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### Assessment of Fodder Species in Western Ramganga Valley, Uttarakhand, India

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**Abstract:** The present study deals with diversity, distribution, availability, community preference rank (CPR) and pressure use index (PUI) of fodder plants in the Western Ramganga Valley, Uttarakhand. A total 254 species belongs to 178 genera and 74 families recorded as fodder resource in the area, of which, 45.28% species were herbs, 22.44% trees, 19.29% shrubs and 12.99% climbers. In availability, 6.69% species found to be rare, 35.53% as uncommon while, 57.48% as common. The study revealed 12 species as most preferred (91–100% preference) under CPR 1 including trees (5 species), herbs (3 species), shrubs and climbers (2 species each). Among tree fodders, pressure use index (PUI) was recorded maximum (26) for *Acer caesium* and *Boehmeria rugulosa*, which followed by *Bauhinia semla*, *Bauhinia variegata*, *Ficus auriculata*, *Ficus semicordata*, *Grewia oppositifolia*, *Meliosma dilleniifolia* and *Quercus semecarpifolia* (24 each). The species in the higher CPRs and larger PUI values are crucial from the conservation point of view, on account of higher anthropogenic pressure.

**Keywords:** Cattle feed, CPR, Forest products, KDF, PUI.

#### INTRODUCTION

The Himalayan mountain ecosystems are very distinct from lowlands, being particularly fragile and highly susceptible to erosion, landslides, avalanches, earthquakes, torrents, and rock falls. The fragile mountains have high conservation significance due

to their magnificent snow-capped peaks, floral, faunal, geo-hydrological, ecological, socio-cultural, and aesthetic values. The region exhibits great topographic, climatic and altitudinal variations which are reflected in great biological diversity. Indian Himalaya Region (IHR) has long been recognized

as a distinct floristic region in India which was divided into two botanical zones *viz.* Eastern and Western Himalaya [1,2,3]. Western Himalaya extending from Jammu & Kashmir to Uttarakhand, is known as dry and less dense as compared to the Eastern Himalaya [4]. Uttarakhand Himalaya has its unique position within IHR, highlights its potential for development, tourism, poultry and wool-based livelihoods, agriculture diversification and ambient natural resources, besides this, the state faces the challenge of promoting livelihood to minimize migration through local employment and income generation, and to enhance the quality of life of people living in the villages.

Mixed farming and animal husbandry are the integral part of economy in Uttarakhand state. Agricultural based activities are the main source of livelihood to large population of the state; about 75–90% population is engaged either in the main occupation of agriculture or its allied practices, dominated by traditional subsistence on cereal farming [5,6]. The undulated topography and rugged terrain does not favour the hill area in terms of productivity of crops. Fragmented and small land holdings, sloping marginal lands and rainfall-dependent farming aggravated by heavy migratory grazing leads to very poor yield.

Fodder collection from the forests is the first step that turns the wheel of rural economy and livelihoods across IHR [7,8], as the fodder produced on arable land is inadequate alone [9]. Extensive and intensive surveys are required to update the information on the fodder resources of several under explored biogeographical regions of the Himalaya [10]. Species of trees and shrubs were studied for fodder preference in earlier studies [11-16]. Forest resource utilization patterns vary from place to place with change in altitude, vegetation and ethnic communities. Traditional knowledge system plays a key role in the use of any plant species as fodder with species preference. Examined community's

preference is also important in order to select key species for development of society and environmental conservation [16].

This paper presents a case study of Ramganga valley in Uttarakhand state aimed to know how many fodder species are used by inhabitants, which are the specie preferred most (Community Preference Rank) and to know their habit, habitat, availability, distributions and pressure used index (PUI).

## MATERIALS AND METHODS

### Study area

Western Ramganga river is one of the few perennial water sources flowing to the Corbett National Park, originating from Kodyabagar area (Gairsain, Chamoli) at the altitude of *ca.* 3,000m amsl. It constitutes a wide valley along its course of flowing and provides habitat to many plant and animal communities. The valley is spread over three districts of Uttarakhand *i.e.* Almora, Chamoli and Pauri. Only, montane zone of Western Ramganga valley which comes under district Chamoli was selected for the present study. Geographically the study area stretches between 29° 57' 33" to 30° 06' 05" N latitudes and 79°11' 33" to 79° 20' 33" E longitudes with altitude range 1200–3100m amsl, falls in the southern part of the Chamoli district, Uttarakhand state. This part of Western Ramganga valley harbours a rich diversity of plants and most of its forest area falls under Kedarnath Forest Division (KFD).

The vegetation of the area is characterized by a comparatively lush flora which represents the sub montane and montane Himalayan plants. On the basis of tree species dominance the forests of the area can be categorized into; Pine-mixed forests (1200–2000m), Pine forests (1300–2200m), Oak-mixed forests (1500–2500m), Oak forests (1800–2000m), and Oak-Abies mixed forests (2500–3000m). Some drier south facing slopes are occupied by scrub vegetation. Summer, rainy and winter

seasons are well marked due to fluctuating precipitation, temperature, light, wind, humidity and even day length. Rainfall, hailstorm, dew, frost are the main forms of precipitation. The upper montane zone, at above 1800m receives sever frost and snow fall during the winter.

### Data collection

Extensive field surveys were conducted to the study area for collection of data on local names, habit, habitat, availability, distribution and CPRs of fodder species during the years 2013–2015 [17]. Habit of species described as herb (H), shrub (S) trees (T) and climber (C) while habitat categorized as agricultural fields/margins, exposed localities, forest localities, grassy localities, shady moist localities, streams/river sides and way/road sides. Based on the relative abundance of fodder species in the area, availability status mention as common, uncommon and rare; rare status mentions the species which were recorded in only populations. The distribution range in terms of elevation (m) has been reported for each species in the area.

The inhabitants of the area, especially old aged peasants and shepherds were consulted for ascertaining any plant species as fodder. Local names also recorded during field visits and are given in regional dialect (*Garhwali*). Community Preference Ranks (CPR) for collected fodder species was evaluated [16,18,19]. However, we distributed all the recorded species into ten CPRs on the basis of preference by respondents (%). Species with 91–100% preference was ranked first (CPR 1), 81–90% preference ranked second (CPR 2) and so on, while 1–10% preference species was ranked 10 (CRP 10). The pressure use index of the species was calculated on the basis of cumulative values of the utilization pattern, altitudinal distribution, availability, status, nativity and endemism [20]. The collected plant specimens were identified with the help of flora and herbaria (BSD, DD & GUH).

