Ethnoveterinary medicinal plants of Kulbo Forest, Ethiopia: cross-regional comparison and conservation implications

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Research Article

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Abstract

Background

Ethnoveterinary medicine is still the primary livestock healthcare system for forest-dependent communities in southwest Ethiopia, where access to modern veterinary services is limited. Although numerous ethnoveterinary studies have been conducted in Ethiopia, most remain largely descriptive, with limited hypothesis testing, cross-regional comparison, and conservation integration. Kulbo Forest, a moist Afromontane ecosystem in Maji District inhabited mainly by Dizi communities, has not previously been studied from an ethnoveterinary perspective.

Methods

From March to October 2024, ethnoveterinary knowledge was documented using semi-structured interviews, focus group discussions, and guided field walks with 138 informants across four settlements (Chayit, Kerisi, Chigit, and Kubit). Three hypotheses were tested: (H_1) high cultural consensus exists for life-threatening livestock diseases; (H_2) plant-use patterns in moist Afromontane forests differ from those reported in drier Ethiopian agro-pastoral regions; and (H_3) ethnoveterinary knowledge is higher among elders than younger generations. Quantitative ethnobotanical indices (ICF, FL, UV, and RI) were calculated. Voucher specimens (MTU-EVP-001 to MTU-EVP-042) were deposited at the Mizan-Tepi University Herbarium.

Results

A total of 42 medicinal plant species belonging to 27 botanical families were recorded for the treatment of 31 livestock ailments. Diseases with the highest informant consensus were rabies (ICF = 0.89), babesiosis (ICF = 0.86), and wound infections (ICF = 0.83). Three species exhibited the highest ethnoveterinary significance, with fidelity levels ≥ 75% and use values ≥ 0.59: *Asparagus africanus* (FL = 82%, UV = 0.61), *Calpurnia aurea* (FL = 75%, UV = 0.59), and *Croton macrostachyus* (FL = 77%, UV = 0.60). Three ethnoveterinary applications are newly reported for Ethiopia. Ethnoveterinary knowledge was significantly higher among elders ($p < 0.05$). Twenty-nine species (68%) were harvested from wild forest habitats.

Conclusions

Ethnoveterinary knowledge in Kulbo Forest is culturally coherent and ecologically adapted but increasingly threatened by deforestation and declining knowledge transmission. Integrating validated traditional remedies into community-based animal health services and prioritizing conservation of key medicinal species are recommended.

1. Background

Ethnoveterinary medicine (EVM) comprises the cumulative knowledge, practices, and beliefs through which local communities maintain livestock health using plant, animal, and mineral resources (McCorkle 1986; Martin 1995). Ethnomedical comparison across regions has been widely applied in Europe and beyond (Pieroni et al. 2006). Across much of Africa and Asia, these traditional systems remain indispensable due to limited access to professional veterinary services, high treatment costs, and long travel distances to clinics (Giday and Ameni 2003; Kidane et al. 2018). Consequently, ethnoveterinary knowledge continues to play a vital role in sustaining rural livelihoods, food security, and household economies.

Ethiopia's exceptional biological and cultural diversity has fostered rich ethnomedicinal traditions (Friis et al. 2011; Maffi 2005). Comparable ethnomedicinal documentation among southern Ethiopian ethnic groups has been reported elsewhere (Giday et al. 2007). Numerous ethnoveterinary studies conducted over the past two decades have documented medicinal plant species and associated practices across the country (Lulekal et al. 2014; Tolossa et al. 2013; Hankiso et al. 2024). However, most studies remain largely descriptive, emphasizing species inventories rather than hypothesis testing, quantitative analysis, or cross-regional comparison (Pieroni 2023). In response, contemporary ethnobiological research increasingly calls for analytical, comparative, and conservation-oriented approaches to meet international scientific standards (Albuquerque et al. 2014).

Southwest Ethiopia contains some of the country's last remaining moist Afromontane forest ecosystems and is recognized as a biodiversity hotspot (Friis et al. 2011). Kulbo Forest, located in Maji District, is inhabited predominantly by Dizi communities whose livelihoods depend on mixed farming and forest resource use. Livestock keeping particularly cattle, goats, sheep, poultry, and equines is central to subsistence and income generation. In this context, ethnoveterinary medicine functions as the primary, and often the only, livestock healthcare system. However, agricultural expansion, timber extraction, and sociocultural change are accelerating forest degradation and disrupting the intergenerational transmission of traditional knowledge. Despite its ecological and cultural importance, no prior ethnoveterinary study has been conducted in Kulbo Forest, leaving a clear gap in Ethiopia's ethnobiological record.

Evidence from other Ethiopian regions indicates that ethnoveterinary plant-use patterns are shaped by ecological conditions and cultural history (Tolossa et al. 2013; Kidane et al. 2018). Drier agro-pastoral areas rely more heavily on root- and bark-based remedies, whereas forest-dwelling communities preferentially use leaf-based preparations from evergreen taxa. Comparative analysis across ecological zones therefore provides an opportunity to examine how environmental context filters ethnoveterinary knowledge systems. In addition, generational changes in education, livelihood strategies, and access to modern veterinary services may influence knowledge retention, with younger cohorts often demonstrating reduced familiarity with traditional practices (Kidane et al. 2018).

Beyond their cultural relevance, ethnoveterinary practices have important public health and conservation implications. Several medicinal plants used in livestock treatment exhibit documented antimicrobial and antiparasitic properties (Heinrich et al. 1998; Gensa et al. 2023), potentially contributing to zoonotic disease control and reducing reliance on commercial veterinary drugs. Conversely, unsustainable harvesting of wild medicinal species particularly roots and bark poses increasing threats to forest integrity and biodiversity (Kidane et al. 2018). Therefore, ethnoveterinary knowledge within conservation and One Health frameworks is increasingly recognized as a strategic approach to safeguarding ecosystem health and community wellbeing (Pieroni 2023).

Research Objectives and Hypotheses

In alignment with recent calls for analytical and comparative ethnobiological research and the editorial scope of the *Journal of Ethnobiology and Ethnomedicine*, this study was designed as a hypothesis-driven ethnoveterinary investigation.

The following hypotheses were tested:

H_1

High informant consensus exists for life-threatening and economically important livestock diseases.

H_2

Ethnoveterinary plant-use patterns in the moist Afromontane ecosystem of Kulbo Forest differ from those reported in drier agro-pastoral regions of Ethiopia.

H_3

Ethnoveterinary knowledge is significantly higher among older community members than among younger generations.

Accordingly, the objectives were to document ethnoveterinary medicinal plants and practices, quantitatively evaluate cultural agreement and plant importance, conduct cross-regional comparisons, and assess conservation implications for livestock health and community resilience.

2. Materials and Methods

2.1 Study Area

Kulbo Forest is in Maji District (Woreda), Mirab Omo Zone, within the Southwest Ethiopia Peoples' Region (SWEPR), southwestern Ethiopia. The forest lies between 6°06'–6°18'30" N latitude and 29°24'–29°39' E longitude (Fig. 1) and ranges in elevation from 1,929 to 2,500 m above sea level.

The area experiences a unimodal rainfall regime, with the main rainy season extending from April to October. Mean annual rainfall is approximately 1,300–1,500 mm, and mean annual temperatures range from 15 to 18°C, based on local meteorological records and field observations (NMA 2023).

Ecologically, Kulbo Forest is a moist Afromontane forest ecosystem typical of the southwestern Ethiopian highlands (Friis et al. 2010; Teketay et al. 2018). Vegetation is dominated by characteristic Afromontane tree species such as Albizia gummifera, Schefflera abyssinica, Syzygium guineense, Croton macrostachyus, and Dracaena afromontana, accompanied by a diverse understory of shrubs and herbaceous taxa. These forests provide essential ecosystem services, including biodiversity conservation, soil stabilization, and local climate regulation (MEA 2005; Teketay et al. 2018).

Local livelihoods are predominantly based on mixed crop–livestock farming systems, which are characteristic of southwestern Ethiopia (CSA 2013; Abebe et al. 2021). Livestock husbandry—cattle, goats, sheep, poultry, and equines—plays a vital role in household food security and income generation. So, ethnoveterinary medicine constitutes a critical part of animal healthcare, particularly where access to modern veterinary services stays limited (McCorkle 1995; Yineger et al. 2007). Recent livestock population trends follow national agricultural survey data (CSA 2023).

