

Ethnoveterinary practice of medicinal plants in Chhatradev Rural Municipality, Arghakhanchi District of Western Nepal

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Abstract. Dhakal A, Khanal S, Pandey M. 2021. Ethnoveterinary practice of medicinal plants in Chhatradev Rural Municipality, Arghakhanchi District of Western Nepal. *Nusantara Bioscience* 13: 29-40. The use of medicinal plants is a traditional system in treating domestic animals in Nepal. This study was done to investigate and document knowledge about using different plants with medicinal value to cure different animal ailments in Chhatradev Rural Municipality, Arghakhanchi district of western Nepal. A total of 100 elderly people rearing domestic animals and having traditional knowledge of ethnoveterinary plants were selected for interview. A semi-structured questionnaire was employed, and interviews were conducted for addressing detailed ethnoveterinary information. The uses of 103 plant species belonging to 56 families were documented for the treatment of 21 animal ailments. Fabaceae was found to be a dominant family with 10 plant species followed by Poaceae (8 species). The most commonly used plant parts were leaf, seed, and fruit. Herbs were dominant with 44 plant species followed by trees (32 species), shrubs (14 species), and climbers (13 species). The wide application of the medicinal plants as the form of paste formulation was observed for 41 plant species, while 25 plant species were used as powder formulation followed by Juice (21 species), raw (20 species), decoction (19 species), infusion (5 species), and roasted formulation (3 species). Oral route was the most common route followed by dermal and ocular. It was found that the informant consensus factor (ICF) values varied from 0.858 to 0.96. A high informant consensus factor was found for ailment of reproductive category (0.96) followed by respiratory (0.957), gastrointestinal (0.949) while the least was in urinary problem category (0.858). The highest citation frequency was found for *Trachyspermum ammi* (L.) Sprague (247) followed by *Myristica fragrans* Houtt. (111), *Sesamum indicum* L. (109), *Saccharum officinarum* L. (107) and *Zea mays* L. (97). The wide use and rich knowledge of ethnoveterinary practice were found in the study area. This study might be handy to discover useful ethnopharmaceutical agents applicable in the livestock industry. Conservation programs should be done from the government level and study on the use of medicinal plants for treating animal diseases is recommended.

Keywords: Animal care, indigenous knowledge, livestock, Nepal, traditional veterinary healers

INTRODUCTION

Medicinal plants have been used by humans for human as well as animal ailments, and disease treatment from the earliest history of human beings (Bartha et al. 2015; Petrovska 2012). Ethnoveterinary medicine is the traditional approach relating to the treatment and maintenance of animal health care. It is following folklore beliefs, skills, and practices of people by using locally available plant species (Hassan et al. 2017; Katerere and Luseba 2010; Ryan 2014). These medicinal plants discovered by traditional societies are an important source of new potential therapeutic drugs (Pan et al. 2014).

The current studies have the equal concern of improving human medication as well as animal health by the use of locally available medicinal plants. In contrast to modern veterinary medicine, ethnoveterinary practices have been established through trial and error methods with deliberate experimentation by farmers in the fields (Baskota and Doj Raj 2013). The increase in the cost of caring for and maintaining animal health in modern health facilities has made researchers increase their enthusiasm towards the study of ethnoveterinary medicinal plants

(Phondani et al. 2010). Nepal is predominantly an agricultural county with about 90% of people in rural areas own livestock as a part of their livelihood (MOAD 2017). For a developing country like Nepal with a huge number of poor farmers, ethnoveterinary practice for animal treatment is a sustainable way of veterinary medicine practice in the new era (NAVS 2015). The indigenous use of ethnoveterinary medicinal plants is of great boon to the developing countries because of its quick accessibility and affordability where there is no easy access to the modern veterinary care facilities (Aziz et al. 2018). Although ethnoveterinary medicinal plants carry great potential in the treatment of the animals, proper documentation of the plants has not been done in the majority of the rural areas of Nepal. The knowledge has been transferred from one to the next generation only verbally or orally (Raut and Shrestha 2012) which is not a dependable way to preserve the knowledge of ethnoveterinary practices. The ease of access to modern health facilities, increase in development of socio-economic aspects, failure to transfer indigenous knowledge regarding medicinal plants, change in technology, and unplanned urbanization have led the use of

ethnoveterinary medicinal plants in a great threat (Subedi 2017; Weckmüller et al. 2019).

As ancient practice of herbal treatment of livestock diseases are still significant today, and are still used by many farmers, veterinarian, Ayurvedic physicians, and *Vaidyas*, so that this study was conducted to investigate, and document local knowledge about the use of different plants with medicinal value in Chhatradev Rural Municipality of Arghakhanchi district in Nepal. The objectives to carry this study were (i) to document the plants with medicinal values used in the treatment of various ailment category of the animals, (ii) to disseminate the formulation technique and the plant part used, (iii) to determine the informant consensus factor and (iv) to record the plant species with the highest citation frequency. This study will be a useful resource for the conservationist, veterinarians, phytochemists, and Ayurvedic physicians to conduct pharmacological studies in the coming days, and will be a valuable asset for the farmers for the treatment of animals health.

MATERIALS AND METHODS

Study area

Chhatradev Rural Municipality is a rural municipality of Arghakhanchi district located in Lumbini province of Nepal. It has an area of 87.62 square kilometres. The climate is tropical to subtropical type with cool and humid. The majority of people are Brahman, Chhetri, Magar, and

other ethnic groups like Kumal, Gurung, Kami, Damai, Sarki, Thakuri, Sanyasi, Newar, Badi, and others (CBS 2012). The rural people are not only dependent on forests and natural vegetation to fulfill their daily needs of fuelwood, fodder, grasses, leaf litter, etc., but also for the treatment of ailments and diseases using medicinal plants. The map of the study area is shown in Figure 1. People here are acquainted more with the traditional ethnobotanical knowledge, and are well practitioner of folk beliefs.

Data collection

The data were collected from July to September 2020. A total of 100 elderly, knowledgeable, and experienced persons rearing domestic animals who had traditional knowledge of ethnoveterinary plants were selected. A questionnaire was prepared, and interviews were taken from them addressing detailed ethnoveterinary information. The interview process followed international codes of ethics (ISE 2006).

Plant specimen collection and identification

Some of the collected specimens were identified in the field, whereas others were identified with the help of standard botanical literature. Nomenclature of the identified species follows standard kinds of literature (Aryal et al. 2016; DPR 2015; IUCN Nepal 2000; POWO 2017).