## RESULTS

### Diversity

The present study resulted 254 species belongs to 178 genera and 74 families as fodder resources in the Western Ramganga valley (**Table 1**). Highest species richness (32 species) recorded for family Poaceae followed by Fabaceae (28 species) and Rosaceae (9 species). *Desmodium* with 9 species revealed as dominant genus followed by *Ficus* (5 species), *Cyperus* (4 species), *Quercus* (4 species) while genera with 3 species were *Acer*, *Amaranthus*, *Calamagrostis*, *Galium*, *Viburnum*, etc. Many of these species found mention in recently published reports from Indian Himalaya [10], Kumaon Himalaya [21], rangelands of Uttarakhand [22,23] and Kedarnath Forest Division [24].

### Habit, habitat and availability

Out of total (254 species), 45.28% species were herbs, 22.44% trees 19.29% shrubs and 12.99% climbers. Earlier report on the fodder data shows 40.14% trees, 24.01% shrubs, 13.26% climber and 22.58% herbs from Indian Himalaya [10]. Among different habitats, maximum species (141 species) were recorded in forest habitat followed by agricultural fields/margins (130 species) and streams/river sides (92 species), while minimum (17 species) in the marshy habitat (**Fig. 1**).

### Community preference ranks (CPRs)

All the recorded species were categorized into ten community preference ranks (CPRs); trees, shrubs and herbs ranked separately. The study revealed 12 species as most preferred (91–100% preference) under CPR 1 including trees (5 species), herbs (3 species), shrubs climbers and climber (2 species each). The species richness per CPRs vary from 4–8 ( $t=9.86$ ,  $df=9$ ,  $P=0.000$ ) for trees, 2–11 ( $t=5.11$ ,  $df=9$ ,  $P=0.001$ ) for shrubs, 2–25 ( $t=4.30$ ,  $df=9$ ,  $P=0.002$ ) for herbs and from 2–6 ( $t=6.98$ ,  $df=9$ ,  $P=0.000$ ) for

**Table 1**  
**Detailed of fodder plants in the Western Ramganga Valley, Uttarakhand.**

<i>Botanical name</i>	<i>Family</i>	<i>Local name</i>	<i>CPR</i> <sup>1</sup>	<i>Habitat</i> <sup>2</sup>	<i>AS</i> <sup>3</sup>	<i>Elevation (m)</i>	<i>PUI</i>
<b>Trees</b>							
<i>Acer acuminatum</i> Wall. ex D. Don	Aceraceae	Kainchui	4	3,6	Un	2200–2500	20
<i>Acer caesium</i> Wall. ex Brandis	Aceraceae	Kainchui	3	3,6	Un	2400–2800	26
<i>Acer cappadocicum</i> Gled.	Aceraceae	Papri	4	3,7	Un	1700–2500	20
<i>Aesculus indica</i> (Wall. ex Cambess.) Hook.	Hippocastanaceae	Paingar	7	3	Un	1900–2200	20
<i>Albizia julibrissin</i> Durazz.	Mimosaceae	Sirash	6	1,3	Un	1500–2000	16
<i>Albizia odoratissima</i> (L.f.) Benth.	Mimosaceae	Siras	6	3,7	Co	1400–1900	14
<i>Bauhinia semla</i> Wunderlin	Caesalpiniaceae	Kandav	2	1,7	Un	1300–1400	24
<i>Bauhinia variegata</i> L.	Caesalpiniaceae	Kwiral	2	1,3	Un	1400–1700	24
<i>Betula alnoides</i> Buch.-Ham. ex D. Don	Betulaceae	Sairu	4	3	Un	1500–2700	18
<i>Boehmeria rugulosa</i> Wedd.	Urticaceae	Geinthe	2	1,3,7	Un	1300–1500	26
<i>Carpinus viminea</i> Wall. ex Lindl.	Corylaceae	Goriya	2	3	Co	1800–2500	20
<i>Cedrela serrata</i> Royle	Meliaceae	Dall	6	3	Ra	1500–1800	20
<i>Celtis australis</i> L.	Ulmaceae	Kharik	7	1,3,8	Un	1300–1600	18
<i>Cerasus cerasoides</i> (Buch.-Ham. ex D. Don) S.Y. Sokolov	Rosaceae	Payain	6	1,3	Co	1300–2300	12
<i>Cornus macrophylla</i> Wall.	Cornaceae	Khagesh	8	3,7	Un	1900–2300	20
<i>Dalbergia sericea</i> G. Don	Fabaceae	-	8	7	Un	1300–1600	16
<i>Dalbergia sissoo</i> DC.	Fabaceae	Sisam	7	3,7	Un	1300–1400	18
<i>Engelhardtia spicata</i> Lechen ex Blume	Juglandaceae	-	5	2,3	Co	1400–1600	20
<i>Euonymus lucidus</i> D. Don	Celastraceae	Katkuk	4	3	Co	1900–2400	18
<i>Euonymus tingens</i> Wall.	Celastraceae	Kunkoo	4	3	Co	2000–2800	18
<i>Eurya acuminata</i> DC.	Theaceae	-	9	3,7	Ra	2500–2800	18
<i>Ficus auriculata</i> Lour.	Moraceae	Timla	3	1,2	Co	1300–2100	24
<i>Ficus nerifolia</i> Sm.	Moraceae	Khilik	2	1,7	Co	1300–2300	22
<i>Ficus semicordata</i> Buch.-Ham. ex Sm.	Moraceae	Khena	3	2,8	Co	1300–1900	24
<i>Ficus subincisa</i> Buch.-Ham. ex Sm.	Moraceae	Chhachhari	2	1,2,8	Co	1300–1900	22
<i>Glochidion heyneanum</i> (Wight & Arn.) Wight	Euphorbiaceae	Mahawa	5	2,8	Un	1800–1900	20
<i>Grewia oppositifolia</i> Roxb. ex DC.	Tiliaceae	Bhimal	1	1,8	Co	1300–2000	24
<i>Ilex diplyrena</i> Wall.	Aquifoliaceae	Badkaniya	1	3	Co	1500–2500	20
<i>Kydia calycina</i> Roxb.	Malvaceae	-	10	2	Un	1300–1400	16
<i>Lannea coromandelica</i> (Houtt.) Merr.	Anacardiaceae	Kalmina	8	3	Un	1300–1500	18
<i>Lonicera quinquelocularis</i> Hard.	Caprifoliaceae	Bhatkukhur	4	3,7	Co	1500–2500	16
<i>Lyonia ovalifolia</i> (Wall.) Drude	Ericaceae	Angyar	3	3,6,7	Co	1300–3000	20

