



RESEARCH ARTICLE

Traditional knowledge of wild plants used in ethnofishery among the Sherdukpen tribe of West Kameng district of Arunachal Pradesh, India

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Abstract

The ethnofishery practice is a small-scale subsistence fishing method of the indigenous communities. The traditional fishing methods are mainly employed by local population of ethnic groups. Gleaning, net fishing, line fishing, use of arrows, harpoons and barriers, set and mobile traps, night fishing, fish poisoning, spear fishing are the common traditional methods of fishing. Ethnobotanical data on wild plant species used in traditional ethnofishery practices among the Sherdukpen tribe of West Kameng district were collected through semi-structured questionnaire, one-on-one interviews and group discussions with selected local informants. Relative frequency of citation (RFC) was used to assess the homogeneity of the ethnobotanical data. A total of 91 informants (70 male and 21 female members) were interviewed covering 80 household and 15 villages of Sherdukpen dominated West Kameng district of Arunachal Pradesh. This study reported 12 plant species found to be used as piscicidal agent by traditional fishermen of Sherdukpen community. The study reveals that the traditional fishermen of Sherdukpen tribe used locally available wild plant species for ethnofishery to sustain community livelihood.

Keywords: Traditional Fishing, Piscicidal Plants, Sherdukpen Tribe, Shergao, West Kameng, Arunachal Pradesh

1. Introduction

Fishing or fishing techniques are methods for catching fish from river or small streams, the term may also be applied to methods for catching other aquatic animals such as molluscs and edible marine invertebrate (Keegan, 1986). Fish catching is one of the oldest occupations of mankind while fish has been reported as most important food items of the human beings since ancient days. In fact, the success of fisheries depends on different forms of indigenous fishing techniques (Sugunan, 1998.). Fishing is an important occupation among the Sherdukpen tribes in the rural area of West Kameng district of Arunachal Pradesh. Fishing with the aid of traditional poisonous plants have been reported to be unique among the tribes of Arunachal Pradesh (Tag et al., 2005). This traditional method of fishing is still practised in remote areas villages of Arunachal Pradesh which sustain community livelihood. In traditional fishing methods, the poisonous ingredients from plants are pounded and thrown into a pool, small stream or dammed sections of a small river and the hallucinated fishes are collected (Tonlong et al., 2023). The traditional fishing techniques are still popularly practiced among the Sherdukpen tribe of West Kameng district at community level which reflects collective community wisdom and efforts. However, literature studies have revealed lack of documentation of traditional piscicidal plants with reference to Sherdukpen tribe. Therefore, this study was conducted in the Sherdukpen dominated Shergao region of West Kameng district of Arunachal Pradesh and documented the traditional knowledge related to wild plant species used in ethnofisheries.

2. Material and method

2.1 Study site

The present study - Sherdukpen dominated area in West Kameng District of Arunachal Pradesh is rich in forest and wildlife (Figure 1). The altitude of study sites ranging from 1000 - 3500 m from mean sea level. Sherdukpen tribal community are primarily settled

in two circles - Rupa (altitude 1954 m) and Shergaon (1408 m) (Anonymous, 2011) and located within geographical coordinates of 91°30' to 92°40' East Longitudes and 26°54' to 28°01' North latitude with a total Sherdukpen population of 9,663 individuals (Census, 2011). They share traditional boundaries with Monpa in the North and West, Bugun (Khowas) and the Hrussos (Akas) in the eastern side of the West Kameng district. The Sherdukpen are dispersed over small settlements which are known locally as *pams* or *luk* (lu-hill, rek-cultivation). This dispersion was originally brought about by their jhum cultivation, and by the necessity of living in proximity to the forest for better livelihood. Some of the important *pams* are: Thungri, Mukhuthung, Jhumyam, Brukpublang, and Gacham. Forests are typically dominated by subtropical species such as *Alnus nepalensis*, *Pinus wallichiana*, *Rhododendron arboreum*, *Magnolia doltsopa*, *Quercus semecarpifolia*, and *Prunus* species etc.

