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Utilisation of bio-diverse resource fodder and fuelwood species by Halakki Vakkaliga communities: An ethnographic study

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Abstract

The Halakki Vakkaligas are an indigenous agrarian and forest-dependent community inhabiting the coastal and semi-forested landscapes of Uttara Kannada district, Karnataka, India. Their livelihood systems are deeply intertwined with local biodiversity, particularly with respect to fodder resources, fuelwood species and utility timber. This study documents the Traditional Ecological Knowledge (TEK) associated with plant species used for firewood, house construction and livestock fodder. Data were collected through, semi-structured interviews, group discussion and personal observation across settlements in Ankola and surrounding forest-edge hamlets. A total of 41 plant species were documented across four categories like fodder (18 species), wild edibles & medicinal plants (12 species), fuelwood (06 species) and timber/utility species (05 species). The findings highlight the ecological intelligence and sustainable harvesting practices followed by the Halakki Vakkaliga community, contributing to biodiversity conservation and climate-resilient livelihoods. This documentation provides a baseline for future ecological restoration, community forestry and ethnobotanical research in the region.

Keywords: Halakki Vakkaliga, Uttara Kannada, ethnobotany, fodder plants

Introduction

India's tribal and rural communities have historically depended on wild plant resources for fodder, medicine, fuel and economic security, forming the foundation of integrated agriculture-livestock systems amid ecological challenges. Numerous ethno-botanical studies document this reliance across diverse regions. In Jammu and Kashmir's Poonch and Rajouri districts, Adil Farooq (2021) ^[1] and Sikarwar *et al.* (2016) ^[10] cataloged wild fodder plants used by nomadic Gujjar and Bakerwal tribes, highlighting overgrazing impacts, while Ali *et al.* (2023) ^[12] surveyed species in Azmatnagar village and Gulshan Kumar and Hem Chander (2018) ^[6] detailed ethno-veterinary fodder uses in Himachal Pradesh's Awah-Devi region. Further, Dubey (2020) ^[5] identified key tree fodders in Madhya Pradesh, Panigrahi *et al.* (2021) ^[9] documented agroforestry fuel-fodder species in Odisha's Koraput district and Nirmal Kumar Ji *et al.* (2007) ^[7] enumerated 50 multifunctional plants from 28 families serving Dangs tribals in Gujarat's Saputara-Purna forests for medicinal, economic and fodder purposes.

Himalayan research provides quantitative insights into collection scales and socio-economic roles. Shah Khan *et al.* (2025) ^[11] reported 38 forestry fodder species mostly herbs from 14 families in rural Leh, yielding 844 tonnes annually (97.57% for subsistence, generating 7,090 man-days of employment), while Tajamul Islam *et al.* (2023) ^[12] identified 74 species in a protected area, with female-dominated collections (60%) ranging 25-90 kg/household/day, positively correlated with livestock numbers. In southern India, Niveditha (2024) ^[8] listed 39 wild fodder species from 23 families vital for Andhra Pradesh's tribes like Savaras and Gadabas, Bhandary (2014) ^[3] explored edible-fodder plants among coastal Karnataka communities and Dhyani *et al.* (2012) ^[4] assessed India's agroforestry extent, emphasizing fodder's critical future role.

These studies consistently plant resources, herb dominance, multifunctionality (fodder, fuel,

medicine) and pressures like overgrazing, shortages and crop failures prompting recommendations for regulated grazing, fodder plantations and agroforestry expansion. Yet significant gaps persist, particularly ethnographic depth on southern Western Ghats, where communities like Uttara Kannada's Halakki Vakkaligas integrate cultivation, cattle rearing (for draught power, milk, manure) and cultural practices with local flora amid deforestation threats.

This ethnographic study addresses this gap by documenting fodder and diverse plant resources in Halakki Vakkaliga settlements through field observations, interviews and participatory mapping. It elucidates species diversity, utilization pattern linking local knowledge to tribal ecology policies and Western Ghats conservation.