contd. table 1

Assessment of Fodder Species in Western Ramganga Valley, Uttarakhand, India

Botanical name	Family	Local name	CPR <sup>1</sup>	Habitat <sup>2</sup>	AS <sup>3</sup>	Elevation (m)	PUI
<i>Machilus dutchiei</i> King	Lauraceae	Kola	7	3,7	Co	1500–2500	10
<i>Mallotus philippensis</i> (Lam.) Müll.Arg.	Euphorbiaceae	Ruina	8	2,8	Co	1300–2000	12
<i>Meliosma dillenifolia</i> (Wall. ex Wight & Arn.) Walp.	Sabiaceae	Gogna	4	3	Un	1800–2000	24
<i>Meliosma simplicifolia</i> (Roxb.) Walp. ssp. pungens xx	Sabiaceae	Ghoogu	5	3,7	Co	1500–1800	22
<i>Morus alba</i> L.	Moraceae	Keemu	6	1,3,7	Un	1300–2200	16
<i>Padus napanensis</i> (Ser.) C.K. Schneid.	Rosaceae	-	9	1,3,7	Ra	1400–1600	20
<i>Pentapanax parasiticus</i> (Buch.-Ham. ex D.Don) Seemann	Araliaceae	Bounr	7	3	Un	1900–2500	14
<i>Persea odoratissima</i> (Nees) Kosterm.	Lauraceae	Kola	9	3,7	Co	1700–2100	14
<i>Phyllanthus emblica</i> L.	Euphorbiaceae	Aola	10	2	Un	1300–1700	18
<i>Populus ciliata</i> Wall. ex Royle	Salicaceae	Pupular	10	7	Un	1600–2000	16
<i>Pyrus pashia</i> Buch.-Ham. ex D. Don	Rosaceae	Melu	7	1,3	Co	1300–2200	14
<i>Quercus floribunda</i> Lindl. ex A. Camus	Fagaceae	Tiløj	1	3	Co	1700–3000	22
<i>Quercus glauca</i> Thunb.	Fagaceae	Phaniyat	2	3,7	Co	1300–1600	21
<i>Quercus leucotrichophora</i> A. Camus)	Fagaceae	Banj	1	1,3,6,7	Co	1300–2500	22
<i>Quercus semecarpifolia</i> Sm.	Fagaceae	Khair	1	3	Co	2500–3000	24
<i>Rhamnus triquetra</i> (Wall.) Brandis	Rhamnaceae	Gontiya	6	1,2	Co	1300–1900	16
<i>Rhododendron arboreum</i> Sm.	Ericaceae	Burans	2	1,3,7	Co	1300–2500	20
<i>Salix wallichiana</i> Anders	Salicaceae	-	8	1,3,7	Un	1700–2100	16
<i>Sorbus cuspidata</i> (Spach) Hedl.	Rosaceae	-	10	3	Ra	2700–3000	20
<i>Stramaesia nussia</i> (Buch.-Ham. ex D.Don) Decne.	Rosaceae	Gad Melu	7	1,7	Ra	1400–1600	20
<i>Symplocos theifolia</i> (Hayata) Hayata	Symplocaceae	-	9	3,7	Co	2000–2300	12
<i>Terminalia chebula</i> Retz.	Combretaceae	Harad	6	2	Ra	1400–1900	18
<i>Toona ciliata</i> M.Roem.	Meliaceae	Tun	6	7	Un	1300–1600	18
<i>Viburnum cotinifolium</i> D. Don	Caprifoliaceae	Ghenu	7	1,3,6,7	Co	1600–3000	14
<i>Viburnum cylindricum</i> Buch.- Ham. ex D. Don	Caprifoliaceae	Tit, Titmoya,	5	3,7	Co	1400–2600	14
<b>Shrubs</b>							
<i>Astilbe rivularis</i> Buch.-Ham. ex D.Don	Saxifragaceae	-	9	3	Un	1500–1900	14
<i>Boehmeria platyphylla</i> D.Don.	Urticaceae	Khagsi	6	1,3,6,7	Co	1400–2300	12
<i>Campylotropis eriocarpa</i> (DC.) Schindl.	Fabaceae	-	10	1,4	Co	1900–2300	12
<i>Campylotropis macrostyla</i> (D.Don) Miq.	Fabaceae	-	9	2,4,7	Un	1300–2300	10
<i>Celastrus paniculatus</i> Willd.	Celastraceae	Kuniya	10	7	Un	1500–2600	10
<i>Cotinus coggygria</i> Scop.	Anacardiaceae	Dasmil	2	1,3,7	Co	1300–1500	22
<i>Cotoneaster affinis</i> Lindl. (= <i>C. bacillaris</i> var. <i>affinis</i> Hook. f.)	Rosaceae	Ruins	8	3	Un	1300–1600	18