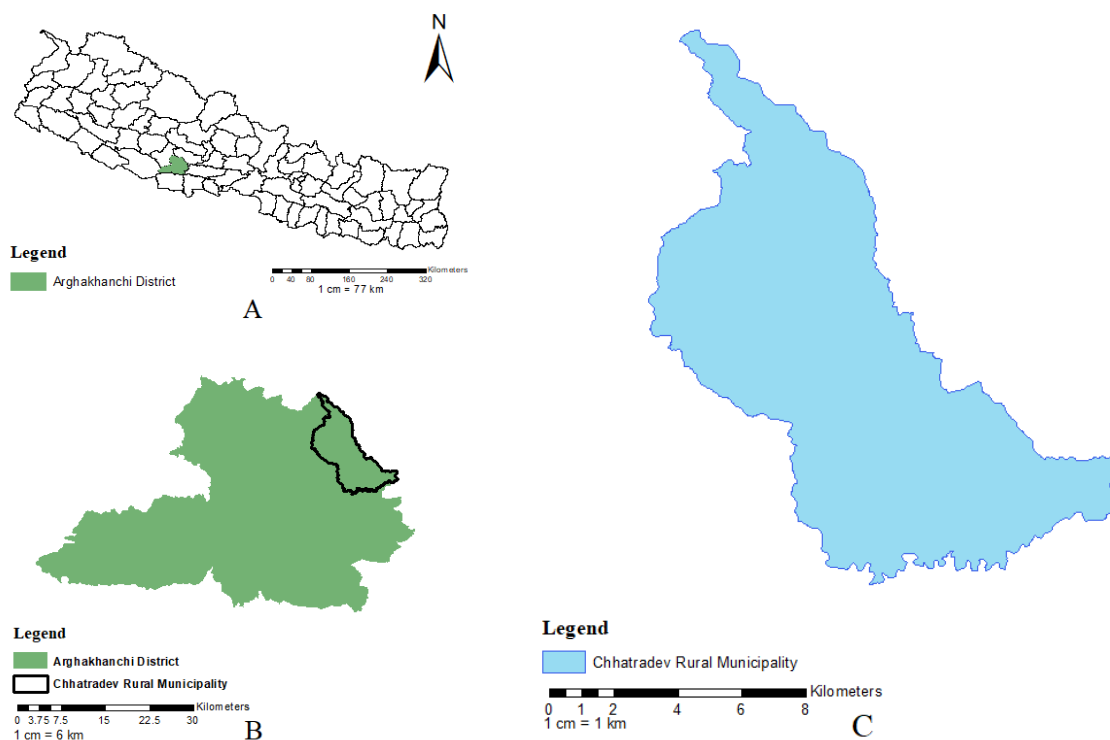


Figure 1. A. Map of Nepal showing Arghakhanchi districts with green color and other hollow ones are other districts. B. Map of Arghakhanchi district showing Chhatradev Rural Municipality. C. Map of Chhatradev Rural Municipality

Data organization

After completion of fieldwork, data entry was done in Microsoft Excel 2016. The life form of the medicinal plants was classified into herbs, shrubs, trees, and climbers. The plant part utilized was classified into bark, bulb, flower, fruit, latex, leaf, rhizome, root, seed, stem, tuber, and whole plant. The preparation technique was classified into different groups, i.e., powder, paste, juice, infusion, raw, decoction, and roast. Route of administration was categorized into oral, dermal, and ocular. The uses of medicinal plants were categorized into ten major categories: reproductive, respiratory, gastrointestinal, antipyretic, parasitic, general weakness, eye, dermatological, osteological, and urinary problems.

Data analysis

For analysis of socio-demographic profile, Microsoft Excel 2016 was used.

Informant consensus factor (ICF)

To determine the agreement among informants in terms of the use of plants, the Informant Consensus Factor (ICF) was calculated (Heinrich et al. 1998). It was followed in the number of Ethnoveterinary studies of Medicinal Plants (Adeniran et al. 2020; Tariq et al. 2014).

$$ICF = \frac{Nur - Nt}{Nur - 1}$$

Where; ICF = Informants consensus factor, Nur = number of use reports from informants for a particular plant-use category; Nt = number of taxa or species that are used for that plant use category for all informants.

The result of this index ranges from 0 to 1. ICF values are low if plants are chosen randomly or if there is no exchange of information about their use among informants, and approach one (1) when there is a well-defined selection criterion in the community and/or if information is exchanged between informants.

Citation frequency (Cf%)

Cf of medicinal plants is useful to determine the most commonly used medicinal plants in the study area.

$$Cf \% = \frac{n}{N} \times 100$$

Where; n refers to the number of times a particular species was mentioned, N refers to the total number of times that all species were mentioned.

RESULTS AND DISCUSSION

Socio-demographic profile of the informants and their domestic animal composition

Out of 100 informants, more than half of the respondents were male (58) while there were 42 female respondents. Most of the interviewees (72) were older than 50 years and 28 interviewees were between 35-50 years old. Agriculture was the main source of household income to 70 respondents while 19 people had government

services, and 11 had remittance as the way to make a living. Among the informants, there were not any illiterate while the majority (70) of the informants had gained primary education, 19 informants had gained secondary education, and the rest (11 informants) had got other higher forms of education (Table 1). Livestock (Buffalo, Goat, Cow, Poultry) were important economic sources of informants. The majority of the respondents (98) kept buffalo, 81 respondents kept goats, 28 respondents kept poultry and 4 respondents kept cow with their total number 191, 237, 191, and 7 respectively (Figure 2).

Source of ethnoveterinary knowledge

The majority of the respondents received the knowledge of ethnoveterinary use of plants from their ancestors whereas some came from neighbors, newspapers, and radio. Elderly people, mainly male, were rich in ethnoveterinary knowledge, and more concerned about the conservation of plants than younger people. This observation has also been reported by Khan et al. (2015).