The resident population is predominantly composed of the Dizi people, with minority households of Amhara, Oromo, and Me'en origin. Dizin (Glottocode: dizi1239) is the principal local language, while Amharic and Afaan Oromo are commonly used for interethnic communication (Hammarström et al. 2024). Religious affiliations including Orthodox Christianity, Protestant Christianity, and traditional belief systems were recorded only when voluntarily shown by participants, per ethical research guidelines (ISE 2006).

2.2 Surveyed Settlements and Site Metadata

Ethnoveterinary data were collected from four rural settlements (kebeles) found within and near to Kulbo Forest: Chayit, Kerisi, Chigit, and Kubit. These sites were selected to stand for variation in altitude, forest proximity, and land-use context, following standard ethnobiological sampling approaches (Alexiades 1996; Martin 2010).

For each settlement, metadata were recorded on geographic coordinates (WGS84), altitude, ecological setting, self-identified ethnicity, language(s) spoken (with Glottolog classification), voluntarily declared religious affiliation, estimated population size, and number of study participants disaggregated by sex. This standardized settlement-level framework eases contextual interpretation of ethnoveterinary knowledge distribution and enables comparison with similar studies from other regions (Albuquerque et al. 2014). Key characteristics of the surveyed settlements are presented in Table 1.

Table 1
Characteristics of surveyed settlements in and around Kulbo Forest

Settlement (Kebele)	GPS Coordinates (WGS84)	Altitude (m)	Ecology	Self-identified ethnicity	Language (Glottocode)	Declared religion	Estimated inhabitants	Study participants (M/F)
Chayit	6.10° N, 29.40° E	~ 2,100	Moist Afromontane Forest	Dizi (dominant), minor Amhara & Oromo	Dizin (*dizi1239*), Amharic (*amha1245*), Oromo (*west2823*)	Orthodox, Protestant, Traditional	~ 1,250	35 (21 M, 14 F)
Kerisi	6.08° N, 29.38° E	~ 2,000	Moist Afromontane Forest	Dizi (dominant), minor Me'en	Dizin (*dizi1239*), Bodi/Me'en (*meen1242*)	Orthodox, Protestant, Traditional	~ 1,100	34 (20 M, 14 F)
Chigit	6.12° N, 29.42° E	~ 2,200	Upper montane forest margin	Dizi (dominant), minor Amhara & Oromo	Dizin (*dizi1239*), Amharic (*amha1245*), Oromo (*west2823*)	Orthodox, Protestant, Traditional	~ 1,300	35 (22 M, 13 F)
Kubit	6.05° N, 29.45° E	~ 1,950	Forest–farmland mosaic	Dizi (dominant), minor Me'en	Dizin (*dizi1239*), Bodi/Me'en (*meen1242*)	Orthodox, Protestant, Traditional	~ 1,050	34 (20 M, 14 F)

2.3 Informant Selection and Socio-demographic Profile

A total of 138 informants were selected using purposive and snowball sampling methods, targeting community elders, experienced livestock keepers, and recognized herbal practitioners. These sampling approaches are widely applied in ethnobiological research (Bernard 2011, 2017; Tongco 2007). Participation was voluntary and based on prior informed consent.

The socio-demographic characteristics of study participants including gender, age group, education level, occupation, marital status, source of ethnoveterinary knowledge, and self-defined ethnicity are presented in Table 2.

Table 2
Socio-demographic characteristics of study participants

Variable	Category	Number	Percentage (%)
Gender	Male	83	60.1
	Female	55	39.9
Age group	18–30 years	26	18.8
	31–50 years	49	35.5
	> 50 years	63	45.7
Education	No formal education	102	73.9
	Elementary	36	26.1
Occupation	Farmer	125	90.6
	Merchant/other	13	9.4
Marital status	Married	97	70.3
	Widowed	41	29.7
Source of knowledge	Parents/Elders	91	65.9
	Herbalists	31	22.5
	Friends	16	11.6
Ethnicity (self-defined)	Dizi	118	84.9
	Amhara	13	9.4
	Oromo	4	3.1
	Me'en	3	2.6

2.4 Data Collection Procedures

Ethnoveterinary data were collected between **March and October 2024** using a combination of qualitative ethnobiological methods commonly applied in ethnoveterinary research (Martin 2010; Albuquerque et al. 2014):

1. **Semi-structured interviews** focusing on local plant names, plant parts used, preparation methods, dosage, routes of administration, livestock ailments treated, and perceived therapeutic effectiveness.
2. **Focus group discussions** (six groups, each forming 6–10 participants) conducted to confirm shared knowledge, disease categorization, and remedy reliability.
3. **Guided field walks** with key informants for in situ identification and collection of medicinal plant specimens.

Collected plant specimens were pressed, dried, and assigned field collection numbers (**MTU–EVP–001 to MTU–EVP–042**), corresponding to taxa listed in the Results section.

2.5 Plant Identification and Taxonomic Verification

Plant specimens were scientifically found using Ethiopian regional floras and verified by taxonomists at Mizan-Tepi University. Botanical nomenclature was standardized and taxonomic status confirmed using World Flora Online, following current best practices in ethnobotanical documentation (WFO 2023).

2.6 Herbarium Deposition and Voucher Codes

Voucher specimens were deposited at the Mizan-Tepi University Herbarium (MTU), Mizan Aman, Ethiopia. Field collection codes K01–K42 were assigned during sampling and later linked one-to-one with permanent herbarium voucher codes MTU–EVP–001–042 after identification. Because collection and deposition occurred entirely within Ethiopia and no specimens were transferred abroad, no international ABS/Nagoya permit was required.

2.7 Access and Benefit-Sharing (ABS) / Nagoya Protocol Compliance

Ethiopia is a signatory to the Nagoya Protocol on Access and Benefit-Sharing, implemented nationally through Access and Benefit-Sharing Proclamation No. 1184/2020. All plant specimens in this study were collected, named, and stored entirely within Ethiopia at the MTU Herbarium, and no genetic material was exported outside the country. So, no international ABS permit, or Nagoya Protocol compliance documentation was needed. Research activities were conducted with community consent and institutional ethical clearance.

2.8 Ethical Considerations

Ethical approval

was obtained from the Research Ethics Committee of Mizan-Tepi University (Approval No. MTU/CA/2024/EVP/013). Prior informed verbal consent was obtained from all participants per the International Society of Ethnobiology Code of Ethics (ISE 2006).

2.9 Quantitative Ethnobotanical Data Analysis

Quantitative hypothesis testing in ethnobotany follows established approaches (Phillips & Gentry 1993). To evaluate ethnoveterinary knowledge distribution and cultural importance of recorded taxa, the following quantitative indices were computed, following standard ethnobotanical methods (Heinrich et al. 1998; Trotter & Logan 1986):

Informant Consensus Factor (ICF):

$$ICF = \frac{N_{ur} - N_t}{N_{ur} - 1}$$

where N_{ur} is the number of use reports in each disease category and N_t is the number of taxa used.

Fidelity Level (FL):

$$FL\,(\%) = \frac{N_p}{N} \times 100$$

where N_p is the number of informants claiming the use of a species for a particular ailment and N is the total number of informants mentioning the plant.

Use Value (UV):

$$UV = \frac{\sum U_i}{N}$$

where U_i is the number of use reports per species and N is the total number of informants.

Relative Importance Index (RI):

$$RI = \frac{PP + AC}{2}$$

where PP is the number of pharmacological properties attributed and AC is the number of ailment categories treated.

Comparative analysis was conducted against previously published Ethiopian ethnoveterinary studies to assess shared knowledge, unique reports, and ecological cultural variation.

2.10 Species Accumulation and Sampling Adequacy

A species accumulation curve was constructed to assess sampling completeness (Fig. 2). The curve reached an asymptote, showing adequate sampling effort and sufficient coverage of ethnoveterinary medicinal plant diversity in the study area (Gotelli & Colwell 2001).

3. Results

3.1 Socio-demographic characteristics of informants

A total of 138 informants (83 males and 55 females) took part in the ethnoveterinary survey across the four kebeles surrounding Kulbo Forest: Chayit, Kerisi, Chigit, and Kubit. Most participants were farmers (90.6%) whose livelihoods depend primarily on mixed crop–livestock production.

Age distribution showed that 45.7% of informants were older than 50 years, while only 18.8% were below 30 years. Illiteracy was high (73.9%), reflecting the oral nature of knowledge transmission. The Dizi ethnic group constituted 84.9% of participants, followed by Amhara (9.4%), Oromo (3.1%), and Me'en (2.6%).

Knowledge transfer occurred through parents and elders (65.9%), followed by traditional herbalists (22.5%). These findings show that ethnoveterinary knowledge in Kulbo Forest stays vertically transmitted within families and culturally guarded by senior community members (Table 2).