contd. table 1



Botanical name	Family	Local name	CPR <sup>1</sup>	Habitat <sup>2</sup>	AS <sup>3</sup>	Elevation (m)	PUI
<i>Cotoneaster acuminatus</i> Lindl.	Rosaceae	Ruins	8	3	Ra	1600–2400	18
<i>Cotoneaster bacillaris</i> Wall. ex Lindl.	Rosaceae	Ruins	8	3	Un	1300–2200	16
<i>Crotalaria tetragona</i> Andrews	Fabaceae	-	7	3,4	Un	1300–1600	14
<i>Cyathula capitata</i> Moq.	Amaranthaceae	Lich kur	9	3,7,8	Co	1300–1800	14
<i>Cyathula tomentosa</i> (Roth) Moq.	Amaranthaceae	-	9	3	Co	1400–2000	12
<i>Debregeasia saeneb</i> (Forssk.) Hepper & J.R.I. Wood (= <i>D. salicifolia</i> (D. Don) Rendle)	Urticaceae	Syanru	6	1,7	Co	1300–2000	12
<i>Dendrophthoe falcata</i> (L.f.) Ettingsh.	Loranthaceae	-	6	2,3,7	Un	1300–1400	16
<i>Desmodium laxiflorum</i> DC.	Fabaceae	-	3	3,4	Un	1300–1400	18
<i>Desmodium podocarpum</i> DC.)	Fabaceae	-	4	3	Un	2300–2800	14
<i>Desmodium elegans</i> DC.	Fabaceae	Chamliya	1	3,5,7	Co	1900–2300	22
<i>Desmodium gangeticum</i> (L.) DC.	Fabaceae	-	8	1,3	Co	1300–1400	14
<i>Desmodium heterocarpon</i> (L.) DC.	Fabaceae	-	6	1,2,4	Co	2000–2300	14
<i>Desmodium velutinum</i> (Willd.) DC.	Fabaceae	-	10	2,3,7	Un	1400–2000	14
<i>Deutzia staminea</i> R.Br. ex Wall.	Hydrangeaceae	Bhatkukur	9	1,2,3	Co	1300–2100	12
<i>Elaeagnus parvifolia</i> Wall. ex Royle	Elaeagnaceae	Giwain	6	1,3,6	Co	2400–2900	14
<i>Gymnosporia royleana</i> Wall. ex M.A. Lawson	Celastraceae	-	8	1,2	Un	1500–2000	14
<i>Holmskioldia sanguinea</i> Retz.	Verbenaceae	-	8	1,7,8	Co	1500–2300	10
<i>Hypericum choisyianum</i> Wall. ex N. Robson	Hypericaceae	-	5	3,6,7	Ra	1500–2000	18
<i>Indigofera bebetepala</i> Benth. ex Baker	Fabaceae	Sakina	3	3	Co	1300–2000	16
<i>Indigofera heterantha</i> Brandis	Fabaceae	Sakina	1	3	Co	1300–2000	18
<i>Maoutia puya</i> (Hook.) Wedd.	Urticaceae	Khagsa	9	2,6,7,8	Co	1500–2500	10
<i>Murraya koenigii</i> (L.) Spreng.	Rutaceae	Karipatta	9	2,8	Un	2400–2900	16
<i>Phyllanthus parvifolius</i> Buch.-Ham. ex D. Don	Euphorbiaceae	-	9	3	Un	1400–2200	12
<i>Polygonatum cirrbifolium</i> (Wall.) Royle	Liliaceae	-	7	1,3,7,8	Co	1500–2300	12
<i>Pseudocaryopteris foetida</i> (D. Don) P.D. Cantino	Verbenaceae	-	9	1,2,7	Un	1300–1400	14
<i>Pseudocaryopteris bicolor</i> (Roxb. ex Hardw.) P.D. Cantino	Verbenaceae	-	9	1,2,8	Co	1300–2200	10
<i>Reinwardtia indica</i> Dumort.	Linaceae	-	4	1,2,3,6	Co	2500–3000	16
<i>Rhamnus purpureus</i> Edgew.	Rhamnaceae	-	5	2,7	Un	1300–1500	18
<i>Rhamnus virgata</i> Roxb.	Rhamnaceae	Chhitok	7	1,2,3	Co	1700–2400	14
<i>Rhus parviflora</i> Roxb.	Anacardiaceae	Tungla	2	1,3,7	Co	1500–2000	16
<i>Salix denticulata</i> Andersson	Salicaceae	Gad-Bains	9	2,3,7	Co	2000–2200	14
<i>Scurrula elata</i> (Edgew.) Danser	Loranthaceae	Banderi	6	1,2,3,8	Co	1300–1600	14

contd. table 1

Assessment of Fodder Species in Western Ramganga Valley, Uttarakhand, India

Botanical name	Family	Local name	CPR <sup>1</sup>	Habitat <sup>2</sup>	AS <sup>3</sup>	Elevation (m)	PUI
<i>Scurrula pulverulenta</i> (Wall.) G. Don	Loranthaceae	Bandari	7	3	Un	1300–1800	14
<i>Spermadictyon suaveolens</i> Roxb.	Rubiaceae	Padera	10	1,2,6,7	Co	1300–2000	12
<i>Staphylea emodi</i> Wall.	Staphyleaceae	-	7	3	Ra	2300–2900	16
<i>Strobilanthes urticifolia</i> Wall. ex Kuntze	Acanthaceae	-	5	3,6	Un	1400–1700	16
<i>Taxillus vestitus</i> (Wall.) Danser	Loranthaceae	Bandari	8	3,8	Co	1700–2200	12
<i>Uraria lagopus</i> DC.	Fabaceae	-	7	1,3,5	Un	1400–2200	12
<i>Viburnum mullaba</i> Buch.-Ham. ex D. Don	Caprifoliaceae	-	5	3,7	Un	1300–1900	18
<i>Viscum album</i> L.	Loranthaceae	-	10	3,7	Co	1800–2000	14
<i>Viscum articulatum</i> Burm. f.	Loranthaceae	-	10	3,7	Un	1400–2000	12
<i>Woodfordia fruticosa</i> (L.) Kurz	Lythraceae	Dhaura	7	2	Co	1500–2300	14
<b>Herbs</b>							
<i>Achyranthes aspera</i> L.	Amaranthaceae	Lichkur	8	1,4,7	Co	1400–1900	12
<i>Aechmanthera gossypina</i> (Wall.) Nees	Acanthaceae	Jundela	6	3,7	Un	2300–2600	14
<i>Amaranthus cruentus</i> L.	Amaranthaceae	-	3	1,2,8	Co	1300–1600	20
<i>Amaranthus spinosus</i> L.	Amaranthaceae	Chuli	10	1,2	Un	2000–2500	16
<i>Amaranthus viridis</i> L.	Amaranthaceae	-	4	1,2,4	Co	1300–1700	18
<i>Anemone vitifolia</i> Buch.-Ham. ex DC.	Ranunculaceae	-	8	3	Un	1500–2000	14
<i>Arundo donax</i> L.	Poaceae	naltura	6	7	Co	1300–2000	10
<i>Avena fatua</i> L.	Poaceae	Jawat	4	3,8	Co	1300–1500	16
<i>Barbarea vulgaris</i> R.Br.	Brassicaceae	-	6	1,7	Ra	2000–2800	14
<i>Barleria cristata</i> L.	Acanthaceae	Kala-bansa	8	1,2,4,8	Co	1400–2100	12
<i>Bidens bipinnata</i> L.	Asteraceae	-	8	1,2,8	Co	1300–2000	12
<i>Bidens pilosa</i> L.	Asteraceae	Kumar	7	1,2,4,8	Co	1300–1600	14
<i>Bothriochloa pertusa</i> (L.) A.Camus	Poaceae	-	6	3	Un	1400–1700	16
<i>Brachiaria ramosa</i> (L.) Stapf	Poaceae	-	6	1,4	Un	1700–2200	14
<i>Brachypodium sylvaticum</i> (Huds.) P.Beauv.	Poaceae	-	6	3,4	Co	2200–2800	12
<i>Calamagrostis emodensis</i> Griseb.	Poaceae	-	7	1,4,8	Un	1300–1900	14
<i>Calamagrostis pseudophragmites</i> (Haller) Koeler	Poaceae	-	6	1,4,8	Un	2000–2500	14
<i>Calamagrostis scabrescens</i> Griseb.	Poaceae	-	6	3	Un	1500–1700	16
<i>Campanula pallida</i> Wall. ( <i>C. colorata</i> Wall.)	Campanulaceae	-	10	1,2,3,8	Co	1500–2100	10
<i>Capillipedium parviflorum</i> (R.Br.) Stapf	Poaceae	-	6	1,4,8	Co	2000–2500	12
<i>Capsella bursa-pastoris</i> (L.) Medik.	Brassicaceae	-	8	1,2,4,8	Un	1400–2000	14
<i>Carex cruciata</i> Wahlenb.	Cyperaceae	-	6	1,5	Co	1500–2200	12
<i>Carex filicina</i> Nees	Cyperaceae	-	6	3,4	Co	1500–2000	12