Materials and Methods

The study was conducted during 2024 -2025 in forest-edge and coastal settlements of Ankola taluk (Badiger and Belambar villages) in Uttara Kannada district of Karnataka. The study area represents a heterogeneous land scape comprising semi-evergreen forests, moist and dry deciduous forest patches, coastal and dune and agricultural land s. The climate is monsoonal, with heavy rainfall during the southwest monsoon period from June to September, followed by a distinct dry season, which strongly influences vegetation composition and seasonal fodder availability. An ethnographic research approach was adopted to document indigenous fodder and other plant resources used by the Halakki Vakkaliga community. The study ensured voluntary participation, anonymity of respondents and respect for community knowledge systems, in accordance with ethical guidelines for ethnobotanical research.

Respondents were selected through purposive sampling, followed by snowball techniques, with emphasis on elders, women farmers, livestock rearers and traditional knowledge holders due to their long-term involvement in fodder collection and agricultural activities. Ethnobotanical data were collected using semi-structured interviews, focus group discussions and participant observation. Semi-structured interviews were conducted in the local language using a pre-tested interview schedule to document vernacular names of fodder and other species. Focus group discussions were organized to validate individual responses and obtain community-level perspectives. Fodder plant species were initially identified based on vernacular knowledge and subsequently cross-verified using stand ard regional floras and botanical references and information obtained from different respondents and methods was cross-checked to ensure reliability. The collected data were analysed using descriptive and qualitative analytical techniques.

Results and Discussion

Fodder resources used by the Halakki Vakkaligas

The fodder resources utilized by the Halakki Vakkaliga community of Uttara Kannada reflect a highly evolved indigenous livestock feeding system intricately embedded within the forest–agriculture–pasture mosaics of the Western Ghats. Livestock feeding practices are shaped by seasonal rainfall variability, access to forest commons, availability of crop residues and species-specific feeding behaviour of cattle, buffaloes and goats. The community employs a wide spectrum of tree, shrub, grass and herbaceous fodder species, with a pronounced dominance of tree-based fodder resources (Table 1). Such reliance on woody perennials is a recurring characteristic of forest-dependent and rainfed livestock systems across India, particularly in ecologically fragile landscapes where cultivated

fodder production is limited and uncertain (Dhyani *et al.*, 2012; Bhandary, 2014; Sikarwar *et al.*, 2020) ^[4, 3, 10].

Tree fodders form the backbone of the Halakki fodder system by ensuring year-round biomass availability, nutritional stability and resilience during lean periods. Grey Downy Balsam (*Garuga pinnata*) is among the most critical summer fodders. Continuous leaf flushing, high palatability and digestibility make these species indispensable when grasses decline during the dry season. The prominence of *Ficus* and other perennial fodder trees aligns with agroforestry-based livestock systems described by Dhyani *et al.*, (2012) ^[4], where woody perennials provide ecological stability, nutritional buffering and livelihood resilience. Similar importance of *Ficus* species has been widely documented among traditional communities of coastal Karnataka and central India (Bhandary, 2014; Sikarwar *et al.*, 2020) ^[3, 10]. Indian Kino or Malabar Kino (*Pterocarpus marsupium*) is regarded locally as a nutritionally superior fodder, particularly for lactating and weak animals. Informants consistently associated its use with improved milk yield, better body condition and enhanced animal health. Comparable perceptions regarding the high fodder quality, palatability and longer lopping cycles of *Pterocarpus* species have been reported from central Indian forests, where such trees are classified as high-value fodder resources within traditional silvipastoral systems (Dhyani *et al.*, 2012; Sikarwar *et al.*, 2020) ^[4, 10]. Similarly, Spinous Kino (*Bridelia retusa*) is valued for its drought tolerance and year-round availability, functioning as a dependable browse species during extended dry spells, a pattern also observed in forest-based livestock systems across India (Sajid Ali *et al.*, 2023).

