	Roots	BUBH0000831
2	<i>Catunaregam spinosa</i> (Thunb.) Tirveng.	Rubiaceae	<i>Biskantro</i> or <i>Bismwina</i>	Kazigaon	Shrub	Fruits	BUBH0000830
3	<i>Schima wallichii</i> (DC.) Korth.	Theaceae	<i>Gugra</i>	Kazigaon	Tree	Bark	BUH0000814
4	<i>Albizia procera</i> (Roxb.) Benth.	Fabaceae	<i>Loukri</i>	Kazigaon	Tree	Bark	BUH0000813
5	<i>Persicaria hydropiper</i> (L.) Delarbre	Polygonaceae	<i>Besongali</i>	Borshijhora Part 1	Herb	Whole Plant	BUH0000812
6	<i>Senna alata</i> (L.) Roxb.	Fabaceae	<i>Solota</i>	Lawdanga	Shrub	Whole Plant	BUH0000810
7	<i>Moringa oleifera</i> Lam.	Moringaceae	<i>Sojona</i>	Bagmara	Tree	Roots	BUH0000808
8	<i>Hellenia speciosa</i> (J. Koenig) S.R. Dutta	Costaceae	<i>Buri Thokon</i>	Borshijhora part 2	Herb	Tuberous Root Stock	BUH0000809
9	<i>Acmella paniculata</i> (Wall. ex DC.) R.K. Jansen	Asteraceae	<i>Usumwi</i>	Borshijhora Part 1	Herb	Whole Plant	BUH0000811

Table-2. Ethnographic data of the informants participating in the study

SL No.		Parameters	No. of Respondents	Percentage (%)
1	Gender	Male	125	62.5
		Female	75	37.5
2	Age group	30-40	92	46.0
		40-50	59	29.5
		50-60	38	19.0
		Above 60	11	5.5
3	Educational qualifications	Illiterate	57	28.5
		Class 1-8	89	44.5
		Class 8-10	41	20.5
		Class 11 to Graduation	13	6.5
4	Occupation	Fisheries & Allied Activities	111	55.5
		Agriculture	83	41.5
		Job holders	6	3.0



Fig. 2 (a) *Derris elliptica* (Wall.) Benth, (b) *Catunaregam spinosa* (Thunb.) Tirveng, (c) *Schima wallichii* (DC.) Korth, (d) *Albizia procera* (Roxb.) Benth. (e) *Persicaria hydropiper* (L.) Delarbre. (f) *Moringa oleifera* Lam., (g) *Senna alata* (L.) Roxb, (h) *Acemella paniculata* (Wall. ex DC.) R.K. Jansen., (i) *Hellenia speciosa* (J. Koenig) S.R. Dutta.

Derris elliptica (Wall.) Benth.: *D. elliptica* is a scandent shrub which falls under the family Fabaceae (Fig. 2a). It is very common plant used extensively in the remote village areas. This plant was reported the most preferred among the fishers due to its strong piscicidal property. During the autumn and pre-winter seasons when the water level gets reduced, approximately 5 to 10 kgs of the roots of this plant is crushed or ground into a paste and then mixed with stagnant waters or slow flowing rivers, streams or rivulets. Bamboo poles are generally used for proper mixing. Sometimes the grounded root paste is taken in cloth sacs and then drifted in the water to and fro for proper mixing, and then the fish are collected after sometime. All varieties of fish present in the water bodies are affected by the plant extract.

Catunaregam spinosa (Thunb.) Tirveng: *C. spinosa* is a shrub which belongs to the family Rubiaceae (Fig. 2b). It was widely believed among the respondents that the fruit of this plant was very toxic that even the birds avoid eating the fruits of this plant. Both ripe and raw fruit of this plant was used for preparation of the piscicidal extract. The crushed or grounded fruit was mixed directly with the water of rivulets, small slow flowing rivers or small stagnant water bodies. This practice was usually observed in the autumn and pre-winter season, since the fruit of this plant were available in these seasons only. All types of fish species were generally reported to be affected by the plant.

Schima wallichii (D.C.) Korth.: *S. wallichii* is a tree which belongs to the family Theaceae (Fig. 2c). It was reported to be a strong piscicidal plant in the study and also used

by the other communities living in the region such as the Santhals. The Bark of this tree was crushed or ground and then mixed with small slow flowing rivulets or stagnant waters, etc. Generally, the plant is available all throughout the year and hence this method was reported use in every season. But autumn and pre-winter season were generally the preferred seasons, since water level are reduced in these seasons which makes the piscicidal plants more effective and easier for the fishers to catch the fish.

Albizzia procera (Roxb.) Benth.: *A. procera* is a tree which belongs to the family Fabaceae (Fig. 2d). The bark of this plant was reported to possess piscicidal activity. The bark was first ground and mixed with the water where fishing was to be done. After sometime the fishes start floating on the water surface due to the effect of the plant extract after which they were collected.