contd. table 1

Botanical name	Family	Local name	CPR <sup>1</sup>	Habitat <sup>2</sup>	AS <sup>3</sup>	Elevation (m)	PUI
<i>Chamaerops humilis</i> L. ( <i>Phoenix humilis</i> Royle)	Arecaceae	-	7	2,7	Un	1800–2200	16
<i>Chenopodium album</i> L.	Chenopodiaceae	Biyoth	4	1,2,8	Co	1400–2000	14
<i>Chenopodium foliosum</i> Asch.	Chenopodiaceae	Biyoth	5	1,8	Co	1600–2400	14
<i>Chrysopogon gryllus</i> (L.) Trin.	Poaceae	Khaur, taiyya	1	2,3,4	Co	1400–2000	18
<i>Chrysopogon serrulatus</i> Trin.	Poaceae	-	2	1,3	Un	1300–1600	22
<i>Cleome viscosa</i> L.	Cleomaceae	Jakhiya	10	2,8	Un	2400–2800	18
<i>Coix lacryma-jobi</i> L.	Poaceae	Sankura	5	1,3,6,7	Un	2400–2700	16
<i>Commelina benghalensis</i> L.	Commelinaceae	-	7	1,2,5,7	Co	1300–1500	14
<i>Craniotome furcata</i> (Link) Kuntze	Lamiaceae	-	9	3,7	Un	1300–2200	12
<i>Crotalaria alata</i> D.Don	Fabaceae	Chhunchhun	7	1,2,4	Co	1300–1600	12
<i>Crotalaria albida</i> Roth	Fabaceae	Chhunchhun	6	1,2,3	Co	1300–2000	10
<i>Cyanotis cristata</i> (L.) D.Don	Commelinaceae	-	8	1,2,3,6	Co	1300–2200	10
<i>Cyanotis vaga</i> (Lour.) Schult. & Schult.f.	Commelinaceae	-	8	6,7	Un	2100–2600	12
<i>Cymbopogon martini</i> (Roxb.) W.Watson	Poaceae	Piriya	5	1,4,7	Co	1400–2000	14
<i>Cyperus cyperoides</i> (L.) Kuntze	Cyperaceae	-	8	1,7	Co	1300–2000	10
<i>Cyperus iria</i> L.	Cyperaceae	-	9	6,7,8	Un	1400–2000	12
<i>Cyperus niveus</i> Retz.	Cyperaceae	-	9	1,4,6,8	Co	1300–1600	12
<i>Cyperus rotundus</i> L.	Cyperaceae	-	8	6,7	Un	1300–1800	14
<i>Desmodium microphyllum</i> (Thunb.) DC.	Fabaceae	Sunsuni	6	1,7	Co	1400–2000	10
<i>Desmodium multiflorum</i> DC.	Fabaceae	-	7	1,2,4,8	Co	1300–1600	12
<i>Desmodium renifolium</i> (L.) Schindl.	Fabaceae	-	8	1,4	Ra	1600–2000	16
<i>Dicliptera chinensis</i> (L.) Juss. (= <i>D. bupleuroides</i> Nees)	Acanthaceae	Kulenkatti	4	1,2,4,8	Co	1300–2100	14
<i>Digera muricata</i> (L.) Mart.	Amaranthaceae	-	9	2,4	Un	1400–1500	14
<i>Digitaria ciliaris</i> (Retz.) Koeler	Poaceae	-	8	1,4,7	Co	1300–1500	12
<i>Digitaria griffithii</i> (Hook.f.) Henrard	Poaceae	-	8	1,4,8	Co	1300–2200	10
<i>Drymaria diandra</i> Blume)	Caryophyllaceae	-	5	3,7	Co	1300–1600	18
<i>Echinochloa crus-galli</i> (L.) P.Beauv.	Poaceae	Daykiya, Seu	5	1,8	Co	1400–2000	14
<i>Eragrostiella nardoides</i> (Trin.) Bor	Poaceae	-	6	1,4,8	Co	1300–2300	10
<i>Eragrostis tenella</i> (L.) Roem. & Schult.)	Poaceae	-	8	1,4,8	Co	1800–2400	12
<i>Eriophorum comosum</i> (Wall.) Nees	Poaceae	-	7	2,4,8	Co	1400–1600	14
<i>Euphorbia heterophylla</i> L.	Euphorbiaceae	-	6	1,4	Co	1300–2300	8
<i>Euphorbia parviflora</i> L.	Euphorbiaceae	Dudiya	6	3,4	Co	1600–2000	14
<i>Fagopyrum dibotrys</i> (D.Don) Hara	Polygonaceae	Kandeya	2	1,6,8	Co	1500–2200	16
<i>Festuca gigantea</i> (L.) Vill.	Poaceae	-	7	3,4,5	Un	1300–2000	14