Leguminous shrub fodders locally grouped under Flemingia (*Flemingia macrophylla*) occupy a strategically important position in the Halakki fodder system. These species are preferentially fed to milch cattle and are believed to enhance both milk quantity and quality. Dhyani *et al.* (2012) ^[4] emphasize the multifunctional role of leguminous fodder species in agroforestry systems, highlighting their contribution to livestock nutrition, soil fertility improvement and overall system sustainability. Comparable findings have been reported from agroforestry landscapes of Odisha and Madhya Pradesh (Panigrahi *et al.*, 2020; Sikarwar *et al.*, 2020) ^[9, 10].

Browse species such as Woody fruit jujube (*Ziziphus xylopyrus*) and Mainphal or Mindhal (*Randia dumetorum*) are predominantly fed to goats in scrublands, fallows and forest margins. Their selection reflects an adaptive alignment with goats' natural browsing behaviour and tolerance to fibrous, thorny and tannin-rich foliage. Similar goat-centric fodder strategies have been documented among Gujjar and Bakerwal pastoral communities, where shrubs and thorny trees form essential low-input fodder resources during grass scarcity (Singh *et al.*, 2016; Adil Farooq, 2021) ^[1, 1].

Several tree species function as emergency or fallback fodders during acute scarcity. Tendu (tender leaves of *Diospyros melanoxylon*) and Kusum tree or Lac tree (*Schleichera oleosa*) are used when routine fodder sources become unavailable. The role of such species as seasonal safety nets is consistent with observations from traditional rangeland and agroforestry systems across India, where fodder trees enhance resilience under climatic stress (Dhyani *et al.*, 2012; Bhandary, 2014; Gulshan Kumar & Hem Chander, 2018) ^[4, 3, 6]. Jackfruit (*Artocarpus heterophyllus*) leaves are commonly fed to buffaloes, reflecting the dual food–fodder function of trees emphasized in indigenous agroforestry models (Dhyani *et al.*, 2012) ^[4].

Fast-growing and drought-tolerant species such as *Acacia* spp., including *Acacia catechu* are frequently lopped for fodder due to their rapid coppicing ability, high biomass production and multifunctionality. Dhyani *et al.*, (2012) ^[4] identify *Acacia* species as key components of traditional agroforestry systems that enhance fodder security, fuelwood availability and farm resilience, a pattern also evident in the Halakki land scape (Panigrahi *et al.*, 2020; Sikarwar *et al.*, 2020) ^[9, 10].

Grass-based fodder resources complement tree and shrub fodders, particularly during the monsoon season. Miniature bamboo (*Pogonatherum paniceum* and other Poaceae members) is extensively grazed due to its soft texture, high palatability and rapid regeneration. During late summer and drought periods, dry fodder consisting of stored dry hay grasses, becomes a crucial feed resource. Such fodder conservation practices align with adaptive strategies documented in indigenous livestock systems facing declining grazing lands and increasing climatic uncertainty (Dhyani *et al.*, 2012) ^[4].

Fuelwood Species used by the Halakki Vakkaligas

Halakki Vakkaligas select fuelwood based on density, burn duration and availability, favoring species that provide sustained heat for cooking without excessive smoke. *Xylia xylocarpa* (Burma Ironwood) stands out for its extremely heavy, hard heartwood, which resists termites and burns slowly, ideal for long fires; this echoes Panigrahi *et al.* (2021) ^[9], where Odisha tribes prioritize similar dense Fabaceae for efficiency over fast fuels.

Calophyllum inophyllum (Tamanu or oil nut tree) offers steady, low-smoke combustion from its oily bark/shoots, linked to its high lipid content yielding prolonged heat, comparable to biofuel studies showing superior thermal efficiency. Australian Babul (*Acacia auriculiformis*) dominates daily use due to rapid growth, abundance as an invasive, and fast ignition, mirroring Sikarwar *et al.* (2016) ^[10] in Jammu & Kashmir where it's harvested opportunistically; *Terminalia paniculata* provides clean, strong flames from its dry wood, aligning with regional *Combretaceae* preferences. (Table 2).

