

## Taxonomic and Economic Classification of Riparian Floral Diversity along River Ganga in Garhwal Himalayan Region of India

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**Abstract:** Ganga is the most widely worshipped of all the renowned rivers due to great antiquity and religious sanctity for millions of Hindus in India. The Indian civilization and culture nurtured along with Ganga. This study elucidates economic classification of riparian floral diversity along Ganga River. A total of 276 riparian plant species belonging to 82 families and 225 genera have been documented and identified, of which 56.16% species were found for medicinal values, which are being used to cure various ailments in human beings while rest species for timber, fuel wood, fodder, ecological/ environmental specific and miscellaneous values. In terms of taxonomic diversity, Poaceae was the dominant family among all the study sites.

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**Keywords:** riparian floral diversity; medicinal value; taxonomic classification; economic classification; Ganga River.

### 1. Introduction

Riparian zones (the fringes of rivers or streams) are the interface between aquatic and terrestrial ecosystems (Reichardson *et al.*, 2007). Buffer strips of riparian vegetation are effective to reducing sediment and nutrient loads (Groffman *et al.*, 1990; Castelle *et al.*, 1994) from non-point sources which are major remaining cause of surface water pollution (Baker, 1992). Aquatic ecosystems are being altered due to these non-point sources. Sedimentation and excess nutrients are the two leading non-point pollution problems in rivers (Baker, 1992). Riparian vegetation reduces the severity of impacts to riparian areas caused by storm events (Bertulli, 1981) that can incise channels and adversely affect functioning of riparian ecosystem (Henshaw and Booth, 2000). The riparian vegetation also shades the stream, stabilizes the stream bank with tree roots, and produces leaf litter, all of which support a greater variety of aquatic life in the stream.

In the Himalayan region, riparian forests play a pivotal role in the life of peoples, to fulfill their daily requirements like timber, fuel, fodder, medicine, fruits and other purposes (Shyam, 2008). The use of plants for different purposes is perhaps as old as mankind. In India, since the Vedic period, information on the utility of plants in medicine finds place in different ancient scriptures. The medicinal importance of riparian plant diversity along river Ganga at Haridwar and dependency of local community upon riparian diversity for curing different diseases has been reported by Gangwar and Joshi (2006). This was the first attempt to report the medicinal and economical importance of riparian vegetation in Uttarakhand. Correspondingly, the present

study is an attempt to bring as much information for highlighting the medicinal and economical importance of riparian vegetation which has been systematically gathered and compiled.

### 2. Material and Methods

#### 2.1. Study Area

The entire study area (latitudes 29° 59'-30° 59' N and longitudes 78° 11' - 78° 56' E) is spread to about 300 km along the Bhagirathi-Ganga river from Haridwar to Gangotri, covering five districts of Uttarakhand state i.e. Haridwar, Dehradun, Pauri Garhwal, Tehri Garhwal and Uttarkashi. Its altitude range varied from 290 m to 3140 m from sea level. Total ten sites viz. Haridwar, Shyampur, Rishikesh, Shivpuri, Devprag, Tehri, Uttarkashi, Maneri Bhali, Lanka and Gangotri were selected to collect the information. Site wise altitudinal variation is given in Figure 1. Such a variation in the altitude of study area provides a wide diversity of landscape and micro-habitats.

#### 2.2. Field survey and Identification of plant species

Extensive floristic surveys were conducted at ten selected spots along Bhagirathi-Ganga River between Haridwar and Gangotri, during 2005-07. Field identification of plants was made with the help of floras and books (Gaur, 1999; Kanjilal, 2004; Kehimkar, 2000; Sahni, 2000; Polunin & Stainton, 2005) as well as local experts.

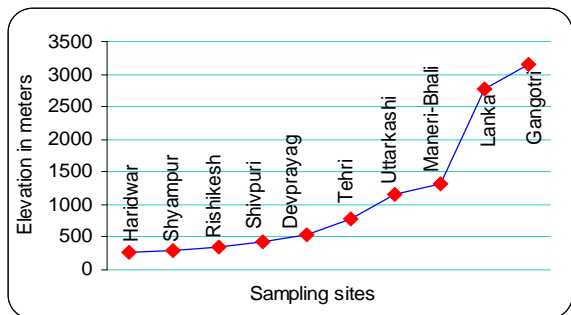


Figure 1. Altitudinal variation among study sites

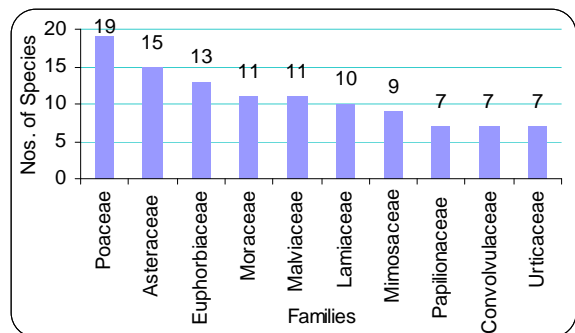


Figure 2. Family wise distribution of plant species.