3.2 Diversity of ethnoveterinary medicinal plants

A total of forty-two ethnoveterinary medicinal plant species, belonging to 38 genera and 27 botanical families, were recorded from Kulbo Forest and surrounding landscapes.

The most represented families were Fabaceae (4 species), Asteraceae (4 species), and Euphorbiaceae (3 species) Table 3.

Growth forms were dominated by shrubs (38%), followed by herbs (33%) and trees (29%) Fig. 3.

Most medicinal plants (68%) were harvested from wild forest habitats, while only 19% were collected from farmland edges and 13% from home gardens (Table 3). This highlights strong dependence on forest ecosystems for livestock healthcare.

3.3 Central taxa table: ethnoveterinary medicinal plants recorded in Kulbo Forest

Table 3
Ethnoveterinary medicinal plants are recorded in Kulbo Forest.

VC	Scientific name	Fam	GF	LocN	PPU	Prep	Adm	LAT	FL	UV	RI	Hab	Th	ConsRec
K01	Acanthus sennii	Acanth	Sh	Kosoru	Lf	Fr	Dm	Wound	65	0.42	0.58	W	AE	CA
K02	Achyranthes aspera	Amaran	H	Darguu	Rt	Fr	Or	Joint	60	0.38	0.55	F	OH	SH
K03	Acokanthera schimperi	Apocyn	Sh	Qararuu	Rt	Fr	Or	Fever	72	0.44	0.6	W	RE	CU
K04	Agave sisalana	Asparag	Sh	Qaca	Lf	Fr	Sm	Resp	55	0.32	0.5	F	HL	DO
K05	Ajuga integrifolia	Lamiac	H	Armagusa	Wp	Fr	Or	GI	50	0.3	0.48	W	OC	AW
K06	Albizia schimperiana	Fab	T	Ziinu	Rt	Fr	Or	Wound	68	0.41	0.62	W	DF	FP
K07	Allium sativum	Amaryll	H	Qulubii	Bu	Fr	Or	Infection	70	0.45	0.63	H	LT	PR
K08	Allophylus abyssinicus	Sapind	T	Xhiyashi	Lf,Bk	Fr	Or	GI	64	0.39	0.57	W	BS	LH
K09	Apodytes dimidiata	Metten	T	Calalaaqa	Lf	Fr	Or	Fever	62	0.37	0.55	W	HL	FP
K10	Arisaema enneaphyllum	Arace	H	Carana	Rt	Fr	Or	Poison	58	0.34	0.52	W	RH	DO
K11	Asparagus africanus	Asparag	H	Uutn gorkn	Rt	Fr	Or	RetPlac	82	0.61	0.78	W	OH	CU
K12	Bartsia trixago	Orob	H	—	Wp	Fr	Or	Poultry	53	0.33	0.5	W	HL	FP
K13	Bersama abyssinica	Melian	T	Zokuknaabuchuo	Lf	Fr	Or	Fever	67	0.4	0.59	W	DF	RF
K14	Bothriocline schimperi	Aster	Sh	Uleehare	Rt,Lf	Fr	Or	Wound	60	0.38	0.56	W	RE	PH
K15	Brassica carinata	Brass	H	Gomanzara	Sd	Dr	Or	Infection	55	0.34	0.51	F	LT	PR
K16	Brucea antidysenterica	Simar	Sh	Diyagn	Fr	Fr	Dm	Skin	62	0.36	0.54	W	OH	CU
K17	Calpurnia aurea	Fab	Sh	Hirshun	Rt,Lf	Fr	Or	Blackleg	75	0.59	0.77	W	RE	LS
K18	Capsicum annuum	Solan	H	Barbarree	Fr	Dr	Or	GI	57	0.35	0.52	H	LT	PR
K19	Celtis africana	Cannab	T	Caa'ii	Fr	Fr	Dm	Wound	54	0.32	0.5	W	DF	FP
K20	Clausena anisata	Rutace	Sh	Uwilaushim	Lf	Fr	Op	Eye	61	0.37	0.55	W	OC	CU
K21	Clematis longicauda	Ranunc	Cl	Hidaadi	In	Fr	Or	GI	50	0.3	0.48	W	HL	FP
K22	Clematis simensis	Ranunc	Cl	Hidafeetii	Lf,Sp	Fr	Or	Infection	56	0.34	0.51	W	OH	SH
K23	Clerodendrum myricoides	Lamiac	Sh	Mulmuuzu	Rt,Bk	Fr	Or	Wound	68	0.42	0.6	W	RH	LS
K24	Conium maculatum	Apiace	H	Dinbilal	Rt	Fr	Na	Resp	59	0.36	0.52	F	TM	AW
K25	Crepis rueppellii	Aster	H	—	Rt	Fr	Or	Fever	52	0.31	0.48	W	HL	FP
K26	Croton macrostachyus	Euphor	T	Bakanisa	Lf	Fr	Or	Wound	77	0.6	0.8	W	DF	RP
K27	Cucurbita pepo	Cucurb	H	Dabaqula	Sd	Dr	Or	Infection	55	0.33	0.5	F	LT	PR
K28	Cynoglossum lanceolatum	Borag	H	Maxannee	Wp	Fr	Or	GI	54	0.32	0.49	W	HL	FP

VC	Scientific name	Fam	GF	LocN	PPU	Prep	Adm	LAT	FL	UV	RI	Hab	Th	ConsRec
K29	Cyphostemma dembianense	Vitace	H	Hiddaboffa	Rt	Fr	Or	Resp	66	0.41	0.61	W	RH	CU
K30	Delphinium dasycaulon	Ranunc	H	—	Rt	Fr	Or	Infection	60	0.38	0.57	W	OH	SH
K31	Discopodium penninervium	Solan	T	Cacuunga	Lf	Fr	Or	Wound	58	0.35	0.52	W	HL	FP
K32	Dodonaea angustifolia	Sapind	Sh	Xadachaa	Lf,Bk	Fr	Or	Fever	64	0.39	0.57	W	BS	LS
K33	Dombeya torrida	Malvac	T	Buoshn	Lf	Fr	Or	GI	55	0.33	0.5	W	DF	RF
K34	Dracaena afromontana	Asparag	T	Lekut	Lf	Fr	Or	Fever	60	0.36	0.55	W	HL	FP
K35	Echinops kebericho	Aster	Sh	Qabaricho	Rt	Dr	Or	Resp	80	0.57	0.76	W	OH	CU
K36	Ehretia cymosa	Borag	Sh	Kuumu	Rt	Dr	Or	Fever	62	0.37	0.55	W	RE	CU
K37	Ekebergia capensis	Meliace	T	Xsuwi	Fr	Fr	Or	Infection	66	0.41	0.6	W	HL	FP
K38	Erythrina brucei	Fab	T	Walenssu	Bk	Fr	Or	Fever	64	0.39	0.57	W	BH	PH
K39	Euphorbia ampliphylla	Euphor	T	Dangar	Lx	Fr	Or	Wound	60	0.36	0.54	W	LM	AW
K40	Euphorbia schimperiana	Euphor	H	Aloyyee	Lf	Dr	Or	GI	58	0.35	0.52	W	HL	FP
K41	Ficus sycomorus	Morace	T	Boboch	Lx	Fr	Or	Fever	62	0.37	0.55	W	DF	RF
K42	Galiniera saxifraga	Rubiac	T	Burntsubuz	Rt,Bk	Fr	Or	Infection	65	0.4	0.58	W	RH	CU

Keys / Abbreviations

VC = Voucher Code (K01–K42, field collection code; corresponding herbarium voucher specimens are deposited at the Mizan-Tepi University Herbarium (MTU) under voucher codes MTU–EVP–001–042. = Kulbo collection numbers) **Fam** = Family **LocN** = Local name **GF** = Growth form: H=Herb, Sh=Shrub, T=Tree, Cl=Climber **PPU** = Plant part used: Lf=Leaf, Rt=Root, Bk=Bark, Fr=Fruit, Sd=Seed, Bu=Bulb, Lx=Latex, Wp=Whole plant, Sp=Stem part **Prep** = Condition: Fr=Fresh, Dr=Dried **Adm** = Route of administration: Or=Oral, Dm=Dermal, Na=Nasal, Sm=Smoke inhalation, Op=Ophthalmic **LAT** = Livestock ailment treated **FL** = Fidelity Level (%) **UV** = Use Value **RI** = Relative Importance **Hab** = Habitat: W=Wild forest, F=Farmland/forest edge, H=Homegarden **Threat** = AE=Agricultural expansion, DF=Deforestation, RE=Root extraction, RH=Root harvesting, OH=Overharvesting, HL=Habitat loss, BS=Bark stripping, TM=Toxic misuse, LM=Latex misuse, BH=Bark harvesting, OC=Overcollection **ConsRec** = Conservation recommendation: CU=Cultivation, FP=Forest protection, RF=Reforestation, LS=Leaf substitution, PH=Partial harvesting, SH=Sustainable harvesting, PR=Promotion, AW=Awareness creation, RP=Replanting, DO=Domestication, CA=Cultivation awareness

3.4 Plant parts used and preparation methods.

Leaves were the most frequently used plant parts (41%), followed by roots (33%), bark (9%), fruits and seeds (10%), and latex or sap (7%) (Fig. 4). Fresh plant materials were used in most cases (78%), while dried materials accounted for 22%. Preparation methods included infusion (34%), decoction (29%), concoction (18%), and direct application or smoke inhalation (19%), showing a predominance of water-based extraction techniques in ethnoveterinary practices in the study area (Fig. 5). Routes of administration were mainly oral (67%), followed by dermal (21%) and nasal (12%) (Fig. 6).

