Appraisal of Ethno-veterinary practices used for different livestock ailments in rural and peri-urban areas of Purba Bardhaman, West Bengal, India

Suvendu Pal, Pritish Mitra, Somen Dey, Arindam Ganguly and Asish Mandal

Correspondence

Suvendu Pal[1], Pritish Mitra[1], Somen Dey[1], Arindam Ganguly[2] and Asish Mandal[1]*

[1]PG Department of Botany, Ramananda College, Ramananda College, Bishnupur, Bankura, PIN: 722122, W.B., India
[2]Department of Microbiology, Bankura Sammilani College, Bankura, PIN: 722102, W.B., India

*Corresponding author: asishbotany24@gmail.com

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Research

Abstract

Background: Plant species contribute fodder and forage to livestock and are also used traditionally as ethnomedicines in curing various health disorders. High cost and massive side effects of conventional drugs, often promotes indigenous people to depend on traditional phytomedicines. This study is an attempt to document the indigenous knowledge of ethnoveterinary plants and practices by the people of Purba Bardhaman District, West Bengal, India.

Methods: 135 informants from different rural and peri-urban areas were interviewed through a standardized questionnaire throughout the year, 2023. The collected ethnoveterinary data was analysed through frequency of citation (FC), relative frequency of citation (RFC), use value (UV), number of use (NU) to determine the level of knowledge and use of plant species by local communities against various diseases.

Results: 38 plant species have been recorded which belong to 37 genera and 27 families. Diarrhoea, chronic wound, eye spot, mastitis, respiratory problem, and worm infection are found to be the most common diseases. The highest FC (77), RFC (0.57) and UV (0.85) were contributed by *Moringa oleifera* against these diseases. The practices in rural and peri-urban areas are more or less same. In most cases the required plants are collected from the field in wild conditions although some plants are cultivated in rural areas. Due to over-exploitation, ignorance, over grazing these plants are needed to be conserved.

Conclusions: The work provides a list of ethnoveterinary plants for livestock medicine preparation. The plants with high value of ethnobotanical indices can be potential sources of novel drugs through modern phytomedicinal approaches.

Keywords: Ethnoveterinary medicine, Indigenous knowledge, Livestock care, Quantitative ethno-veterinary.

Background

Domestication of animals has been accepted as an essential step for sustaining human life during the course of development of human society. Animals provide food, labour, security, companion and with the advancement of civilization domesticated animals gradually become the part of social life and culture. Nowadays, animal farming has become an alternative source of economy, providing a diverse range of products including milk, eggs, meat, wool, manure, hides, feather and other commodities. Ploughing by bullocks and buffaloes is practiced by farmers. Thus, the livestock species play an important role to maintain the livelihood of traditional people of countries like India. Simultaneously, traditional knowledge on livestock healthcare management system has developed, that became the basis of ethnoveterinary medicines. It includes expertise understanding in ethnobotany which encompasses the intricate interplay between humans, plants and animals. Preparation of ethno-veterinary medicine requires the knowledge, skills, methods, practices and beliefs that people employ in animal husbandry (Mc Corkle 1986). Generally, this knowledge, developed by livestock rearers in the barns and fields, is transmitted orally and varies from region to region, locality to locality, and even within communities (Viegi *et al*. 2003). Ethnoveterinary knowledge have grown by trial-and-error method and also sometimes by experiments and innovations (Mc Corkle 1996).

India, the seventh largest country of the world in area, has an agriculture-based economy. It is also a mega biodiversity country and a store house of ethno-herbal knowledge. The livestock sector in India holds about 11.6 % of the world (BAHS 2014). It is estimated that Indian traditional, folk and herbal medicines use about 6000 plants which represent 75% of medicine needs (Rajshekharan 2002). In India, cattle rearing has been embedded in the culture since ancient times, embraced with profound emotional attachment. Ethno-medicine for livestock healthcare management in India started long before the Vedic age (Somvanshi 2006) with the development of Ayurveda for treatment of people and since then medicinal plants contribute ethnoveterinary medicines also. Livestock healers and rearers apply their traditional knowledge to diagnose and classify the disease types and use plants with appropriate way for treating animal ailments till today. A number of active ingredients are administered in traditional methods as the whole plants or parts of plants. There is a distinct progress towards modern scientific drug discovery using traditional experience. Common ethnoveterinary plants can be utilized through different *in silico* and *in vitro* study for drug development. Crude extracts of plants can be developed into modern drugs following standard procedures. Modern techniques including plant tissue homogenization, serial exhaustive extraction, Soxhlet extraction, maceration, decoction, infusion, digestion, percolation, sonication, supercritical fluid extraction (Hussain, 2019) are different processes of isolating and using the active principles in phytomedicine preparation. The field of herbal medicine has been gaining exponentially popularity both in developed and developing countries. In fact, some allopathic drug facilities are also available but these are much costly and come with potential side effects. The majority of livestock-rearers prefer to utilize ethnoveterinary medicine for the treatment of their domesticated animals (Sharma *et al*. 2012). Collection of information to prepare a database and documentation on ethnoveterinary knowledge focussing medicinal plants in India are getting importance for scientific utilization, creating a new line of research (Jain 1999; Pande *et al*. 2007; Dey and De 2010; Galav *et al*. 2013; Bharali *et al*. 2015; Khandelwal 2017; Nad *et al*. 2021). Traditional communities from different rural and suburban areas were explored for ethnoveterinary data collection to prepare a sound repository of indigenous knowledge on ethnoveterinary medicines for ailment of specific animal diseases (Mandal and Rahaman 2022).

In West Bengal, a state of India, there is a lack of concerted effort in gathering ethno-veterinary information. In this state a number of tribal and traditional ethnic groups of people are living. With the common experience the people generally find the plants from the nature and sometime they like to cultivate in the field nearby their houses or empty lands or places between agricultural lands. Thus, the people conserve these plants as a part of their traditional culture. Government supported animal healthcare systems are there and they primarily focus on providing artificial insemination for cattle and vaccination of livestock against specific diseases. Availability of veterinary experts is insufficient. Efforts should be taken to improve the condition and for this purpose gathering of knowledge from the traditional treatment is the primary need and it should be used in modern scientific processes for application. Dey and De (2010) demonstrated some ethnoveterinary important plant species from Purulia district of West Bengal. Mandal and Rahaman (2022) have recently compiled a catalogue of ethnoveterinary medicinal plants found in certain lateritic areas of West Bengal. Traditional healers in West Bengal employ a range of therapeutic agents, including non-plant-based materials like mushrooms, alongside plant-based products, to effectively manage and treat diseases in livestock, highlighting the complexity and depth of their traditional knowledge. Ganguly *et al*., (2021) conducted a vivid survey and identified certain mushrooms having immense medicinal significance. Further investigation is required among the traditional people to restore this type of ancient therapeutic knowledge. The primary method of treating animals in this region remains folk phototherapy. However, the decline of this age-old practice is evident due to the shift in traditional lifestyles by the influence of modern socio-economic conditions. In

west Bengal the economy is mainly agriculture based and with the use of modern techniques in agriculture the people of this regions became more dependent on machines rather than of bullocks and buffaloes. The number of bullocks and buffaloes are becoming lower and there is every possibility to lose the interest in ethnoveterinary approach among the new generation. The oral transmission of ethnic knowledge comes with limitations in promptly managing multiple diseases. So, it becomes very crucial to search and preserve the traditional knowledge immediately. Thus, current research work is important as it tends to cataloguing of medicinal plants for the treatment of livestock diseases and uncover the precious knowledge of ethnoveterinary practices in rural and peri-urban areas of Purba Bardhaman district of West Bengal, India.