contd. table 1



Assessment of Fodder Species in Western Ramganga Valley, Uttarakhand, India

Botanical name	Family	Local name	CPR <sup>1</sup>	Habitat <sup>2</sup>	AS <sup>3</sup>	Elevation (m)	PUI
<i>Flemingia fruticulosa</i> Wall. ex Benth.	Fabaceae	-	10	1,2,4	Co	1300–2100	10
<i>Flemingia macrophylla</i> (Willd.) Merr.	Fabaceae	-	10	1,3,4	Un	2400–3000	12
<i>Galium aparine</i> L.	Rubiaceae	-	8	1,5,6	Co	2000–3000	10
<i>Galium asperifolium</i> Wall.	Rubiaceae	-	7	1,5,6,7	Co	2500–2800	13
<i>Galium elegans</i> Wall. ex Roxb.	Rubiaceae	-	7	1,6,8	Co	1500–2300	12
<i>Geranium ocellatum</i> Cambess)	Geraniaceae	-	8	1,5,6	Co	1300–2000	12
<i>Geum roylei</i> Wall. & F.Bolle	Rosaceae	-	9	3,6,7	Un	1400–1900	12
<i>Girardinia diversifolia</i> (Link) Friis	Urticaceae	Bhaiskandali	6	1,2,3,7	Co	1500–2600	12
<i>Heteropogon melanocarpus</i> (Elliott) Benth.	Poaceae	Kooriya	5	1,4,8	Co	1600–2200	14
<i>Hypericum elodeoides</i> Choisy	Hypericaceae	-	9	3	Co	1600–2200	10
<i>Hypericum japonicum</i> Thunb.	Hypericaceae	-	10	3,6	Ra	1300–2000	14
<i>Kickxia ramosissima</i> (Wall.) Janch.	Scrophulariaceae	-	10	1,2,4	Un	1600–2500	12
<i>Kyllinga brevifolia</i> Rottb.	Cyperaceae	-	8	1,4,6	Co	1800–2500	10
<i>Lactuca brunoniana</i> (DC.) Wall. ex C.B.Clarke	Asteraceae	Ganpatiya	7	3,6	Un	1300–1400	14
<i>Lobelia pyramidalis</i> Wall.	Lobeliaceae	-	9	2,4,6	Ra	1300–1800	14
<i>Melilotus indicus</i> (L.) All.	Fabaceae	-	8	1,7	Un	1900–2300	14
<i>Nasturtium officinale</i> R.Br.	Brassicaceae	-	9	5,8	Co	1600–2500	14
<i>Ophiopogon intermedius</i> D.Don	Liliaceae	-	8	3	Co	1300–2000	10
<i>Oplismenus compositus</i> (L.) P.Beauv.	Poaceae	-	7	3	Un	1300–2000	14
<i>Oxalis corniculata</i> L.	Oxalidaceae	Bhilmori	5	1,2,5,8	Co	1400–2000	16
<i>Paspalum distichum</i> L.	Poaceae	-	7	1,4,8	Co	1300–1600	14
<i>Pennisetum orientale</i> Rich.	Poaceae	-	6	3	Co	1300–1500	1
<i>Pentanema indicum</i> (L.) Ling	Asteraceae	-	6	1,2,3,4	Co	1300–1600	12
<i>Perotis bordejiformis</i> Nees ex Hook. & Arn.	Poaceae	-	9	1,4,8	un	1600–2400	12
<i>Persicaria amplexicaulis</i> (D.Don) Ronse Decr.	Polygonaceae	Totiya	1	3	Co	1300–2200	16
<i>Persicaria capitata</i> (Buch.-Ham. ex D.Don) H.Gross	Polygonaceae	-	9	1,3,5,6	Co	1350–1450	12
<i>Persicaria nepalensis</i> (Meisn.) Miyabe	Polygonaceae	-	6	1,6,7,8	Co	1600–2200	12
<i>Phryma leptostachya</i> var. <i>oblongifolia</i> (Koidz.) Honda	Phrymaceae	-	9	1,3	Un	1300–1500	14
<i>Pilea scripta</i> (Buch.-Ham. ex D. Don) Wedd	Urticaceae	-	7	1,3,5,7	Co	1400–2000	12
<i>Pilea umbrosa</i> Blume	Urticaceae	-	5	6,7	Co	1300–2200	14
<i>Polygonatum verticillatum</i> (L.) All.	Liliaceae	-	7	3,6	Co	1300–2000	12
<i>Polypogon fugax</i> Nees ex Steud.	Poaceae	-	9	1,4,8	Co	1500–1900	14