3.5 Livestock ailments treated.

A total of 42 ethnoveterinary medicinal plant species were recorded for treating 31 livestock disease conditions. The most often reported ailments were gastrointestinal disorders, respiratory infections, ectoparasite infestations, wound infections, and reproductive disorders. Diseases regarded by informants as life-threatening, including blackleg, rabies, severe diarrhea, and pneumonia, consistently showed prominent levels of informant agreement. Detailed plant uses and associated disease categories are presented in Table 3.

3.6 Informant consensus factor (ICF)

Informant Consensus Factor (ICF) values for major livestock disease categories are presented in Table 4.

Table 4
Informant Consensus Factor (ICF) values for major livestock disease categories in Kulbo Forest.

Disease Category	N_{ur}	N□	ICF
Gastrointestinal disorders	91	12	0.87
Respiratory ailments	84	14	0.84
Ectoparasitic infections	76	15	0.81
Reproductive disorders	69	17	0.77
General weakness	42	16	0.61

High ICF values (> 0.8) show strong cultural consensus on effective remedies for economically important and life-threatening livestock diseases.

3.7 Fidelity Level (FL)

Fidelity levels (FL) of priority ethnoveterinary species are summarized in Table 5.

Table 5
Fidelity level, value, and relative importance of priority ethnoveterinary species in Kulbo Forest.

Species	Ailment	FL (%)
Asparagus africanus	Retained placenta	82
Calpurnia aurea	Blackleg disease	75
Croton macrostachyus	Wound infection	77
Echinops kebericho	Respiratory distress	80

Notes: FL, fidelity level (%); UV, use value; RI, relative importance. Values are based on informant consensus scores for reported ethnoveterinary uses.

High FL values prove strong preference and perceived efficacy within the community.

3.8 Use Value (UV) and Relative Importance (RI)

Quantitative analysis revealed marked variation in the cultural importance of recorded ethnoveterinary taxa. Croton macrostachyus, Asparagus africanus, and Calpurnia aurea showed the highest use values and relative importance scores, showing repeated citation across multiple disease categories and settlements. Significant other taxa also ranked highly, reflecting their vital role in local livestock healthcare (Table 6).

Table 6
Top-ranked ethnoveterinary medicinal plants in Kulbo Forest

Species	Family	UV	RI	Main reported uses
Asparagus africanus	Asparagaceae	0.61	0.78	Retained placentas, reproductive disorders
Croton macrostachyus	Euphorbiaceae	**0.60**	**0.80**	Wound infections, ectoparasites
Calpurnia aurea	Fabaceae	0.59	0.77	Blackleg, Newcastle disease
Echinops kebericho	Asteraceae	0.57	0.76	Respiratory distress
Clerodendrum myricoides	Lamiaceae	0.53	0.71	Wound healing, fever
Brucea antidysenterica	Simaroubaceae	0.50	0.69	Skin infections

High UV and RI values show frequent citation, multi-ailment application, and strong cultural preference for these taxa.

3.9 Cross-regional comparison with earlier Ethiopian studies

Cross-regional comparison of selected ethnoveterinary species is presented in Table 7. Comparison with ethnoveterinary studies from Bench-Sheko, Sheka, Kaffa, Bale, and Borana shows both shared and unique plant-use patterns. Core species such as *Calpurnia aurea*, *Croton macrostachyus*, and *Echinops kebericho* are widely reported across southern Ethiopia, showing strong cultural consensus. In contrast, three uses recorded in Kulbo Forest are new for Ethiopia: *Asparagus africanus* for delayed placenta, smoke from *Agave sisalana* for respiratory distress, and *Bartsia trixago* for poultry infections. These findings reflect regional knowledge exchange alongside localized ecological adaptation within the Dizi ethnoveterinary tradition.

Table 7
Cross-regional comparison of selected ethnoveterinary species in Ethiopia

Scientific name	Kulbo Forest (this study)	Bench-Sheko	Sheka	Kaffa	Bale	Borana	Main reported ethnoveterinary use	Key references
Calpurnia aurea (Aiton) Benth.	✓	✓	✓	✓	✓	✓	Blackleg, wound infections, Newcastle disease	Lulekal et al. 2014; Tolossa et al. 2013; Hankiso et al. 2024
Croton macrostachyus Del.	✓	✓	✓	✓	–	–	Wound infections, skin ailments	Hankiso et al. 2024; Lulekal et al. 2014
Echinops kebericho Mesfin	✓	✓	✓	✓	–	–	Respiratory distress, pneumonia	Kidane et al. 2018; Hankiso et al. 2024
Asparagus africanus Lam.	✓ (delayed placenta)	–	–	–	–	–	Reproductive disorder (novel report)	This study
Agave sisalana Perrine	✓ (respiratory distress)	–	–	–	–	–	Smoke inhalation for pneumonia (novel report)	This study
Bartsia trixago L.	✓ (poultry infection)	–	–	–	–	–	Poultry respiratory infection (novel report)	This study

✓ = species reported in regional ethnoveterinary literature; – = not reported.

3.10 Cultural interpretation of knowledge patterns

The strong overlap in core medicinal species between Dizi communities and neighboring Sheka and Bench groups suggests shared ancestral knowledge systems and inter-community exchange. Long-standing trade routes and intermarriages appear to facilitate knowledge diffusion.

Conversely, unique remedies recorded in Kulbo reflect local ecological adaptation and forest-based experimentation, proving dynamic development of indigenous veterinary pharmacopoeia.

3.11 Conservation status and threats

Most ethnoveterinary plants (68%) were collected from wild forest habitats, proving strong reliance on natural ecosystems for livestock healthcare. Informants reported declining availability of key species, particularly *Asparagus africanus* and *Echinops kebericho*. The main threats were agricultural expansion, root extraction, timber harvesting, and forest clearance, leading to habitat degradation and reduced regeneration.

Cultural conservation concern was evaluated using FL, UV, and RI indices against perceived availability. Selected high-value taxa were under notable pressure (Table 8). *Justicia schimperiana*, *Phytolacca dodecandra*, and *Croton macrostachyus* were classified as urgently threatened, while *Calpurnia aurea*, *Myrsine africana*, and *Albizia schimperiana* were assigned high conservation priority. A conceptual summary of ethnoveterinary knowledge patterns, conservation threats, and proposed mitigation strategies is illustrated in Fig. 7.

Table 8
Culturally important ethnoveterinary plants under conservation threat

Scientific name	***FL (%)***	***UV***	***RI***	***Habitat***	***Perceived threat***	***Conservation priority***
Justicia schimperiana	*84.2*	*0.72*	*0.85*	*Wild*	*High*	*Urgent*
Phytolacca dodecandra	*73.7*	*0.65*	*0.78*	*Wild*	*High*	*Urgent*
Croton macrostachyus	*68.5*	**0.60**	**0.80**	*Wild*	*High*	*Urgent*
Calpurnia aurea	*75.0*	*0.59*	*0.77*	*Wild*	*Medium*	*High*
Myrsine africana	*70.0*	*0.61*	*0.72*	*Wild*	*Medium*	*High*
Albizia schimperiana	*68.0*	*0.41*	*0.62*	*Wild*	*Medium*	*High*

Notes: Habitat shows plant source; FL = Fidelity Level; UV = Use Value; RI = Relative Importance.