Materials and Methods

Study area

The district Purba Bardhaman (Fig. 1) is situated between 23°53' N to 22°56' N latitude and between 88°25' E to 87°56' E longitude and occupies an area of 5,432.69 square km. For collection of demographic information, systematic field surveys were conducted through 4 sub-divisions containing Ketugram-I, Ketugram-II, Katwa-I, Katwa-II, Kalna-I, Kalna-II, Jamalpur, Ausgram-I, Mongalkote, Bhatar, Purbasthali-I, Burdwan-I, Khandaghosh, Monteswar and Memari-I blocks. Out of these blocks Katwa-I, Kalna-I and Memari-I are the peri-urban region and the rest are of rural area. The river Bhagirathi-Hooghly is situated in the east, the Damodar with its branches in the south-west and the Ajay with its tributaries in the at the north position of the district. The whole study area is alluvial plain. The climate is tropical, marked by hot and humid conditions. Typically, the months of May and June experience the highest temperatures, while the coldest months are December and January. The monsoon season is from June to September with an annual average rainfall of 1400 mm, 75% of it falling in the monsoon. As per the 2011 census data, Purba Bardhaman district had a total population of 4,835,532 of which a good portion belongs to different tribal communities including Sām̐ōtāla, Māhāli, Kōrā, Muṇḍā, and Kiṣāṇa.

The district boasts agricultural prosperity, with many tribal communities engaged either as agricultural labourers or as farmers cultivating their own land. Paddy is considered as the primary crop in this district, with other economically significant crops including wheat, jute, potato, pulses and oilseed. Peoples are also engaged in livestock husbandry as alternative source of income. Feeding habitat of livestock mainly depend on grazing and agricultural byproducts.

Demography and data collection

For collection of demographic information, systematic field surveys were conducted in 15 blocks (Ketugram-I, Ketugram-II, Katwa-I, Katwa-II, Kalna-I, Kalna-II, Jamalpur, Ausgram-I, Mongalkote, Bhatar, Purbasthali-I, Burdwan-I, Khandaghosh, Monteswar and Memari-I) covering 4 sub-divisions for one year in different seasons (Fig. 1). The well-informed persons who had adequate knowledge in livestock ailments, ethnoveterinary practices and local plant identification were selected for interviews (Fig. 2) and group discussion in relevant area through semi-structured standardized questionnaires. A diverse cohort of 135 individuals were surveyed, hailing from assorted regions and encompassing a spectrum of occupations such as healers, farmers, cattle owners, gardeners, traders, and shopkeepers. The information collected from one area was further cross-checked with the other area for accuracy. The International Union for Conservation of Nature (IUCN) red list of threatened species was followed to evaluate the present conservation status of the species (Ganguly *et al.* 2018).

Statistical analysis

The results of the ethnoveterinary survey were analysed to determine the level of knowledge and use of plant species by different communities of Purba Bardhaman district of West Bengal, India; using various quantitative indices such as Frequency of citation (FC), Relative frequency of citations (RFC), Number of use (NU), Use value (UV). To understand the potential use of each species and to assess the importance of the recorded plant species, these different indices were calculated in order.

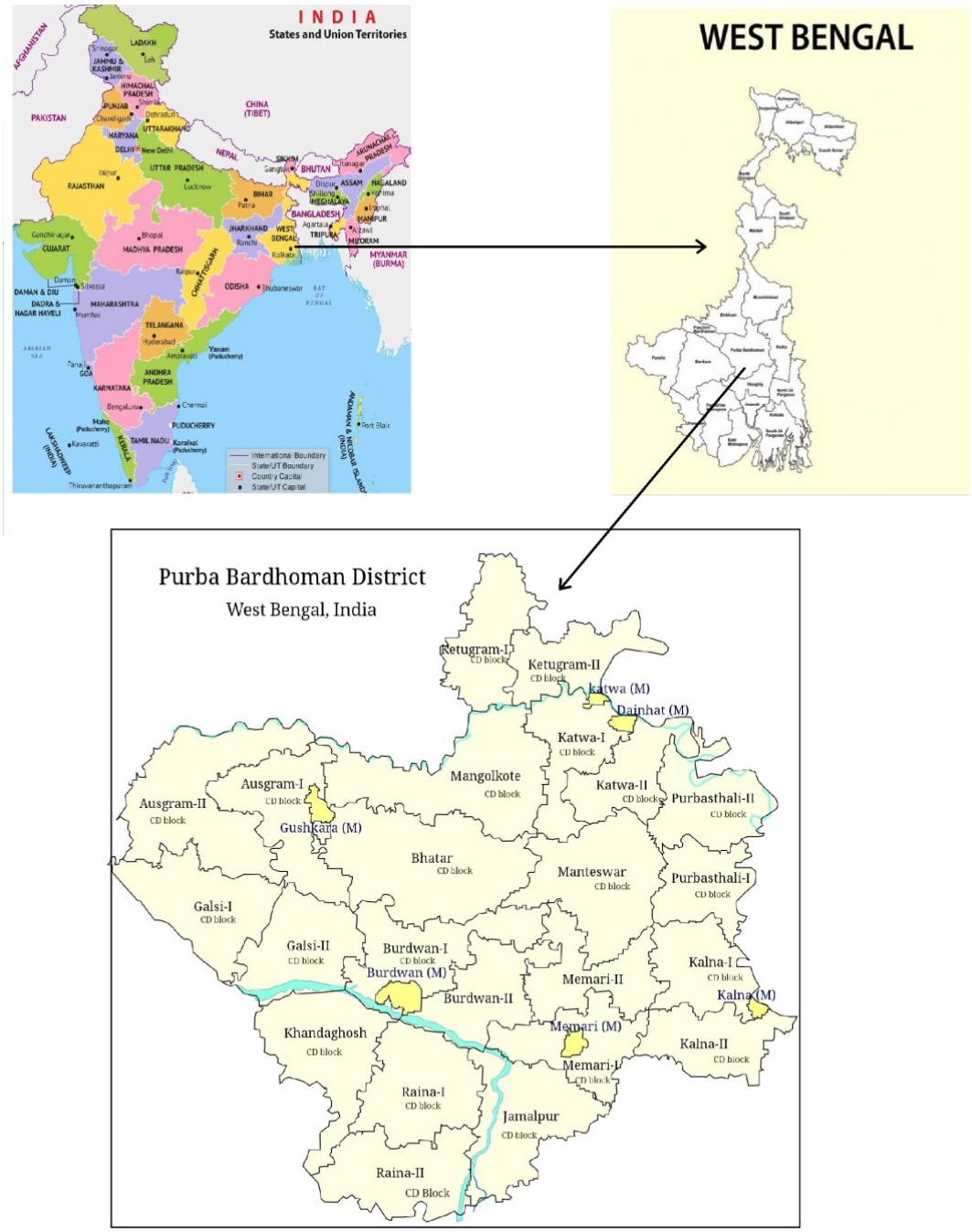

Figure 1. Map of the study area

Figure 2. Field study with livestock rearers

Frequency of citation (FC):

Frequency of citation is the sum of the number of informants who use the particular taxa traditionally. The FC value is calculated by using the formula

$$FC=\sum_{i=i1}^{iN} URi$$

where UR = use report and N = total number of informants interviewed (Ali *et al*. 2019; Prance *et al*. 1987).

