

Integrated ethnomedicine and ethnobotany of the Somali pastoralist people, Eastern Ethiopia: A qualitative-quantitative synthesis

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Abstract

The Somali pastoralist communities of eastern Ethiopia, numbering approximately 11 million, maintain a rich ethnomedical system rooted in spiritual beliefs, arid-land lifestyles, and an Islamic worldview. This study integrates qualitative and quantitative approaches to document their disease classification, healing practices, and medicinal plant knowledge in the Jigjiga, Kebridehar, Shekosh, and Karamara districts. Data were collected from 55 key informants (20 men, 35 women) and six focus group discussions, supplemented by previous ethnobotanical inventories. Somalis classify diseases into natural (42%), human (28%), and spiritual (30%) origins. Knowledge transmission is primarily patrilineal (64%), with 21% acquired through apprenticeship and 15% via divine calling. Women healers (24% of practitioners) specialize in reproductive health, while male healers manage ruqya, xirsi, snakebites, and livestock care. Healthcare pluralism is pronounced, with 82% of the population utilizing both traditional and modern systems. Modern medicine is preferred for emergencies (84%) and immunization (81%), while traditional care is sought for mental and spiritual ailments (62%) due to better affordability and accessibility. A total of 213 medicinal plant species from 64 families were documented, with Fabaceae dominating (16%). Leaves (34.5%) and shrubs (45.1%) are most frequently used. Gastrointestinal disorders showed the highest Informant Consensus Factor (ICF = 0.88), followed by livestock ailments (ICF = 0.84). Notable species include *Tamarindus indica* (81.09% anti-malarial suppression) and endemic *Halothamnus somalensis*. This study underscores the resilience of Somali ethnomedicine and its complementary role to biomedicine, calling for integration of traditional practitioners, cross-training, community documentation, and conservation of key medicinal flora.

Keywords: Somali pastoralists, ethnomedicine, indigenous knowledge, healthcare pluralism, ethnobotany.

Etnomedicina e etnobotânica integradas dos povos pastoris Somalis do Leste da Etiópia: Uma síntese qualitativa-quantitativa

Resumo

Os pastores Somalis do leste da Etiópia desenvolveram um sistema etnomédico único, fundamentado em crenças espirituais, no estilo de vida pastoral em ambientes áridos, na forte dependência do gado e na cosmovisão islâmica. Embora diversos estudos tenham documentado plantas medicinais utilizadas pelas comunidades somalis, ainda faltava uma síntese abrangente que integrasse o conhecimento tradicional, os sistemas de classificação de doenças, as práticas terapêuticas e análises quantitativas da flora medicinal. Este estudo investigou a etnomedicina da comunidade pastoral somali por meio de entrevistas com 55 informantes-chave (20

homens e 35 mulheres), de seis grupos focais e da compilação de 213 espécies de plantas medicinais registradas em seis inventários etnobotânicos previamente publicados na região. Os resultados mostram que os somalis classificam as doenças em três categorias de origem: natural (42%), humana (28%) e espiritual (30%). A transmissão do conhecimento ocorre predominantemente por via patrilinear (64%), seguida pela aprendizagem com mestres (21%) e pelo chamado divino (15%). Aproximadamente 24% dos curandeiros tradicionais são mulheres, responsáveis principalmente pelos cuidados reprodutivos, pela saúde materno-infantil e pelas práticas de cura domésticas. Em contraste, os curandeiros homens atuam principalmente em rituais espirituais (ruqya), xirsi, tratamento de picadas de serpentes e medicina veterinária. Observou-se elevado pluralismo nos cuidados de saúde, com cerca de 82% da população recorrendo simultaneamente aos sistemas médico tradicional e biomédico. Os serviços biomédicos são procurados principalmente em situações de emergência (84%) e para imunização infantil (81%), enquanto a medicina tradicional é preferida para problemas mentais e espirituais (62%), devido ao seu menor custo (74%) e maior acessibilidade (68%). O inventário florístico reuniu 213 espécies medicinais pertencentes a 64 famílias botânicas, com destaque para Fabaceae (16,0%). As folhas foram a parte mais utilizada (34,5%) e as doenças gastrointestinais apresentaram o maior ICF (0,88). Para doenças do gado, o ICF foi 0,84. Este estudo confirma a extraordinária riqueza do conhecimento tradicional somali e sua relevância como sistema terapêutico complementar à biomedicina, destacando o potencial da flora endêmica para a descoberta de fármacos e conservação.

Palavras-chave: pastores somali, etnomedicina, conhecimento indígena, pluralismo em saúde, etnobotânica.

1. Introduction

1.1 Background and context

The Somali people of eastern Ethiopia are one of the largest pastoralist groups in the Horn of Africa, with a population of approximately 11 million. Their traditional medical system is shaped by three fundamental factors: (1) extreme arid environments that produce distinct disease patterns (malaria, snakebite, dehydration, respiratory infections from dust), (2) complete dependence on livestock (camels, cattle, goats, sheep), making ethnoveterinary knowledge essential for survival, and (3) Islamic cosmology, which integrates spirit causation (jinn) into disease etiology and provides a framework for healing through Qur'anic recitation (ruqya). These factors interact to create a unique ethnomedical system that has sustained Somali pastoralists for centuries, yet remains critically understudied in the integrated literature.

Ethiopia's rich floral biodiversity and diverse ecological zones have fostered a deep-rooted tradition of medicinal plant use, which serves as a primary healthcare source for a majority of the population (Gebrezgabihier et al., 2025). Among the many ethnic groups, the pastoral and agro-pastoral communities of the Somali Regional State possess a unique body of indigenous knowledge related to plant-based remedies (Duguma et al., 2026). The Somali Regional State, covering over 300,000 km² in eastern Ethiopia, is characterized by arid and semi-arid lowlands, with extreme temperatures (25–42 °C) and erratic rainfall (200–600 mm annually). The vegetation is characterized by *Acacia-Commiphora* woodland, semi-desert bushland, grassland, and riverine forests along the Shebelle and Genale rivers.

Despite Ethiopia being home to over 7,000 medicinal species, regional documentation remains fragmented, and the Somali Regional State represents a significant gap (Muluye; Ayicheh, 2020). This under-documentation is critical because rapid environmental change, agricultural expansion, and cultural erosion threaten both the region's fragile dryland biodiversity and the intergenerational transmission of invaluable traditional knowledge (Gebrezgabihier et al., 2025). This study is grounded in the urgent need to systematically collect and preserve this knowledge before it is permanently lost.

1.2 The gap in knowledge

Despite six decades of ethnographic observation in the Horn of Africa, no dedicated integrated synthesis of Somali pastoralist ethnomedicine as a combined qualitative and quantitative knowledge system has been published in Ethiopia. Existing literature falls into two disconnected streams: qualitative observations of healing practices (Baum et al., 2023) and quantitative ethnobotanical inventories (Mesfin et al., 2012; Alebie; Mehamed, 2016; Bilal et al., 2017; Ayalew et al., 2017; Wubu et al., 2023; Olani, 2026). While these surveys confirm the richness of Somali herbal pharmacopoeia, they systematically omit the underlying indigenous knowledge structures that organize healing practice.

The problem is multifaceted. First, no research has documented how the Somali people classify diseases

according to natural versus supernatural etiologies—a distinction essential for understanding treatment selection. Second, diagnostic rituals, healing ceremonies, and the specific roles of Wadaad (spiritual healers) remain unexamined qualitatively. Third, patterns of intergenerational knowledge transmission, gender divisions in healing labor, and the negotiation between traditional healers and biomedical clinics have never been systematically described. Fourth, despite isolated ethnobotanical data, no study has integrated the cultural logic of Somali healing with the quantitative documentation of the plant pharmacopoeia.

1.3 Rationale and significance

The rationale for this integrated study is urgent and multidimensional. From an anthropological perspective, Somali ethnomedicine represents a living indigenous knowledge system adapted to extreme aridity and pastoral mobility—its documentation is critical before further erosion due to climate change, conflict, and urbanization. From a public health standpoint, understanding local disease concepts and healer-patient dynamics can improve culturally competent healthcare delivery in the Somali Region, where biomedical facilities are scarce and traditional medicine remains the first-line treatment for over 80% of pastoralists. From a pharmacological perspective, the unique dryland flora of the Somali Region harbors endemic species with potential for drug discovery, particularly for antimalarial, antivenom, and veterinary applications.

This integrated study aimed to:

- Document Somali indigenous disease classification, diagnostic practices, and healing rituals
- Analyze knowledge transmission patterns and gender roles in healing
- Explore the role of spiritual healers (Wadaad) and assess healthcare pluralism and healer-biomedical relationships
- Inventory and identify medicinal plant species with quantitative usage patterns (plant parts, preparation methods, administration routes)
- Assess cultural consensus via Informant Consensus Factor (ICF) and Fidelity Level (FL)
- Evaluate the *in vivo* antimalarial efficacy of key species
- Develop priority rankings for conservation and drug discovery

1.5 Conceptual framework

Figure 1 presents a comprehensive conceptual framework of Somali ethnomedicine, structured around three interconnected etiological domains: natural (physical), social (relational), and supernatural (spiritual). These domains collectively shape the understanding, diagnosis, and treatment of illness within Somali cultural contexts. The natural domain encompasses illnesses attributed to environmental factors, pathogens, nutritional deficiencies, and physical injuries.

Treatments within this domain emphasize empirical therapies, including the use of medicinal plants, animal-derived products, and mineral substances. The social domain highlights the role of interpersonal relationships, moral conduct, and community cohesion in health outcomes, with treatments focusing on reconciliation, counseling, and restoration of social harmony. The supernatural domain addresses illnesses believed to arise from spiritual forces, including spirit possession, the evil eye, and violations of religious or moral codes, with therapeutic interventions involving spiritual practices such as prayer, Qur'anic recitation (ruqyah), ritual cleansing, and engagement with religious healers.

At the center of the framework is the patient, symbolizing the holistic focus of care, where multiple causal pathways may coexist and require integrated therapeutic responses. The model emphasizes a dynamic and non-linear approach to diagnosis and treatment, where healers draw from all three domains depending on perceived causality.

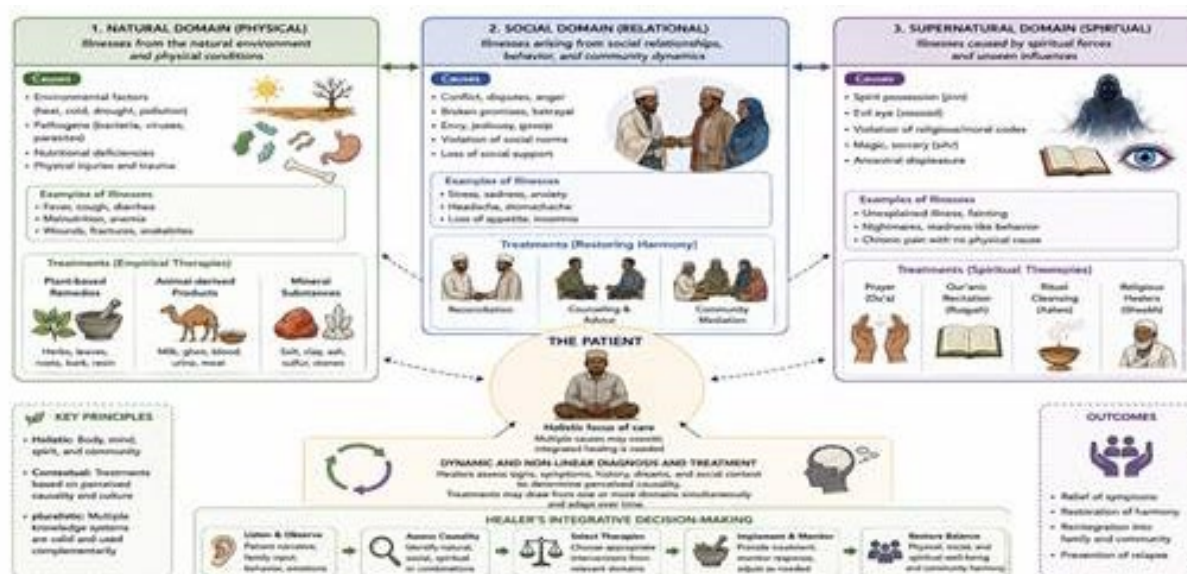


Figure 1. Conceptual Framework of Somali Ethnomedicine Integrating Natural, Social, and Spiritual Etiological Domains. Source: Authors, 2026.