2.2. Survey method

Ethnobotanical survey was conducted in the 15 villages of Sherdukpen in the West Kameng district of Arunachal Pradesh during the month of May and June 2023 namely: Shergaon, Rupa, Jigaon, Mushaksing, Chillipam, Lumbaktang, Thungree, Mukuthing, Membachar, Garbow, Brokpublang, Jungpam, Dikshipam, Dukumpam, Yokmupam. A total of 80 household and the 91 informants were interviewed out of which 70 were male and 21 were female.

2.3. Data collection

The ethnobotanical data were collected from traditional fishermen using structured and semi-structured questionnaires format, group discussion and participants observation following the method suggested by Rao and Jain (1976) and Martin (1995). Traditional utilization knowledge related to harvesting, processing and applications of fish poison plants were recorded in field notebook. The digital photographs and voucher specimen were

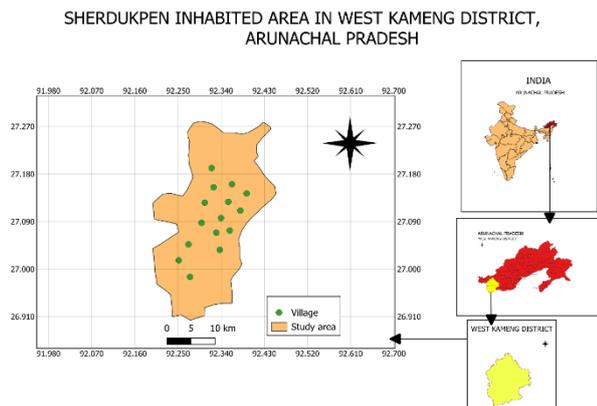


Figure 1. Map showing study area of Sherdukpen inhabited villages in West Kameng District, Arunachal Pradesh.

collected for each species. The local names, life forms, parts harvest and processing methods used for ethnofisheries were recorded.

2.4. Identification of plants

Plant species were identified through consultation of the standard flora such as *Flora of Lower Subansiri District, Arunachal Pradesh (India)* Vol. 1 & 2 (Pal, 2013), *Flora of Sikkim* Vol. 1 & 2 (Debabrata and Gaur, 2023) and *Flora of Kurung Kumey District, Arunachal Pradesh* (Dash and Paramjit 2017). The accepted names were verified in the website Plants of the World Online (POWO) hosted by Royal Botanic Garden, Kew.

2.5. Quantitative ethnobotanical data analysis

2.5.1. Frequency of Citation (FC)

In the present study, frequency of citation (FC) suggested by Tardo M. Pardo-De-Santayana (2008) to measure the how commonly a particular plant species was mentioned by the informants during ethnobotanical survey. Frequency of Citation (FC) is the number of informants who independently mention the use of a given plant species for any purpose (medicine, food, ritual, etc.). In this study, *Relative Frequency of Citation (RFC)* of each species was calculated using following formula:

$$RFC = \frac{FC}{N}$$

Where:

- FC = Frequency of citation of a species
- N = Total number of informants interviewed

The value of RFC ranges between 0 and 1. The species with highest RFC value of 1 indicate higher cultural and economic significance of the species among the informants.

3. Result

3.1. Demographic descriptions of the informants

In the present study, 15 villages of Sherdukpen were surveyed during the month of May and June 2023 and interviewed 91 local residents (Table 1). Majority of the ethnobotanical information related to plants of ethnofishery information were reported by Male informants which accounts for 76.92% while 23.08% of the informants were female. The informants interviewed were observed to be matured which falls within the age group of 30-45 (54.95%), followed by informants with age group between 45-65 (32.97%) while the age group above 65 were represented by few informants (12.08%) but observed to be more knowledgeable. This study shows 46.15% of the informant interviewed to be literate while 53.85% informants were illiterate. Farmer constitute 49.45% of the total informants interviewed which is followed by Yak Herders (17.58%), Housewives (10.99%), Government employees (10.99%), Shopkeepers (5.49%) and Healers (5.50%).