Relative frequency of citation (RFC) index:

The RFC function calculates the relative frequency of citation for each species in the present survey report. RFC index is detected by using the formula

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

where FC = Frequency of citation and N = total number of informants interviewed (Tardio and Pardo-de-Santayana 2008).

Number of use (NU):

The NU function calculates the number of uses for each species in the present survey report. NU value is calculated by using the formula

$$NU = \sum_{u=u1}^{uNC} U$$

where NC = number of use categories, NU = the sum of all categories used for a particular species. (Prance *et al*. 1987).

Use value (UV):

Use value (UV) is a quantitative method which shows the importance of a species on local scale. UV is measured by using the formula

$$UV = \sum \frac{Ui}{Ni}$$

where Ui = use reports for a particular plant species and
Ni = total number of informants interviewed for the particular species in the survey (Akhter et al. 2000).

Results

The result of the current study demonstrates that the local peoples of Purba Bardhaman districts mainly use the ethnoveterinary medicines for livestock treatment. The survey was thoroughly done among the experienced people. They have less formal education but with the experience with traditional veterinary knowledge they are well known in the area. The most utilised plants used as medicine are *Moringa olifera* (sajne), *Centella asiatica* (Thunkuni), *Artocarpus heterophyllus* (Kathal), *Neptunia oleracea* (Ghol khori). All the plants are collected from the local areas. During the survey the plants are identified by the informants and the photographs are being taken.

Informant's demography

A total of 135 informants (Table 1) were interviewed at their homes, fields and cattle farms through questionnaires specially prepared for this purpose. Among the total informants 108 were male and 27 were female. The group of informants included individuals aged over 70 years, who possessed a greater depth of knowledge on traditional plants compared to younger counterparts. There are 45 young informants aged 35-45 years, 62 informants aged 46-60 years, and the remaining 18 informants were aged 61-70 years. There were 52 individuals who did not possess any formal educational qualification, while 78 had obtained a matriculation/ intermediate qualification. The remaining 5 informants had achieved a graduation level educational qualification. The study revealed that out of the total 135 informants, 14 had an experience ranging from 1 to 5 years, 51 had an experience ranging from 5 to 10 years, 58 had an experience ranging from 10 to 20 years, and the remaining 12 informants had more than 20 years of experience in ethnoveterinary knowledge. All interviews were conducted in the native tongue for better communication. The main inquiries were the plant's native name, its parts, preparation and administration techniques, dosages, and individual experiences 189 related to its use. During this survey it is realized that the modern generation are not much interested regarding the traditional ethnoveterinary practices and the knowledge has been starting deterioration.

Table 1. Informant's demography

Occupation	No of informants	Gender		Experience (years)			Educational qualification			
		Male	Female	(1-5)	(5-10)	(10-20)	More than 20	Illiterate	Matric/ Intermediate	Graduation level
Healer	38	31	7	5	15	15	3	18	20	0
Cattle owner	33	20	13	3	16	13	1	14	19	0
Farmer	22	20	2	5	7	8	2	5	15	2
Gardener	15	13	2	0	5	8	2	8	7	0
Trader	10	10	0	0	6	4	0	0	8	2
Shopkeeper	7	7	0	1	2	3	1	0	6	1
Elder (not professional)	10	7	3	0	0	7	3	7	3	0

Taxonomic family wise distribution of ethno-veterinary plants and their uses

The study reported 38 plants (Table 2) belonging to 27 families (Fig. 3) which were used for ethnoveterinary medicine. According to the current report, 24 species (about 63%) were herbaceous growth habit, 7 species (about 18.5%) were shrubs and 7 species (about 18.5%) were trees. According to the use of ethnoveterinary purpose, the family Fabaceae was the dominant, which contributed 4 species, followed by Amaranthaceae (3 species), Asteraceae Moraceae, Malvaceae, Zingiberaceae, Convolvulaceae, Euphorbiaceae, (containing 2 species on each family). The remaining families Asclepiadaceae, Verbenaceae, Asperagaceae, Nyctaginaceae, Anacardiaceae, Boraginaceae, Nymphaeaceae, Acanthaceae, Asphodelaceae, Cucurbitaceae, Plantaginaceae, Musaceae, Lamiaceae, Rubiaceae, Apiaceae, Annonaceae, Amaryllidaceae, Anacardiaceae, Moringaceae were represented by one species. The local community members use different plant parts (Fig. 4) and formulations for making ethnoveterinary medicine. Leaves are the most used parts (about 43%), followed by root (about 15 %), rhizome (about 11 %), whole plant (about 7 %), seed-leaf base-latex (about 4 % each) and fruit-cotyledon-apical twig-bulb-prop root (about 2 % each) for the ethnoveterinary treatment.