Unidentified specimens were preserved following the method of Jain and Rao (1976) and brought to Gurukul Kangri University, Haridwar for further examination and identification. Herbaria of Wildlife Institute of India (WII), Dehradun and Forest Research Institute (FRI), Dehradun was used to cross check the identity of various species. Taxonomists of WII and FRI also were consulted for the identification of plant samples.

### 2.3. Ethno-botany

Ethno-botanical information, particularly on the use of wild plants for medicinal and other purposes, was collected through direct interactions and interviews with the local community, where ever in habituated. Therefore, the ethno-botanical knowledge of people and listing of plants of particular region are important tools that may help in understanding human environment interactions. Information was collected on trees, shrubs and herbs and their uses for different purposes at local indigenous levels. The economic dependence of local people is essentially on the plant resources growing in the riparian zone of Ganga river between Haridwar and Gangotri. The parameters considered are (1) medicinal, (2) timber, (3) fodder, (4) fuel wood (5) ecological/ environmental specific (soil binder, pollutants absorbent, air purifier etc) and (6) miscellaneous values including edible, religious, ornamental and handicraft.

### 3. Results

The economically important plants are the species, which have social and economic values. A total of 276 riparian floral species belonging to 82 families and 225 genera were identified and classified for medicinal and economic values. Out of 82 families, maximum number of species were recorded from Poaceae family (19sp.) followed by Asteraceae, Euphorbiaceae, Moraceae & Malvaceae, Lamiaceae, Mimosaceae, Papilionaceae, Convolvulaceae and Urticaceae are depicted in Figure 2 and uses of all documented species are given in Table 1. The families and species within a family are arranged in alphabetical order.

Species names are followed by Hindi names, habit of plant and plant uses. A total number of 155 species were noted for medicinal importance, which are being used by locals to cure various ailments whereas 45 species, 26 species, 44 species, 22 species and 59 species of plants have found for the timber, fuel wood, and fodder, ecological / environmental specific and miscellaneous uses, respectively (Figure- 3). The qualitative analysis of all the species documented showed that, the maximum species were herbs (41.30%) followed by trees (29.35%), shrubs (25.36%) and climber (3.98%) as given in Figure- 4.

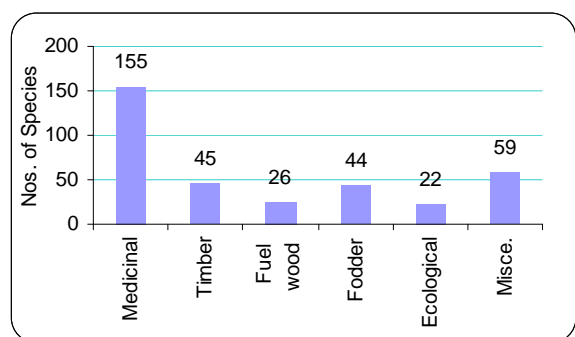


Figure 3. Plant species used for Medicinal and other Economic purposes.

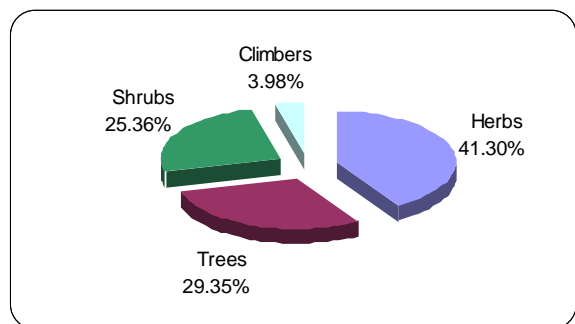


Figure 4. Distribution of riparian flora for its vegetative habit.