Timber/Utility species used by the Halakki Vakkaligas

Timber choices emphasize durability, weight, and resistance for construction in humid coastal conditions (Table 3). Australian

Babul (*Acacia auriculiformis*) excels in poles/rafters due to termite-proof, straight-grained wood, paralleling Bhandary (2014) ^[3] documentation of its multipurpose role in local homegardens. *Hopea parviflora* (Ironwood) delivers high-strength beams from its dense Dipterocarpaceae timber, echoing Dhyani *et al.* (2012) ^[4] national agroforestry patterns for structural longevity; *Vateria indica* shares similar traits. *Syzygium* spp. yield hard wood for tools/ploughs, valued for rot resistance. Lighter *Kydia calycina* suits frames/tools, while *Ailanthus triphysa* provides fast-regenerating poles for temporary builds, indicating a balanced harvest strategy to avoid overexploitation.

Edible/Medicinal Plants used by the Halakki Vakkaligas

These plants highlight self-reliant healthcare and nutrition, with multipurpose uses validated across studies. *Costus igneus* leaves lower blood sugar via spirulina-like compounds, akin to Nirmal Kumar Ji *et al.* (2007) ^[7] Gujarat tribal remedies. *Tinospora cordifolia* (Guduchi) stems boost immunity and manage diabetes through berberine/tinosporin, with clinical trials confirming reduced fasting glucose without liver/renal harm, matching the cited work. *Syzygium cumini* (Wild Jamun) fruits/seeds aid gastric/diabetic issues in chutneys, aligning with Ali *et al.* (2023) ^[2]. Others like *Zingiber officinale* (digestion), *Carissa carandas* (vitamin C pickles), and *Coleus amboinicus* (respiratory relief) show pan-Indian continuity, with *Limonia acidissima* cooling digestion; overall, they underscore biodiversity conservation needs amid tribal dependence (Table 4).

Overall, the Halakki Vakkaliga fodder system is characterized by high species diversity, strong seasonal calibration and functional redundancy. The integrated use of tree lopping, shrub browsing, grass grazing and hay storage distributes grazing pressure across multiple ecological niches, enhancing sustainability and resilience. In line with the agroforestry framework proposed by Dhyani *et al.* (2012) ^[4], the Halakki system exemplifies how indigenous knowledge, native biodiversity and multifunctional trees together support climate-resilient livestock production. Recognizing and strengthening such systems is essential for sustainable rangeland management and ecologically sound agroforestry interventions in the Western Ghats.