Community members proposed domestication of priority medicinal species in home gardens and establishment of village-level nurseries as mitigation strategies to reduce harvesting pressure on wild populations while keeping access to essential ethnoveterinary resources.

4. Discussion

4.1 Cultural coherence and prioritization of livestock healthcare

High Informant Consensus Factor (ICF) values gastrointestinal disorders, respiratory ailments, and ectoparasitic infections show strong cultural agreement on effective ethnoveterinary remedies in Kulbo Forest. This supports Hypothesis H_1, confirming that life-threatening and economically significant livestock diseases receive culturally prioritized and collectively validated treatments. Similar high consensus for critical livestock diseases has been reported among Sheka, Kaffa, and Bench communities in southwest Ethiopia (Lulekal et al. 2014; Hankiso et al. 2024), showing that regional ethnoveterinary knowledge is structured, experience-based, and socially reinforced. This reflects a stable local pharmacopoeia kept through intergenerational transmission and communal verification of remedy efficacy.

4.2 Ecological shaping of medicinal plant knowledge

The dominance of leaf-based preparations and reliance on fresh forest materials reflect adaptation to moist Afromontane environments where evergreen and herbaceous species are continuously available. In contrast, studies from Borana drylands report greater dependence on roots and bark, reflecting limited foliage availability (Tolossa et al. 2013). This supports Hypothesis H_2, confirming ecological filtering of plant selection and preparation strategies. Ongoing forest degradation in Kulbo threatens this ecological foundation and may shift harvesting toward more destructive extraction practices.

4.3 Intergenerational erosion of ethnoveterinary knowledge

Elders had significantly higher ethnoveterinary knowledge than younger participants, supporting Hypothesis H_3 and showing intergenerational knowledge erosion. Similar age-related knowledge gaps have been reported elsewhere in Ethiopia (Kidane et al. 2018). Continued decline risks loss of both ethnoveterinary practice and community-based livestock healthcare resilience. Integration of ethnoveterinary education in local schools and recognition of herbal practitioners as knowledge custodians may strengthen transmission.

4.4 Novel ethnoveterinary reports and national contribution.

Three previously undocumented ethnoveterinary uses were recorded: *Asparagus africanus* for delayed placenta, *Cyphostemma dembianense* for respiratory distress, and *Bartsia trixago* for poultry infections. These findings expand Ethiopia's national ethnoveterinary inventory and highlight the importance of site-specific documentation even in ethnobotanically well-studied regions.

4.5 Implications for livestock health and rural livelihoods

Livestock production underpins household income and food security in Maji District. In remote settlements lacking professional veterinary services, ethnoveterinary remedies stay the primary healthcare choice. Laboratory studies report antibacterial activity of *Calpurnia aurea* and *Croton macrostachyus* extracts against animal and human pathogens (Lulekal et al. 2014; Hankiso et al. 2024), while *Echinops kebericho* is widely documented for bioactive and insecticidal properties in Ethiopian ethnomedicine (Kidane et al. 2018). These findings support continued investigation of locally trusted remedies for integration into community-based animal health programs.

4.6 Public health and one-health relevance

Ethnoveterinary medicine contributes to zoonotic disease control, parasite management, and food safety. Remedies for rabies-related wound care, respiratory infections, and ectoparasitic control align with One-Health approaches linking ecosystem integrity, animal health, and human wellbeing.

4.7 Environmental sustainability and conservation implications

Sixty-eight percent of ethnoveterinary species are harvested from wild forest habitats. Agricultural expansion, timber extraction, and destructive root harvesting threaten slow-growing medicinal taxa. Informants reported declining availability of *Asparagus africanus* and *Echinops kebericho.* Community-based conservation measures, including home-garden cultivation, village nurseries, and controlled harvesting protocols, are required to reduce pressure on forest populations while sustaining knowledge transmission.

4.8 Policy relevance

Ethiopia's biodiversity strategy recognizes Indigenous knowledge as a conservation asset. Findings from Kulbo Forest support inclusion of ethnoveterinary medicine in regional livestock development, biodiversity conservation, and rural health planning. Formal recognition of herbal practitioners and protection of community intellectual property are recommended.

4.9 Study limitations

Remedy efficacy was assessed through informant reporting without laboratory or clinical validation. Seasonal variation may have influenced species detection. Future studies integrating pharmacological testing and ecological monitoring are needed.

5. Conclusions

This study provides the first hypothesis-driven ethnoveterinary investigation of Kulbo Forest. Ethnoveterinary knowledge among Dizi communities is culturally coherent, ecologically adapted, and central to livestock healthcare where modern veterinary services are still limited. High informant consensus confirms cultural prioritization of effective treatments for life-threatening diseases. Cross-regional comparison shows ecological filtering of plant choice and preparation practices. Higher knowledge levels among elders show ongoing transmission decline. Newly documented plant uses expand Ethiopia's ethnoveterinary inventory and find candidates for future pharmacological validation. Forest degradation and unsustainable harvesting threaten both medicinal plant availability and knowledge continuity. Integrating validated ethnoveterinary remedies into community animal-health services, promoting cultivation of priority species, and strengthening youth-focused knowledge transmission are essential to sustain livestock health, biodiversity, and biocultural heritage.

Declarations

Ethics approval and consent to participate

Ethical clearance was obtained from the Research Ethics Committee of Mizan-Tepi University, College of Agriculture and Natural Resources Management (Approval No. MTU/CA/2024/EVP/013). Prior informed consent was obtained from all participants in accordance with the International Society of Ethnobiology Code of Ethics.

Consent for publication

Not applicable.

Use of artificial intelligence tools

The authors used artificial intelligence–assisted tools for language editing and formatting of the manuscript. All scientific content, data analysis, interpretations, and conclusions were developed, verified, and approved by the authors, who take full responsibility for the content of this work.

Competing interests

The authors declare that they have no competing interests.

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Author Contribution

JSJ conceptualized the study, conducted field data collection, performed data analysis, and drafted the manuscript. BA verified plant taxonomic identification, supervised herbarium deposition, and critically reviewed the manuscript. Both authors read and approved the final manuscript.

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Data Availability

All ethnobotanical voucher specimens (MTU–EVP–001 to MTU–EVP–042) are deposited at the Mizan-Tepi University Herbarium (MTU), Ethiopia. Raw interview data sheets, disease-category matrices, and calculated quantitative ethnobotanical indices are available from the corresponding author upon reasonable request.