Table 1. Socio-demographic characteristics of respondents

Description	Frequency
Age	
35- 50	28
>50	72
Gender	
Female	42
Male	58
Educational level	
Primary	70
Secondary	19
Others	11
Primary occupation	
Agriculture	70
Government services	19
Remittance	11

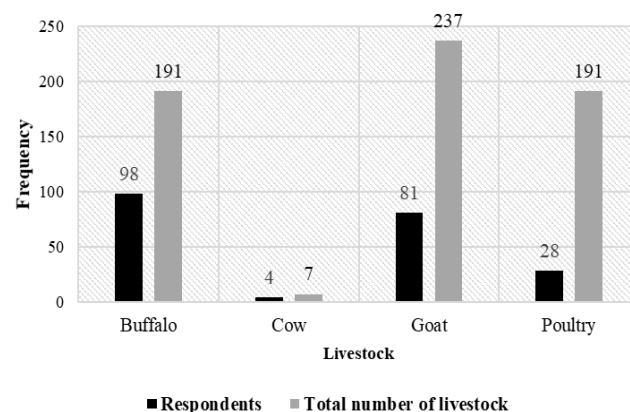


Figure 2. Respondents with the number of their livestock in the study area

Table 2. List of the ethnoveterinary medicinal plants identified in the study area

Botanical name	Family	Local name	Life form	Part used	Form of medication	Route	Method of use and application
<i>Justicia adhatoda</i> L.	Acanthaceae	Asuro	Shrub	Whole plant	Decoction	Oral	Decoction prepared from the whole plant is given twice a day orally until cure of common cold
				Leaf	Paste	Dermal	Leaves are ground to make a paste and mixed with turmeric powder to cure ectoparasite
<i>Achyranthes aspera</i> L.	Amaranthaceae	Datyun	Herb	Whole plant	Raw	Oral	Fed as a feed to cure endoparasite
<i>Chenopodium album</i> L.	Amaranthaceae	Bethe	Herb	Whole plant	Juice	Oral	The whole plant is crushed and obtained juice is given orally to treat dysentery
<i>Allium sativum</i> L.	Amaryllidaceae	Lasun	Herb	Bulb	Paste	Oral	<i>Allium sativum</i> L. and <i>Mentha arvensis</i> L. are mixed in a ratio of 1: 2. They are crushed and given to animal to cure diarrhea
						Dermal	Bulb is crushed with camphor to make paste and applied to the wound.
<i>Mangifera indica</i> L.	Anacardiaceae	Aap	Tree	Bark	Powder	Dermal	The bark is dried then ground with camphor and applied to the burn area
<i>Rhus javanica</i> L.	Anacardiaceae	Bhakkimlo	Tree	Fruit	Infusion	Oral	Ripe fruits are soaked in water, and water is given twice a day to animal by mixing with curd to treat diarrhea and dysentery
<i>Semecarpus anacardium</i> L.	Anacardiaceae	Bhela	Tree	Fruits	Juice	Dermal	Fruit is ground with mustard oil and applied to wound
<i>Centella asiatica</i> (L.) Urb.	Apiaceae	Ghodtapre	Herb	Whole plant	Raw	Oral	The whole plant is fed to treat urinary disorders.
<i>Trachyspermum ammi</i> (L.) Sprague	Apiaceae	Juwano	Shrub	Seed	Powder, Decoction	Oral	The required amount of dry seed is crushed and fed with water, cornflour meal. It can also be boiled in water and fed twice a day to cure cough, diarrhea, and fever. Whereas dried seeds of <i>Trachyspermum ammi</i> (L.) Sprague, <i>Sesamum indicum</i> L. and <i>Myristica fragrans</i> Houtt. are crushed to make powder, and given to animals by mixing with cornflour to cure constipation and increase milk production.
<i>Calotropis gigantea</i> (L.) Dryand.	Apocynaceae	Aank	Tree	Leaf	Paste	Dermal	Lightly crushed leaves are warmed on fire and kept on swelling joints
<i>Holarrhena pubescens</i> Wall. ex G.Don	Apocynaceae	Indrajau	Tree	Bark	Decoction	Oral	Decoction obtained from bark is given to the livestock to treat constipation, diarrhea, and dysentery
<i>Marsdenia tenacissima</i> (Roxb.) Moon	Apocynaceae	Bilajor	Climber	Root	Paste	Dermal	Root paste is applied on swelling bone area
<i>Acorus calamus</i> L.	Araceae	Bojho	Herb	Rhizome	Paste	Dermal	Paste prepared from the rhizomes is applied to the body of animals to remove lice
<i>Colocasia esculenta</i> (L.) Schott	Araceae	Karkalo	Herb	Leaf, Stem	Decoction	Oral	Small pieces are made by cutting them and given to animal by cooking with cornflour to cure endoparasite and diarrhea
<i>Agave cantula</i> Roxb.	Asparagaceae	Ketuki	Herb	Leaf	Decoction	Oral	Juice extracted from boiled leaf is given orally to cure fever
					Juice	Oral	Leaves are ground to obtain juice and fed for any urinary related problem
<i>Aloe vera</i> (L.) Burm.f.	Asphodelaceae	Ghyu kumari	Herb	Leaf	Raw	Dermal	Jelly portion of leaf is rubbed in burn area and cure mastitis
<i>Begonia picta</i> Smith	Begoniaceae	Magarkanche	Herb	Root	Infusion	Ocular	Water obtained after infusion of the root is applied to treat conjunctivitis of buffalos
<i>Oroxylum indicum</i> (L.) Kurz	Bignoniaceae	Tatahalo	Tree	Bark	Powder	Oral	Bark of <i>Oroxylum indicum</i> (L.) Kurz and <i>Schima wallichii</i> (DC.) Korth. are dried, then ground to obtain powder, and fed to cure diarrhea
				Leaf, seed	Paste	Oral	Fresh leaves and seeds are ground to make a paste, and fed to cure urinary problem
<i>Cynoglossum zeylanicum</i> Thumb. ex. Lehm.	Boraginaceae	Bhere kuro	Herb	Whole plant	Powder	Ocular	Powder obtained from dried plant is blown to eye problem
					Paste	Dermal	Paste of plant mixed with water and applied to cure skin scabies and wound
<i>Brassica nigra</i> L.	Brassicaceae	Tori	Herb	Seed	Juice	Oral	The mustard oil is directly fed to cure endoparasite and uterus prolapse
					Paste	Dermal	Mustard cake is mixed with maize flour, and fed to increase milk production Mustard cake is applied to cure skin scabies