Persicaria hydropiper (L.) Delarbre: *P. hydropiper* is a common herb which belongs to the family Polygonaceae (Fig. 2e). During autumn, pre-winter and winter seasons this plant can be seen growing extensively in all the regions and therefore, it was found to be used extensively in all the survey areas. The whole plant was crushed or ground and poured into the slow flowing rivulets or small stagnant waters. Usually, about 5 to 10 kgs are used at a time for the purpose of fishing.

Moringa oleifera Lam.: *M. oleifera* is a tree under the family Moringaceae (Fig. 2f). Generally, it was reported that the roots of this plant were believed to be highly toxic that even the snakes can't stay in the areas where the roots extracts were applied. The

roots of this plant were ground and applied in water bodies for piscicidal practices. Since the use of this plant results in extraction of its roots which ultimately kills the plant, its use was found to be restricted and generally not a preferred plant for use in fishing. Moringa is more important for harvesting its fruit and leaf for various purposes.

Senna alata (L.) Roxb.: Very few respondents (~5%) reported the use of this plant for piscicidal properties. *S. alata* is a shrub belonging to the family Fabaceae (Fig. 2g). Generally, the whole plant was reported to be used for its piscicidal property.

Acmella paniculata (Wall. ex DC.) R.K. Jansen: *A. paniculata* is a herb which falls under the family Asteraceae (Fig. 2h). The whole part of this plant was ground and used for its piscicidal effect. But generally, this plant was not preferred as it was less potent than other piscicidal plants.

Hellenia speciosa (J. Koenig) S.R. Dutta: *H. speciosa* is a herb which belongs to the family Costaceae (Fig. 2i). The ground tuberous root stock of this plant was used for its piscicidal effect. Generally, the Bodos don't prefer this plant for piscicidal practices as it was less effective compared to other plants such as *D. elliptica*, *C. spinosa*, etc. Also, very less people were found to be aware about its piscicidal activity.

The present study revealed that the traditional ethnobotanical use of some plant species by the Bodo tribal fishers of Kokrajhar, Assam for their piscicidal activity. Piscicidal or ichthyotoxic plants are primarily reported to be used for eliminating invasive fish species

before the introduction of new fish species in the pond¹⁵. However, in the present study, these plants were used by the Bodos for harvesting fish for consumption and according to the respondents these plants do not render the fish toxic for human consumption. Similar reports are available in most studies, where piscicidal plants do not make the fish unhealthy or poisonous for the consumption¹⁵.

Plant species such as *D. elliptica*, *C. spinosa*, *S. wallichii*, *A. procera* and *P. hydropiper* were found to be used frequently by the Bodos for their piscicidal properties. *D. elliptica* has also been reported by many researchers in different regions for piscicidal practices. The root of this plant was reported to be utilised in different regions of Asia³⁵ and North East India^{6, 11} including the Tiwa tribe of Assam³⁷, the tribes of Goalpara district of Assam for the capturing of *Monopterus albus*³ and in the Arunachal Pradesh of Northeast India¹⁸. The bark, roots, stem and seeds were reported to be effective in some regions of India¹⁵ but the Bodos were found to use only the root of this plant. The root of this plant is known to contain a bioactive compound known as rotenone which has a strong piscicidal properties¹⁵.

The piscicidal use of the plant *Catunaregam spinosa* was also reported by some researchers. Different parts have been reported to be effective in different studies. The fruits of this plant were used in different regions of India¹⁵ including the tribes of the Madurai district in Tamil Nadu¹⁴ whereas the stem bark was used by the Gond tribe of the Kawal Wildlife Sanctuary, Andhra Pradesh, India²⁴. It was also reported among the fishing

practices of Thailand⁸. The presence of bioactive compound known as piperine were reported in this plant²⁴ which may be responsible for piscicidal activity.

The piscicidal properties of the plant *S. wallichii* reported in our study corroborates with similar reports in different studies. For instance, the use of the bark of this plant was reported in India¹⁵ by the tribes of North East India⁷ and also in the Eastern Himalayan Region of Nepal²¹. The use of leaf, bark and fruits of this plant were also reported in Nepal¹⁶ and Thailand⁸. It was also reported in some Northeastern states like Mizoram and Nagaland¹¹ and in Mizoram²⁰. This plant is also reported to have therapeutic properties like anthelmintic, rubefacient and antipyretic (young leaves) and also useful for the treatment of flatulence⁹. The presence of some bioactive compounds such as Tannin, Saponin, Schiwallin, Alpha-spinasterol, Phytol and Octacosanol were reported from *S. wallichii* which gives this plant both piscicidal and ethnobotanical uses⁹.

Similar report of the use of the bark of *A. procera* for its piscicidal properties in this study were also reported in North East India⁶ like Arunachal Pradesh, Mizoram and Nagaland¹¹, in Mizoram²⁰ and by the *Adi* tribe of Arunachal Pradesh³⁹. A different species of *Albizzia* was found to be used by Tiwa tribes of Assam³⁷, whereas *A. odoratissima* was reported in the Karbi Anglong district of Assam¹⁷. The main bioactive compound found in the plant such as saponins, beta-sitosterol, triterpene and isoflavones²⁰ which may be responsible for both the piscicidal properties

and its ethnobotanical uses.