Table 1. Taxonomic and economic characteristics of riparian floral diversity along River Ganga between Haridwar and Gangotri.

| <b>Families &amp; Botanical Name</b>             | <b>Local / Common Name</b> | <b>Habit</b> | <b>Economic Uses</b> |
|--------------------------------------------------|----------------------------|--------------|----------------------|
| <b>Acanthaceae</b>                               |                            |              |                      |
| <i>Adhatoda zeylanica</i> Nees.                  | Adusa                      | S            | MD                   |
| <i>Barleria cristata</i> L.                      | Saundi                     | H            | MD                   |
| <i>Barleria prionitis</i> L.                     | Peela-bansa                | H            | MD                   |
| <i>Rungia pectinata</i> (L.) Nees                | Pindikunda                 | H            | MD                   |
| <b>Aceraceae</b>                                 |                            |              |                      |
| <i>Acer cappadocicum</i> Gled.                   | Kainchali                  | T            | FL                   |
| <b>Agavaceae</b>                                 |                            |              |                      |
| <i>Agave americana</i> L.                        | Rambans                    | S            | MD                   |
| <b>Amaranthaceae</b>                             |                            |              |                      |
| <i>Achyranthus aspera</i> Linn.                  | Chirchita                  | H            | MD                   |
| <i>Aerva lanata</i>                              | Chaya                      | H            | FD                   |
| <i>Alternanthera sissilis</i> (L.) R.Br. ex DC   | Gudrisag                   | H            | MD                   |
| <i>Amaranthus spinosus</i> Linn.                 | Kanta-Chaulai              | H            | MD                   |
| <i>Amaranthus viridis</i> L.                     | Chaulai                    | H            | FD                   |
| <i>Pupalia lappacea</i> (L.) Juss.               | Nagdaminee                 | S            | MD                   |
| <b>Amaryllidaceae</b>                            |                            |              |                      |
| <i>Zephyranthes carinata</i> Herbert             | Rain Lily                  | H            | MS                   |
| <b>Anacardiaceae</b>                             |                            |              |                      |
| <i>Lannea coromandelica</i> (Houtt) Merr.        | Jhinghan                   | T            | TR, FD               |
| <i>Rhus cotinus</i> Linn.                        | Tung                       | S            | MS                   |
| <i>Rhus parviflora</i> Roxb.                     | Tungla                     | S            | MD                   |
| <b>Apiaceae</b>                                  |                            |              |                      |
| <i>Centella asiatica</i> (Linn.) Urban.          | Brahmi                     | H            | MD                   |
| <b>Apocynaceae</b>                               |                            |              |                      |
| <i>Carissa opaca</i> Stapf.                      | Karonda                    | S            | MS                   |
| <i>Holarrhena antidysenterica</i> Wall.          | Kura/Kurchi                | T            | TR, FL               |
| <i>Rauwolfia serpentina</i> (L.) Benth.          | Sarpgandha                 | S            | MD                   |
| <i>Vallisneria spiralis</i> Spreng               | Dudhi-bel                  | CI           | MS                   |
| <i>Wrightia tomentosa</i> Roem.                  | Dudhali                    | T            | TR                   |
| <b>Asclepiadaceae</b>                            |                            |              |                      |
| <i>Calotropis procera</i> (Air.) R.Br            | Aak                        | S            | MD                   |
| <i>Calotropis gigantea</i> (L.) Dryander         | Mudar                      | S            | MD                   |
| <i>Cryptolepis buchananii</i> Roem. & Schult.    | Medha-singhi               | CI           | MD                   |
| <b>Arecaceae</b>                                 |                            |              |                      |
| <i>Phoenix sylvestris</i> Roxb.                  | Khajur                     | S            | MD                   |
| <b>Asteraceae</b>                                |                            |              |                      |
| <i>Ageratum conyzoides</i> Linn.                 | Visadodi                   | H            | MD                   |
| <i>Artemisia nilagirica</i> (Clarke) Pamp.       | Kunja                      | H            | MD                   |
| <i>Artemisia roxburgiana</i> Linn.               | -                          | H            | MD                   |
| <i>Bidens biternata</i> (Lour.) M. & Sh.         | Mangrinya                  | H            | MD                   |
| <i>Blumea lacera</i> (Burm. F.) DC               | Kukronda                   | H            | MD                   |
| <i>Eclipta alba</i> L.                           | Bhangaru                   | H            | MD                   |
| <i>Eclipta prostrata</i> (Linn.) Linn            | Keshraj                    | H            | MD                   |
| <i>Emilia sonchifolia</i> (Linn) DC              | Dudhi                      | H            | MD                   |
| <i>Galinsoga ciliata</i> (Rafinesque-Sch.) Blake | -                          | H            | MS                   |
| <i>Gnaphalium leuto album</i> L.                 | Bal-raksha                 | H            | MD                   |
| <i>Launnea procumbens</i>                        | Van-gobhi                  | H            | FD                   |
| <i>Parthenium hysterophorus</i> L.               | Gazarghas                  | H            | MS                   |
| <i>Taraxacum officinale</i> W. ex W.             | Dudhiphen                  | H            | MD                   |
| <i>Tridax procumbens</i> L.                      | Keshraj                    | H            | MD                   |
| <i>Xanthium strumarium</i> L.                    | Chota-dhatura              | H            | MD                   |