<i>Cannabis sativa</i> L.	Cannabaceae	Ganja	Herb	Leaf, seed	Powder	Oral	The mixture of leaf and seed is ground then drenched with water to cure diarrhea, fever, and urinary related problems	
<i>Crateva unilocularis</i> Buch.-Ham	Capparaceae	Simlikan	Tree	Leaf, stem	Raw	Oral	The grass and edible stem are directly fed to cure endoparasite	
<i>Carica papaya</i> L.	Caricaceae	Mewa	Tree	Seed	Powder	Oral	Matured dry seeds are crushed to make powder, and given orally to cattle once a day for up to six days against internal parasites	
<i>Terminalia bellirica</i> (Gaertn.) Roxb.	Combretaceae	Barro	Tree	Fruit	Powder	Oral	Fresh fruit is given orally to treat diarrhea	
<i>Commelina benghalensis</i> L.	Commelinaceae	Khane jhar	Herb	Leaf	Paste	Dermal	Paste obtained from leaf is made and applied locally on fresh wounds in animals as antiseptic	
<i>Artemisia indica</i> L.	Compositae	Titepati	Herb	Leaf	Juice	Dermal	Leaf and kerosene are crushed to make a juice and applied to cure ectoparasite	
				Whole plant	Decoction	Oral		<i>Artemisia indica</i> L., <i>Azadirachta indica</i> A.Juss. and <i>Melia azedarach</i> L. (Leaf) are taken and cut into pieces, mixed with cornflour, cooked, and fed to cure endoparasite
				Leaf	Paste	Dermal		Leaf and camphor are crushed to make a paste and applied in a wounded area twice a day
<i>Tagetes patula</i> L.	Compositae	Sayapatri	Herb	Root	Paste	Oral	Fresh roots are ground and fed to treat urinary problem	
<i>Cuscuta reflexa</i> Roxb.	Convolvulaceae	Aakash beli	Climber	Stem	Infusion	Oral	Stem along with local tomato, ghee, butter, and curd is placed in a copper vessel over a night. It is given orally to cattle against endoparasites	
<i>Cucumis sativus</i> L.	Cucurbitaceae	Kakro	Climber	Seed	Powder	Oral	Dried seeds are crushed to make powder and fed by drenching with water to cure urinary problems	
<i>Cucurbita maxima</i> Duchesne	Cucurbitaceae	Farsi	Herb	Fruit	Decoction	Oral	Ripen yellow pumpkin is cooked with cornflour and feed to cure mastitis	
<i>Solena heterophylla</i> Lour.	Cucurbitaceae	Golkankri	Climber	Root	Paste	Dermal	The paste prepared from the root is applied to cure mastitis	
				Whole plant	Raw	Oral	The whole plant is considered a nutritious feed, and also used to increase milk production	
<i>Trichosanthes cucumerina</i> L.	Cucurbitaceae	Chichinno	Climber	Seed	Powder	Oral	Dried seeds are crushed to make powder and fed by mixing with turmeric to cure endoparasite	
				Fruit	Raw		Fruit is fed raw to treat mastitis and removing the placenta	
<i>Cyperus difformis</i> L.	Cyperaceae	Mothe Jhar	Herb	Root	Paste	Oral	The root nodules are crushed and fed to cure any urinary related problem	
<i>Dioscorea deltoidea</i> Wall. ex Griseb.	Dioscoreaceae	Bhayakur	Climber	Tuber	Juice	Oral	Juice obtained from tuber is given twice a day is to treat constipation	
<i>Equisetum debile</i> Roxb. ex Vaucher	Equisetaceae	Kurkure Jhar	Herb	Stem	Paste	Dermal	Paste obtained from stem is applied externally on fractured bone	
<i>Albizia procera</i> (Roxb.) Benth.	Fabaceae	Jukret	Shrub	Bark	Powder	Oral	Dried bark is crushed to make powder, and drenched with water to cure bone related problems	
<i>Bauhinia purpurea</i> L.	Fabaceae	Koiralo	Tree	Leaf	Raw	Oral	Oral administrations of leaves as feed to enhance lactation	
				Bark	Decoction	Dermal	Slightly warm stem bark decoction is used to cure wounds	
<i>Cassia fistula</i> L.	Fabaceae	Rajbrikshya	Tree	Fruit, seed	Powder	Oral	Dried seed and fruit are ground to make powder, and fed to cure urinary problem	
<i>Dalbergia sissoo</i> Roxb.	Fabaceae	Sissoo	Tree	Leaf	Juice	Oral	Leaf is crushed to obtain juice, and then mixed with churning curd, and fed to cure diarrhea	
<i>Erythrina stricta</i> Roxb.	Fabaceae	Phaledo	Tree	Bark	Infusion	Dermal	Bark is soaked in water and applied over the body to treat scabies	
<i>Lens culinaris</i> Medikus	Fabaceae	Masuro	Herb	Seed	Decoction	Oral	Seeds are cooked with maize flour and given to animal twice a day to increase milk production	
<i>Mimosa pudica</i> L.	Fabaceae	Lajjawati jhar	Herb	Whole plant	Raw	Oral	Fed whole plant to animal as feed to cure uterus prolapse	
<i>Phanera vahlii</i> (Wight & Arn.) Benth.	Fabaceae	Bharla	Climber	Bark	Powder	Oral	Dried bark is ground to make powder and fed with honey to treat joint-related problem	