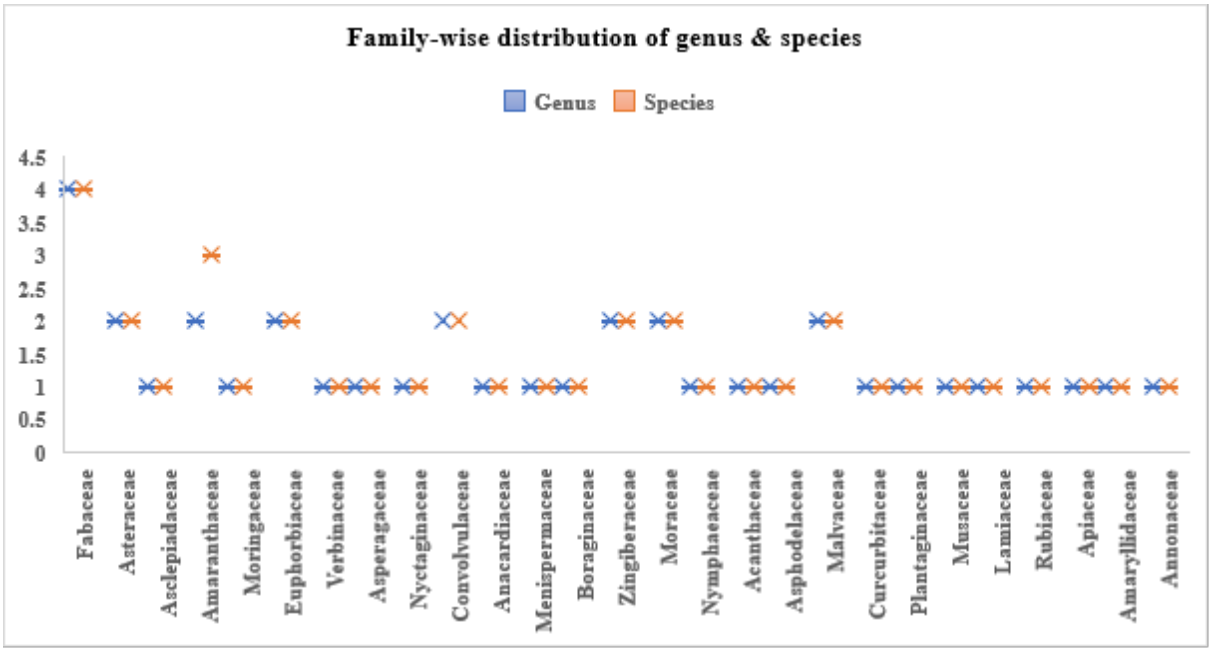

Figure 3. Taxonomic family wise distribution of genus & species (In this bar graph x- axis represent name of different families whereas, y-axis represents the number of genus (denoted on blue colour) and species (in saffron colour) included in each specific family.)

Table 2. Ethnoveterinary use of the plants of district Purba Bardhaman, West Bengal, India

Botanical name	Family	Native name	Habit	Current status	Part(s) used	Applied animal(s)	Ethno-veterinary remedies	Dosage
Cassia fistula L.	Fabaceae	Bandor lathi	Tree	Least concern	F	Calf, Goat, Sheep	Fruits cut into small pieces and soaked with water throughout the whole night and use in morning before meal to cure constipation with bleeding problem	About 20-25 ml of soaked water applied in early morning before meal for2-3 day
Eclipta prostrata (L.) L.	Asteraceae	Keshut	Herb	Least concern	L	Calf	Juice of crushed leaves applied in pinkeye treatment	About 5-10 drops of juice applied 3 times a day for 5 days
Calotropis procera (Aiton.) Dryand	Asclepiadaceae	Aakanda	Shrub	Least concern	AT	Cow, Buffalo	Apical twig with bud (flower) is used for treatment of monsoon fever	Fresh apical twig applied as fodder 3 times a day for 2-3 days
Achyranthes aspera L.	Amaranthaceae	Chat-chati	Herb	Least concern	R	All cattle	Crushed roots mixed with mustard oil properly and used in bone fracture with the bamboo strips	About 500gm of crushed leaf paste applied one time during tied with bamboo strips
Moringa oleifera Lam.	Moringaceae	Sajne	Tree	Least concern	L	Cow, Buffalo, Calf, Goat, Sheep	Fresh crushed leaves mixed with coconut oil properly to make paste and applied on skin to cure skin rash or major wounds	About 500-750 gm of crushed leaves applied as ointment with 2 times a day for 2-3 days
Euphorbia resinifera O.Berg.	Euphorbiaceae	Narasujii	Herb	Secure	LX	Cow, Buffalo	Latex is used to treatment of toothache	About 10-15 gm of latex is applied for teeth polish

Neptunia oleracea Lour.	Fabaceae	Gholkhori	Herb	Least Concern	L	All cattle	Fresh crushed leaves applied to control loose, watery stools that occur more frequently than usual	About 50-60 gm of crushed leaves applied as fodder 2 times a day for 2-3 days
Lantana camara (L) Moldenke.	Verbenaceae	Putus	Shrub	Secure	L	Cow, Buffalo	Leaves cut into small pieces and wash with pure water. Then mixed with normal fodder and used to kill warms in intestine	About 25-35 gm of leaf piece applied every morning before meal for 2 days
Asparagus racemosus Will.	Asperagaceae	Satamuli	Herb	Endangered	R	Bull, Buffalo	Dried roots pounded to form powder, mixed with salt properly to get more energy during ploughing	The mixture is applied as demulcent 10-15gm/day for 3 days
Boerhavia diffusa L.	Nyctaginaceae	Punarnaba	Herb	Secure	L	Cow, Buffalo, Sheep	Leaves are thrashed to make juice and used on eyes to stop watering	About 10-15 drops of infusion are applied 3-5 days
					L	Cow, Buffalo, Sheep	Crushed fresh leaves to make poultice and applied on cattle legs for curing joint pain	About 50-55 gm poultice applied on joint twice a day for 3-5 days
Evolvulus alsinoides (L.) L.	Convolvulaceae	Pa lata	Herb	Secure	S & R	Bull, Buffalo	Crushed stem and root mixed with mustard oil (1:5:3) to make paste and then applied to wound or sore on neck during ploughing	The mixture is applied on wound or sore on neck every night during rest for 7-10 days

Mangifera indica L.	Anacardiaceae	Aam	Tree	Data deficient	CD	All cattle	Dried cotyledons mixed with a little amount of ethanol solution to prepare paste and used on injured organ to stop bleeding	Mixture is applied on injure one time during bleeding
					LX	All cattle	Latex from fresh twig mixed with mustard oil and applied on tooth to cure toothache	About 15-20 drops of latex mixed with 5-10 gm mustard oil is applied thrice a day for 2-3 days
Alternanthera sessilis (L.) R.Br. exDC	Amaranthaceae	Salinchi	Herb	Least concern	WP	Hen, Duck	Whole plant cut into very small species and used to feed hen and duck to improve laying egg	About 10-15 gm applied as fodder every night for 5-7 days
Tinospora cordifolia (Will.) Miers.	Menispermaceae	Kham alu	Herb	Secure	L	Cow, Buffalo	Fresh leaves used as fodder to increase milk productivity	About 200-250gm leaves applied 2 times a day for 15-20 days
Heliotropium indicum L.	Boraginaceae	Hatisur	Herb	Least concern	L	Cow, Buffalo	Leaves are thrashed to make juice to recovery wound infection	About 10-15 drops of juice applied on wound 3 times for 5 days
					L	Calf, Goat, Sheep	Fresh crushed leaves mixed with mustard oil properly to make paste and applied on skin to cure skin rash or minor wounds	About 30-35 gm paste applied wound or rash twice a day for 3-5 day