|                                                      |               |    |        |
|------------------------------------------------------|---------------|----|--------|
| <b>Berberidaceae</b>                                 |               |    |        |
| <i>Berberis lycium</i> Royle                         | Kingori       | S  | MD     |
| <i>Berberis asiatica</i> Roxb. ex DC                 | Kilmora       | S  | MD     |
| <i>Berberis aristata</i> DC.                         | Kingora       | S  | MD     |
| <b>Betulaceae</b>                                    |               |    |        |
| <i>Alnus nepalensis</i> D. Don                       | Utis          | T  | TR, FL |
| <i>Betula utilis</i> D. Don                          | Bhojpatra     | T  | TR, MS |
| <b>Bignoniaceae</b>                                  |               |    |        |
| <i>Jacaranda mimosifolia</i> D. Don                  | Nila Gulmohar | T  | MS     |
| <b>Bombacaceae</b>                                   |               |    |        |
| <i>Bombex ceiba</i> Linn.                            | Semal         | T  | TR, MD |
| <b>Boraginaceae</b>                                  |               |    |        |
| <i>Cynoglossum zeylanicum</i> (Vabl) Thunb. ex Lehm. | Andhahuli     | H  | MD     |
| <i>Ehretia leavis</i> Roxb.                          | Lasaura       | T  | TR     |
| <i>Cordia dichotoma</i> Forst. f.                    | Chamror       | T  | FD, TR |
| <b>Brassicaceae</b>                                  |               |    |        |
| <i>Capsella bursa-pastoris</i> (L.) Medik.           | Tuntkya       | H  | MD     |
| <b>Buddlejaceae</b>                                  |               |    |        |
| <i>Buddleja asiatica</i> Lour.                       | Bhati         | S  | MD, MS |
| <i>Buddleja paniculata</i> Wall.                     | Sendroi       | S  | FL     |
| <b>Cactaceae</b>                                     |               |    |        |
| <i>Opuntia dilleni</i> Haw                           | Nagphani      | S  | MD     |
| <b>Cannabaceae</b>                                   |               |    |        |
| <i>Cannabis sativa</i> Linn.                         | Bhang         | S  | MD     |
| <b>Capparaceae</b>                                   |               |    |        |
| <i>Crateva magna</i> (Lour.) DC.                     | Barna         | T  | MD     |
| <b>Capparidaceae</b>                                 |               |    |        |
| <i>Capparis zeylanica</i> Linn.                      | Hins          | Cl | MD     |
| <i>Cleome viscosa</i> Linn                           | Hurhur        | H  | MD     |
| <b>Cornaceae</b>                                     |               |    |        |
| <i>Alangium lamarckii</i> Thwaites                   | Bismar        | T  | FL, MD |
| <b>Caprifoliaceae</b>                                |               |    |        |
| <i>Viburnum cotonifolium</i> D. Don                  | Bhatyanu      | S  | MD     |
| <b>Cesalpiniaceae</b>                                |               |    |        |
| <i>Bauhinia purpurea</i> Linn.                       | Guiral        | T  | FD, MS |
| <i>Bauhinia racemosa</i> Lam.                        | Jhanjhora     | T  | FL     |
| <i>Bauhinia vahlii</i> W. & A.                       | Maljhan       | Cl | FD     |
| <i>Bauhinia variegata</i> Linn.                      | Kachnar       | T  | FD, MD |
| <i>Caesalpinia bonducella</i> (L.) Roxb.             | Kath Karanj   | Cl | MD     |
| <i>Cassia fistula</i> Linn.                          | Amaltas       | T  | ES     |
| <i>Cassia mimosoides</i> Linn.                       | Patwa ghas    | H  | MD     |
| <i>Cassia occidentalis</i> Linn.                     | Chakunda      | H  | FL     |
| <i>Cassia saemea</i> Lam.                            | Kasondi       | T  | MS     |
| <i>Cassia tora</i> Linn                              | Panwar        | H  | MD     |
| <b>Chenopodiaceae</b>                                |               |    |        |
| <i>Chenopodium ambrosioides</i> Linn.                | Bathua        | H  | MS     |
| <i>Chenopodium album</i> L.                          | Bathua        | H  | MS     |
| <b>Combretaceae</b>                                  |               |    |        |
| <i>Anogeissus latifolia</i> Wall                     | Bakali        | T  | FD, TR |
| <i>Terminalia alata</i> Heyne ex Roth                | Sain          | T  | TR     |
| <i>Terminalia arjuna</i> (Roxb.) W. & A.             | Arjun         | T  | TR     |
| <i>Terminalia bellerica</i> (Gaertn.) Roxb.          | Bahera        | T  | MD, TR |
| <b>Commelinaceae</b>                                 |               |    |        |
| <i>Commelina benghalensis</i>                        | Kanchara      | H  | MD, MS |
| <b>Compositae</b>                                    |               |    |        |