<i>Trigonella foenum-graecum</i> L.	Fabaceae	Methi	Herb	Seed	Infusion	Oral	Soaked seeds are mixed with cornflour meal, and given orally to cure chronic cough and fever
					Decoction		<i>Trigonella foenum-graecum</i> L. and <i>Zingiber officinale</i> Roscoe are mixed and fed to cure joint swelling
<i>Mentha arvensis</i> L.	Lamiaceae	Pudina	Herb	Leaf	Paste	Oral	<i>Mentha arvensis</i> L. and <i>Allium sativum</i> L. are mixed in a ratio of 2: 1, and feed after crushing to cure diarrhea
						Dermal	The whole plant is rubbed into the body of the animal to cure ectoparasite
<i>Ocimum tenuiflorum</i> L.	Lamiaceae	Tulsi	Shrub	Leaf	Paste	Dermal	Leaf paste is applied externally to healing wounds
<i>Pogostemon benghalensis</i> (Burm. F.) O. Ktze	Lamiaceae	Rudilo	Herb	Leaf, flower	Powder	Oral	Leaf and flower are dried in sun. Powder is prepared by crushing them and fed to cure diarrhea
					Paste	Dermal	Leaf and flower are crushed to make a paste, and applied to cure a wound
<i>Lindera neesiana</i> (Wall. ex Nees) Kurz.	Lauraceae	Siltimur	Tree	Fruit	Juice	Oral	The fruit juice is given to cure any weakness
<i>Asparagus racemosus</i> Willd	Liliaceae	Kurilo	Shrub	Root	Paste	Oral	Tuberous roots are crushed and mixed with cattle feed for any bone related problem and mastitis
<i>Linum usitatissimum</i> L.	Linaceae	Aalus	Shrub	Seed	Powder	Oral	<i>Linum usitatissimum</i> L. and <i>Sesamum indicum</i> L. are fried and crushed to make powder. It is then fed orally to cure mastitis. Similarly, Powder obtained from dried seed of <i>Linum usitatissimum</i> L., <i>Sesamum indicum</i> L. and <i>Trachyspermum ammi</i> (L.) Sprague are mixed and fed with cornflour twice a day to increase milk production
<i>Viscum album</i> L.	Loranthaceae	Hardjor laharo	Climber	Stem	Paste	Dermal, Oral	The stem is crushed and paste is applied to the swelling area. It can also be fed by mixing with ghee and honey
<i>Abelmoschus esculentus</i> (L.) Moench	Malvaceae	Bhindi	Shrub	Root	Paste	Oral	Root is crushed and fed to cure urinary related problems
<i>Bombax ceiba</i> L.	Malvaceae	Simal	Tree	Flower	Juice	Oral	Flower is crushed and fed to cure constipation
				Bark	Powder		Powder obtained from bark is mixed with powder of pepper and ginger, and then given orally to cure dysentery
				Bark	Juice		Raw bark is crushed to obtain juice and given to remove the placenta
				Seed	Paste	Dermal	The seed is ground with mustard oil, and then applied to treat the wounds
<i>Corchorus capsularis</i> L.	Malvaceae	Jute Plant	Shrub	Stem	Roast	Oral	Stem is burned, and obtained ash is mixed with mustard, then fed to treat diarrhea
<i>Osbeckia stellata</i> Buch. Ham ex D. Don.	Melastomataceae	Aangaru	Shrub	Leaf, Fruit	Decoction	Oral	A decoction of the leaf and fruit twice a day is given to domestic animals for any kind of weakness
<i>Azadirachta indica</i> A.Juss.	Meliaceae	Neem	Tree	Leaf, seed	Paste	Dermal	Paste is made by crushing leaf and applied to cure ectoparasite, and fed to cure wound
					Decoction	Oral	<i>Azadirachta indica</i> A.Juss. , <i>Artemisia indica</i> L and <i>Melia azedarach</i> L. are taken and cut into pieces, then cooked with cornflour to cure endoparasite
<i>Melia azedarach</i> L.	Meliaceae	Bakaino	Tree	Leaf, seed	Juice	Dermal	Seed and leaf are crushed to make juice. It is applied by mixing with turmeric and salt to cure ectoparasite
					Decoction	Oral	<i>Melia azedarach</i> L., <i>Azadirachta indica</i> A.Juss., and <i>Artemisia indica</i> L. are taken and cut into pieces. It is cooked with cornflour then feed to treat endoparasite
					Paste	Dermal	Seed and leaf are crushed to make a paste. It is applied to cure wound by mixing with camphor
<i>Tinospora cordifolia</i> (Thunb.) Miers	Menispermaceae	Ganigurjo	Climber	Stem	Decoction	Oral	Stem is made into small pieces, then boiled with water and fed to cure chronic cough and constipation
					Powder		The powder is obtained from dried stem and given orally with water to treat diarrhea

<i>Artocarpus heterophyllus</i> Lam.	Moraceae	Rukh katar	Tree	Fruit	Raw	Oral, Dermal	Ripen jackfruit is fed directly, and the fruit core is applied in teats to cure mastitis
<i>Ficus religiosa</i> L.	Moraceae	Peepal	Tree	Bark	Powder	Dermal	Dry bark is ground to obtain powder and applied to the burn area
<i>Ficus semicordata</i> Buch.-Ham. ex Sm.	Moraceae	Khanyu	Tree	Leaf	Raw	Oral	Leaves as fodder are given to remove the placenta
<i>Morus australis</i> Poir.	Moraceae	Ban kimbu	Tree	Root	Paste	Oral	Fresh root is crushed to make a paste and fed to animal for treating endoparasite
<i>Musa x paradisiaca</i> L.	Musaceae	Malvoc Kera	Herb	Fruit	Raw	Oral	Ripen banana is given to treat mastitis
<i>Myristica fragrans</i> Houltt.	Myristicaceae	Jaifal	Tree	Seed	Powder	Oral	Powder is obtained from seeds of <i>Myristica fragrans</i> Houltt., <i>Trachyspermum ammi</i> (L.), and <i>Sesamum indicum</i> L., then fed to cure chronic cough, constipation. Solely it is given to increase milk production and urinary problems
<i>Fraxinus floribunda</i> Wall.	Oleaceae	Lankuri	Tree	Bark	Powder Paste	Oral Dermal	Bark is ground to make powder to cure diarrhea A paste of bark is applied to treat broken legs and arms of animal
<i>Oxalis corniculata</i> L.	Oxalidaceae	Chariamilo	Herb	Leaf	Juice	Ocular	Juice obtained by pounding fresh leaves is dropped into the eyes for any eye problems
<i>Sesamum indicum</i> L.	Pedaliaceae	Kalo Til	Herb	Seed	Powder	Oral	Powder is obtained from seeds of <i>Sesamum indicum</i> L., <i>Trachyspermum ammi</i> (L.) Sprague and <i>Myristica fragrans</i> Houltt, and then fed to cure chronic cough and constipation <i>Sesamum indicum</i> L., <i>Trachyspermum ammi</i> (L.) Sprague and <i>Linum usitatissimum</i> L. are fried and crushed to make powder and fed to cure mastitis and increase milk production
<i>Phyllanthus emblica</i> L.	Phyllanthaceae	Amala	Tree	Fruit, leaf	Paste	Dermal	Paste is made by crushing leaves and fruit. Then applied to the burn area
<i>Pinus roxburghii</i> Sarg.	Pinaceae	Sallo	Tree	Latex	Juice	Dermal	Latex obtained from stem is mixed with mustard oil and applied to wound skin
<i>Piper nigrum</i> L.	Piperaceae	Marich	Climber	Seed	Powder	Ocular	Powder is prepared and blown to the eye gently to cure eye-related problem
<i>Scoparia dulcis</i> L.	Plantaginaceae	Chini jahr	Herb	Stem	Paste	Dermal	The stem is crushed, and the paste is applied to the swelling area. Cloth is generally used to make it attach to the swelling area
<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	Dubo	Herb	Whole plant	Raw Paste	Oral Dermal	Whole plant is fed to livestock twice a day to enhance the lactation Paste is made by crushing the whole plant and applied in a wounded area
<i>Eleusine coracana</i> Gaertn.	Poaceae	Kodho	Herb	Seed	Decoction	Oral	Seeds are boiled in water and mixed with cornflour meal to cure chronic cough and any weakness
<i>Eulaliopsis binnata</i> (Retz.) C.E. Hubb.	Poaceae	Babio khar	Herb	Whole plant	Raw	Oral	Grass is given raw to cure weakness
<i>Hordeum vulgare</i> L.	Poaceae	Jau	Herb	Leaf Seed	Juice Decoction	Ocular Oral	Newly born leaf is crushed to obtain juice and used to cure eye-related problems Seed is boiled in water. The obtained Oily material is fed orally to treat mastitis
<i>Imperata cylindrical</i> (L.) P.Beauv.	Poaceae	Siru	Herb	Root	Paste	Oral	Root is crushed to make a paste and used to cure endoparasite
<i>Saccharum officinarum</i> L.	Poaceae	Ukhu	Herb	Stem Leaf	Juice Raw	Oral Oral	Stem is crushed to obtain juice, boiled, and fed by mixing with cornflour to increase milk production Leaf is given as feed to remove placenta
<i>Thysanolaena maxima</i> (Roxb.) Kuntz	Poaceae	Amriso	Herb	Leaf	Raw	Oral	Leaves as a feed are given to remove placenta
<i>Zea mays</i> L.	Poaceae	Makai	Herb	Fruit Seed	Paste Decoction	Oral	Head smut infected corn is crushed by mixing with lemon juice and fed to treat diarrhea Maize flour is made from corn seed and boiled with salt and water to increase milk production
<i>Prunus persica</i> (L.) Batsch.	Rosaceae	Aaru	Tree	Leaf	Juice, Paste	Dermal	Newly born leaf buds are taken and crushed to make juice. Then it is mixed with camphor and applied when endoparasites are seen. It is also applied to treat wound
<i>Rubus ellipticus</i> Sm.	Rosaceae	Aiselu	Shrub	Leaf	Paste	Dermal	Leaves are crushed to make a paste and applied in the wound area