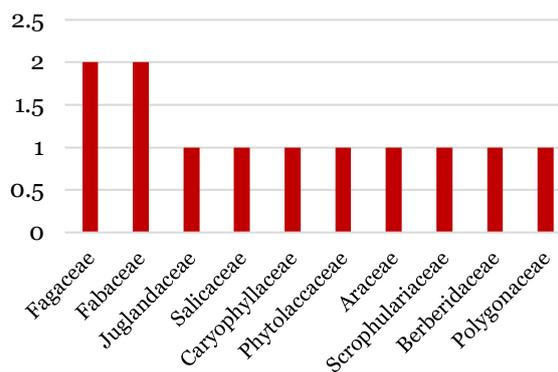


Figure 2. Graph showing frequency of the most used plant family for fish poisoning.

3.2. Diversity of plants species used in ethnofishery

Present study recorded 12 plant species used by the Sherdukpen tribe as piscidal agents during ethnofishery practices and the local name, part harvested and traditional uses are presented in Table 2, Figure 1-4 and Figure 5-9. The species commonly harvested are *Albizia arunachalensis* K.C., *Juglans regia* L., *Quercus coccifera* L., *Quercus semecarpifolia* Sm., *Homalium racemosum* Jacq., *Silene baccifera* (L.) Durande, *Phytolacca americana* L., *Arisaema heterophyllum* Blume., *Verbascum thapsus* L., *Indigofera heterantha* Wall. ex-Brandis, *Berberis insignis* Hook.f. & Thomson., *Persicaria hydropiper* (L.) Delarbre and belonging to angiosperm plant family Fabaceae, Juglandaceae, Fagaceae, Fagaceae, Salicaceae, Caryophyllaceae, Phytolaccaceae, Araceae, Scrophulariaceae, Fabaceae, Berberidaceae and Polygonaceae respectively.

3.4. Methods of fish poison preparation and applications

This revealed Sherdukpen tribe to be rich in traditional knowledge related to identification and harvesting of wild plants for the preparation fish poison agents which are employed in traditional ethnofishery which were observed to be ecofriendly and sustainable (Table 2, Figure 5-9). Fish species like Trout, Catfish and Tadpole are commonly found in the stream water and local fishermen employed different methods of traditional techniques to catch the fish. Of the many methods developed by local people to catch fish, the most common method of catching fish was reported to be damming the water with logs and diverting it on to a dry land on a higher level. The water surges forward and then subside, leaving the fish on dry ground where they are readily caught by hand with application of piscidal agents. This method essentially requires communal effort which requires a great deal of labour forces. The results are, however, commensurate with the efforts and huge catch is dried and smoke and kept for future use. Stem (bark), leaves and seeds were observed to be commonly used for preparation of fish poisoning agents. They are mixed and pounded to paste and thrown to the river and streams to hallucinate the fishes. The hallucinated fishes floating over the surface of river are collected, smoke dried and preserved for future use. Poisoning was generally done in stagnant pools or slow-flowing streams and rivers. Sometimes streams would be partly blocked to slow down the water flow. Collection of fishes were observed to be done by hand, but collected through baskets, local bamboo made conical trap which is locally known as *hobe* and nets were sometimes employed to catch the fishes. Of the total 12 species reported, 05 species were found to be threatened species listed under IUCN Redlist Category (Table 3).

3.6. Quantitative analysis

3.6.1. Relative frequency of citation (RFC)

Highest relative frequency of citation (RFC) was recorded for *Juglans regia* (0.55) which is followed *Persicaria hydropiper* (0.44), *Quercus coccifera* (0.40), *Albizia arunachalensis* (0.33),

Quercus semecarpifolia (0.33) which implies these plant species are widely known for their potency and application as fish poisoning agents used among the local fishermen of the Sherdukpen community. Low RFC value was recorded for *Phytolacca americana* (0.22), *Homalium racemosum* (0.22), *Indigofera heterantha* (0.15), *Verbascum Thapsus* (0.11) and *Berberis insignis* (0.09) which indicates less frequency of citation which implies that the plant has limited or specialized use and knowledge is restricted to few traditional fishermen who use these plants as fish poisoning agents.