Table 1: Fodder Species Used by Halakki Vakkaligas in Uttara Kannada

Sl. No.	Common/English Name	Botanical Identification	Family	Parts used	Ethnobotanical / Utilitarian Notes
1.	Grey Downy Balsam	<i>Garuga pinnata</i>	Burseraceae	Leaves, young twigs	Highly digestible; major lean-season fodder.
2.	Indian Kino or Malabar Kino	<i>Pterocarpus marsupium</i>	Fabaceae	Leaves, tender leaves, pods	Protein-rich leafy fodder fed to milch cattle.
3.	Spinous Kino	<i>Bridelia retusa</i>	Phyllanthaceae	Leaves, young branches	Drought-resilient species; available year-round.
4.	Flemingia	<i>Flemingia macrophylla</i>	Fabaceae	Leaves, stems (leguminous fodder)	High-protein legumes; improve milk yield and digestion.
5.	Woody fruit jujube	<i>Ziziphus xylopyrus</i>	Rhamnaceae	Leaves, fruits, twigs	Preferred by goats; abundant in scrubland s.
6.	Tendu	<i>Diospyros melanoxylon</i> (tender leaves)	Ebenaceae	Tender leaves, young shoots	Used occasionally during fodder scarcity.
7.	Kusum tree or Lac tree	<i>Schleichera oleosa</i>	Sapindaceae	Leaves, flowers, fruits	Tender leaves fed to cattle; moderate fodder value.
8.	Black Cutch	<i>Acacia catechu</i>	Fabaceae	Leaves, pods, young shoots	Most common lopped fodder tree; drought tolerant.
9.	Jackfruit	<i>Artocarpus heterophyllus</i>	Moraceae	Young leaves, fruits (unripe)	Buffalo fodder; improves appetite and milk yield.
10.	White teak	<i>Gmelina arborea</i>	Lamiaceae	Leaves, tender twigs	Soft, easily digestible green fodder.
11.	Hopbush	<i>Dodonaea viscosa</i>	Sapindaceae	Leaves, young shoots	Hardy dryland fodder shrub; browsed by goats.
12.	Tamanu or oil nut tree	<i>Calophyllum inophyllum</i>	Calophyllaceae	Leaves (Calophyllum); heartwood shavings (rare)	Moderate fodder quality; used mainly in scarcity.

				Pterocarpus)	
13.	Jamun or Java plum	<i>Syzygium cumini</i>	Myrtaceae	Leaves, fruits, tender shoots	Lopped fresh for cattle during monsoon; good palatability.
14.	Miniature bamboo	<i>Pogonatherum paniceum</i> / local Poaceae species	Poaceae	Whole grass, stems, leaves	Frequently grazed; soft texture, highly palatable.
15.	Mainphal or Mindhal	<i>Randia dumetorum</i>	Rubiaceae	Leaves, fruits	Goats browse tender shoots; common in moist forests.
16.	Local fodder grasses	Local hay grasses	Poaceae	Whole plant, stems, leaves	Harvested and stored for lean months.
17.	White Saffron	<i>Wendlandia tinctoria</i>	Rubiaceae	Leaves, young twigs	Traditional browse species for goats and cattle.
18.	Burma Ironwood	<i>Xylia xylocarpa</i>	Fabaceae	Leaves, pods, tender branches	Fed during late summer when green fodder is limited.

Table 2: Fuelwood Species Used by Halakki Vakkaligas

Sl. No	Common / English Name	Botanical Name	Family	Parts used	Ethnobotanical / Utilitarian Notes
1.	Burma Ironwood	<i>Xylia xylocarpa</i>	Fabaceae	Bark and shoot	Very dense, heavy wood, preferred for long-burning fires.
2.	Tamanu or oil nut tree	<i>Calophyllum inophyllum</i>	Calophyllaceae	Bark and shoot	Burns slowly, steady heat; highly valued for traditional cooking.
3.	Ben Teak	<i>Lagerstroemia microcarpa</i>	Lythraceae	Bark and shoot	Common dry wood collected from foothill forests.
4.	Teak	<i>Tectona grandis</i>	Lamiaceae	Bark and shoot	Moderately good fuel; easily available near villages.
5.	Australian Babul	<i>Acacia auriculiformis</i>	Fabaceae	Bark and shoot	Most widely used daily fuelwood; fast-burning and abundant.
6.	Kindal tree or Flowering Murdah	<i>Terminalia paniculata</i>	Combretaceae	Bark and shoot	Gives strong flame; preferred for cooking due to clean combustion.