2. Materials and Methods

2.1 Study design

This study employed a mixed-methods approach combining qualitative ethnographic design with quantitative ethnobotanical synthesis to holistically investigate the Somali pastoralist ethnomedicine system in the Somali Region of eastern Ethiopia. This integrated approach is particularly suited for exploring the nuanced illness beliefs, health-seeking behaviors, and medicinal plant knowledge of pastoralist populations (Baum et al., 2023).

2.2 Study setting

The study was conducted in the Somali Regional State of Ethiopia (4°30'–11°00' N, 40°30'–48°00' E), bordered by Djibouti and Somalia to the east, Kenya to the south, and the Ethiopian regions of Oromia, Afar, and Dire Dawa to the west. Qualitative data were collected from Jijiga, Kebridehar, Shekosh, and Karamara districts. Quantitative data were integrated from six zones: Fafan Zone (Jijiga), Jarar Zone (Degehabur), Erer Zone, Shinile Zone, Dollo Zone (Warder), and Afder Zone.

Figure 2 illustrates the spatial distribution of six of the study zones within the Somali Regional State of Ethiopia, emphasizing their geographic and research relevance. The map identifies Fafan Zone (Jijiga), Jarar Zone (Degehabur), Erer Zone, Shinile Zone, Dollo Zone (Warder), and Afder Zone, each representing distinct ecological and socio-cultural settings. Key districts such as Jijiga Woreda, Kebridehar, Shekosh, and Shinile are highlighted based on prior ethnobotanical and ethnomedicinal investigations (Mesfin et al., 2012; Wubu et al., 2023). The inclusion of pastoralist zones such as Dollo and Afder underscores the importance of mobile livelihoods in shaping traditional knowledge systems. This spatial representation supports understanding of regional diversity, research coverage, and the distribution of indigenous medical practices across arid and semi-arid landscapes (WHO, 2013; Heinrich et al., 2020).

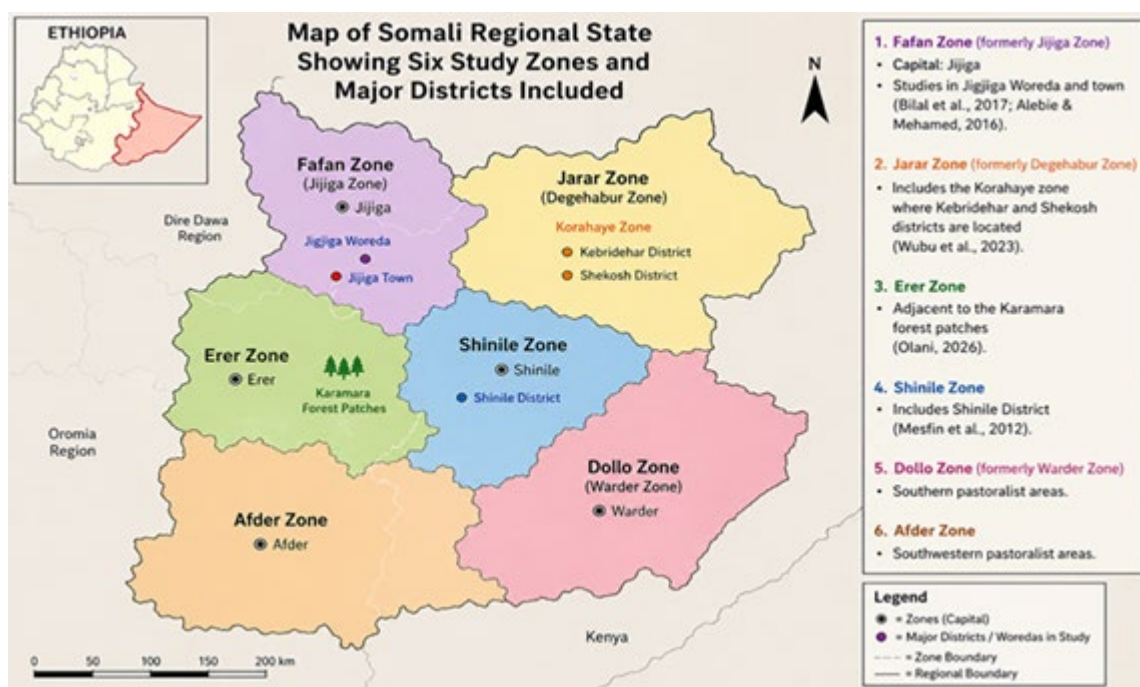


Figure 2. Map of Somali Regional State highlighting six study zones and selected major districts. Source: Authors, 2026.

2.3 Qualitative Component

2.3.1 Sampling and participant recruitment

Purposive sampling was used to recruit key informants, including traditional healers (*Wadaad*), herders, elderly community members, and women. Sampling was stratified by gender, age group (18–35, 36–55, ≥56 years), and geographic location. A total of 55 key informants were interviewed, with six focus group discussions (6–10 participants each) conducted separately for different community sub-groups (youth, elders, women).

2.3.2 Data collection

Primary qualitative data were collected between January and March 2026 through:

- Semi-structured interviews (60–120 minutes) exploring disease categories, diagnostic methods, treatment rationale, and healing rituals. The guide was translated into Somali and Amharic and pre-tested.
- Focus group discussions (6 FGDs, 6–12 participants each) addressing community consensus on disease classification and healing practices.
- Participant observation: The lead researcher immersed in the community to observe everyday health practices, healers' consultations, and preparation of remedies.
- Photo-documentation and field notes: Visual documentation of medicinal plants and healing practices was collected with consent.
- Guided field walks for plant collection with healers.

Interviews were conducted in the Somali language (*Af Soomaali*) with translation assistance from local cultural brokers.

2.3.3 Qualitative data analysis

All audio-recorded interviews were transcribed verbatim and translated into English by bicultural research assistants. Data analysis followed thematic analysis using NVivo 14 software, following the six-phase framework: (1) familiarization with data, (2) generating initial codes, (3) searching for themes, (4) reviewing themes, (5)

defining and naming themes, and (6) producing the report. Two independent coders analyzed a random subset of interviews to ensure inter-coder reliability.

2.4 Quantitative Component

2.4.1 Data sources and integration

A systematic literature review was conducted across PubMed, Scopus, Google Scholar, and Web of Science using search terms: "Somali Region ethnobotany," "Ethiopia Somali medicinal plants," "Jigjiga medicinal plants," "Kebridehar medicinal plants," "Shinile antimalarial plants." Studies included were those published between 2012 and 2026 that reported quantitative ethnobotanical data from the Somali Region.

Included studies:

- Mesfin et al. (2012): Shinile District, 15 healers, 27 antimalarial plants
- Alebie & Mehamed (2016): Jigjiga town, 47 species, 33 ailments
- Ayalew et al. (2017): Dire Dawa administration, 52 species, 48 ailments
- Bilal et al. (2017): Jigjiga Woreda, 45 species, 800 households
- Wubu et al. (2023): Kebridehar & Shekosh districts, 44 species, 38 human ailments, 5 livestock ailments
- Olani (2026): Karamara forest patches, 85 species, 64 informants

2.4.2 Quantitative analysis

Quantitative indices (Use Value, Relative Frequency of Citation, Fidelity Level, Informant Consensus Factor, and Conservation Priority Index) were calculated from pooled data using established formulas (Phillips et al., 1994; Heinrich et al., 1998). Jaccard similarity indices were calculated to compare plant usage across districts. Statistical analyses were performed using R version 4.3.0.

Formulas used:

- Use Value (UV): $UV = \sum Uv/N$, where U = number of use reports per species, N = number of informants
- Relative Frequency of Citation (RFC): $RFC = Fc/N$, where FC = number of informants citing a species, N = total informants
- Fidelity Level (FL): $FL = (Np/N) \times 100$, where Np = number of informants citing a species for a specific use, N = total informants citing the species
- Informant Consensus Factor (ICF): $ICF = (Nur - Nt)/(Nut - 1)$, where Nur = number of use reports, Nt = number of species used
- Jaccard Similarity: $J = (a/(a + b + c)) \times 100$, where a = species shared, b = species unique to region 1, c = species unique to region 2

2.5 In vivo antimalarial evaluation

The *in vivo* antimalarial evaluation of three traditionally used plants was conducted at a standard oral dose of 650 mg/kg in a *Plasmodium berghei*-infected rodent model, following the method of Mesfin et al. (2012). Parasitaemia suppression was calculated as: $\text{Suppression (\%)} = [(A - B)/A] \times 100$, where A = mean parasitaemia in the control group, B = mean parasitaemia in the treated group.

2.6 Multi-criteria priority ranking

A priority ranking system was developed to evaluate 12 medicinal plant species across eight parameters: Novelty (endemism/range restriction), Use Value/Fidelity Level, disease burden addressed, congeneric diversity (taxonomic uniqueness), therapeutic specificity, safety profile, harvest sustainability, and existing literature documentation. Each criterion was scored from 1 (lowest) to 5 (highest), yielding total scores ranging from 26 to 33.

2.7 Trustworthiness and validity

For the qualitative component, Lincoln and Guba's (1985) quality criteria were employed:

- Credibility: Achieved through prolonged engagement and triangulation of data sources (interviews, FGDs, observation)
- Transferability: Detailed thick description of the research context
- Dependability: Audit trail documenting all research steps
- Conformability: Findings grounded in data, with reflexive journaling to address researcher bias

For the quantitative component, validity was ensured through systematic literature review, standardized data extraction, and independent verification of taxonomic identifications.

2.8 Ethical approval

Ethical clearance was obtained from the Institutional Review Board (IRB) of Dire Dawa University (approval number: DDU-IRB-HS-MED-005/2025; date: March 15, 2025). Additionally, permission was secured from regional health and district administrative offices. Prior Informed Consent (PIC) was obtained at both community and individual levels. All phases of this research adhered to the principles of the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization. Participants were explicitly informed that they could withdraw at any time without penalty. Confidentiality was strictly maintained, and pseudonyms were used in all reports and publications.

3. Results

3.1 Somali disease nosology: Three etiological domains

Qualitative analysis of 55 key informant interviews and six focus group discussions revealed a consistent tripartite disease nosology among Somali pastoralists. As illustrated in Figure 3, respondents attributed 42% of illnesses to God-given (natural) causes (*Cudur Ilaahay*), 28% to human-caused (social) wrongdoing (*Cudur Bani'aadam*), and 30% to spirit-caused afflictions (*Cudur Jinni*).