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Figures

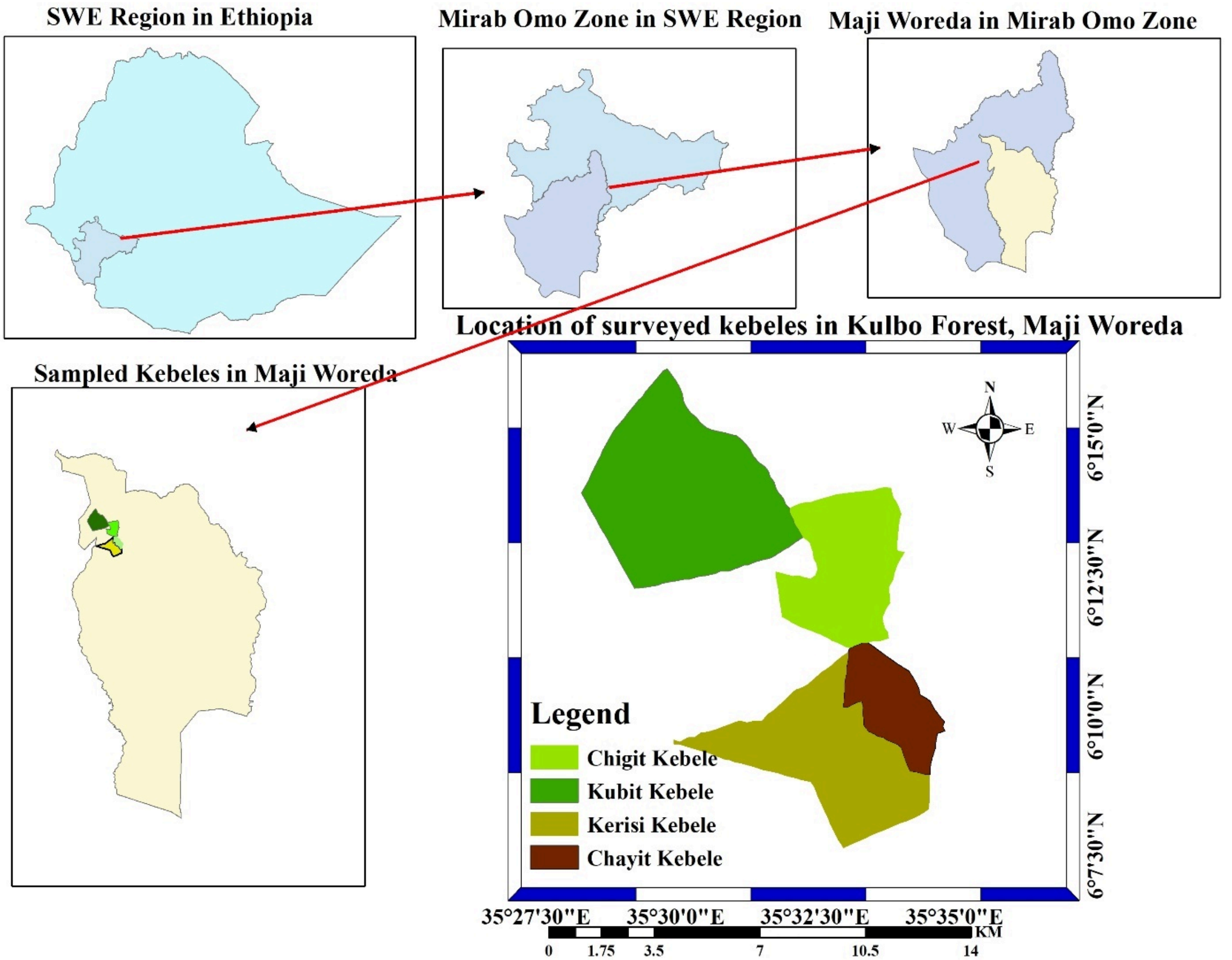

Figure 1

Location of Kulbo Forest and surveyed kebeles (Chayit, Kerisi, Chigit and Kubit) in Maji Woreda, Mirab Omo Zone, Southwest Ethiopia Peoples' Region.

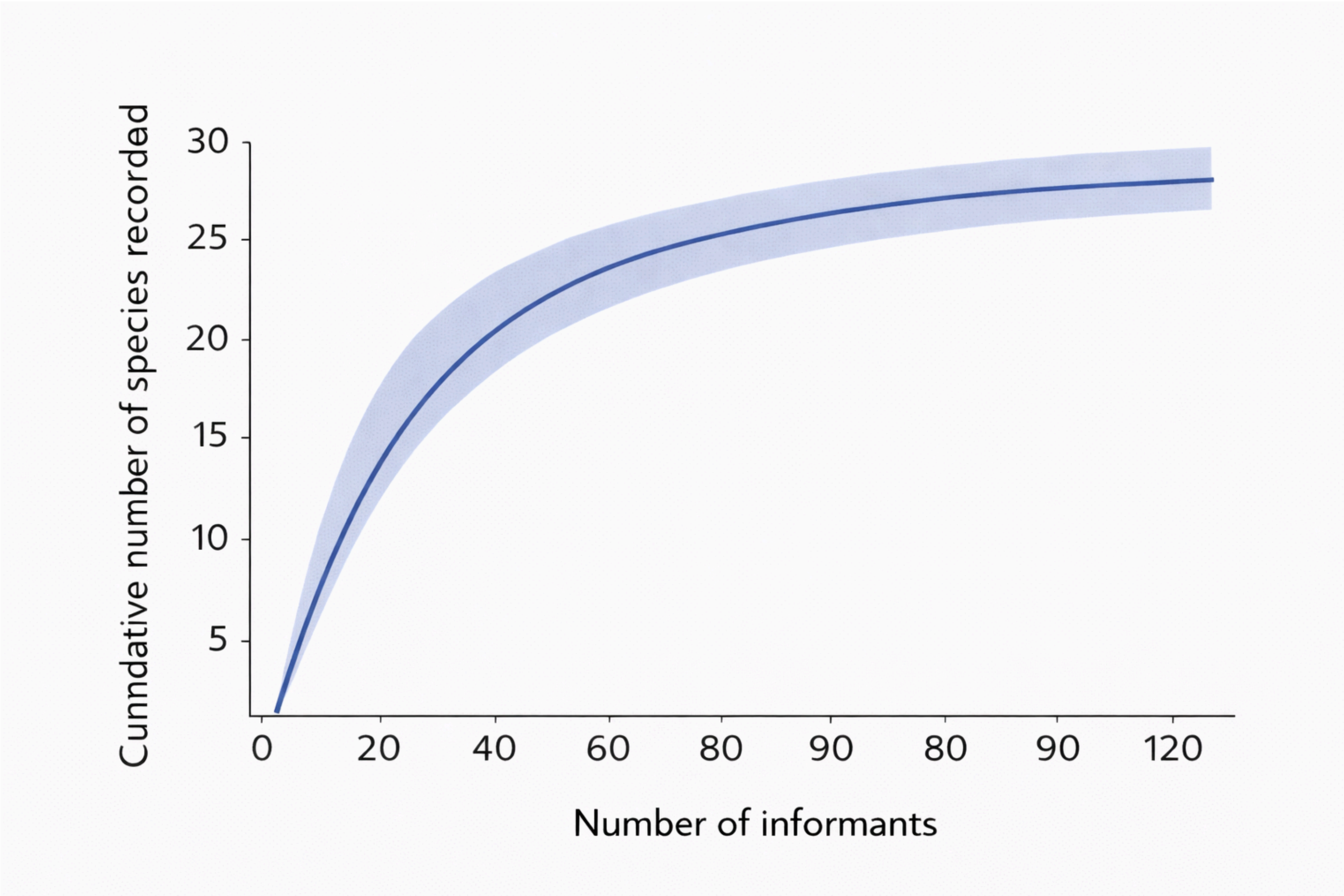

Figure 2

Species accumulation curve for ethnoveterinary medicinal plants recorded in Kulbo Forest.

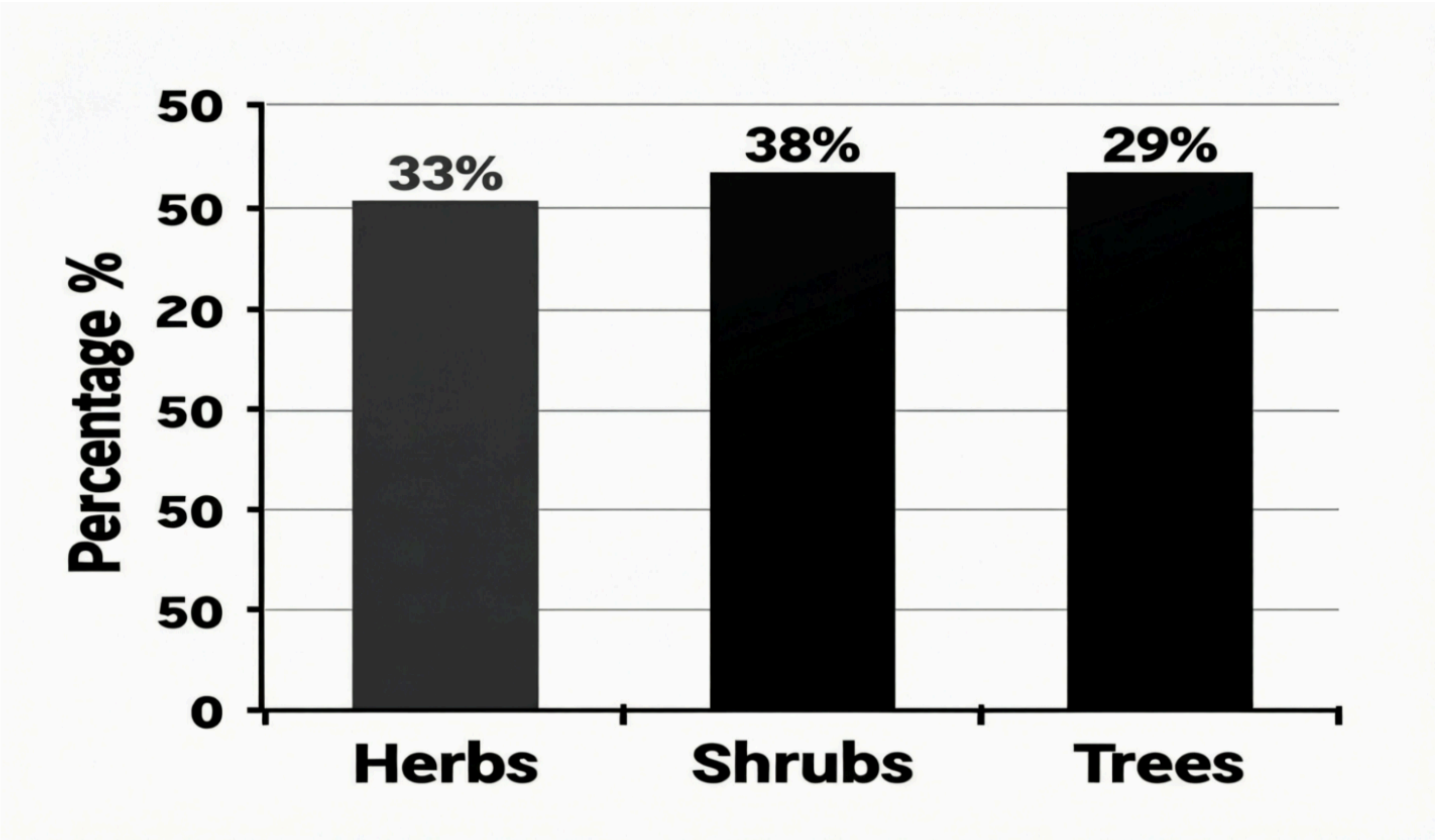

Figure 3

Growth-form distribution of ethnoveterinary medicinal plants in Kulbo Forest.