<i>Aegle marmelos</i> (L.) Corrêa	Rutaceae	Bel	Tree	Fruit	Paste	Oral	The fruit is crushed and made paste to treat fever
<i>Boenninghausenia albiflora</i> (Hook.) Rechb. ex Meissn	Rutaceae	Upiya jhar	Herb	Leaf	Juice	Dermal	Leaves juice is applied over the body to remove flea, bug, lice, and external parasites
<i>Citrus limon</i> (L.) Osbeck	Rutaceae	Kagati	Shrub	Fruit	Paste Juice	Oral	Fresh twigs leaves are ground with camphor and applied to the wound Lemon juice is mixed with egg. If head smut infected corn is available then its powder is mixed and given to animal to cure fever
<i>Citrus maxima</i> Merr.	Rutaceae	Bhogate	Shrub	Leaf	Raw Paste Juice	Dermal Oral Ocular	Juice is rubbed to swelling area Leaves are crushed and mixed with cornflour to cure endoparasite Juice obtained is mixed with salt and applied to eye problem
<i>Citrus medica</i> L.	Rutaceae	Bimiro	Tree	Root	Juice	Oral	Juice obtained by pounding root and given orally to treat endoparasite
<i>Osyris wightiana</i> Wall. ex Wight	Santalaceae	Nun dhiki	Shrub	Bark	Powder	Oral	Dried bark is crushed to make powder and fed to cure joint swelling
<i>Sapindus mukorossi</i> Gaertn.	Sapindaceae	Ritho	Tree	Fruit	Paste	Oral	Fruit with its covering are cooked with cornflour and water to cure urinary problem
<i>Diploknema butyracea</i> (Roxb.) H.J.Lam	Sapotaceae	Chyuri	Tree	Root	Paste	Oral	Root is crushed to make a paste and fed to cure fever
<i>Capsicum annuum</i> L.	Solanaceae	Khursani	Shrub	Fruit	Raw	Dermal Oral	Fruit is crushed and paste obtained is applied to cure mastitis Bark is ground with water and applied by mixing with camphor to cure the wound Fruit is directly given to the animal to treat urinary related problem
<i>Datura metal</i> L.	Solanaceae	Dhatur	Herb	Fruit	Roast	Oral	Fruits are roasted on open fire, and fed to treat diarrhea, dysentery and fever
<i>Solanum lycopersicum</i> L.	Solanaceae	Tamatar	Herb	Fruit	Juice Raw	Dermal Oral	Fruit is crushed, and then the juice is applied to the burn area Fruit is directly fed to livestock to cure endoparasite
<i>Solanum melongena</i> L.	Solanaceae	Bhenta	Herb	Fruit Leaf	Roast Paste	Dermal Oral	Fruit juice is applied to cure mastitis The fruit is roasted and fed to animal to cure diarrhea The newly born leaf is crushed and fed to remove the placenta
<i>Solanum tuberosum</i> L.	Solanaceae	Aalu	Herb	Tuber	Raw	Dermal	Tuber is cut and rubbed externally on burns twice a day
<i>Schima wallichii</i> (DC.) Korth.	Theaceae	Chilaune	Tree	Bark	Powder	Oral	Bark of <i>Schima wallichii</i> (DC.) Korth. and <i>Oroxylum indicum</i> (L.) Kurz are dried, then ground to obtain powder, and given orally to cure diarrhea. <i>Schima wallichii</i> (DC.) Korth. alone is given to cure endoparasite
<i>Urtica dioica</i> L.	Urticaceae	Sisno	Herb	Leaf	Decoction	Oral	Leaf is boiled, and water is fed to an animal to cure mastitis and urinary problem
<i>Vitex negundo</i> L.	Verbenaceae	Simali	Tree	Leaf	Decoction	Dermal	Boiled extract of the leaf is applied on scabies and other skin infections in animals
<i>Ampelocissus divaricata</i> (Wall. ex M.A.Lawson) Planch.	Vitaceae	Purreni	Climber	Stem	Raw	Ocular	One end of fresh-cut stem is brought near to eye and watery like substance oozing out from stem is let go into eye by blowing air
<i>Cissus repens</i> Lam.	Vitaceae	Charchare laharo	Climber	Root	Juice	Ocular	Stem is gently crushed to obtain juice and applied to any eye problem
<i>Curcuma longa</i> L.	Zingiberaceae	Besar	Herb	Rhizome	Powder, Paste Powder	Dermal Ocular	A dried rhizome is crushed and mixed with mustard oil. Then, applied in burn area, wound and to treat ectoparasite. Little powder is blown to the eye to treat eye-related problem
<i>Elettaria cardamomum</i> (L.) Maton	Zingiberaceae	Alaichi	Herb	Seed	Powder	Oral	Powder is made by crushing dry seeds and fed to animal to cure fever
<i>Zingiber officinale</i> Roscoe	Zingiberaceae	Aduwa	Herb	Rhizome	Paste	Oral, Dermal	Raw rhizome is crushed and given to cure diarrhea, mastitis. It is crushed with <i>Trigonella foenum-graecum</i> L. to treat joint swelling Raw rhizome is ground with camphor to treat wounds