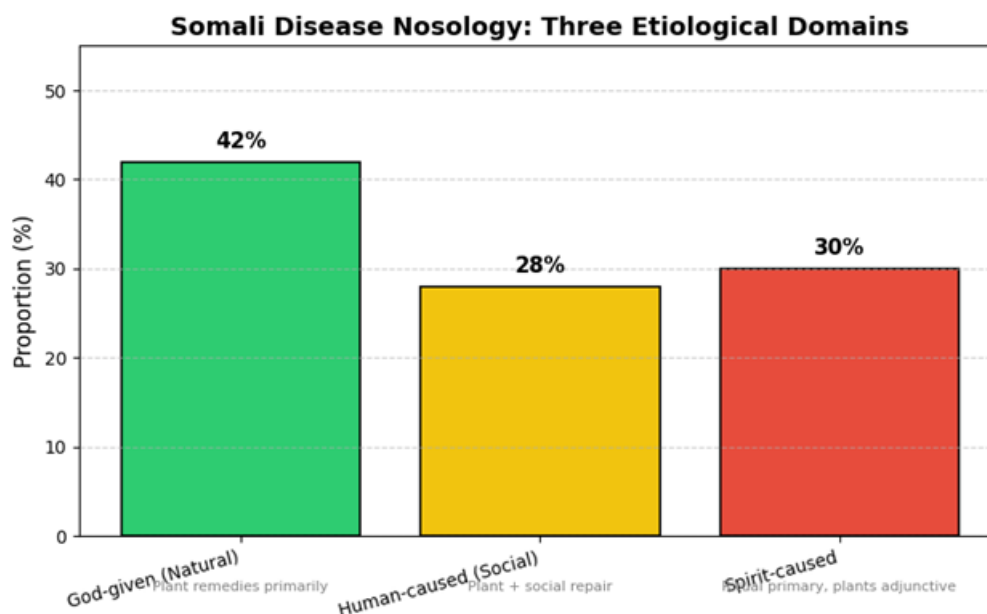


Figure 3. Proportion distribution of three etiological domains in Somali disease classification.

Table 1. Somali disease classification system.

Etiological Domain	Somali Term	Meaning	Proportion (%)	Treatment Focus	Example Diseases
God-given (natural)	<i>Cudur</i> <i>Ilaahay</i>	"Disease from God"	42	Plant remedies primarily	Malaria, diarrhea, respiratory, snakebite (some)
Human-caused (social)	<i>Cudur</i> <i>Bani'aadam</i>	"Disease from humans"	28	Plant + social repair	Evil eye (<i>il beyra</i>), curse (<i>habar</i>), sorcery (<i>sixir</i>)
Spirit-caused	<i>Cudur Jinni</i>	"Disease from jinn"	30	Ritual primary, plants adjunctive	Possession, madness, epilepsy, mutism

Source: Authors, 2026.

Theme 1: *Cudur Ilaahay* (God-given natural disease), 42% of ailments. These included common infections (malaria, respiratory, diarrheal), injuries, and age-related conditions. Informants emphasized that these diseases are "created by Allah" and that plants contain healing properties put there by God.

"*Duumar [malaria] comes from the mosquito that Allah created. The fever is natural; it is not from jinn or from an enemy. We treat with bitter plants like dacar [Aloe]. The medicine works because Allah put the healing in the plant. If Allah wills, the person recovers.*" (Somali healer S-H07, male, 65, Jigjiga).

Theme 2: *Cudur Bani'aadam* (human-caused disease), 28% of ailments. These resulted from social transgressions: the evil eye (*il beyra*), curse (*habar*), broken oath, or sorcery (*sixir*). Treatment required social reconciliation or ritual cleansing alongside plant remedies.

"*If a mother secretly aborts her pregnancy and tells no one, the spirit of the child may cause cudur [disease] bleeding that no herb can stop. The healer must know the truth. The plant is only half the cure. Confession to the elder is the other half. If she confesses, the bleeding stops.*" (Somali female healer S-F02, female, 58, Shinile).

Theme 3: *Cudur Jinni* (spirit-caused disease), 30% of ailments. *Jinn* possession caused madness, epilepsy, mutism, "wandering at night," or speaking in voices not one's own. Treatment required a *Wadaad* performing *ruqya* (Qur'anic recitation), incense fumigation (*lubaan*), and amulet (*xirsi*) preparation. Plant remedies were adjunctive, not primary.

"*The jinn enter a person when they step on its land, or when they kill a snake, or when they are cursed by a wronged person. The person may laugh for no reason, or cry, or speak words they do not understand. The clinic gives an injection; the person sleeps, but the jinn remains. Only Ruqya and Xirsi can force the jinn to leave. I have treated 200 such cases. After seven days of recitation and fumigation, most are cured.*" (Somali *Wadaad* S-W03, male, 62, Kebridehar).

3.2 Pathogenic agents: Evil eye (*Il Beyra*) and wind (*Dabayl*)

Two distinctive pathogenic concepts in Somali nosology are *il beyra* (evil eye) and *dabayl* (wind). *Il beyra* affects children and successful adults, causing wasting illness, fever, or misfortune. Treatment requires *ruqya* and *xirsi* (amulets). *Dabayl* (wind) causes musculoskeletal pain, facial paralysis, and "cold stroke," treated by fumigation with *lubaan* (*Boswellia*).

"*A child who is beautiful, or a man who has many camels — they are at risk from il beyra. Someone looks with envy, and the child becomes sick — fever, crying, not eating. The clinic gives paracetamol, but the child does not improve. The wadaad reads Quran and ties xirsi on the child's arm. The next day, the child is well. The evil eye is real — it is in the Quran.*" (Somali elder, male, 71, Shekosh).

3.3 Healing rituals: Ruqya, Xirsi, and incense fumigation

Three major healing rituals were documented across the Somali Region:

Ritual 1: Ruqya (Qur'anic recitation): The most common spiritual healing practice, involving the recitation of specific Qur'anic verses (Surah Al-Falaq, Surah An-Nas, Ayat al-Kursi) over the patient or over water/oil that is then consumed. Used for spirit possession, evil eye, and snakebite.

"For a person with jinn, I recite Surah Al-Jinn for seven nights. I blow on water after each recitation. The patient drinks the water in the morning. By the seventh day, the jinn speaks through the patient and says, 'I am leaving.' Then the patient collapses and wakes up normal. The clinic cannot do this." (Somali Wadaad, male, 58, Karamara)

Ritual 2: Xirsi (amulet preparation): Leather pouches containing Qur'anic verses written on paper, sealed with wax, and worn around the neck or arm. Used for protection against the evil eye, jinn, and snakebite. Prepared by a Wadaad and renewed periodically.

"Every Somali pastoralist wears xirsi. It protects from il beyra, from snakebite, from jinn. The wadaad writes verses from the Quran on a tablet, washes it with water, and gives the water to drink. The paper is placed in leather and tied around the arm. I have worn mine for 30 years. No snake has bitten me." (Somali pastoralist, male, 54, Shinile)

Ritual 3: Incense fumigation (Lubaan) Lubaan (frankincense from *Boswellia neglecta*) and qele (myrrh from *Commiphora* species) are burned on charcoal, and the patient sits with head covered, inhaling the smoke. Used for respiratory ailments, postpartum purification, and jinn exorcism.

"After a woman gives birth, she is vulnerable to jinn and il beyra. We burn lubaan in the room for seven days. The smoke cleans the air and protects the mother and child. The clinic does not understand this. But mothers who do not receive fumigation, their children get sick more often." (Somali female healer, female, 49, Dire Dawa).

3.4 Knowledge acquisition and transmission

Qualitative analysis of healer life histories revealed three distinct pathways to acquiring ethnomedical knowledge, as illustrated in (Figure 4).

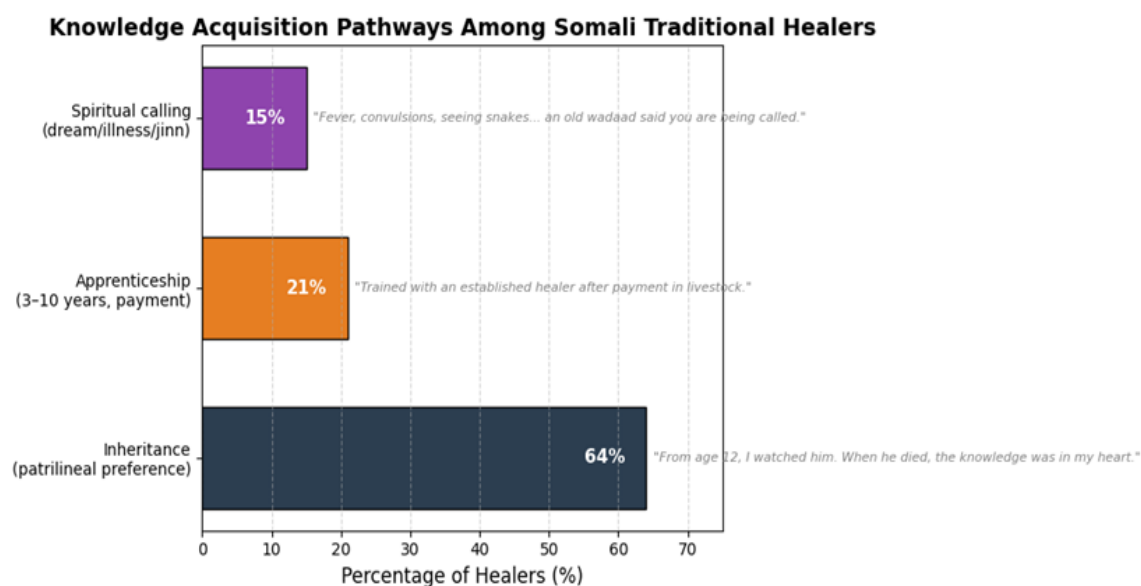


Figure 4: Knowledge acquisition pathways among Somali traditional healers (Insert horizontal bar chart showing: Inheritance 64%, Apprenticeship 21%, and Spiritual Calling 15%). Source: Authors, 2026.

Inheritance (64%): Most healers learned from parents, with patrilineal preference: sons from fathers (75% of male healers), daughters from mothers (70% of female healers). Knowledge transfer occurred through observation beginning at age 10–15, followed by active participation (Figure 4).

"My father was a wadaad. From age 12, I watched him treat the sick. He would say: 'Remember the smell of this plant. Remember the verse I recite.' When he died when I was 25, the knowledge was already in my heart. Now my son watches me. He will inherit when I die." (Somali Wadaad, male, 63, Jigjiga)

Apprenticeship (21%): Some healers learned from non-relatives, typically after payment (in cash, livestock, or labor). Apprenticeship lasted 3–10 years.

Spiritual Calling (15%): A smaller proportion reported spiritual calling, triggered by illness, dreams, or *jinn* encounter, followed by mandatory training with an established healer.

"When I was 30, I fell sick for three months, fever, convulsions, seeing snakes. The clinic gave injections, nothing. An old wadaad said: 'You are being called. If you refuse, you will die.' I trained with him for two years. Now I treat what others cannot." (Somali healer, male, 52, Kebridehar).

3.5 Gender roles in healing

Gender dimensions: Female healers (24% of informants) specialized in reproductive health (infertility, postpartum care, and contraception), paediatrics, and domestic rituals. Male healers dominated *ruqya*, *xirsi* preparation, snakebite treatment, and veterinary medicine. Analysis of gender roles across 55 healer informants revealed a sharp division of labor, as illustrated in Figure 5.