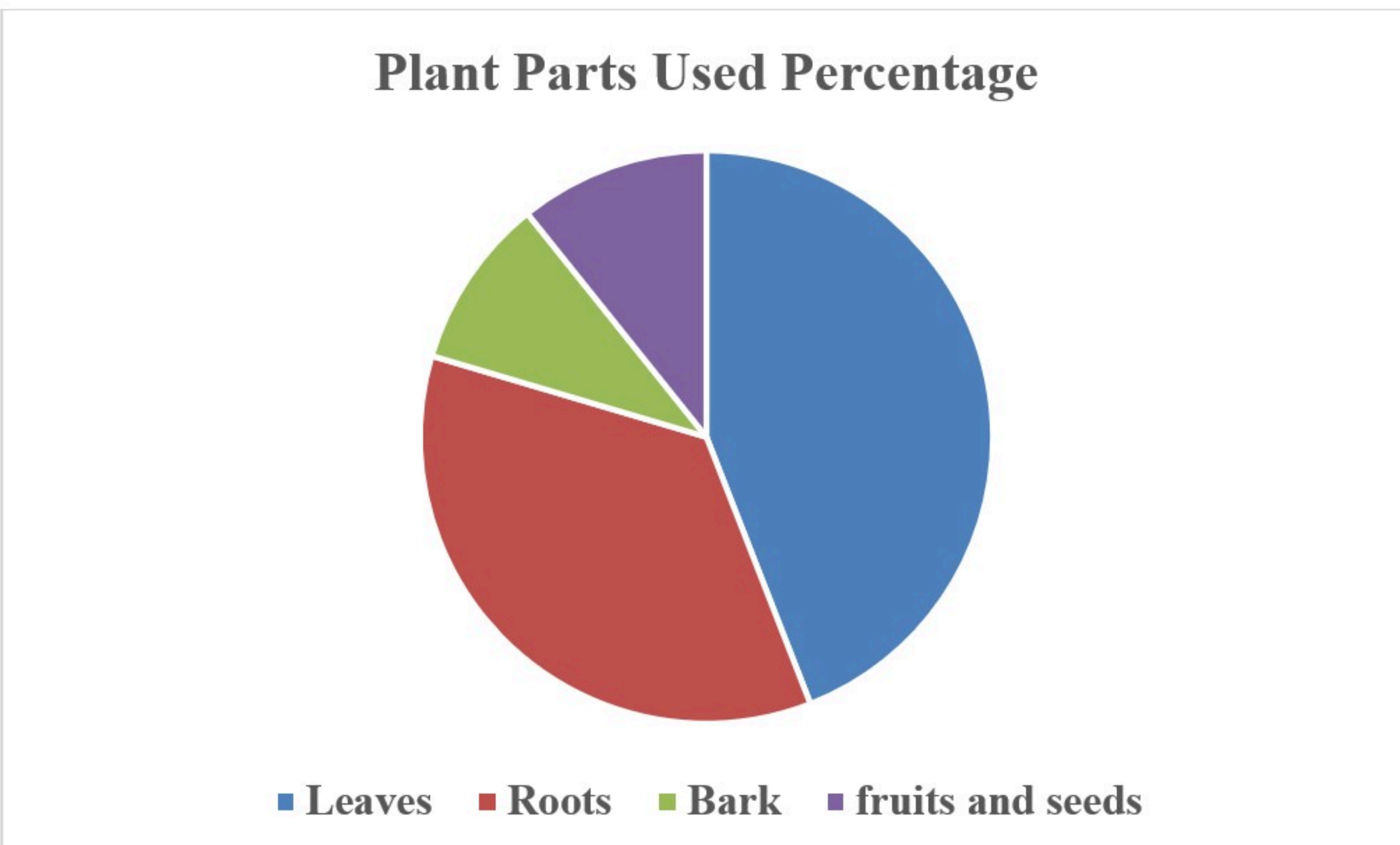

Figure 4

Plant parts used in ethnoveterinary medicinal preparations in Kulbo Forest.

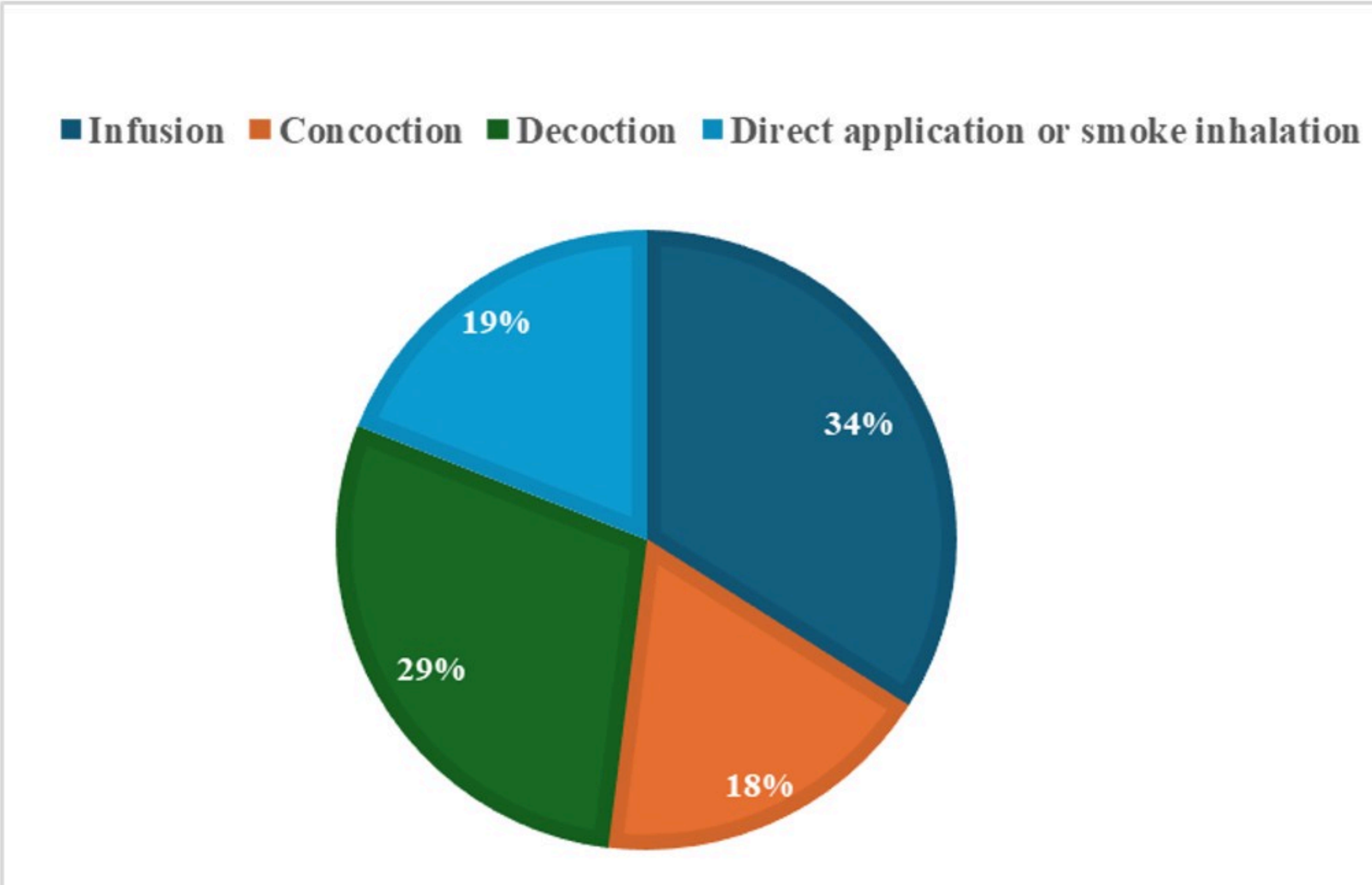

Figure 5

Preparation methods employed in ethnoveterinary remedy preparation in Kulbo Forest.