Plant diversity and uses

The present study revealed the ethnoveterinary use of 103 plant species belonging to 56 families to cure 21 animal ailments. Mostly, plants were collected by local people from forests, marginal land, grassland, and cultivated fields. Out of 56 families, Fabaceae was found to be dominant with 10 plant species similar to the findings of Acharya et al. (2015). This might be due to its higher abundance in the study area and high bioactivity. Fabaceae was followed by Poaceae (8 species), Rutaceae and Solanaceae (5 species each), Cucurbitaceae and Moraceae (4 species each), Anacardiaceae, Apocynaceae, Lamiaceae, Malvaceae, and Zingiberaceae (3 species each). The remaining 45 families had less than 3 species each. In contrast to our study, Raut and Shrestha (2012) found Liliaceae as a dominating family. This difference in observation might be due to different vegetation of the study area or might be due to differences in traditional beliefs. The list of the ethnoveterinary medicinal plants identified in the study area is shown in Table 2. whereas Families with their number of plant species are shown in Table 3.

Plant parts used and their life forms

It was found that the informants used varieties of plant parts for treating different ailments of animals. However, the most commonly used plant part was leaf (of 32 plant species), followed by seed (of 21 plant species), fruit (of 20 plant species), and bark (of 13 plant species). A study by Malla and Chhetri (2012); Acharya et al. (2015) also found leaf as the most used plant part similar to this present study. A preferred use of leaf might be ease of collection as compared to other plant parts. The leaf is also the center for many physiological processes and contains different metabolites (Tariq et al. 2014). The collection of leaves over other parts have no threat to the survival of the plant (Poffenberger et al. 2010). In contrast to this study, Acharya and Acharya (2010) found maximum use of whole plant whereas maximum use of fruit and seed was found by Raut and Shrestha (2012). The plant parts and the number of plant used reports are provided in Figure 3. In addition to this, the data on the life form of plants indicate that most plant species were herbs (44 species), trees (32 species), shrubs (14 species), and climbers (13 species) (Figure 4). Herbs are available everywhere and easy to collect as compared to other life forms. Herbs were also found to be the prevailing life form in the study by Acharya et al. (2015). It might be due to ease of collection, storage, extraction, and transportation than other life forms. But, in contrast to this study Acharya and Acharya (2010) found climbers as mostly used life form.

Preparation technique and routes of administration

The application of the medicinal plants as the form of paste formulation was observed for 41 plant species while 25 plant species were used as powder formulation followed by Juice (21 species), raw (20 species), decoction (19 species), infusion (5 species), and roasted formulation (3 species). In contrast to this study, juice was the widely used preparation technique in previous studies in other parts of

Nepal (Acharya and Acharya 2010; Raut and Shrestha 2012).

Table 3. Taxonomic diversity of medicinal plants

Family name	Number of plant species
Acanthaceae	1
Amaranthaceae	2
Amaryllidaceae	1
Anacardiaceae	3
Apiaceae	2
Apocynaceae	3
Araceae	2
Asparagaceae	1
Asphodelaceae	1
Begoniaceae	1
Bignoniaceae	1
Boraginaceae	1
Brassicaceae	1
Cannabaceae	1
Capparaceae	1
Caricaceae	1
Combretaceae	1
Commelinaceae	1
Compositae	2
Convolvulaceae	1
Cucurbitaceae	4
Cyperaceae	1
Dioscoreaceae	1
Equisetaceae	1
Fabaceae	10
Lamiaceae	3
Lauraceae	1
Liliaceae	1
Linaceae	1
Loranthaceae	1
Malvaceae	3
Melastomataceae	1
Meliaceae	2
Menispermaceae	1
Moraceae	4
Musaceae	1
Myristicaceae	1
Oleaceae	1
Oxalidaceae	1
Pedaliaceae	1
Phyllanthaceae	1
Pinaceae	1
Piperaceae	1
Plantaginaceae	1
Poaceae	8
Rosaceae	2
Rutaceae	5
Santalaceae	1
Sapindaceae	1
Sapotaceae	1
Solanaceae	5
Theaceae	1
Urticaceae	1
Verbenaceae	1
Vitaceae	2
Zingiberaceae	3

Similarly, different types of vehicles were found to be used for the administration of plant recipes like water, mustard oil, cornflour, curd, and water. Out of them cornflour and water were the most commonly used. The common route of administration was oral, followed by dermal, and ocular. Maximum use of oral route of medication was similar to the findings of Raut and Shrestha (2012). Nasal way of administration was not found in this study. Different preparation techniques and routes of administration with number of plants are shown in Table 4 and Table 5 respectively. Similar to our study, a single plant, as well as a combination of two or more plant species, was used to cure ailments (Acharya et al. 2015).

Informant consensus factor (ICF)

Informant consensus factors of different ailment categories are shown in Table 6. It was found that the ICF values vary from 0.858 to 0.96 with an average value of 0.926. High informant consensus factor was found for reproductive (0.96), followed by respiratory (0.957), gastrointestinal (0.949) while the least was for urinary problems (0.858). The high ICF value for the reproductive category indicated that reproductive ailments are common in the area. Furthermore, three plant species were used for four ailments categories, eight plant species for three ailments categories, twenty-nine plant species for two ailments categories, and sixty-three plant species were used for single ailment category (Figure 5).