|                                                  |               |    |            |
|--------------------------------------------------|---------------|----|------------|
| <i>Cirsium arvense</i> (L.) Scop.                | Kardra        | H  | MD         |
| <i>Eupatorium odoratum</i> L.                    | Tivra gandha  | S  | MD         |
| <i>Sonchus oleraceus</i>                         | Dudhi         | H  | MD, FD     |
| <b>Convolvulaceae</b>                            |               |    |            |
| <i>Argyreia nervosa</i> (Burm.f.) Boj.           | Ghav bel      | Cl | MD         |
| <i>Convolvulus arvensis</i> L.                   | Heyranpatu    | H  | MD         |
| <i>Evolvulus alsinoides</i> (L.) L               | Shankhpushpi  | Cl | MD         |
| <i>Ipomoea carnea</i> Jacq.                      | Sadasuhagan   | S  | FL, MD     |
| <i>Ipomoea nil</i> L.                            | Guj           | Cl | FD         |
| <i>Ipomoea pes tigris</i> L.                     | Panch patri   | Cl | FD         |
| <i>Merremia tridentata</i> (Linn.)Hall. F.       | Prasarini     | H  | MD         |
| <b>Crassulaceae</b>                              |               |    |            |
| <i>Rhodiola hirtophylla</i>                      | -             | H  | MD         |
| <i>Rosularia adenotricha</i> (Wallich ex Edgew.) | Looniya       | H  | MD         |
| <i>Sedum adenotrichum</i>                        | -             | H  | MD         |
| <b>Cupressaceae</b>                              |               |    |            |
| <i>Juniperus squamata</i> Buch.-Ham. ex D. Don   | Thelu         | S  | ES, FL     |
| <b>Cyperaceae</b>                                |               |    |            |
| <i>Cyperus rotundus</i> Linn.                    | Motha         | H  | MD         |
| <b>Dipterocarpaceae</b>                          |               |    |            |
| <i>Shorea robusta</i> Gaertn. f.                 | Sal           |    | TR         |
| <b>Ericaceae</b>                                 |               |    |            |
| <i>Rhododendron companulatum</i> D. Don          | Simris        | S  | MD         |
| <b>Euphorbiaceae</b>                             |               |    |            |
| <i>Bridelia retusa</i> Spreng                    | Ekdania       | T  | FD, MS     |
| <i>Embllica officinalis</i> Gaertn.              | Aonla         | T  | MD, MS, FD |
| <i>Euphorbia hirta</i> L.                        | Dudhi         | H  | MD         |
| <i>Euphorbia hetrophylla</i>                     | Dudhi         | H  | MD, FD     |
| <i>Euphorbia rothiana</i>                        | -             | H  | MD         |
| <i>Euphorbia royleana</i> Boiss.                 | Thor          | S  | MD         |
| <i>Jatropha curcas</i> Linn.                     | Jatropha      | S  | MS         |
| <i>Mallotus philippinensis</i> (Lam.) Muell.Arg  | Rohini        | T  | FD, MD, FL |
| <i>Putranjiva roxburghii</i> Wall.               | Jiaputa       | T  | FD, FL     |
| <i>Ricinus communis</i> Linn.                    | Arandi        | S  | MD         |
| <i>Sapium insigne</i> Benth.                     | Khinda        | T  | MD         |
| <i>Sapium sebiferum</i> Roxb.                    | Tarcharvi     | T  | MD         |
| <i>Trewia nudiflora</i> Linn.                    | Gutel         | T  | TR         |
| <b>Gentianaceae</b>                              |               |    |            |
| <i>Swertia ciliata</i> (G. Don) Burt             | Chirotu       | H  | MD         |
| <b>Geraniaceae</b>                               |               |    |            |
| <i>Geranium nepalense</i> Sw.                    | Phori         | H  | MD         |
| <b>Grossulariaceae</b>                           |               |    |            |
| <i>Curculigo orchioides</i> Gaertn.              | -             | H  | MD         |
| <i>Ribes orientale</i> Desf.                     | Darbag        | H  | MD         |
| <b>Hypoxidaceae</b>                              |               |    |            |
| <i>Ribes alpestre</i> Wall. ex D. Don            | Kali-musli    | H  | MD         |
| <b>Lamiaceae</b>                                 |               |    |            |
| <i>Anisomeles indica</i> (L.) Kuntze             | Goplya        | H  | MD         |
| <i>Calamintha umbrosum</i> (M. Bieb.) K. Koch    | Birchee       | H  | MD         |
| <i>Colebrookia oppositifolia</i> Sm              | Binda/ Pansra | S  | MD         |
| <i>Coleus barbatus</i> (Andrews) Benth.          | Fiwain        | H  | MD         |
| <i>Hyptis suaveolense</i> (L.) Poit.             | Vilayti tulsi | H  | MS         |
| <i>Leucas aspera</i> (Willd) Link.               | Gopha         | H  | MD         |
| <i>Micromeria biflora</i> (Buch.-Ham. ex D. Don) | Gorakhopan    | H  | MD         |
| <i>Ocimum basilicum</i> Linn.                    | Jungli-tulsi  | H  | MD         |