Curcuma longa L.	Zingiberaceae	Halud	Herb	Data deficient	RH	Calf, Goat, Sheep	Fresh crushed underground rhizome mixed with mustard oil. Then the mixture is swallowed to the cattle to prevent warm infection in intestine	About 75-100 gm mixture applied one day morning before meal
					RH	Calf, Goat, Sheep	Fresh crushed underground rhizome mixed with lime. Then the mixture is applied on leg joint to prevent joint pain	About 25-35 gm rhizome and 15-25 gm lime mixed properly and applied thrice a day for 3-5 days
					RH	Cow, Buffalo	Fresh crushed underground rhizome mixed with lime and coconut oil. Then the mixture is applied on broken horn	About 25-35 gm rhizome, 10-15 gm lime and 20-30 drops of coconut oil mixed properly and applied on broken horn as require
Artocarpus heterophyllus Lamk.	Moraceae	Kathal	Tree	Secure	L	Sheep, Goat	Fresh crushed leaves mixed with mustard oil properly to make paste and applied with fodder to stop loose watery stool	About 35-50 gm mixture applied as fodder 2 times for 3 days
Nymphaea rubra Roxb. ex Salisb.	Nymphaeaceae	Shaluk	Herb	Least concern	RH	All cattle	Boiled rhizomatous stem applied with other fodder to cure urinary tract infection	About 35-50 gm applied as fodder 3 times for 3-4 days

Helianthus annus L.	Asteraceae	Suryamukhi	Shrub	Least concern	S	Calf, Goat, Sheep	Seeds are crushed to make powder and applied orally for curing general weakness	About 25-50 gm is applied at every morning for 15-20days
					S	Calf, Goat, Sheep	Seeds are crushed to make powder and mixed with boiled water and applied orally for curing cold and respiratory disorder	About 20-25 gm powdered seed with ½ litter boiled water applied thrice a day for 3-5 days
Alternanthera brasiliana (L.) Kuntze.	Amaranthaceae	Bissallakarabi	Herb	Secure	L	All cattle	Crushed fresh leaves are used to stop bleeding on injury	About 10-15 gm is applied during injury
Justicia adhatoda L.	Acanthaceae	Vashak	Shrub	Least concern	L	Cow, Buffalo	Juice of boiled leaves are used to swallow respiratory disorder	About 15-25 ml of juice applied twice a day for 5-7 days
*Mimosa pudica*L.	Fabaceae	Lajjabati	Herb	Least concern	R	Cow, Buffalo	Root paste with coconut oil is applied on easily non curing wound	About 10-15 gm of paste is applied twice a day for 3-5 days
Aloe vera (L.) Burm.f.	Asphodelaceae	Ghritokumari	Herb	Secure	L	All cattle	Pulp abstracts from Leaves applied on burn wound as ointment	Ointment applied as quantity as wound
Abutilon hirtum (Lamk.)	Malvaceae	Teppu	Shrub	Secure	R	Calf, Goat, Sheep	Juice obtains from crushed roots applied on eye to recovery white spot	About 10-15 drops of juice applied twice a day for 3-5 days
					L	Calf, Goat, Sheep	Juice obtains from crushed leaves applied on minor wounds	About 10-15 drops of juice applied twice a day for 3-5 days

Coccinia grandis (L.) Voigt	Cucurbitaceae	Telakuchu	Herb	Secure	L	All cattle	Juice obtains from crushed leaves applied on eye to recovery white spot	About 10-15 drops of juice applied twice a day for 3-5 days
Crotalaria pallida Aiton.	Fabaceae	Atoshi	Shrub	Secure	R	All cattle	Juice obtains from Fresh roots used to swallow, when cattle take any poisonous material with fodder	About 20-30 ml of juice applied twice a day for 2-3 days
Scoparia dulcis L.	Plantaginaceae	Madhumalati	Herb	Secure	WP	All cattle	Paste of whole fresh plant is used with fodder to recovery urine with blood problem	About 25-35 gm of paste applied twice a day before heavy meal for 3-5 days
Zingiber officinale Rosc.	Zingiberaceae	Ada	Herb	Least concern	RH	Cow, Buffalo	Crushed fresh rhizomatous stem is used on muscle for recovery sprains, cramps, arthritis, pain etc.	About 75-100 gm paste applied thrice a day for 3-5 days
Musa paradisica L.	Musaceae	Banana	Herb	Secure	LB	All cattle	Juice obtains from fresh leaf and sheathing leaf base is used to swallow for cure of dysentery with blood	About 75-100 ml of juice applied twice a day for 3-5 days
					LB	All cattle	Juice obtains from fresh leaf and sheathing leaf base is used to swallow for cure of loose watery stool	About 75-100 ml of juice applied twice a day for 3-5 days

Hibiscus rosa-sinensis L.	Malvaceae	Jaba	Shrub	Secure	R	Cow, Buffalo	Fumigation with dried roots is applied to udder for curing blood with lactation	About 150-250 gm dried roots applied thrice a day for 5-7 days
Leucas aspera (Wild.) Link.	Lamiaceae	Set dron	Herb	Secure	R	All cattle	Crushed fresh roots mixed with mastered oil properly and used on nose for curing respiratory disorder	About 25-30 gm of mixture applied twice a day for 7-10 days
Croton bonplandianus Baill.	Euphorbiaceae	Ban tulshi	Herb	Secure	L	Cow, Buffalo	Crushed fresh leaves are applied with fodder to overcome reproductive disorder	About 75-100 gm roots applied in the morning for 7-10 days to
Neolamarckia cadamba (Roxb.) Bosser	Rubiaceae	Kadam	Tree	Secure	L	Calf, Sheep	Juice extracted from crushed leaves used on white eye inflammation	About 10-15 drops juice applied thrice a day for 3-5 days
Centella asiatica (L.) Urb.	Apiaceae	Than kuni	Herb	Least concern	L	Cow, buffalo	Crushed fresh leaves make paste and used as ointment for hypertrophic wound	Ointment applied as quantity of wound
					L	Calf, Goat, Sheep	Fresh crushed leaves applied to control loose, watery stools that occur more frequently than usual	About 50-60 gm of crushed leaves applied as fodder 2 times a day for 2-3 days
Allium sativum L.	Amaryllidaceae	Rasun	Herb	Secure	B	Cow, buffalo, sheep, goat	Crushed bulbs mixed with warm coconut oil, mixed properly and applied on easily non curing wound	Ointment applied 2-3 times a day until cure

Cuscuta reflexa Roxb.	Convolvulaceae	Sarno lota	Herb	Least concern	WP	All cattle	About 500gm of crushed whole plant mixed with fresh water and applied orally for food poisoning of cattle	3-4 times applied a day for 2 days
Ficus benghalensis L.	Moraceae	Bot	Tree	Not evaluate	PR	Cow, buffalo, goat, sheep	10-15 cm long apical red prop roots are applied with other fodder in dysentery treatment	2-3 roots each time is applied 2-3 times a day for 3 days
Annona squamosa L.	Annonaceae	Aata	Tree	Least concern	L	Cow, buffalo, sheep	Crushed leaf juice is applied with mastered oil for treatment of body lice	The mixture is applied thoroughly to the whole body and stay for 1-2 hours and then cleaned with water

F = Fruit, L = Leaf, R = Root, S = Seed, WP = Whole plant, PR= Prop root, B=Bulb, RH = Rhizome, LB = Leaf base, LX = Latex, CD = Cotyledon, AT = Apical twig, S & R = Stem and Root