contd. table 1

Botanical name	Family	Local name	CPR <sup>1</sup>	Habitat <sup>2</sup>	AS <sup>3</sup>	Elevation (m)	PUI
<i>Pupalia lappacea</i> (L.) Juss.	Amaranthaceae	-	9	1,2,4,8	Un	1800–2000	16
<i>Ranunculus cantoniensis</i> DC.	Ranunculaceae	Kanjiya	7	1,5,6	Co	1300–1800	10
<i>Ranunculus diffusus</i> DC.	Ranunculaceae	-	7	3,6,7	Co	1500–2300	10
<i>Ranunculus distans</i> Royle (= <i>R. laetus</i> Wall ex D. Don)	Ranunculaceae	-	7	3,6	Un	1300–1900	14
<i>Saccharum rufipilum</i> Steud.	Poaceae	Kansa	3	1,4,7	Co	1300–1800	16
<i>Saccharum spontaneum</i> L.	Poaceae	-	5	7	Un	1300–1600	18
<i>Scutellaria grossa</i> Wall.	Lamiaceae	-	8	1,6	Co	1300–1500	12
<i>Senecio chrysanthemoides</i> DC.	Asteraceae	-	9	1,3	Co	1600–2000	12
<i>Setaria pumila</i> (Poir.) Roem. & Schult.	Poaceae	-	6	1,4,8	Co	1300–1900	12
<i>Silene falconeriana</i> Benth.	Caryophyllaceae	-	10	1,3	Un	1300–2800	10
<i>Smithia ciliata</i> Royle	Fabaceae	-	10	1,4	Co	1300–2500	8
<i>Sonchus brachyotus</i> DC.	Asteraceae	-	6	1,4,8	Co	2500–3000	8
<i>Sonchus oleraceus</i> (L.) L.	Asteraceae	-	7	1,4,8	Co	1300–2000	12
<i>Sporobolus fertilis</i> (Steud.) Clayton	Poaceae	-	9	1,3,8	Un	1800–2200	14
<i>Stachys melissifolia</i> Benth.	Lamiaceae	-	8	3	Un	1600–2000	16
<i>Stachys sericea</i> Cav.	Lamiaceae	-	8	3,4	Un	1400–1600	16
<i>Stellaria media</i> (L.) Vill.	Caryophyllaceae	Badaw	6	1,5,6,7	Co	1300–1800	12
<i>Stellaria monosperma</i> Buch.-Ham. ex D. Don	Caryophyllaceae	-	9	3,6,7	Co	1500–2000	10
<i>Stellaria patens</i> D. Don	Caryophyllaceae	-	5	1,5,6	Co	1400–1600	14
<i>Strobilanthes atropurpureus</i> Nees	Acanthaceae	Jimiliya	1	1,3,6,8	Co	1600–1800	18
<i>Thamnocalamus spatbiflorus</i> (Trin.) Munro	Poaceae	-	4	1,4,8	Co	1500–1900	20
<i>Thysanolaena latifolia</i> (Roxb. ex Hornem.) Honda ( <i>T. maxima</i> (Roxb.) Kuntze	Poaceae	-	6	6,7	Co	1300–2000	14
<i>Trifolium resupinatum</i> L.	Fabaceae	-	9	1	Un	1400–1900	12
<i>Trifolium repens</i> L.	Fabaceae	Tinptiya	4	1,5,6,8	Co	1600–2000	14
<i>Urtica dioica</i> L.	Urticaceae	Kandali	6	1,2,7,8	Co	1300–1500	18
<i>Vicia sativa</i> L.	Fabaceae	-	5	1,7	Co	1300–1600	14
<b>Climbers</b>							0
<i>Ampelocissus divaricata</i> (Wall. ex M.A. Lawson) Planch.	Vitaceae	-	4	1,3,6	Co	1300–2100	16
<i>Ampelocissus latifolia</i> (Roxb.) Planch.	Vitaceae	Lagul	6	3	Co	1600–2200	12
<i>Caesalpinia decapetala</i> (Roth) Alston	Caesalpinaceae	Karanj	10	1,5,7	Un	1300–1400	16
<i>Clematis montana</i> Buch.-Ham. ex DC.	Ranunculaceae	-	8	3	Ra	2500–3000	16

contd. table 1

Assessment of Fodder Species in Western Ramganga Valley, Uttarakhand, India

Botanical name	Family	Local name	CPR <sup>1</sup>	Habitat <sup>2</sup>	AS <sup>3</sup>	Elevation (m)	PUI
<i>Cryptolepis buchamani</i> roem & Schultz.	Asclepiadaceae	Dudhiya	8	1,2,4,8	Co	1400–1800	12
<i>Dioscorea melanophyma</i> Prain & Burkill	Dioscoreaceae	Tairu	8	1,3	Un	1600–2000	12
<i>Ficus sarmentosa</i> Buch.-Ham. ex Sm.	Moraceae	Beduli	1	1,3,7	Co	1300–2200	16
<i>Hedera nepalensis</i> K.Koch	Hydrangeaceae	Kainwali	2	2,3,6,7	Co	1600–2800	16
<i>Herpetospermum pedunculatum</i> (Ser.) C.B. Clarke	Cucurbitaceae	Bankakri	5	3	Un	2700–3000	20
<i>Holboellia latifolia</i> Wall.	Lardizabalaceae	Gumfal	6	3	Un	2000–2300	16
<i>Hydrangea anomala</i> D. Don	Hydrangeaceae	-	5	3,6,7	Co	1600–2300	12
<i>Ipomoea purpurea</i> (L.) Roth	Convolvulaceae	Sulkani	8	1,2,4,8	Un	1300–2000	12
<i>Jasminum dispersum</i> Wall.	Oleaceae	-	8	1,3	Un	1500–2000	12
<i>Parthenocissus semicordata</i> (Wall.) Planch.	Vitaceae	Chhipari	6	1,2,3,8	Co	1400–2000	12
<i>Rhynchosia rothii</i> Aitch.	Fabaceae	-	7	3,4	Ra	2000–2300	16
<i>Rubia manjith</i> Roxb. ex Fleming	Rubiaceae	Majeithi	7	1,2,3,6	Co	1600–2300	14
<i>Rubus paniculatus</i> Sm.	Rosaceae	Kutrin	10	1,2,3,7	Co	1400–2200	12
<i>Schisandra grandiflora</i> (Wall.) Hook.f. & Thomson	Schisandraceae	Lagul	3	3, 7	Un	1700–2200	20
<i>Schisandra propinqua</i> (Wall.) Baill.	Schisandraceae	Aageli	3	3	Un	1600–2000	22
<i>Smilax aspera</i> L.	Smilacaceae	Kukurdar	2	1,2,3,8	Co	1300–2500	16
<i>Smilax elegans</i> Wall. ex Kunth	Smilacaceae	Kukurdar	3	2, 3	Co	1500–2500	14
<i>Smilax ocreata</i> A.DC.	Smilacaceae	Kukurdar	7	7	Ra	1300–1400	16
<i>Solena amplexicaulis</i> (Lam.) Gandhi	Cucurbitaceae	Gui-Kakari	3	1,2,4,8	Co	1300–2200	18
<i>Tetrastigma affine</i> (Gagnep. ex Osmaston) Raizada & H.O. Saxena	Vitaceae	Lagul	10	3,7	Un	1600–1700	16
<i>Tetrastigma obtectum</i> (Wall. ex M.A. Lawson) Planch. ex Franch.	Vitaceae	-	10	3,7	Un	1300–1600	14
<i>Tetrastigma serrulatum</i> (Roxb.) Planch.	Vitaceae	-	9	3,7	Co	1600–1800	12
<i>Tinospora cordifolia</i> (Willd.) Miers	Menispermaceae	Geloi	1	1,7	Ra	1300–1800	24
<i>Trachelospermum axillare</i> Hook.f.	Apocynaceae	Dudhiya	3	3,7	Un	1700–2000	20
<i>Trachelospermum lucidum</i> (D.Don) K.Schum.	Apocynaceae	Dudiya	3	3,7	Co	1600–1700	18
<i>Trichosanthes tricuspidata</i> Lour.	Cucurbitaceae	-	9	1,2,7,8	Co	1300–2200	14
<i>Vigna vexillata</i> (L.) A.Rich.	Fabaceae	-	4	1,4	Un	1500–2100	16
<i>Vitis jacquemontii</i> R.Parker	Vitaceae	Lagul	9	3	Un	2000–2100	14
<i>Vitis beyneana</i> Roem. & Schult.	Vitaceae	Lagul	10	1,2	Co	1300–1800	10

**Abbreviations used:** <sup>1</sup>CPR=community preference rank; <sup>2</sup>Habitat: 1=agricultural field margins, 2= exposed, 3=forest, 4=grassy, 5=marshy, 6=shady moist, 7=stream/river side, 8=way/road side; <sup>3</sup>AS (availability status), Co=common, Un=uncommon, Ra=rare.

climber (Fig. 2). Significant difference ( $F_{3,36}=5.93$ ,  $P=0.002$ ) was recorded in the species richness per CPRs ranks for different habits (trees, shrubs, herbs and climber).