Citation frequency (Cf%)

The total number of times that all species mentioned was 2450 times (N). The highest citation frequency was found for *Trachyspermum ammi* (L.) Sprague 247 (10.08%) followed by *Myristica fragrans* Houtt. 111 (4.53%), *Sesamum indicum* L. 109 (4.44%), *Saccharum officinarum* L. 107 (4.36%), and *Zea mays* L. 97 (3.95%). The top 20 plant species with the highest citation frequency are provided in Table 7. n refers to the number of times a particular species was mentioned.

Table 4. Preparation technique with a number of ethnoveterinary medicinal plants identified in the study area

Preparation technique	Number of plants
Paste	41
Powder	25
Juice	21
Raw	20
Decoction	19
Infusion	5
Roast	3

Table 5. Routes of administration of the ethnoveterinary medicinal plants identified in the study area

Route	Number of plants
Oral	76
Dermal	41
Ocular	9

Table 6. Informant consensus factor by categories of ailments in the study area

Ailment category	Nur	Nt	ICF
Reproductive	651	27	0.96
Respiratory	143	7	0.957
Gastrointestinal	454	24	0.949
Antipyretic	148	9	0.946
Parasitic	385	22	0.945
General weakness	43	4	0.928
Eye	98	9	0.917
Dermatological	329	29	0.914
Osteological	113	13	0.892
Urinary problem	86	13	0.858

Table 7. Top 20 medicinal plant species with highest citation frequency

Botanical name	Local name	n	Cf%
<i>Trachyspermum ammi</i> (L.) Sprague	Juwano	247	10.08
<i>Myristica fragrans</i> Houtt.	Jaifal	111	4.53
<i>Sesamum indicum</i> L.	Kalo til	109	4.44
<i>Saccharum officinarum</i> L.	Ukhu	107	4.36
<i>Zea mays</i> L.	Makai	97	3.95
<i>Artemisia indica</i> L.	Titepati	95	3.87
<i>Cannabis sativa</i> L.	Ganja	89	3.63
<i>Azadirachta indica</i> A.Juss.	Neem	81	3.30
<i>Solanum melongena</i> L.	Bhenta	80	3.26
<i>Artocarpus heterophyllus</i> Lam.	Rukh katar	77	3.14
<i>Marsdenia tenacissima</i> (Roxb.) Moon	Bilajor	68	2.77
<i>Carica papaya</i> L.	Mewa	64	2.61
<i>Melia azedarach</i> L.	Bakaino	62	2.53
<i>Aloe vera</i> (L.) Burm.f.	Ghyukumari	60	2.44
<i>Curcuma longa</i> L.	Besar	55	2.24
<i>Piper nigrum</i> L.	Marich	47	1.91
<i>Musa x paradisiaca</i> L.	Malboe kera	41	1.67
<i>Brassica nigra</i> L.	Tori	41	1.67
<i>Trigonella foenum-graecum</i> L.	Methi	39	1.59
<i>Pisum sativum</i> L.	Simi	36	1.46

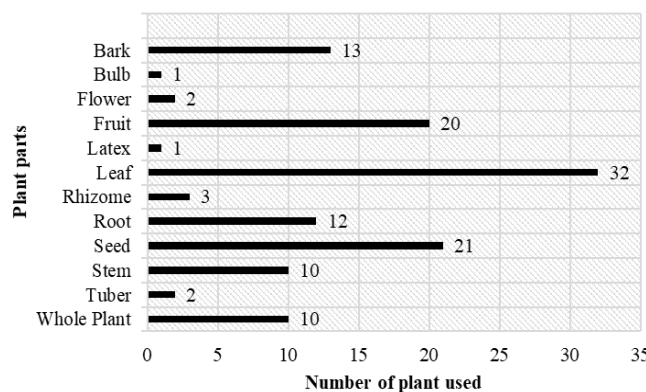


Figure 3. Different plant parts used

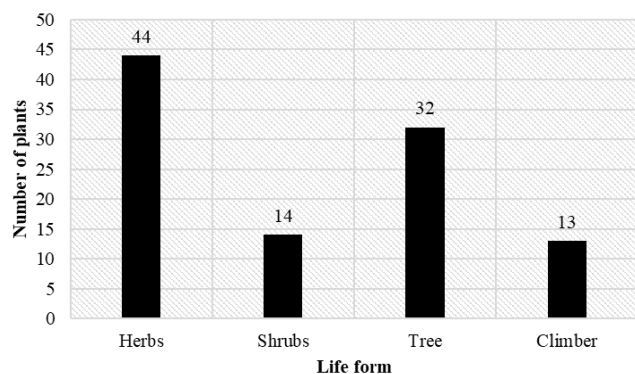


Figure 4. Life form of medicinal plants

In conclusion, traditional medicine is widely practiced by the people of Chhatradev Rural Municipality, Arghakhanchi district as it has become a part of social life and culture, and modern medicine implies a higher cost. People are dependable on the locally available indigenous plant species for the treatment of animals. As the people of younger generations are not acquainted with the knowledge on the use of medicinal plants, the actions should be taken for the documentation of uses of plants, to save the knowledge of ethnoveterinary medicinal plants from generation to generation, and increase the interest of young generation for the study of ethnoveterinary medicinal plants. It is of utmost necessity to involve the community in preserving and rational use of medicinal plants at the local level. Conservation programs should be done from the government level, and study on the use of medicinal plants as well as animals for treating animal diseases is recommended to a bigger extent.

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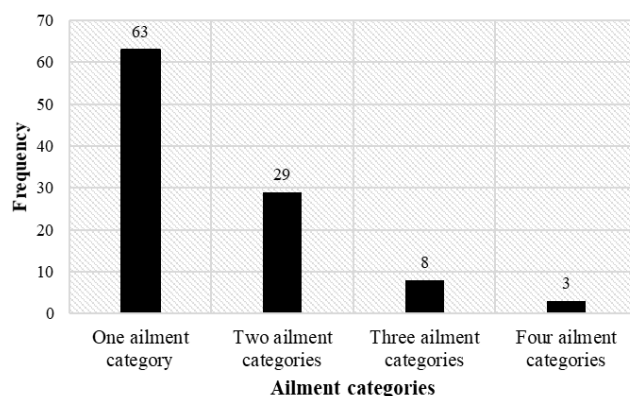


Figure 5. Number of plant species used for number of ailment categories

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