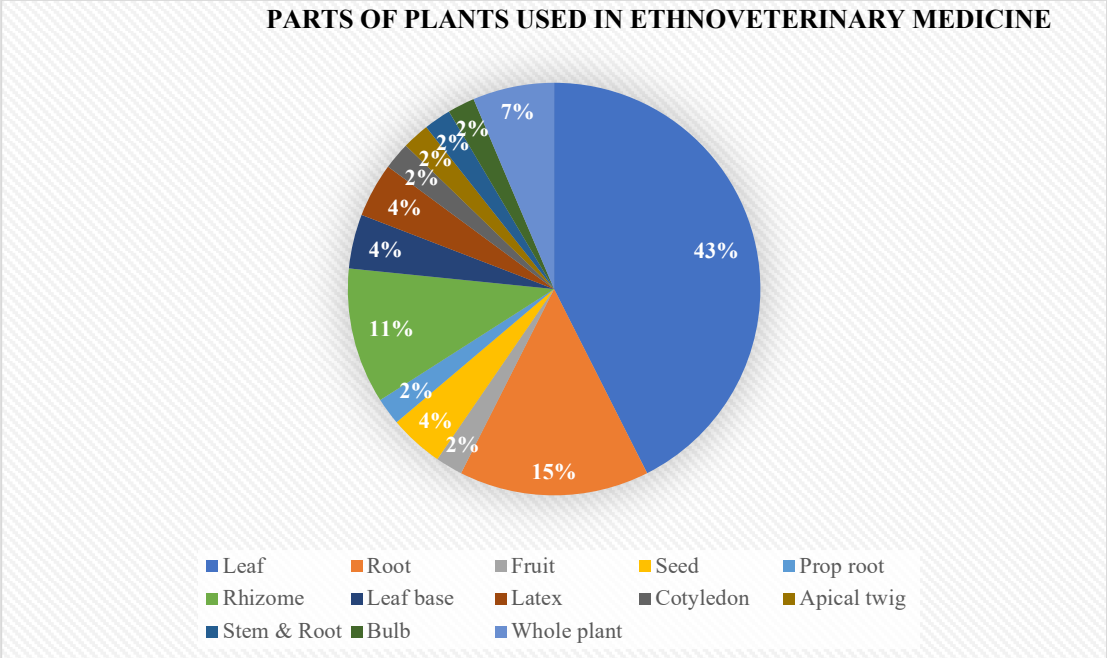

Figure 4. Plant parts used to cure different animal ailments. This pie chart represents percentage wise usefulness of plant parts as ethnoveterinary medicine.

Enumeration of use frequency of ethno-medicinal plants against livestock disease

The current study provides information on twenty major therapeutic uses (Fig. 5) which includes diarrhoea (cow, buffalo, goat, sheep), wound (cow, buffalo, sheep, goat), pinkeye (calf, sheep, cow), respiratory problem (cow, buffalo), urinary tract infection (cow, buffalo), poisonous material intake (cow, buffalo, sheep, goat), dysentery (cow, buffalo, goat, sheep), warm in intestine (cow, buffalo, goat, sheep), teeth ache (cow, buffalo), bleeding (cow, buffalo, goat, sheep), weakness (sheep, goat), joint pain (cow, buffalo), sore on neck (cow, buffalo), bone fracture (cow, buffalo, sheep, goat), fever (cow, buffalo, sheep, goat), constipation (sheep, goat, calf), body lice (calf, sheep, cow), reproductive disorder (cow, buffalo, sheep, goat) and also increase milk production in animals (cow, buffalo) & increase laying capacity of birds. The current survey list includes every ethnoveterinary plant species, along with their scientific name, author citation, family, local name, parts used, as well as a brief description of the mode of preparation and dosages.

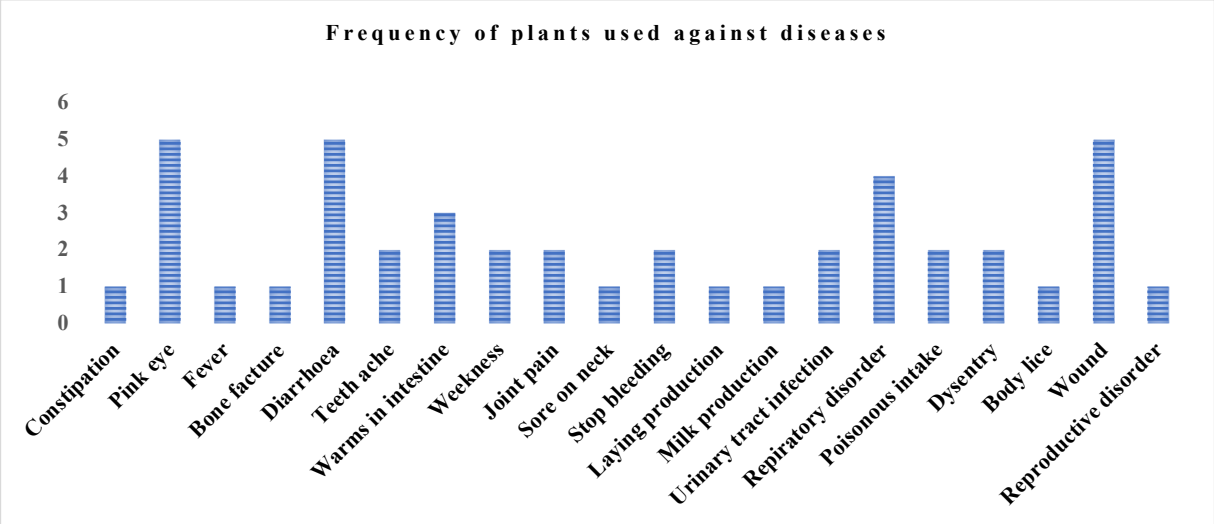

Figure 5. Frequency of plants species used against twenty livestock diseases as studied. The bar length represents the number of plants used for treatment.

The present survey recorded a total 38 plant species are used as different ethnoveterinary medicine purpose. Out of 38 plant species (Fig. 6) 24 belongs to herb (about 63%), 7 belongs to tree category (about 18.5%), and rest 7 belongs to shrub categories (about 18.5%). It is observed that herb plant species are used more frequently than the tree and herb as it presents much amount at the agricultural field.