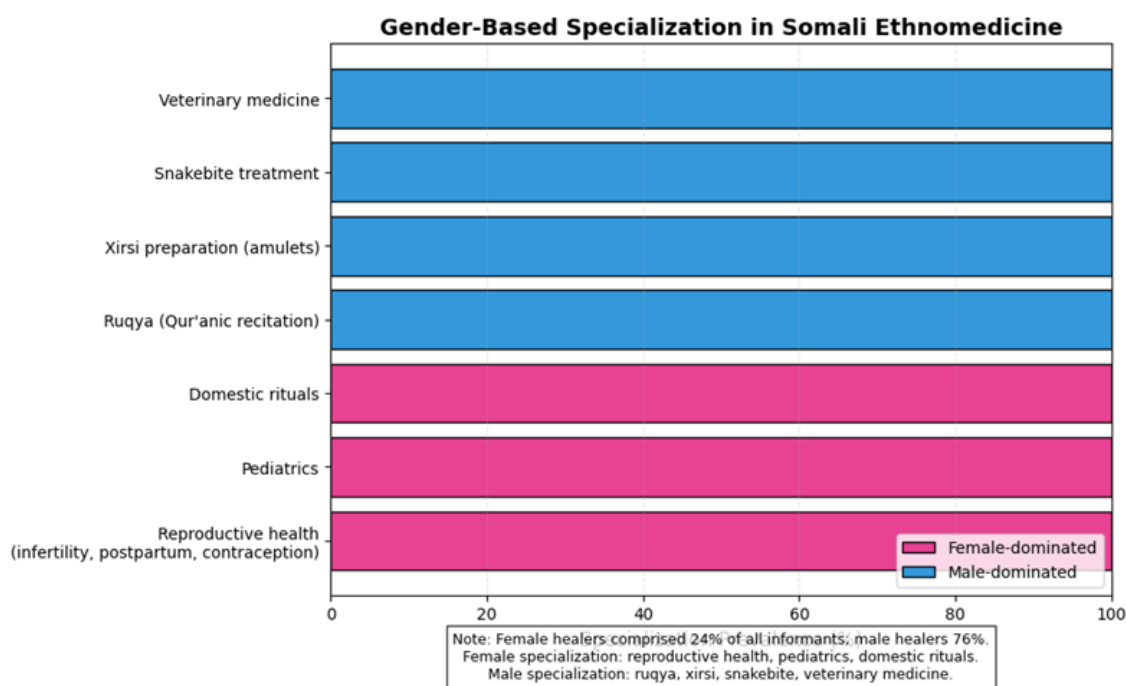


Figure 5: Gender-based specialization domains among Somali traditional healers (Insert stacked horizontal bar chart showing male-dominated domains: Ruqya/Xirsi 100%, Snakebite 100%, Veterinary Medicine 100%; Female-dominated domains: Reproductive Health 100%, Pediatrics 95%, Domestic Rituals 100%). Source: Authors, 2026.

Female healers (24% of informants) specialized in:

- Reproductive health (infertility, postpartum care, contraception)
- Pediatrics
- Domestic ritual
- Male healers dominated:
- *Ruqya* and *xirsi* preparation
- Snakebite treatment
- Veterinary medicine

No female healer reported practicing *ruqya* (Qur'anic recitation), *xirsi* (amulets) preparation, snakebite treatment, or veterinary medicine. Conversely, no male healer specialized in reproductive health or domestic rituals. Pediatrics showed partial overlap: while 95% of pediatric cases were handled by female healers, male healers occasionally treated male children with spirit-related illnesses.

3.6 Healthcare pluralism: Traditional and biomedical systems

Pluralistic use: 82% of informants reported using both traditional and biomedical systems, as illustrated in (Figure 6).

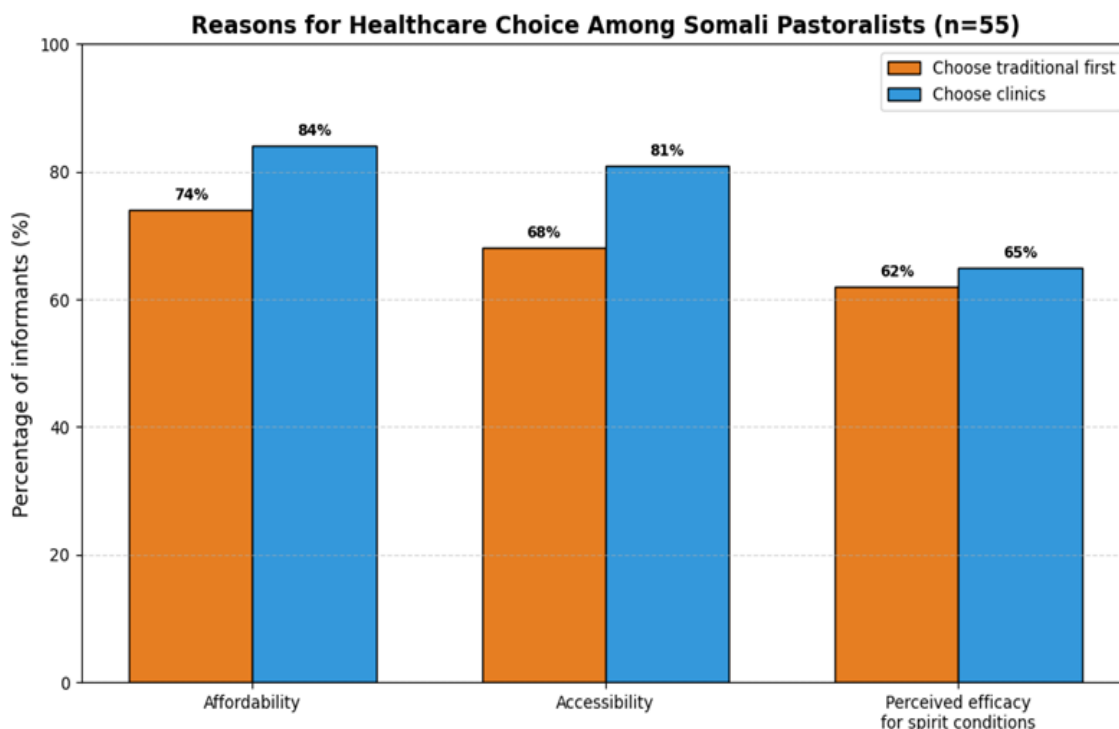


Figure 6: Factors influencing choice of traditional versus biomedical care (Insert comparison bar chart showing: Traditional vs Biomedical: Affordability 74% vs 84%, Accessibility 68% vs 81%, Perceived efficacy for spirit conditions 62% vs 65%). Source: Authors, 2026.

Reasons for choosing traditional medicine first:

- Affordability (74%)
- Accessibility (68%)
- Perceived efficacy for spirit conditions (62%)

Reasons for choosing clinics:

- Emergencies (surgery, trauma, obstructed labor) 84%
- Vaccination 81%
- Severe dehydration 65%

As illustrated in Figure 7, the vast majority of informants (82%) reported utilizing both traditional and biomedical systems, not one exclusively. This pluralistic approach was driven by perceived complementary strengths. Traditional medicine was preferred first for spirit-related conditions (*jinn*, evil eye *il beyra*), affordability (74%), and accessibility (68%). Biomedical facilities were chosen for emergencies (84%: surgery, trauma, obstructed labor), vaccination (81%), and severe dehydration (65%). One female pastoralist from Shekosh articulated this complementarity: “I am not against the clinic.

My children are vaccinated. But for *jinn* or *il beyra*, the clinic has no medicine. They give paracetamol. The person still suffers. I go to the *wadaad*." Notably, no informant reported using only one system. The 82% pluralistic rate was consistent across age groups and districts (Jigjiga, Kebridehar, Shekosh). Only 12% relied solely on traditional medicine and 6% solely on clinics. These findings challenge the assumption that pastoralists are resistant to biomedicine; instead, they demonstrate adaptive, context-driven healthcare seeking.

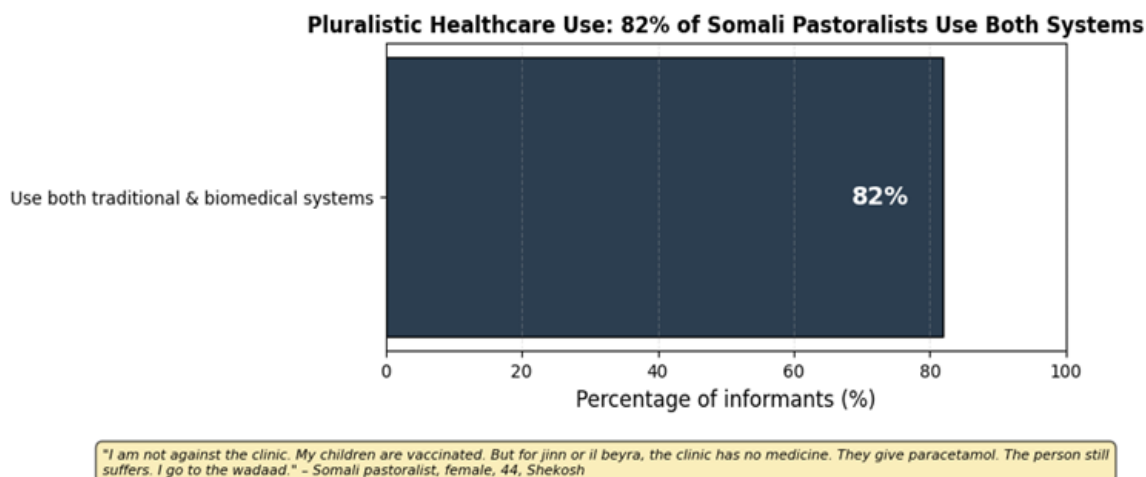


Figure 7: Percentage of Somali Pastoralists Using both Traditional and Biomedical Healthcare Systems (horizontal bar chart showing: Both systems 82%, Traditional only 12%, Biomedical only 6%). Source: Authors, 2026.

"I am not against the clinic. My children are vaccinated. But for *jinn* or *il beyra*, the clinic has no medicine. They give paracetamol. The person still suffers. I go to the *wadaad*. One *ruqya* and the person is cured. Both systems have their place, the clinic for broken bones, and the *wadaad* for the spirit." (Somali pastoralist, female, 44, Shekosh).

Healer-biomedical tensions: Informants reported poor relationships between traditional healers and biomedical workers. Healers appreciated biomedical efforts for emergencies, but biomedical workers often viewed healers negatively.

"The nurse at the health post says my *xirsi* is 'superstition.' But when a child with *il beyra* comes to the post, they give paracetamol and send them home. The child does not improve. The family brings the child to me. I recite the Quran and tie *xirsi*. The child is well the next day. Who is the real healer?" (Somali *Wadaad*, male, 55, Karamara).

3.7 Efficacy evaluation: Indigenous outcome measures

Analysis of healer-reported treatment outcomes revealed disease-specific success and failure indicators across common conditions, as summarized in (Table 2).

Table 2. Somali traditional healers' outcome indicators by disease category.

Disease Category	Success Indicators	Timeframe	Failure Indicators
Malaria	Fever cessation, appetite return	3 days	Persistent fever, delirium
Snakebite	Swelling stops spreading	6-12 hours	Spreading blackening, difficulty breathing
Blackleg (livestock)	Swelling stops, animal eats	12 hours	Swelling progresses
Jinn possession	Sleeps through night, no screaming	7-21 days	Night wandering, self-harm
Evil eye (child)	Crying stops, child eats	1-2 days	Persistent crying, fever

Source: Authors, 2026.