4. Discussion and conclusion

Traditional knowledge related to utilization of fish poison plants among the Sherdukpen tribe is unique and innovative. Earlier studies of Tag et al (2005) and Tonlong et al (2023) have reported some fish poison plant species from Nyishi and Nocte tribe but in the present studies, the Sherdukpen fishermen uses some species such as *Albizia arunachalensis* K.C. Shani & H.B. Naithani, *Silene baccifera* (L.) Durande, *Homalium racemosum* Jacq., *Juglans regia* L., and *Berberis insignis* Hook.f. & Thomson. *Quercus coccifera* L., *Quercus semecarpifolia* sm., *Phytolacca americana* L., *Arisaema heterophyllum* Blume., *Verbascum thapsus* L., *Indigofera heterantha* Wall. ex Brandis which are new insights and reported to be the ethnobotanical novelty in present study. Of the total 12 species of piscicidal plant species reported, 5 species were reported under IUCN Redlist of threatened species such as Endangered (EN), Near Threatened (NT), Threatened (T), for instance; *Albizia arunachalensis* K.C. Shani & H.B. Naithani, *Silene baccifera* (L.) Durande, *Homalium racemosum* Jacq., *Juglans regia* L., and *Berberis insignis* Hook.f. & Thomson. which need conservation attention. Traditional fishing methods using local fish poisoning plants were reported to be safe, non-pollutants and ecofriendly because the volatile phytochemicals including some formic acids from plant extracts released in the less amount of water hallucinate fish which enable easy catch by the fishermen but the phytochemicals as natural products are quickly dissolved and diluted when large amount of water flow are allowed thus help the fish to regain and swim again (Tag et al., 2005, Tonlong et al., Bilave et al., 2018). It was also observed that informant with age group 60 years and above reported and shared valuable information about wild plants used in ethnofishery which implies that the increment in traditional knowledge of the community has the direct correlation with increasing age of the informants. Catching of fishes among the Sherdukpen were found to be community participatory in nature which need participation of the community members for better harvest. Local fishermen comprise of young to old age group from the villages participate during damming of the water with logs and rocks, river diversion to a dry land on higher level. The large number of hallucinated fishes are caught after application of plant extracts in the river. The excess catches are smoke dried, preserved as protein sources and

Table 1. Demography of the respondents interviewed from the study site.

Variable	Categories	No of persons	Percentage
Gender	Male	70	76.92
	Female	21	23.08
Total		91	100
Age group	30-45	50	54.95
	45-65	30	32.97
	Above 65	11	12.08
Total		91	100
Education Level	Literate	42	46.15
	Illiterate	49	53.85
Total		91	100
Profession	Govt. Employees	10	10.99
	Shopkeepers	5	5.49
	Herders	10	10.99
	Housewives	16	17.58
	Farmer	45	49.45
	Healer	5	5.50
Total		91	100

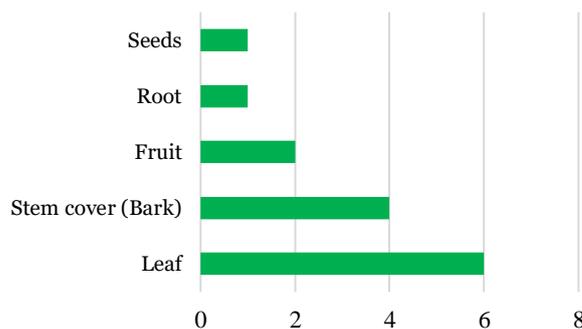


Figure 3. Graph showing distribution of plant parts used among the species for fish poisoning.