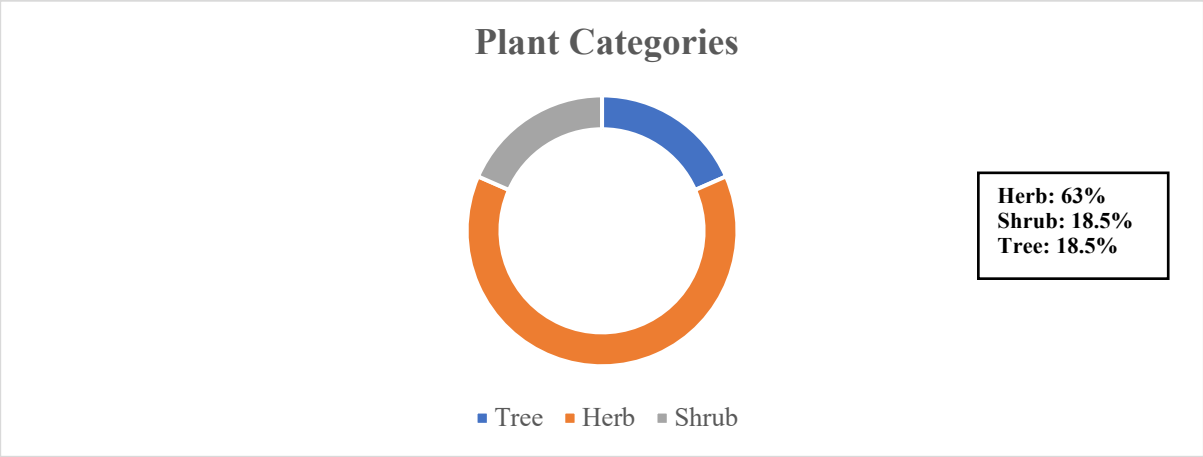

Figure 6. Types as Tree (blue in colour), Herb (saffron in colour) & Shrub (grey in colour) of plants among collected ethnomedicinal plants.

Quantitative analysis of collected data

The relative frequency of citation, number of use and use value were calculated precisely (Table 3) to determine the mostly used plant species. The RFC ranges from 0.17 to 0.57. The plant *Moringa oleifera* (0.57) has the highest RFC value followed by *Centella asiatica* (0.44), *Artocarpus heterophyllus* (0.43), *Neptunia oleracea* (0.40) etc. The lowest RFC is recorded for *Lantana camara* (0.17). The number of use (NU) ranges from 3 to 1. The species *Curcuma longa* has the highest NU (3), followed by *Boerhavia diffusa, Mangifera indica, Tinospora cordifolia, Helianthus annus, Abutilon hirtum*which bear NU value 2 and the rest of the species has NU value 1. The UV ranges from 0.21 to 0.85. *Moringa oleifera* has the highest UV (0.85) followed by *Neptunia oleracea* (0.83), *Artocarpus heterophyllus* b (0.73) *Centella asiatica* (0.66). The lowest UV value is recorded for *Aloe vera* (0.21).

Table 3. Quantitative analysis of the ethnoveterinary medicinal plants

Species name	Frequency of Citation (FC)	Relative Frequency of Citation (RFC)	Number of Uses (NU)	Use value (UV)
Cassia fistula	45	0.33	1	0.52
Eclipta prostrata	42	0.31	1	0.67
Calotropis procera	37	0.27	1	0.42
Achyranthes aspera	52	0.38	1	0.35
Moringa oleifera	77	0.57	1	0.85
Euphorbia resinifera	35	0.26	1	0.34
Neptunia oleracea	55	0.40	1	0.83
Lantana camara	23	0.17	1	0.35
Asparagus recemosus	38	0.28	1	0.45
Boerhavia diffusa	36	0.27	2	0.41
Evolvulus alsinoides	39	0.29	1	0.32
Mangifera indica	31	0.23	2	0.33
Alternanthera sessilis	37	0.27	1	0.33
Tinospora cordifolia	30	0.22	2	0.23
Heliotropium indicum	47	0.38	1	0.73
Curcuma longa	49	0.36	3	0.44
Artocarpus heterophyllus	59	0.44	1	0.73

Nymphaea rubra	38	0.28	1	0.32
Helianthus annus	35	0.26	2	0.24
Alternanthera brasiliana	38	0.28	1	0.27
Justicia adhatoda	41	0.30	1	0.27
Mimosa pudica	37	0.27	1	0.42
Aloe vera	35	0.26	1	0.21
Abutilon hirtum	40	0.30	2	0.22
Coccinia grandis	38	0.28	1	0.41
Crotalaria pallida	41	0.30	1	0.23
Scoparia dulcuis	32	0.24	1	0.25
Zingiber officinale	45	0.33	1	0.26
Musa paradisica	45	0.33	2	0.32
Hibiscus rosa-sinensis	44	0.32	1	0.22
Leucas aspera	43	0.32	1	0.31
Croton bonplandianus	40	0.30	1	0.22
Neolamarckia cadamba	39	0.29	1	0.54
Centella asiatica	60	0.44	2	0.66
Allium sativum	30	0.22	1	0.23
Cuscuta reflexa	34	0.25	1	0.25
Ficus benghalensis	32	0.24	1	0.24
Annona squamosa	35	0.26	1	0.35

Discussion

The primary goal of ethnoveterinary survey is collection and compilation of medicinal plants with their applications from unexplored regions. The exploration and documentation of ethnoveterinary plants from diverse regions holds great importance in the realm of research, as it paves the way for the discovery of innovative biological compounds that can be utilized as novel drugs. Ethnoveterinary medicine is preferred by rural residents over allopathic care because it is less expensive, has less adverse effects, and is readily available in the natural world. India has great variety of flora and people of different regions have century's old traditional knowledge of using plants in medicine that has been transferred through verbal communication and personal experience. In most cases, farmers rely on traditional healers for cure of livestock diseases.

The taxonomic analysis indicated that the plants belong to Fabaceae are used most frequently (Fig. 3) against various animal ailments followed by the family Amaranthaceae, Euphorbiaceae, Moraceae, Zingiberaceae, Malvaceae, Convolvulaceae and Asteraceae etc. The family Fabaceae has been identified very rich family in medicinal flora due to present of different biologically active phytochemicals of different biological groups (Leonti *et al*. 2003; Molares and Ladio 2009). Along with Fabaceae, it has also been found that plants from other families like Amaranthaceae (Rehman *et al.* 2022) and Euphorbiaceae (Eshetu *et al.* 2015) used in many tribal areas to cure livestock diseases.

Among the recorded plant taxa, most of the plants are of herbaceous habit and rests are trees and shrubs (Fig. 5). Herbaceous plants can be grown easily in small places and they can easily be utilized for medicinal purpose (Albuquerque *et al*. 2005). In case of trees or shrubs a single plant can be utilized for much medicine production. So, the management of those plants in proper way will be important for the availability of them. The present study demonstrated that leaves are used in higher percentage followed by roots and rhizomes (Fig. 3). Mukherjee and Moktan (2021) reported similar kind of finding in qualitative ethno-botanical study on traditional use of medicinal plants in Malda district of West Bengal, India. McGaw *et al.* (2020) also demonstrated in his review article that leaves are the prime choice as ethnoveterinary medicine (EMV).

The different plant species are reported for use through different mode of administration (Table 2). Some are of used as feed for treatment of diarrhoea, constipation, warms in intestine, weakness, dysentery, reproductive disorder, poisonous intake, urinary tract infection, respiratory disorder, fever and also for increase milk production and egg-laying production. Some are used as ointment or poultice for treatment of wound infection, pink eye, bone fracture, joint pain, body lice,

sore, stop bleeding and also teeth polish. Mondal and Rahaman (2022) reported about ethnoveterinary medicinal knowledge among the local people of Eastern India for treatment of these types of cattle diseases.