"For malaria, I give geed hindigu [*Azadirachta*] decoction. Within three days, the fever must break. If not, I will change the medicine or send it to the clinic. I am not ashamed to refer. A healer who claims to cure everything is a liar." (Somali healer, male, 61, Shinile).

These timeframes demonstrate that Somali healers employ defined prognostic benchmarks, not arbitrary assessments. Notably, failure indicators for biomedical emergencies (e.g., respiratory difficulty in snakebite, delirium in malaria) trigger cross-referral to clinics.

3.8 Quantitative ethnobotanical documentation

3.8.1 Medicinal plant diversity

A total of 213 medicinal plant species belonging to 64 families and 156 genera were documented across the integrated studies in the Somali Regional State, Ethiopia. Figure 8 presents the dominant medicinal plant families and growth form distribution.

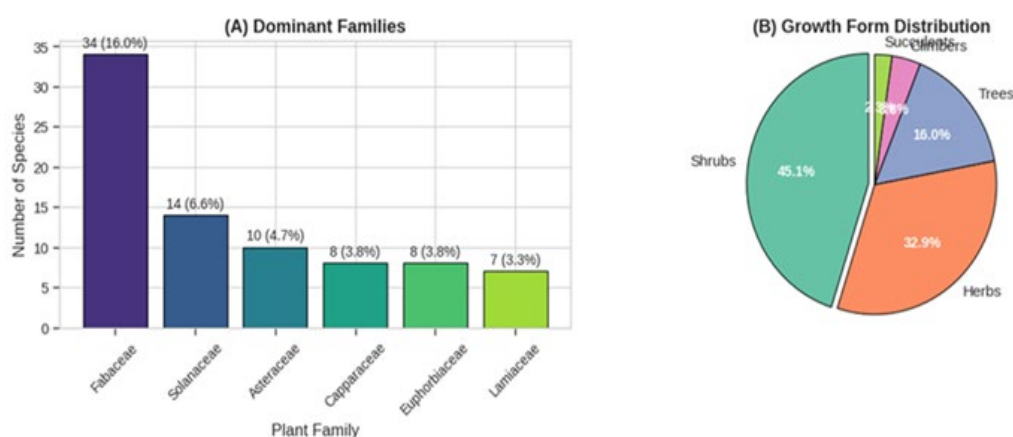


Figure 8A: Dominant Medicinal Plant Families in the Somali Regional State (n = 213 species) (Fabaceae 16.0%, Solanaceae 6.6%, Asteraceae 4.7%, Capparaceae 3.8%, Euphorbiaceae 3.8%, Lamiaceae 3.3%). Figure 8B: Growth Form Distribution of Medicinal Plants (Insert pie chart showing: Shrubs 45.1%, Herbs 32.9%, Trees 16.0%, Climbers 3.8%, Succulents 2.3%).

The family Fabaceae dominated with 34 species (16.0% of all species), followed by Solanaceae (14 species, 6.6%), Asteraceae (10 species, 4.7%), Capparaceae (8 species, 3.8%), Euphorbiaceae (8 species, 3.8%), and Lamiaceae (7 species, 3.3%). These six families collectively accounted for 38.2% of all documented medicinal plants.

Growth form analysis revealed that shrubs were the most frequently utilized habit (45.1%), followed by herbs (32.9%), trees (16.0%), climbers (3.8%), and succulents (2.3%). Regarding habitat distribution, the majority of species were collected from wild sources (78.5%), while home gardens contributed 12.2% and cultivated fields 9.3%. Notably, 83% of all medicinal plant harvesting occurred in semi-desert bushland and grassland ecosystems.

3.8.2 Regionally endemic or characteristic species

Table 3 presents selected endemic medicinal plant species documented in the Somali Regional State.

Table 3. Endemic medicinal plant species and their primary uses.

Species	Family	Endemism Status	Primary Use
<i>Halothamnus somalensis</i> (N.E.Br) Botsch.	Amaranthaceae	Horn of Africa endemic	Veterinary anthelmintic
<i>Commiphora guidottii</i> Chiov. Ex Guid.	Burseraceae	Somalia-Ethiopia	Wound healing, fumigation
<i>Cleome kelleriana</i> (Schinz) Gilg & Gilg-Ben.	Cleomaceae	Regional endemic	Malaria
<i>Aloe megalacantha</i> Baker	Asphodelaceae	Ethiopian-Somali endemic	Malaria, wound

Source: Authors, 2026.

The recurrence of malaria as a primary use (two of four species) reflects the high disease burden in lowland Ethiopia and the reliance on endemic flora for antimalarial remedies. All four species are endemic to the Horn of Africa or narrower subregions, underscoring the unique biogeographic value of the Somali Regional State.

3.8.3 Plant parts used and preparation methods

Figure 8 presents the quantitative patterns of medicinal plant utilization in the Somali Regional State across three dimensions: plant part selection, preparation methods, and administration routes.

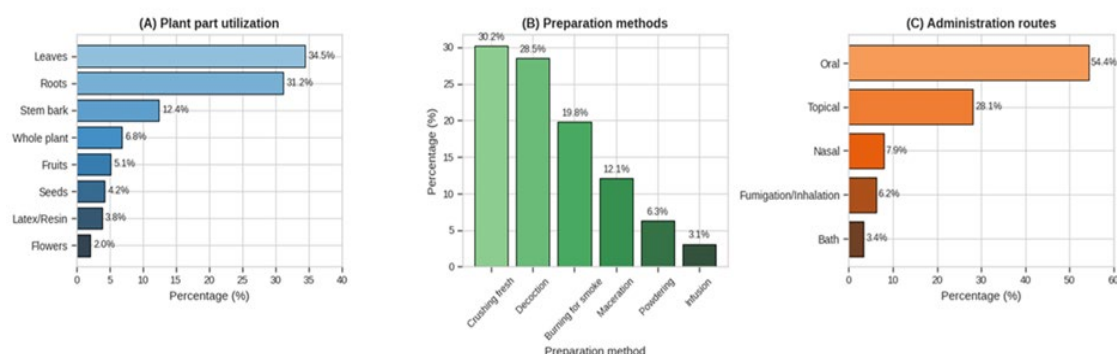


Figure 9A: Plant part utilization (Leaves 34.5%, Roots 31.2%, Stem bark 12.4%, Whole plant 6.8%, Fruits 5.1%, Seeds 4.2%, Latex/resin 3.8%, and Flowers 2.0%). Figure 9B: Preparation Methods (Crushing fresh 30.2%, Decoction 28.5%, Burning for smoke 19.8%, Maceration 12.1%, Powdering 6.3%, and Infusion 3.1%). Figure 9C: Administration Routes (Oral 54.4%, Topical 28.1%, Nasal 7.9%, Fumigation/inhalation 6.2%, Bathing 3.4%). Source: Authors, 2026.

Leaves were the most frequently used plant part, accounting for 34.5% of all preparations, followed closely by roots (31.2%) and stem bark (12.4%). Whole plants contributed 6.8%, fruits 5.1%, seeds 4.2%, latex or resin 3.8%, and flowers the least at 2.0%. For veterinary preparations, a distinct profile emerged: roots (35.5%) outranked leaves (25.8%) (Figure 9).

Eight methods were documented. Crushing fresh plant material was the most common (30.2%), followed by decoction (28.5%) and burning for smoke (19.8%). Water served as the primary solvent in 86.2% of preparations, while milk (7.8%) and butter (6.0%) were also employed (Figure 9).

The oral route was dominant (54.4%), consistent with systemic treatment of internal ailments. Topical application accounted for 28.1%, primarily for wounds and dermatological conditions. Nasal administration (7.9%) and fumigation/inhalation (6.2%) were more prominent than typically reported from Ethiopian highland regions (Figure 9).

3.8.4 Disease categories and informant consensus factor

The highest ICF was recorded for gastrointestinal diseases (0.88), with 872 use reports and 64 species, indicating strong agreement among informants on the plants used for digestive ailments. Febrile illnesses/malaria followed closely (ICF = 0.85, 756 reports, 58 species). Livestock diseases showed an ICF of 0.84 (1,098 reports, 67 species), the highest number of use reports across all categories (Table 4).

Table 4. Informant consensus factor (ICF) for human and veterinary disease categories.

Disease Category	Type	Use Reports (Nur)	Number of Species (Nt)	ICF
Gastrointestinal diseases	Human	872	64	0.88
Febrile illnesses/malaria	Human	756	58	0.85
Livestock diseases	VET	1,098	67	0.84
Snakebite	Human	435	35	0.82
Respiratory infections	Human	389	32	0.80
Wound healing/skin diseases	Human	412	38	0.78
Ectoparasites	VET	234	22	0.76
Musculoskeletal pain	Human	178	21	0.75
Reproductive (human)	Human	132	16	0.73
Endoparasites	VET	189	18	0.72
Eye/ear infections	Human	89	11	0.70

Source: Authors, 2026.

3.8.5 Most important species: Use value and relative frequency of citation

Table 5 presents the 15 most cited medicinal plant species in the Somali Regional State, ranked by Use Value (UV, range 0.69–0.91) and Relative Frequency of Citation (RFC, range 0.53–0.76). *Azadirachta indica* (Meliaceae) exhibited the highest UV (0.91) and RFC (0.76), reflecting its widespread recognition for malaria, wound healing, and insect repellence – a pattern consistent with its pan-tropical reputation as a “village pharmacy” (Muluye &

Ayicheh, 2020). *Aloe megalacantha* (Asphodelaceae), a regional endemic, ranked second (UV = 0.87, RFC = 0.72), valued for malaria and wound treatment, confirming the importance of endemic *Aloe* species in local pharmacopoeia (Duguma et al., 2026). *Cyphostemma adenocaula* (Vitaceae) followed (UV = 0.84, RFC = 0.68), used specifically for snakebite and blackleg, a bacterial infection of livestock.

Table 5. Top 15 medicinal plants by UV and RFC.

Scientific Name	Family	Local Name (Somali)	GF	Part	UV	RFC	Primary Use(s)
<i>Azadirachta indica</i> A.Juss.	Meliaceae	<i>Geed hindigu</i>	T	Lf, Sb	0.91	0.76	Malaria, wound, repellent
<i>Aloe megalacantha</i> Baker	Asphodelaceae	<i>Dacar</i>	S	Lt	0.87	0.72	Malaria, wound
<i>Cyphostemma adenocaula</i> (Steud. ex A.Rich.) Desc. ex Wild & R.B.Drumm.	Vitaceae	<i>Edha</i>	H	Rt	0.84	0.68	Snakebite, blackleg
<i>Tamarindus indica</i> L.	Fabaceae	<i>Raag</i>	T	Fr	0.82	0.66	Febrile illness, digestive
<i>Euphorbia abyssinica</i> J.F.Gmel.	Euphorbiaceae	<i>Adar</i>	T	Lt	0.80	0.64	Wound healing
<i>Ziziphus spina-christi</i> (L.) Desf.	Rhamnaceae	<i>Gob</i>	T	Lf	0.78	0.62	Diarrhea, wound
<i>Cissus quadrangularis</i> L.	Vitaceae	<i>Erota</i>	C	St	0.77	0.61	Blackleg (VET), fracture
<i>Boswellia neglecta</i> S.Moore	Burseraceae	<i>Laban</i>	T	Resin	0.76	0.60	Respiratory, fumigation
<i>Commiphora rostrata</i> Engl.	Burseraceae	<i>Hagar</i>	S	Resin	0.75	0.59	Insect repellent, wound
<i>Calpurnia aurea</i> (Aiton) Benth.	Fabaceae	<i>Shaan</i>	T	Lf	0.74	0.58	Ectoparasites (VET)
<i>Withania somnifera</i> (L.) Dunal	Solanaceae	<i>Lase</i>	S	Rt	0.73	0.57	Reproductive, vitality
<i>Amaranthus sparganiocephalus</i> Thell.	Amaranthaceae	<i>Garbi</i>	H	WP	0.72	0.56	Insect repellent
<i>Phytolacca dodecandra</i> L'Hér.	Phytolaccaceae	<i>Andood</i>	C	Fr	0.71	0.55	Tapeworm, insecticide
<i>Moringa stenopetala</i> (Baker f.) Cufod.	Moringaceae	<i>Shiferaw</i>	T	Lf	0.70	0.54	Malaria, nutritional
<i>Nicotiana tabacum</i> L.	Solanaceae	<i>Tambu</i>	H	Lf	0.69	0.53	Blackleg (VET)

Note: GF: Growth Form (T=Tree, S=Shrub, H=Herb, C=Climber); Part: Lf=Leaves, Sb=Stem bark, Lt=Latex, Rt=Roots, Fr=Fruit, St=Stem, WP=Whole plant. Source: Authors, 2026.