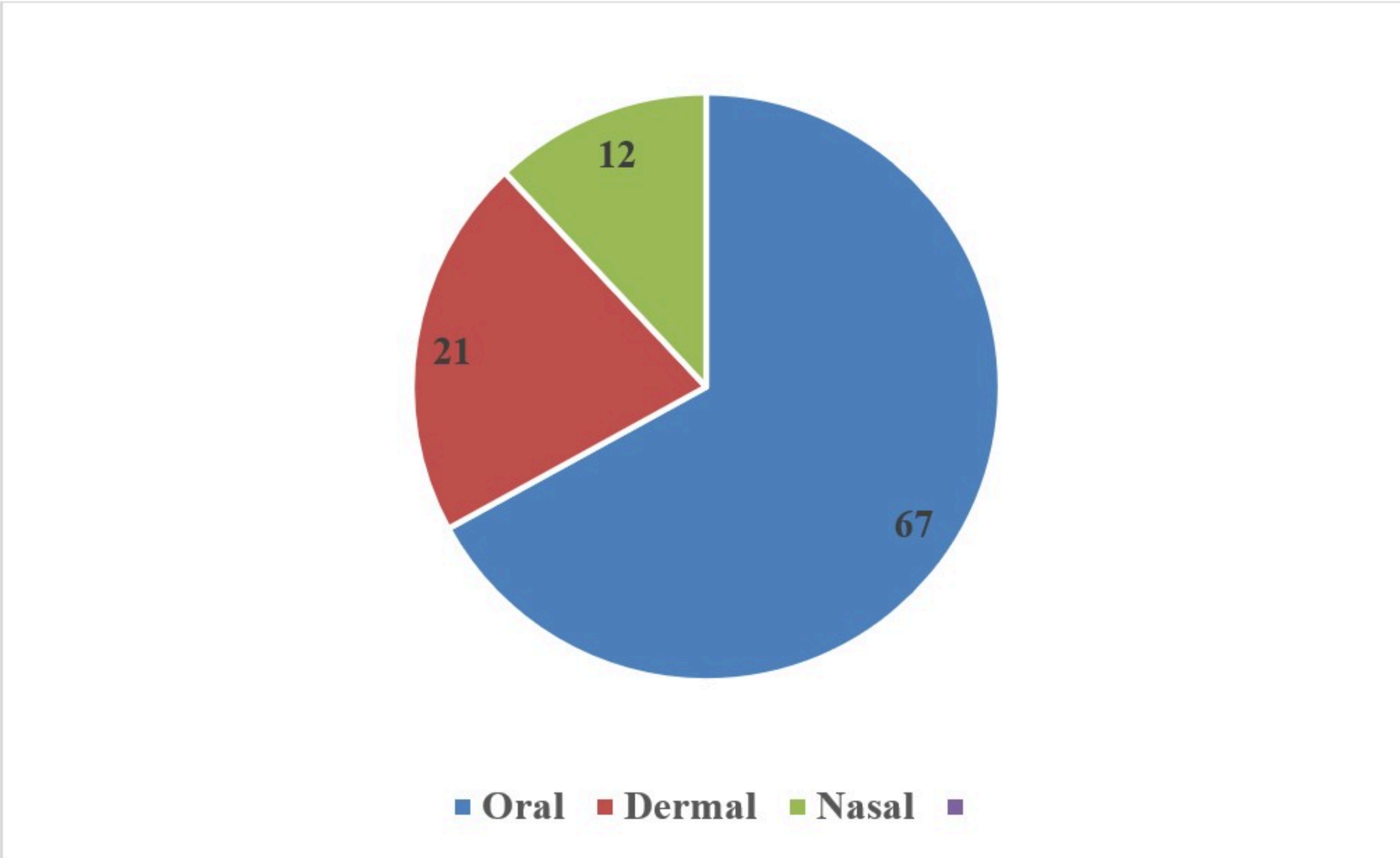

Figure 6

Routes of administration of ethnoveterinary remedies used for livestock healthcare.

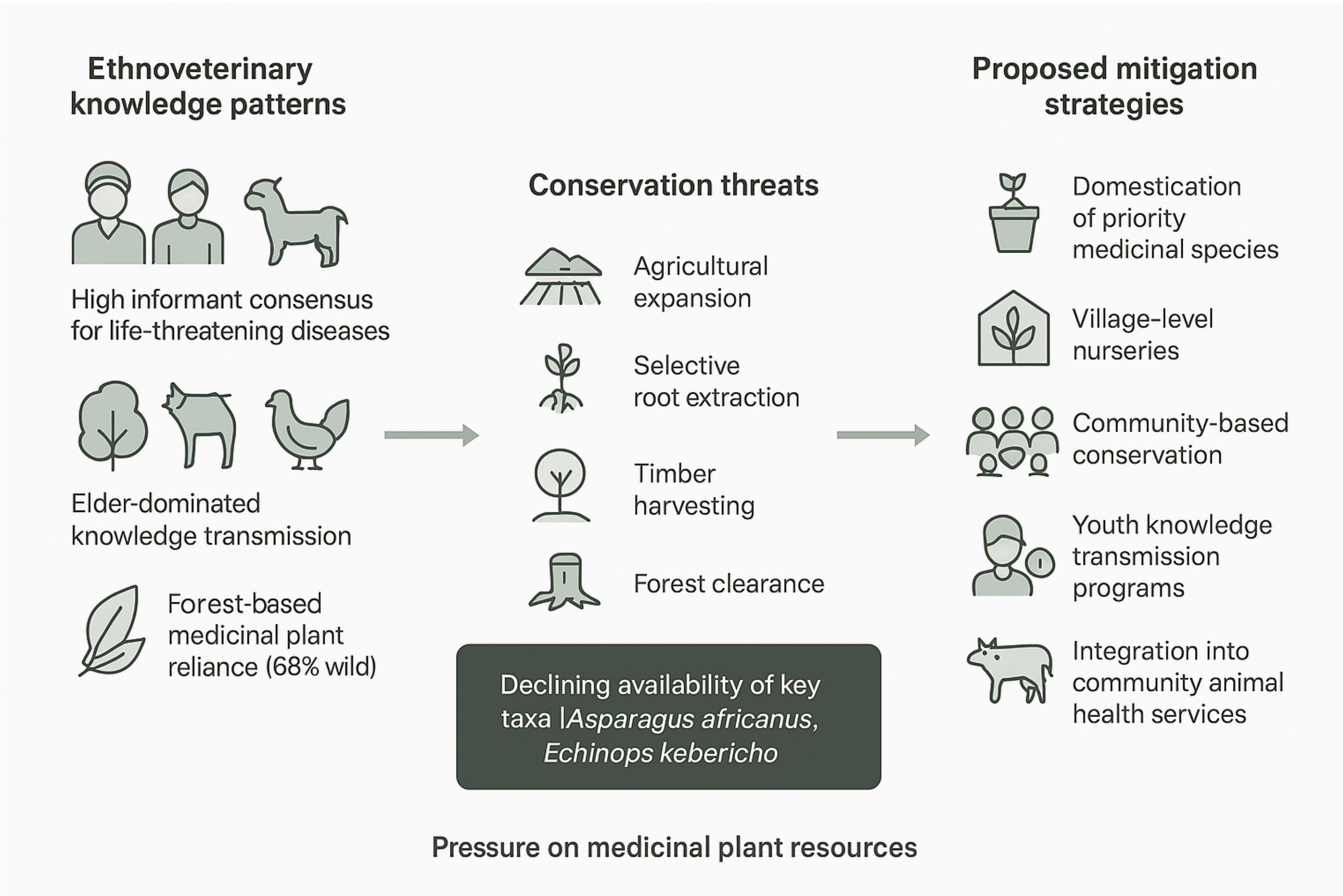

Figure 7

Summary diagram of key ethnoveterinary knowledge patterns, conservation threats, and proposed mitigation strategies in Kulbo Forest.