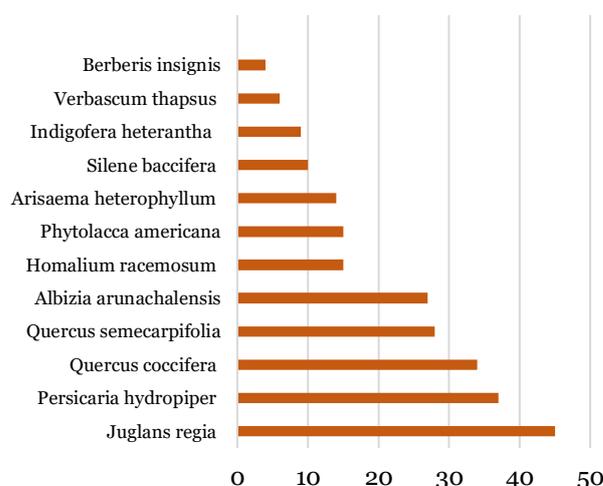


Figure 4. Graph showing frequency of plant species diversity used in fishing. Y-axis showing Plant species and X- axis showing total no. of informant cited the usefulness of species.

Table 3. The IUCN status of Fish poisoning plants used by Sherdukpen tribe of West Kameng district, Arunachal Pradesh. (EN- Endangered, R- Rare, T- Threatened, NT- Near threatened, LC- Least concern, S- Secure).

SN	Botanical name	IUCN status
1	<i>Albizia arunachalensis</i> K.C. Shani & H.B. Naithani	EN
2	<i>Juglans regia</i> L.	NT
3	<i>Quercus coccifera</i> L.	LC
4	<i>Quercus semecarpifolia</i> Sm.	LC
5	<i>Homalium racemosum</i> Jacq.	T
6	<i>Silene baccifera</i> (L.) Durande	EN
7	<i>Phytolacca americana</i> L.	S
8	<i>Arisaema heterophyllum</i> Blume.	LC
9	<i>Verbascum thapsus</i> L.	LC
10	<i>Indigofera heterantha</i> Wall. ex Brandis	LC
11	<i>Berberis insignis</i> Hook.f. & Thomson	NT
12	<i>Persicaria hydropiper</i> (L.) Delarbre	NE

consumed in the subsequent months. Higher Relative Frequency of Citation (RFC) was recorded for *Juglans regia* (0.55) which is followed *Persicaria hydropiper* (0.44), *Quercus coccifera* (0.40), *Albizia arunachalensis* (0.33), *Quercus semecarpifolia* (0.33) which implies higher local preferences and reliance on these plant species as trusted and potent piscicidal agents among the local fishermen. Phytochemical study on these plant species could yield valuable chemicals responsible for inhibiting the neurological function of the fishes.



Figure 5. **a,b;** *Albizia arunachalensis* K.C. Shani & H.B. Naithani, **c,d;** *Quercus coccifera* L., **e,f;** *Juglans regia* L.



Figure 6. a,b: *Quercus semecarpifolia* Sm, c,d: *Homalium racemosum* Jacq., e,f: *Silene baccifera* (L.) Durande



Figure 7. a,b: *Phytolacca americana* L., **c,d:** *Arisaema heterophyllum* Blume., **e,f:** *Verbasicum thapsus* L.



Figure 8. a,b; *Indigofera heterantha* Wall.ex Brandis, c,d; *Berberis insignis* Hook.f. & Thomson, e,f; *Persicaria hydropiper* (L.) Delarbre



Figure 9. Methods of fish poisoning; a. Collection of Juglans leaves, **b.** Damming stream water, **c.** Pounding Juglans leaves, **d.** Extract solution flowing in water, **e.** Hallucinated fish floating in the surface of water, **f.** Village person holding fish.

Table 2. Checklist of piscicidal plant species with local name, life forms, part used, nativity, FC and RFC value used by the Sherdukpen tribe of West Kameng district, Arunachal Pradesh.