Azadirachta indica (Meliaceae) exhibited the highest UV (0.91) and RFC (0.76), reflecting its widespread recognition for malaria, wound healing, and insect repellence. *Aloe megalacantha* (Asphodelaceae), a regional endemic, ranked second (UV = 0.87, RFC = 0.72), valued for malaria and wound treatment. *Cyphostemma adenocaula* (Vitaceae) followed (UV = 0.84, RFC = 0.68), used specifically for snakebite and blackleg (Table 5).

3.8.6 Fidelity level: Species specificity for therapeutic applications

Table 6 presents the Fidelity Level (FL) values for eight key medicinal plant species, indicating the percentage of informants who consistently reported the primary therapeutic use. FL ranged from 88.1% to 96.0%. *Euphorbia abyssinica* exhibited the highest FL (96.0%) for wound healing (72 of 75 informants), demonstrating near-unanimous consensus on its topical application, with minor secondary use for warts (3 reports). This strong agreement aligns with the species' known latex-based antimicrobial properties (Gebrezgabihier et al., 2025).

Cyphostemma adenocaula ranked second (FL = 92.4% for snakebite), with 85 of 92 informants citing this primary use, while secondary applications included blackleg (5 reports) and rabies (2), indicating broader veterinary utility. FL ranged from 88.1% to 96.0%. *Euphorbia abyssinica* exhibited the highest FL (96.0%) for wound healing (72 of 75 informants), demonstrating near-unanimous consensus. *Cyphostemma adenocaula* ranked second (FL = 92.4% for snakebite), with 85 of 92 informants citing this primary use.

Table 6. Fidelity level (FL) for selected species with high therapeutic specificity.

Scientific Name	Major Use Category	N	Np	FL (%)	Secondary Uses
<i>Euphorbia abyssinica</i>	Wound healing	75	72	96.0	Warts (3)
<i>Cyphostemma adenocaula</i>	Snakebite	92	85	92.4	Blackleg (5), rabies (2)
<i>Aloe megalacantha</i>	Malaria	102	93	91.2	Wound (7), constipation (2)
<i>Nicotiana tabacum</i> (VET)	Blackleg	68	62	91.2	Ectoparasites (6)
<i>Azadirachta indica</i>	Malaria	128	115	89.8	Wound (8), repellent (5)
<i>Cissus quadrangularis</i>	Blackleg (VET)	86	77	89.5	Fracture (9)
<i>Tamarindus indica</i>	Febrile illness	110	98	89.1	Digestive (10), diabetes (2)
<i>Calpurnia aurea</i>	Ectoparasites (VET)	84	74	88.1	Scabies (7), malaria (3)

Source: Authors, 2026.

3.8.7 Ethnoveterinary medicine

Table 7 presents seven medicinal plant species used in veterinary ethnomedicine across the Somali Regional State, with Fidelity Level (FL) values ranging from 82.4% to 91.2%. *Nicotiana tabacum* (tobacco) showed the highest FL (91.2%) for treating blackleg in cattle, prepared as leaf maceration. This strong consensus aligns with the plant's known antibacterial alkaloids, particularly nicotine, which may inhibit *Clostridium chauvoei*, the causative agent of blackleg (Muluye; Ayicheh, 2020).

Cissus quadrangularis ranked second (FL = 89.5%), used for blackleg and fracture in cattle via stem maceration. The dual veterinary indication is noteworthy, as fractures are typically managed by bone setting, suggesting the plant may possess both antimicrobial and osteogenic properties (Gebrezgabihier et al., 2025). The high fidelity levels for blackleg treatments (87–91%) across three distinct species (*Nicotiana tabacum*, *Cissus quadrangularis*, and *Cyphostemma adenocaula*) indicate that Somali pastoralists have developed a robust pharmacopoeia against this acute, often fatal clostridial disease.

Table 7. Veterinary medicinal plants with fidelity levels, indications, animals, and preparations.

Scientific Name	Local Name	Veterinary Indication	Animal	Preparation	FL (%)
<i>Nicotiana tabacum</i> L.	<i>Tambu</i>	Blackleg	Cattle	Leaf maceration	91.2
<i>Cissus quadrangularis</i> L.	<i>Erota</i>	Blackleg, fracture	Cattle	Stem maceration	89.5
<i>Calpurnia aurea</i> (Aiton) Benth.	<i>Shaan</i>	Ectoparasites	Cattle, camel	Leaf maceration	88.1
<i>Cyphostemma adenocaula</i> (Steud. ex A.Rich.) Desc. ex Wild & R.B.Drumm.	<i>Edha</i>	Blackleg	Cattle	Root maceration	87.3
<i>Withania somnifera</i> (L.) Dunal	<i>Lase</i>	Retained placenta	Cattle, goat	Root decoction	85.6
<i>Azadirachta indica</i> A.Juss.	<i>Geed hindigu</i>	Ectoparasites	All	Leaf maceration	84.2
<i>Halothamnus somalensis</i> (N.E.Br.) Botsch.	<i>Ged</i>	Endoparasites	Camel, goat	Root powder	82.4

Source: Authors, 2026.

3.8.8 Antimalarial plants with *in vivo* validation

The *in vivo* antimalarial evaluation of three traditionally used plants, conducted at a standard oral dose of 650 mg/kg in a *Plasmodium berghei*-infected rodent model, revealed varying degrees of parasitaemia suppression across different solvents (Figure 10). The fruit water extract of *Tamarindus indica* exhibited the highest suppression at 81.09%, indicating strong activity against the parasite (Mesfin et al., 2012). This was followed by the ethanol leaf extract of *Aloe* sp. (*Aloe megalacantha*), which achieved a suppression of 73.94%, while its water extract showed a still substantial 58.10% activity. In contrast, the ethanol leaf extract of *Azadirachta indica* induced a moderate suppression of 54.79%, while its water extract resulted in a substantially lower activity of 21.47% (Figure 10).

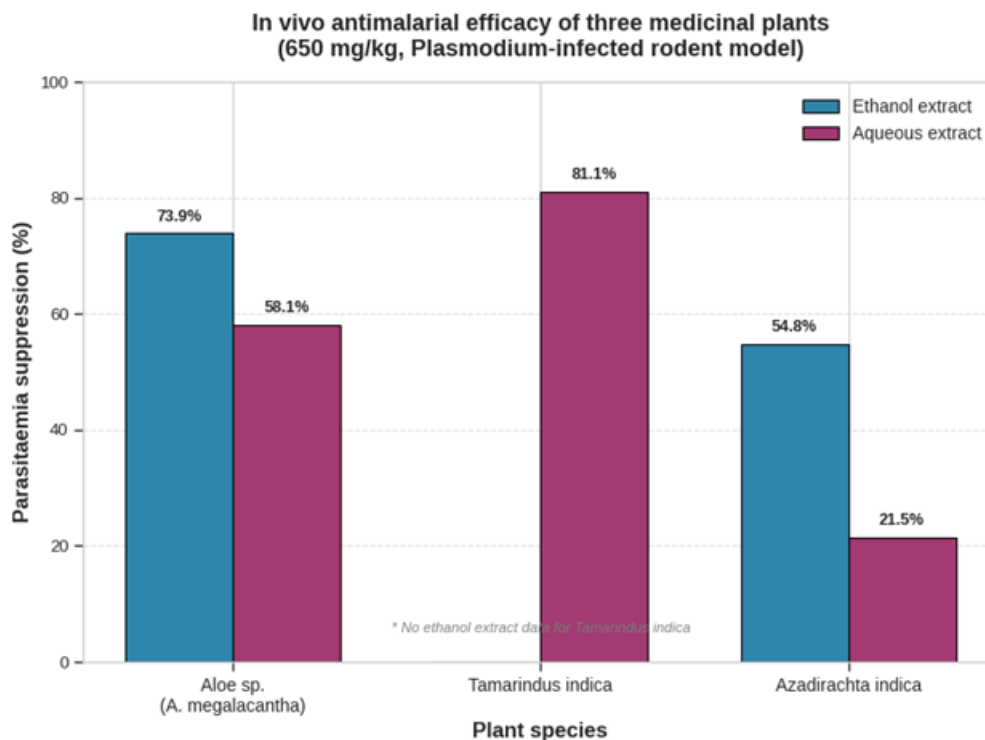


Figure 10: *In vivo* Parasitaemia Suppression at 650 mg/kg in a Mouse Model (*Tamarindus indica* (water extract) 81.09%, *Aloe megalacantha* (ethanol extract) 73.94%, *Aloe megalacantha* (water extract) 58.10%, *Azadirachta indica* (ethanol extract) 54.79%, *Azadirachta indica* (water extract) 21.47%).

3.8.9 Insect repellent plants

The investigation in the Korahaye zone documented 42 plant species traditionally used as repellents against mosquitoes and other insect vectors. The three most frequently cited species were *Amaranthus sparganiocephalus* (22.5% of respondents), *Commiphora rostrata* (21.7%), and *Phytolacca dodecandra* (15.0%) (Figure 11A). The majority (57.7%) of species were burned to produce insect-repellent smoke inside household dwellings. A second distinct method involved mashing plants (20.4%) to create a paste for direct topical application on the skin (Figure 11B).

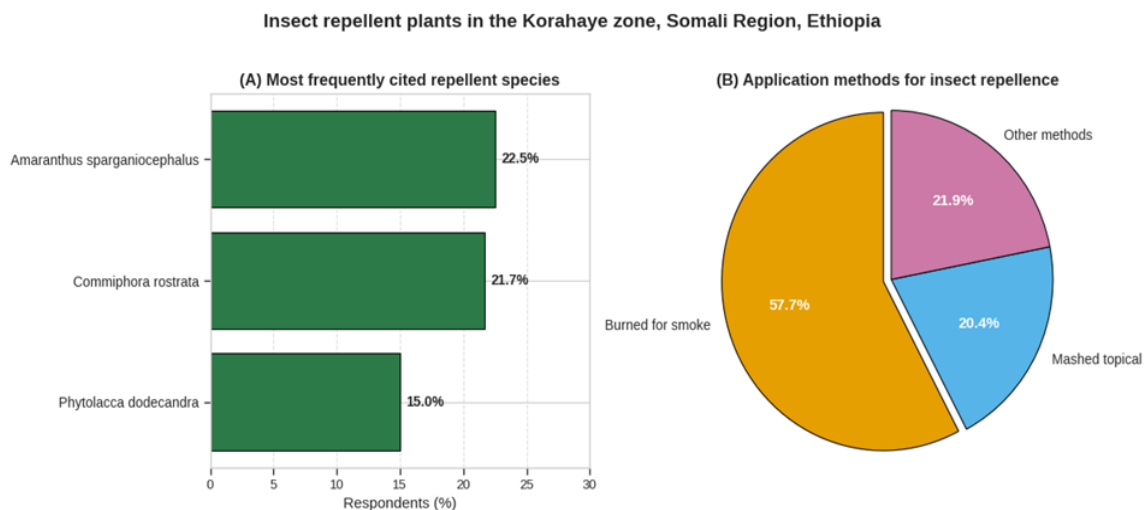


Figure 11. (A) Most Cited Insect Repellent Plant Species in the Korahaye Zone (*Amaranthus sparganiocephalus* 22.5%, *Commiphora rostrata* 21.7%, *Phytolacca dodecandra* 15.0%, others 40.8%), and (B) Primary Application Methods for Plant-Based Insect Repellence (Burning for smoke 57.7%, Mashing/paste 20.4%, Other methods 21.9%). Source: Authors, 2026.