### Pressure use index (PUI)

Among tree fodders, pressure use index (PUI) was recorded maximum (26) for *Acer caesium* and *Boehmeria rugulosa*, which followed by *Bauhinia semla*, *Bauhinia variegata*, *Ficus auriculata*, *Ficus semicordata*, *Grewia oppositifolia*, *Meliosma dilleniifolia* and *Quercus semecarpifolia* (24 each). *Cotinus coggygria* and *Desmodium elegans* showed highest PUI (22 each) among shrubs; *Chrysopogon serrulatus* (22), *Amaranthus cruentus* (20) and *Thamnocalamus spathiflorus* (20) among herbs. *Tinospora cordifolia* showed highest PUI (24) among climbers, followed by *Schisandra propinqua* (22), *Herpetospermum pedunculatum* (20), *Schisandra grandiflora* (20) and *Trachelospermum axillare* (20).

### DISCUSSION

Documenting indigenous knowledge through ethnobotanical studies is important for the conservation of fodder resources and their sustainable utilization. The present study provides comprehensive information especially the availability status, flowering, fruiting and altitudinal distribution on the fodder resources in the Ramganga valley and will be helpful in identify species for further research and developmental prospects. The species in the higher CPRs and PUI are crucial from the conservational point of view, on account of higher anthropogenic pressure.

The study revealed that the number of tree fodder species decrease with increase in CPRs from 1 to 10, while total species richness increase towards lower CPRs (Fig. 3). The higher ranked fodder plants consisted of comparably smaller number of species, but these fulfilled more than 50% fodder demand of inhabitants in the valley. In availability, 6.69% species found to be rare, 35.53% as uncommon

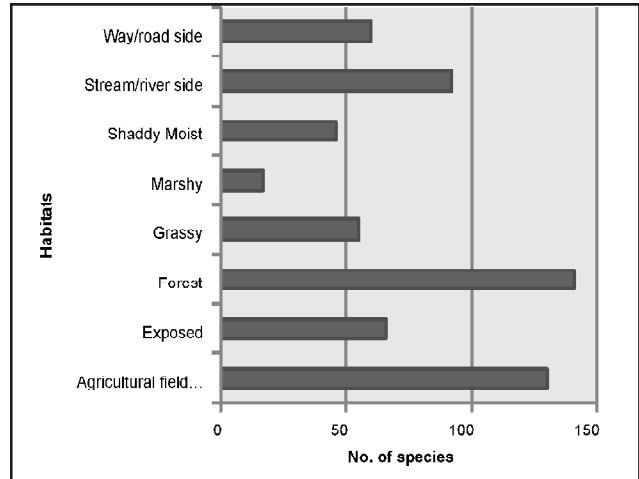


Figure 1: Diversity of fodder plants in different habitats

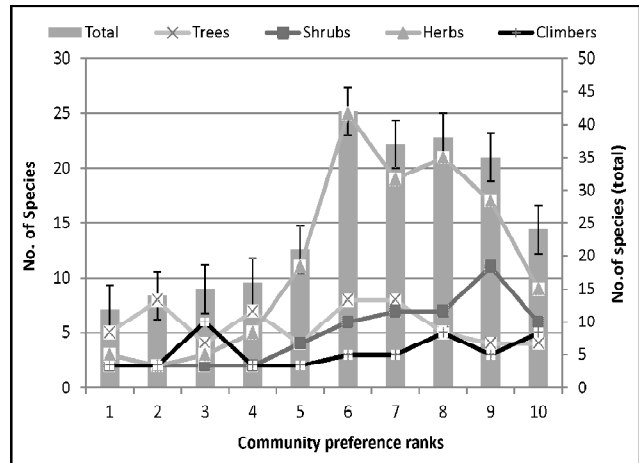


Figure 2: Distribution of life form in different CPRs

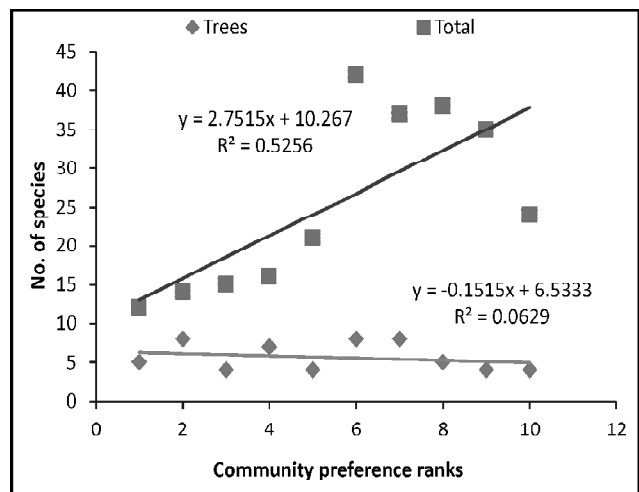


Figure 3: Relation of CPRs

while, 57.48% as common. Among trees, *Grewia oppositifolia*, *Ilex dipyrrena*, *Quercus floribunda*, *Q. leucotrichophora* and *Q. semecarpifolia* were most preferred species (91–100%). People's preference for *Q. leucotrichophora* was 98% in Chamoli and 100% in Pithorath, while 50% for *Q. floribunda*, 41% *Grewia oppositifolia* and *Q. glauca* [16]. Among fodder trees, Oaks were highly preferred because of their high nutrient content and palatability [25].

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### DECLARATION

There is no conflict of interest among the authors of the manuscript

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