Traditionally the Bodo fishers use the whole plant of *P. hydropiper* for fishing. Similar use of this plant was reported in the Tiwa tribe of Assam³⁷, the Karbi Anglong area of Assam¹⁷, the Eastern Himalayan Region of Nepal²¹, Nepal¹⁶ and in Arunachal Pradesh¹⁸. The leaves and stem of this plant *P. hydropiper* are also used as anthelmintic in the Kokrajhar district of Assam in India³⁶.

It was observed in our study that some of the recorded plants (such as *S. alata*, *M. oleifera*, *H. speciosa* and *A. paniculata*) were not used extensively by the Bodos for fishing in spite of their piscicidal properties. Low piscicidal potency of these plants compared to the other plants like *D. elliptica* and *C. spinosa* were cited as the main reason for this. This results in limited awareness among local fisherman especially the younger generations about these plants. Through extensive literature review, it was found that few reports exist on its uses. Dutta *et al.*¹¹ and Kalita *et al.*¹⁸ reported the use of the bark of *S. alata* in Arunachal Pradesh, Northeast India for its piscicidal properties whereas, in the present study, the Bodos were found to use the whole plant. However, the use of this plant as a traditional medicine to treat various diseases (such as diabetes, asthma, malaria, typhoid, blotch, scabies, eczema, herpes, *etc.*) and the antimicrobial properties have been widely reported^{10,27}. The knowledge and use of this plant among the Bodos was also found to be limited to some regions, and very few people were aware of its piscicidal activity. Some of the bioactive compounds such as tannins, saponins, alkaloids, *etc.* were reported

from this plant^{10,27} which were found to be toxic to fish and aquatic organisms at higher concentrations^{2,28}.

Although *M. oleifera* is not the most preferred plant for the piscicidal properties, its roots were reported to possess piscicidal activities in the present study. The piscicidal effect of *M. oleifera* on the *Clarias gariepinus* was reported by Adalakun *et al.*¹. The use of *C. speciosus* and *H. speciosa* were reported in different regions of India for its piscicidal properties¹⁵. There are reports of the use of this plant for piscicidal fishing methods by the Gonds of Kawal Wildlife Sanctuary, Andhra Pradesh²⁴ and Mendha village of Gadchiroli district, Maharashtra, India¹⁹, the tribals of Panchakot hills of Purulia in West Bengal³⁰ and in Manipur^{11,23}. Diosgenin which is a bioactive compound responsible for piscicidal activity¹¹ was reported to be present in the plant which make it toxic for the fish.

The plant *A. paniculata* is reported to be less potent than other piscicidal plants and hence it reported restricted use in our study. The use of the whole plant for piscicidal practices was also reported in the Arunachal Pradesh^{11,18}. The presence of alkaloids, saponins, tannins, etc. were reported from the extract of this plant²². These bioactive compounds such as tannins, saponins, etc. were found to be toxic to fish and aquatic organisms at higher concentrations^{2,28}.

The technique of fishing by using ichthyotoxic plants are considered excellent, since it does not kill the whole fish like the chemical poison does¹⁹. Our study revealed

that this traditional method of fishing was extensively practiced by the Bodos earlier but, presently this practice was reduced significantly, mainly due to the diminishing plants species in the region and effect of modern fishing methods. Hence, such methods are now restricted only to the remote areas located near the forest reserves such as the Takampur FV and Kachugaon FV areas, near the Raimona National Park in the Gossaigaon subdivision of the Kokrajhar, Assam, and in the Kazigaon village in the Parbatjhora subdivision of the Kokrajhar district of Assam.

Traditional knowledge system represents the unique cultural identity of an ethnic community which needs to be preserved for future generations. Many a times such traditional ethnobiological methods may lead to discovery or development of alternative therapy or methods in pharmaceutical industries. Many ethnic groups worldwide traditionally use piscicidal plants for collecting and harvesting fish²⁴. Plant fish poisons are considered as environmentally friendly because they are biodegradable, do not have any residual effect and also easily available at low cost³⁴. Therefore, the use of plants for ichthyotoxic properties may be preferred over harmful chemicals, for eradication of unwanted predatory fish in aquacultural set ups. This indicates the huge potential for wide application of these plants in the aquaculture industry.

This study has identified the unique technique of using of piscicidal plants for fishing by the Bodos of Kokrajhar district, Assam, India. A total of 9 piscicidal plants falling under 7 families and 9 genera was recorded. The general mode of preparation and utilization of the plants in fishing was to make a paste of the

effective parts of the plant and mix with the water bodies to induce its piscicidal effects. However, the use of such piscicidal plant for fishing was found to be restricted to fishers in the remote areas. The possible reasons for this may be higher labour input and diminishing plant resources. Nevertheless, these plants may be a good alternative for the harmful synthetic chemicals used extensively to remove unwanted or predatory fish in aquaculture units. Moreover, with further studies on the identification and purification of active ingredients in these plants, these plants may be a source for novel biomolecules having wide application in aquaculture and allied industry as well as in medicine. Results obtained from this study may help in better understanding of the indigenous piscicidal plants and their potential applications for sustainable management of fisheries in the region.

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