Table 3: Timber / Utility Wood Species Used

Sl.no	Common / English Name	Botanical Name	Family	Parts used	Ethnobotanical / Utilitarian Notes
1.	Australian Wattle / Ear Pod Wattle	<i>Acacia auriculiformis</i>	Fabaceae	Timber	Used for poles, rafters, fencing stakes, house posts; durable and termite-resistant.
2.	Kydia / Wild Kydia	<i>Kydia calycina</i>	Malvaceae	Timber	Light timber used for house frames, storage structures and small tools.
3.	Rose-apple / Wild Syzygium	<i>Syzygium</i> spp.	Myrtaceae	Timber	Hard durable wood used for tool handles, plough parts and traditional implements.
4.	Ironwood / Malabar Ironwood	<i>Hopea parviflora</i> / <i>Vateria indica</i>	Dipterocarpaceae	Timber	High-strength timber; used for beams, rafters and long-lasting structural work.
5.	Malabar Tree of Heaven / White Cedar	<i>Ailanthus triphysa</i>	Simaroubaceae	Timber	Lightweight wood ideal for roofing poles, canoe frames and temporary structures.

Table 4: Wild Edible and Medicinal Plants Used by Halakki Vakkaligas

Sl. No.	Common / English Name	Botanical Name	Family	Parts used	Ethnobotanical / Utilitarian Notes
1.	Insulin Plant	<i>Costus igneus</i>	Costaceae	Leaves (occasional)	Leaves chewed or boiled as decoction to regulate blood sugar; improves digestion and liver function.
2.	Wild Ginger	<i>Zingiber officinale</i>	Zingiberaceae	Rhizomes	Aromatic rhizome used in chutneys, pickles and rasam; boosts digestion and relieves throat congestion.
3.	Mountain sweet thorn	<i>Flacourtia montana</i>	Salicaceae	Leaves, ripe fruits	Used for chutneys, pickles and as souring agent in curries; dried for rainy season.
4.	Bengal currant or Christ's thorn	<i>Carissa carandas</i>	Apocynaceae	Leaves, fruits, young shoots	Tangy fruit used in pickles and chutneys; rich in vitamin C. Bushes form natural boundaries.
5.	Wild Jamun	<i>Syzygium cumini</i>	Myrtaceae	Leaves, tender shoots, fruits	Consumed fresh; used in <i>nerale gojju</i> ; seed powder helps manage diabetes and gastric issues.
6.	Wild Fig	<i>Ficus carica</i>	Moraceae	Leaves, tender shoots, fruits	Fiber-rich fruit eaten raw or used in chutney; latex applied to treat warts and skin rashes.
7.	Common Leucas or White Dead	<i>Leucas aspera</i>	Lamiaceae	Leaves, stems	Decoction used for colds, fever and respiratory issues; for insect bites.
8.	Wood apple	<i>Limonia acidissima</i>	Rutaceae	Leaves, young fruits	Sour-bitter fruit used in <i>gojju</i> and pickles; juice taken for indigestion and to reduce body heat.
9.	Moss Rose / Mexican Rose	<i>Portulaca grandiflora</i>	Portulacaceae	Leaves, stems	Leaves chewed for mouth ulcers; paste used for boils and inflammation.
10.	Wild Yam	<i>Dioscoreaceae villosa</i>	Dioscoreaceae	Tubers, young leaves (limited)	Boiled and eaten as starchy food; used for menstrual disorders and general weakness.
11.	Heart-leaved Moonseed or Tinospora or Guduchi	<i>Tinospora cordifolia</i>	Menispermaceae	Stems, leaves	Immunity booster; used for fever, jaundice, diabetes, weakness; stem juice/paste widely used.
12.	Indian Borage / Mexican Mint	<i>Coleus amboinicus</i>	Lamiaceae	Leaves	Chewed for cough, sore throat; used in kashaya, chutneys; applied to insect bites and swelling.

Conclusion

This study provides a comprehensive account of plant species used as fodder, firewood and utility timber by the Halakki Vakkaligas of Uttara Kannada. The community's traditional ecological knowledge is sophisticated, adaptive and rooted in sustainable principles. Recognizing and integrating such knowledge into local forest management policies, climate adaptation plans and biodiversity conservation initiatives is essential. Further research should explore gender-specific ecological knowledge, the impact of climate change on fodder availability.

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