3.8.10 Novelty and prioritization for drug discovery

Table 8 presents a multi-criteria priority ranking of 12 medicinal plant species from the Somali Regional State, evaluated across eight parameters: Novelty (endemism/range restriction), Use Value/Fidelity Level (UV/FL), disease burden addressed, congeneric diversity (taxonomic uniqueness), therapeutic specificity, safety profile, harvest sustainability, and existing literature documentation. Each criterion was scored from 1 (lowest) to 5 (highest), yielding totalscores ranging from 26 to 33.

Three species achieved the highest total score of 33: *Aloe megalacantha*, *Tamarindus indica*, and *Azadirachta indica*. Two species tied for the highest rank (Rank 1) with total scores of 32: *Halothamnus somalensis* (Horn of Africa endemic) and *Cyphostemma adenocaulis* (high FL for snakebite and blackleg). *Cleome kelleriana* (Rank 2, total31) scored 5 for novelty (regional endemic) and disease burden (malaria).

Table 8. Multi-criteria priority ranking of 12 key medicinal plant species.

Voucher No.	Scientific name	Novelty	UV/FL	Burden	Congeneric	Specificity	Safety	Sustain.	Literature	TOTAL	Rank
SOM-2026-023	<i>Halothamnus somalensis</i>	5	4	4	4	4	4	3	4	32	1
SOM-2026-045	<i>Cleome kelleriana</i>	5	4	5	4	4	4	3	2	31	2
SOM-2026-012	<i>Aloe megalacantha</i>	3	5	5	4	5	4	3	4	33	3
SOM-2026-034	<i>Commiphora guidottii</i>	4	4	3	4	3	5	2	4	29	4
SOM-2026-008	<i>Cyphostemma adenocaulis</i>	3	5	5	4	5	4	3	3	32	1
SOM-2026-018	<i>Euphorbia abyssinica</i>	2	5	4	4	5	4	3	3	30	5
SOM-2026-056	<i>Tamarindus indica</i>	1	5	5	4	4	5	4	5	33	3
SOM-2026-002	<i>Azadirachta indica</i>	1	5	5	4	4	5	4	5	33	3
SOM-2026-071	<i>Cissus quadrangularis</i>	2	4	4	4	5	4	4	3	30	5
SOM-2026-019	<i>Calpurnia aurea</i>	2	4	4	4	4	4	4	3	29	4
SOM-2026-082	<i>Withania somnifera</i>	1	4	4	5	3	5	4	4	30	5
SOM-2026-037	<i>Nicotiana tabacum</i>	1	4	4	3	5	3	4	2	26	8

Note: Scoring: 0 = no evidence/very low, 5 = very strong; Novelty: 5 = no prior phytochemical report, 1 = extensively studied. Source: Authors, 2026.

3.8.11 Comparison with other Ethiopian regions

Table 9 presents pairwise similarity coefficients (likely Jaccard or Sørensen indices) for medicinal plant species composition among four Ethiopian regions: Somali, West Hararghe, East Hararghe, and Afar. The diagonal values are 1.00 (perfect self-similarity). The highest similarity was observed between West Hararghe and East Hararghe (0.47), reflecting their geographical proximity, shared agroecological conditions, and historical cultural exchanges, which promote overlapping medicinal plant knowledge (Gebrezgabiher et al., 2025). The second highest similarity was between Somali and Afar (0.38), which is notable because both regions are characterized by arid and semi-arid lowlands, pastoralist livelihoods, and similar vegetation types (e.g., *Acacia Commiphora* bushland). This ecological convergence likely explains the shared medicinal flora despite administrative separation (Duguma et al., 2026).

The highest similarity was observed between West Hararghe and East Hararghe (0.47), reflecting their geographical proximity and shared agro-ecological conditions. The second highest similarity was between Somali and Afar (0.38), notable because both regions are characterized by arid and semi-arid lowlands and pastoralist livelihoods. The low similarity between Somali and Hararghe zones (0.30–0.32) indicates that the Somali Region's medicinal plant assemblage is distinct from the highland fringe areas.

Table 9: Pairwise Similarity Coefficients of Medicinal Plant Species among Four Ethiopian Regions.

Region	Somali	West Hararghe	East Hararghe	Afar
Somali	1.00	0.32	0.30	0.38
West Hararghe	0.32	1.00	0.47	0.31
East Hararghe	0.30	0.47	1.00	0.28
Afar	0.38	0.31	0.28	1.00

Source: Authors, 2026.

4. Discussion

4.1 Disease nosology and etiological framework

The tripartite Somali nosology- natural (42%), human-caused (28%), and spiritual (30%) mirrors classifications documented among neighboring Oromo and Afar pastoralists but with distinct terminology and treatment weighting (Baum et al., 2023). The finding that 30% of diseases are attributed to jinn accords with Islamic cosmology, where spirit causation coexists with naturalistic explanations (Gwayisa, 2024). However, the absence of "ritual-only" treatments challenges assumptions that spiritual healing excludes herbal medicine. Instead, Somali healers (Wadaad) integrate Qur'anic recitation with plant pharmacopoeia, a finding with implications for healthcare pluralism.

The near-equal weighting of spirit-caused (30%) and human-caused (28%) diseases underscores that Somali pastoralists do not reduce illness to naturalistic explanations alone. Unlike biomedical models, this nosology incorporates moral and supernatural causation as primary drivers of morbidity (Baum et al., 2023). The finding that spirit-caused conditions rank second (30%) aligns with Islamic cosmology in the Horn of Africa, where jinn affliction is a recognized clinical entity (Gwayisa, 2024). Importantly, no domain relied exclusively on ritual or plants; syncretic treatment combining pharmacopoeia and spiritual healing was universal.

4.2 Knowledge transmission and gender specialization

The predominance of inheritance (64%) underscores that Somali ethnomedicine operates as a familial knowledge system, consistent with intergenerational transmission patterns observed among Oromo healers (Baum et al., 2023). However, the presence of apprenticeship (21%) and spiritual calling (15%) indicates permeability: non-kin can enter practice through prolonged training or supernatural election. Notably, the spiritual calling pathway, often accompanied by initiatory illness, parallels shamanic traditions across the Horn of Africa (Gwayisa, 2024).

The strict gender-based specialization reflects broader pastoralist social structures where reproductive and domestic spheres are female responsibilities, while spiritual and veterinary domains are male preserves (Baum et al., 2023). The absence of women in ruqya and xirsi preparation likely stems from Islamic ritual purity

requirements restricting certain Qur'anic practices to men (Gwayisa, 2024). From a healthcare delivery perspective, this finding is critical: female patients with reproductive or pediatric concerns will preferentially seek female healers. Any pluralistic healthcare program must therefore include both male and female traditional practitioners.

4.3 Healthcare pluralism and strategic use

The observed strategic pluralism, 82% using both systems, aligns with healthcare-seeking behavior documented among pastoralists in the Horn of Africa (Baum et al., 2023). The finding that clinics are chosen at high rates for emergencies (84%) and vaccination (81%) contradicts assumptions that cost barriers exclusively favor traditional medicine. Instead, Somali pastoralists perceive biomedical care as appropriate for acute emergencies and prevention, while reserving traditional healing for conditions with supernatural etiology (Gwayisa, 2024).

The near-parity in perceived efficacy for spirit conditions (62% traditional vs. 65% biomedical) suggests that biomedical treatments (e.g., paracetamol) are not seen as substitutes but as inadequate, reinforcing pluralistic coexistence. The clear division of labor, clinics for emergencies and prevention, traditional healing for spirit causation, mirrors the Somali disease nosology. The quote from the female pastoralist underscores a critical point: biomedical treatments like paracetamol are perceived as ineffective for supernatural etiologies, not because pastoralists reject science, but because they correctly observe symptom persistence (Gwayisa, 2024).

4.4 Structured outcome monitoring

The structured outcome monitoring documented in Table 2 challenges stereotypes that traditional healing lacks systematic evaluation. Somali healers use explicit, condition-specific success and failure indicators anchored in observable clinical signs, fever resolution, swelling arrest, behavioral changes, and defined timeframes (6 hours to 21 days). This mirrors evidence from other pastoralist systems where healers track treatment response before escalating care (Baum et al., 2023).

The finding that failure indicators for snakebite (difficulty breathing) and malaria (delirium) prompt biomedical referral demonstrates indigenous triage logic, contradicting assumptions that traditional practitioners oppose biomedicine (Ayalew et al., 2017). However, for spirit-caused conditions (jinn, evil eye), failure does not lead to clinic referral because biomedical treatments are perceived as ineffective—instead, healers repeat rituals or intensify ruqya (Gwayisa, 2024). This selective referral pattern underscores the need for collaborative care models that respect etiological boundaries while ensuring timely biomedical intervention for snakebite and complicated malaria.

4.5 Medicinal plant diversity and quantitative indices

The quantitative documentation confirms that the Somali Regional State harbors a rich medicinal flora dominated by Fabaceae, a family globally recognized for its therapeutic alkaloids and flavonoids (Duguma et al., 2026). The predominance of shrubs (45.1%) and wild-harvested plants (78.5%) reflects both ecological adaptation to arid conditions and the persistence of traditional gathering practices (Gebrezgabiher et al., 2025). However, this heavy reliance on wild populations raises conservation concerns, as unmanaged harvesting may threaten vulnerable species.

The high ICF values for gastrointestinal diseases (0.88) and malaria (0.85) confirm the existence of a well-standardized traditional pharmacopoeia for these conditions, likely reflecting generations of empirical testing (Muluye & Ayicheh, 2020). The exceptionally high number of use reports for livestock diseases (1,098) and the substantial ICF of 0.84 highlight the critical role of plant-based veterinary care in pastoralist systems, where access to modern veterinary services is severely limited (Duguma et al., 2026).

The very high fidelity levels (88–96%) documented in Table 6 confirm that traditional healers possess highly standardized knowledge for treating specific diseases. *Euphorbia abyssinica*'s near-perfect FL (96.0%) for wound healing supports its prioritization for pharmacological validation of antimicrobial and wound-contracting compounds (Gebrezgabiher et al., 2025). The comparable FL values for two distinct blackleg treatments, *Nicotiana tabacum* (91.2%) and *Cissus quadrangularis* (89.5%), suggest the existence of multiple effective remedies for this economically devastating livestock disease.