SN	Local name (Sherdukpen)	Botanical name	Family	Coll. No.	Life form	Part used	Geo Origin	Preparation and administration	FC	RFC	Coordinates
1	Cheneh chow	<i>Albizia arunachalensis</i> K.C. Shani & H.B. Naithani	Fabaceae	RNT12 10-04-2023, Rupa	Tree	Stem cover (Bark), Leaves	Native	The bark is pounded, and the active ingredient is released by mashing the appropriate plant parts, which are then thrown to the water environment.	30	0.33	27°07'22"N 92°15'14"E
2	Mukhu hing	<i>Juglans regia</i> L.	Juglandaceae	RNT 133 13-04-2023, Shergaon	Tree	Stem cover (Bark) and leaves	Native	The leaves and bark are mash or pounded, the active ingredient is released by mashing the appropriate <i>Juglans regia</i> leaves, and thrown to the water environment.	50	0.55	27°07'12"N 92°14'14"E
3	Hingmu hing	<i>Quercus cocCIFera</i> L.	Fagaceae	RNT 198 25-04-2023, Shergaon	Tree	Stem cover (Bark)	Native	Stem cover (bark) is used for fish poisoning, bark is pounded or mashed, and the chemical released in water hallucinates the fishes.	36	0.40	27°17'12"N 92°14'17"E
4	Hingpu hing	<i>Quercus semecarpifolia</i> Sm.	Fagaceae	RNT 199 26-04-2023, Shergaon	Tree	Stem cover (Bark)	Native	The bark is generally mash and pounded and are released in stagnant or slow flowing stream.	30	0.33	27°18'12"N 92°14'19"E
5	Jhurmeh chow	<i>Homalium racemosum</i> Jacq.	Salicaceae	RNT 334 27-04-2023, Shergaon	Tree	Stem cover	Exotic	Stem and root used to poison fish. Stem and roots are mashed properly and used for fish poisoning.	20	0.22	27°17'12"N 92°14'17"E
6	Sang thaki	<i>Silene baccifera</i> (L.) Durande	Caryophyllaceae	RNT 229 01-05-2023, Shergaon	Climber	Stem	Native	Stem is coiled and insert in fish inhibiting region and fishes are allowed to enter and catch.	15	0.16	27°15'12"N 92°11'17"E
7	Mandoyoma	<i>Phytolacca americana</i> L.	Phytolaccaceae	RNT 180 01-05-2023, Shergaon	Herb	Fruits (Berries)	Exotic	The berries are crushed and the extract is released in water to hallucinate the fish.	20	0.22	27°21'12"N 92°20'17"E
8	Oho bak bacham ha	<i>Arisaema heterophyllum</i> Blume.	Araceae	RNT 312 02-05-2023, Shergaon	Herb	Leaves and fruits	Native	The roots and the fruits are crushed and the extract is used to poison the fish.	18	0.20	27°21'10"N 92°22'17"E
9	Phowdonzan	<i>Verbascum thapsus</i> L.	Scrophulariaceae	RNT 259 03-05-2023, Shergaon	Herb	Leaves	Native	Leaves are crushed and used for fish poisoning.	10	0.11	27°21'13"N 92°21'17"E
10	Minto kit	<i>Indigofera heterantha</i> Wall.ex Brandis	Fabaceae	RNT 131 04-05-2023, Shergaon	Herb	Leaves	Native	Whole plant is pounded to paste and phytochemicals are allowed released in water body which acts as poison to fish.	14	0.15	27°21'14"N 92°20'17"E
11	Gorongchung bazow	<i>Berberis insignis</i> Hook.f. & Thomson	Berberidaceae	RNT 31 06-05-2023, Shergaon	Shrub	Root	Native	Roots are crushed and thrown into the water. The phytochemicals released from extracts hallucinates the fish.	8	0.09	27°11'14"N 92°20'12"E
12	Zang nuh	<i>Persicaria hydropiper</i> (L.) Delarbre	Polygonaceae	RNT 177 07-05-2023, Shergaon	Herb	Leaves	Native	Leaves of <i>Persicaria hydropiper</i> are pounded to paste and thrown into water body. The phytochemical released from the plant hallucinate the fish. Floating fishes are then collected.	40	0.44	27°16'14"N 92°20'22"E

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Authors' contribution: Rinchin Norbu Thungon – Field survey, collection, documentation and first draft of the manuscript. JB: Data evaluation and manuscript editing. Hui Tag (HT): research design, supervision, concept and final manuscript draft and communication.

Ethics approval and consent to participate: Prior Informed Consent (PIC) were obtained from the traditional knowledge holders “Gaon Bura”, village head locally known as “Thuk Supu” and local people.

Conflict of interest: Authors have no conflict of interest.

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