Accurate estimation of the plant use frequency is made by the quantitative ethnobotanical indices such as Frequency of citation (FC), Relative frequency of citation (RFC), Number of uses (NU), Use value (UV). The results have identified several important medicinal plants from both wild habit and cultivated land. The plant *Moringa oleifera* has highest FC (77) and RFC value (0.57) followed by *Centella asiatica* (0.44), *Artocarpus heterophyllus* (0.43), *Neptunia oleracea* (0.40) etc., listed in Table no. 3. The leaf of *Moringa oleifera* has been reported for antimicrobial activity against different bacterial strains (Jahan S *et al*. 2022). The plant *Centella asiatica, Artocarpus heterophyllus* and *Neptunia oleracea* also have antimicrobial activity (Mudaliana 2021; Kham *et al*. 2003; Zainuddin *et al.* 2020). *Lantana camara* displays the lowest FC value of 23 and an RFC value of 0.17. *Moringa oleifera* exhibits the highest UV value at 0.85, followed by *Neptunia oleracea* at 0.83, *Centella asiatica* at 0.66, *Neolamarckia cadamba* at 0.54, among others. Although the local people of this region don't have proper scientific knowledge about the bioactive compounds, they are using these plants to treat diseases. The report of use of *Moringa oleifera* thus is supporting that there must have important bioactive compounds. Further critical studies are needed to discover those materials. There are examples of using the plants in ethnoveterinary practices and some of these plants were also studied chemically and pharmacologically for their presence of bioactive compounds (Bhalla *et al.,* 2021). But which compound will be responsible for which disease and the mode of action in each case is not explored. Further modern sophisticated research is required to fill the gap. Raheela *et al.* (2021) studied the efficacy of bioactive compound of *Moringa oleifera* against fungal and bacterial pathogens such as *Trichophyton mentagrophytes, Microsporumcanis, Staphylococcus aureus, Vibrio cholerae, Klebsiella pneumoniae, Vibrio parahaemolyticus, Enterococcus faecalis, Salmonella enteritidis* etc.

This recent survey work also intended to insight on overarching research questions and development of recent modifications on livestock farming using local veterinary knowledge to become more economic. Sustainability of small rural veterinary market depends on spreading of awareness on uses of EVM among local residents. Local veterinary doctors or healers have the historic knowledge of medicinal plants as well as their applications, can meet the viable and sustainable needs of livestock farmers (Henry *et al.* 2024). Measurement should be taken to communicate with local people with traditional knowledge by arranging social awareness programme in academic institutes or social organizations to transport the therapeutic applications of medicinal plants in next generation (Bonnaud and Fortané 2021). The exploration on traditional knowledge thus can lead to modern scientific approaches in veterinary sciences and ethnopharmacological study is an urgent step towards the production, development and management of nature-based drugs.

In this survey it is known that the inhabitants of Purba Bardhaman district use ethnoveterinary medicinal plants to treat livestock. Here in this study 38 plants having ethnoveterinary importance are cited (Table 2). Majority of these are used to cure single disease. The plant *Curcuma longa* is cited for three different animal ailments namely intestine warm infection, joint pain, broken horn. *Curcuma longa* have been reported for neuroprotective activity (Kadri *et al*. 2018), anti-arthritis activity (Nonose *et al*. 2014), antimicrobial activity (Sasidharan *et al*. 2014) and anti-diarrheal activity (Ouyang *et al*. 2019). *Curcuma longa* has highest NU value (3) followed by *Boerhaavia diffusa, Mangifera indica, Tinospora cordifolia, Helianthus annus, Abutilon hirtum, Musa paradisica* and *Centella asiatica* each of which has NU value 2. Rest of the species has NU value 1. These are very commonly found plants of West Bengal and easily available. Further studies can be performed in searching the chemistry of the drugs present within these plants. The century long traditional knowledge is experienced with the accuracy of the use of the plants against diseases and the modern sophisticated scientific studies can be successful in isolation of drugs from these plants.

Conservation status of above listed plants (Table 2) is mostly least concern and secure category according to IUCN current status. The plants are easily available in this area due to their wild habitat; farming and people can use these plants for ethnoveterinary purpose. But over exploitation or unwise uses can disturb their natural habitat. The utilization of ethnoveterinary medicinal plants based on indigenous knowledge plays a crucial role in ensuring the sustainable use of local plant diversity (Dhar *et al*. 2000). The results provide insightful scientific information against over grazing, and excessive and unwise utilization for the particular region.

Conclusion

The present study is an inventory of therapeutic practices used by indigenous people of Purba Bardhaman district for different livestock ailments. It is estimated that the local people of this area possess a wealthy ethnoveterinary knowledge inherited verbally and the knowledge is still survived among the rural poor people. So, the formulation and the plant species with high FC, RFC, NU and UV value will provide useful alternatives to the conventional drugs. However, it is alarming that the younger generation appears to have less access to this important knowledge, which is turning into a global problem. The changing socio-economic condition in rural areas has led to a decline in ethnic consciousness. The knowledge on ethnoveterinary medicine is at risk of being lost or distorted due to a lack of proper documentation. Therefore, this survey plays a crucial role in collecting data on the medicinal properties of 38 plant species for animal healthcare. This documentation aims to preserve this valuable knowledge before it becomes extinct within rural communities and also encourages further research in ethnoveterinary medicine, particularly in other regions of West Bengal. This is the first report to record and analysed of this area. The investigation also draws attention to the general concern about conservation and sustainable utilization of frequently used ethnoveterinary medicinal plants.

Declarations

List of abbreviations: F = Fruit, L = Leaf, R = Root, S = Seed, WP = Whole plant, PR= Prop root, B=Bulb, RH = Rhizome, LB = Leaf base, LX = Latex, CD = Cotyledon, AT = Apical twig, S & R = Stem and Root, FC= Frequency of Citation (FC), RFC= Relative frequency of citation, NU= Number of Uses, UV= Use value.

Ethical approval and consent to participate: This study was authorized by the PG Department of Botany, Ramananda College, Bankura University, West Bengal, India. Consent was obtained from all participants before conducting interviews. The participant shown in figure 2 agreed to have their image published.

Data and material availability: The data is only stored by authors.

Disclosure statement: The authors declare that there is no competing interest.

Authors Contribution: Each author has made substantial effort to complete this research work. Asish Mandal involved in concept building. Sketch out this work was constructed by Asish Mandal, Suvendu Pal, Pritish Mitra and Somen Dey. Plant collection and their identification; data collection was accomplished by Suvendu Pal. Quantitative data analysis was carried out by Suvendu Pal. Manuscript preparation was done by Suvendu Pal, Pritish Mitra, Somen Dey and Asish Mandal. Revision of the MS was performed by Dr. Arindam Ganguly.

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