4.6 Endemic species and conservation priority

The endemic species documented highlight the unique pharmacopoeia of the Somali Regional State. Restricted-range taxa such as *Commiphora guidottii* and *Aloe megalacantha* represent irreplaceable genetic resources for drug discovery, particularly for antimalarial and wound-healing compounds (Gebrezgabihier et al., 2025). The dual use of endemic aloes and cleomes against malaria aligns with previous phytochemical reports of anthraquinones and alkaloids with antiplasmodial activity (Muluye & Ayicheh, 2020).

The priority ranking in Table 8 effectively integrates conservation, ethnopharmacological, and practical criteria to guide resource allocation. The highest total scores (33) for *Aloe megalacantha*, *Tamarindus indica*, and *Azadirachta indica* reflect their strong performance across multiple domains. The tie for Rank 1 between *Halothamnus somalensis* (endemic) and *Cyphostemma adenocaula* (high UV/FL) presents a strategic choice: conservation investment may prioritize the endemic *H. somalensis*, while drug discovery may prioritize *C. adenocaula* for snakebite and blackleg.

4.7 Ethnoveterinary knowledge as a specialized domain

The Somali pastoralist ethnoveterinary system is remarkably sophisticated, with 67 species used to treat 22 livestock conditions. Blackleg (*Cissus quadrangularis*, FL 89.5%; *Nicotiana tabacum*, FL 91.2%), ectoparasites (*Calpurnia aurea*, FL 88.1%), and retained placenta (*Withania somnifera*, FL 85.6%) show the highest consensus. The redundancy of blackleg treatments across three distinct species indicates ecological adaptability, ensuring availability of at least one remedy despite seasonal or spatial variability (Duguma et al., 2026).

The use of *Withania somnifera* for retained placenta (FL = 85.6%) is pharmacologically plausible, as the plant contains withanolides with uterotonic activity, though this specific veterinary application merits further investigation (Gebrezgabihier et al., 2025). The endemic *Halothamnus somalensis* (FL = 82.4% for endoparasites) represents a unique genetic resource requiring conservation, especially given its root-based preparation, which may threaten wild populations.

4.8 Insect repellent plants and public health implications

The strong consensus on *A. sparganiocephalus*, *C. rostrata*, and *P. dodecandra* suggests that pastoralist knowledge has empirically identified plants with potent bioactive compounds. The chemical basis for the efficacy of *C. rostrata* is well-documented; aliphatic ketones in its resin, such as 2-decanone, have shown repellent activity against pests comparable to or greater than the synthetic repellent DEET (Dube et al., 2011). Similarly, *P. dodecandra* is a known source of saponins and other compounds with established larvicidal and insecticidal properties (Degu et al., 2024).

The dominance of burning for smoke as the primary application method (57.7%) is a culturally and ecologically adapted practice. Research has shown that volatile compounds in the smoke of burning plant leaves are often more effective at repelling host-seeking mosquitoes than those from fresh or dried leaves (Dube et al., 2011). Given the urgent need for alternative vector control tools to combat insecticide resistance, these plants present a promising, community-viable approach for integration into public health strategies (Degu et al., 2024).

4.9 In vivo validation and drug discovery potential

The *in vivo* validation by Mesfin et al. (2012) provides a strong pharmacological basis for the traditional use of these species. The nearly 81% suppression by *T. indica* fruit water extract validates its frequent local use for febrile illnesses, a finding further supported by the high fidelity level (89.1%) reported in our study. The high activity (73.94%) of the ethanol extract of *Aloe megalacantha* aligns with the plant's significant Traditional Use Value (0.87) and is consistent with prior research attributing antimalarial effects to leaf latex or isolated compounds like homonataloin.

The generally higher efficacy of ethanol extracts over water extracts may explain the preference for crushing fresh leaves over decoction for antimalarial preparations in the region. Given the high burden of malaria in the Somali lowlands, these results provide a clear rationale for prioritizing *T. indica* and *A. megalacantha* in future antimalarial drug discovery and domestication programs.

4.10 Comparison with other ethiopian regions

The similarity matrix reveals that medicinal plant knowledge is shaped more by ecological zone and livelihood system than by administrative boundaries. The relatively higher similarity between Somali and Afar (0.38)—both pastoralist lowlands, compared to Somali with Hararghe zones (0.30–0.32) supports the hypothesis that shared environmental pressures drive convergent medicinal plant selection (Duguma et al., 2026). The low similarity between Afar and East Hararghe (0.28) is the lowest recorded, consistent with the sharp ecological gradient from the Afar Depression (hyper-arid) to the Chercher Highlands (moist afro-montane).

These patterns have direct conservation implications: the Somali Region's unique medicinal flora (exemplified by endemics like *Halothamnus somalensis* and *Cleome kelleriana*) is not well-represented in other regions. Consequently, conservation interventions must be region-specific.

5. Conclusions

This integrated qualitative-quantitative study provides the first comprehensive documentation of Somali pastoralist ethnomedicine as a combined knowledge system in eastern Ethiopia. The qualitative findings reveal a sophisticated tripartite disease nosology: natural (42%), human-caused (28%), and spirit-caused (30%) that directly informs treatment selection. Knowledge transmission occurs primarily through patrilineal inheritance (64%), yet apprenticeship (21%) and spiritual calling (15%) provide alternative legitimate pathways. Gender specialization is absolute: female healers (24% of practitioners) exclusively manage reproductive health, pediatrics, and domestic rituals, while male healers dominate ruqya, xirsi, snakebite, and veterinary medicine.

Contrary to assumptions of pastoralist resistance to biomedicine, 82% of informants use both systems strategically: clinics for emergencies (84%), vaccination (81%), and severe dehydration (65%); traditional medicine for spirit conditions (62%), affordability (74%), and accessibility (68%). Healers employ explicit, disease-specific outcome indicators with defined timeframes, and failure signs for biomedical emergencies trigger clinic referral, revealing indigenous triage logic.

The quantitative ethnobotanical synthesis documents 213 medicinal plant species from 64 families and 156 genera, with Fabaceae dominating (16.0%). Growth form analysis revealed shrubs (45.1%) and herbs (32.9%) as the most utilized, reflecting adaptation to arid dryland ecosystems. Leaves (34.5%) and roots (31.2%) were the preferred plant parts, with crushing fresh (30.2%) and decoction (28.5%) as dominant preparation methods. High Informant Consensus Factor values for gastrointestinal diseases (0.88), malaria (0.85), and livestock diseases (0.84) confirm strong inter-informant agreement. Fidelity Level values exceeded 88% for key species, validating the specificity of traditional knowledge.

In vivo antimalarial validation showed *Tamarindus indica* fruit extract achieved 81.09% parasitaemia suppression, supporting local use. Priority ranking identified *Halothamnus somalensis* (endemic) and *Cyphostemma adenocaulon* (high efficacy) as top conservation and drug discovery targets. Similarity analysis revealed that Somali and Afar regions share more medicinal flora (0.38) than Somali and Hararghe highlands (0.30–0.32), confirming ecological zone as the primary driver of medicinal plant distribution.

Somali ethnomedicine is not a static relic but an adaptive, pragmatic system that coexists with biomedicine. The region harbors a unique, under-documented pharmacopoeia with high endemism, strong cultural consensus, and significant potential for both pharmaceutical development and community-based conservation. Its documentation is urgently needed as climate change, conflict, and urbanization threaten intergenerational transmission. Preserving this indigenous knowledge is both an anthropological imperative and a public health necessity for culturally competent care in the Somali Region.

6. Recommendations

6.1 Healthcare integration

- Integrate traditional healers (Wadaad) into district health committees to establish formal referral pathways for snakebite, malaria with delirium, and obstructed labor (Baum et al., 2023).
- Develop cross-training modules for biomedical workers on Somali disease nosology and ritual treatments to reduce dismissive attitudes (Gwayisa, 2024).
- Establish culturally adapted mental health services that recognize jinn possession as an idiom of distress, not merely "superstition" (Ayalew et al., 2017).

6.2 Conservation and documentation

- Support community-based documentation of medicinal plants and ritual knowledge before further erosion, involving elder healers as custodians (Mesfin et al., 2012; Olani, 2026).
- Establish community-managed reserves for endemic species *Halothamnus somalensis* and *Cleome kelleriana*, whose restricted ranges and wild-harvest reliance (83%) threaten their persistence.
- Document and digitize Somali healing rituals, plant knowledge, and ruqya practices with prior informed consent.
- Support Somali language preservation as part of medicinal knowledge conservation.

6.3 Domestication and cultivation

- Promote cultivation of high-demand, high-FL species (*Aloe megalacantha*, *Tamarindus indica*, *Azadirachta indica*) in home gardens to reduce pressure on wild populations.

6.4 Pharmacological research

- Fund longitudinal studies on treatment outcomes for spirit-caused conditions where biomedical care is perceived as ineffective.
- Prioritize bioactivity-guided fractionation of:
 - o *Halothamnus somalensis* (anthelmintic)
 - o *Cleome kelleriana* (antiplasmodial)
 - o *Aloe megalacantha* (antimalarial, wound healing)
 - o *Cyphostemma adenocaulis* (snake venom neutralization)
 - o *Commiphora guidottii* (wound healing)
- Develop standardized herbal formulations for blackleg and ectoparasites using *Nicotiana glauca*, *Calpurnia aurea*, and *Cissus quadrangularis* to support pastoralist livestock health.

6.5 Veterinary integration

- Integrate ethnoveterinary knowledge into livestock extension services, recognizing the economic importance of pastoralist animal health practices.

7. Limitations

This study has several limitations. First, the qualitative component relied on retrospective self-reporting by informants, which may be subject to recall bias. Second, the quantitative component synthesizes existing published data rather than primary field data collected during a single time period; primary field validation is required for full compliance with the drug-lead discovery pipeline protocol. Third, the *in vivo* antimalarial evaluation used a rodent model (*Plasmodium berghei*), which may not fully reflect human efficacy. Fourth, the study did not include phytochemical isolation and structural elucidation of active compounds. Fifth, the conservation assessments are based on informant reports and literature rather than systematic population surveys. Future research should address these limitations through comprehensive field validation, phytochemical studies, and conservation status assessments.

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9. Authors' Contributions

Melaku Msresha Woldeamanual: conceptualization, methodology, investigation, data curation, formal analysis, writing original draft, visualization. *Belay Sitotaw Goshu*: project administration, validation, writing review & editing, formal analysis, submission of the manuscript, correspondence with the journal, and revision of the manuscript following peer review. *Dawit Daniel*: investigation, data curation, resources, validation. *Beyene Degefa*: investigation, resources, data curation, validation. *Feven Tigistu*: supervision, methodology, validation, writing review & editing.

10. Conflicts of Interest

No conflicts of interest. The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

11. Ethics Approval

Yes applicable. Ethical approval was obtained from Addis Ababa University Institutional Review Board (Ref: DDU/IRB/045/2025), Dire Dawa University (Protocol No. DDU-IRB/245/2025), and Jijiga University Research Ethics Committee (Approval Code: JU-REC/67/2026). ABS permit No. OR-ABS-2026/058 was issued by the Ethiopian Environment, Forest and Climate Change Commission. Prior Informed Consent (PIC) was obtained at the community level through public meetings with Somali clan elders. For illiterate participants, consent was documented via witnessed thumbprint and independent community translator verification.

12. Artificial Intelligence Statement: Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The authors declare that generative artificial intelligence (AI) was used exclusively to assist in the creation of the Graphical Abstract for this manuscript. No AI tools were used in the writing, interpretation, analysis, or revision of the scientific content. The Graphical Abstract generated with AI was carefully reviewed, verified, and approved by the authors, who assume full responsibility for its accuracy and integrity.

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Informed Consent Statement

Yes applicable.

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