|                                                  |                    |   |            |
|--------------------------------------------------|--------------------|---|------------|
| <i>Pogostemon plecranthoides</i> Desf.           | Raudera            | S | MS         |
| <i>Roylea cinerea</i> (D. Don) Baillon           | Karu               | H | MD         |
| <i>Salbia plebeia</i> R. Br.                     | Sathi, Samundarsok | H | MD         |
| <b>Leeaceae</b>                                  |                    |   |            |
| <i>Leea aspera</i> M. Laws.                      | Kunwai             | S | MD         |
| <b>Liliaceae</b>                                 |                    |   |            |
| <i>Polygonatum cirrhifolium</i> (Wallich) Royle  | Khakan             | H | MD, MS     |
| <i>Asparagus racemosus</i> Willd.                | Satrawal           | S | MD         |
| <i>Urginea indica</i> (Roxb.) Kunth              | -                  | H | MD         |
| <b>Lythraceae</b>                                |                    |   |            |
| <i>Lagerstroemia parviflora</i> Roxb.            | Dhaudi             | T | TR         |
| <i>Punica granatum</i> Linn.                     | Anar               | T | MS         |
| <i>Woodfordia fruticosa</i> Kurz.                | Dhaura             | S | ES         |
| <b>Malvaceae</b>                                 |                    |   |            |
| <i>Abutilon indicum</i> L                        | Kanghi             | S | MD, FL     |
| <i>Azanza lampas</i> (Cav.) Aly.                 | Jangli bhindi      | S | MD         |
| <i>Kydia calycina</i> Roxb.                      | Pula               | T | FD, FL     |
| <i>Malvastrum coromandelianum</i> (L.)Garcke     | Suchi              | H | MD         |
| <i>Malva parviflora</i> L.                       | Soncheli           | H | MS, MD     |
| <i>Sida acuta</i> Burm. f.                       | Bala               | H | MD, MS     |
| <i>Sida cordata</i> (Burm. f.) Borssum           | Bhiyli             | H | MD         |
| <i>Sida cordifolia</i> Linn.                     | Kunghi             | H | MD         |
| <i>Sida rhombifolia</i> Linn.                    | Kharenti           | H | MD, FL     |
| <i>Thespesia lampas</i> Dalz. & Gibs.            | Ban kapasi         | S | FL         |
| <i>Urena lobata</i> Linn.                        | Ungoo              | H | MD         |
| <b>Martyniaceae</b>                              |                    |   |            |
| <i>Martynia annua</i> L.                         | Hathajori          | H | MD, MS     |
| <b>Meliaceae</b>                                 |                    |   |            |
| <i>Azadirachta indica</i> A.Juss.                | Neem               | T | MD, TR, ES |
| <i>Toona ciliata</i> M. Roem.                    | Bakain             | T | TR         |
| <i>Melia azadirach</i> Linn.                     | Tun                | T | TR         |
| <b>Mimosaceae</b>                                |                    |   |            |
| <i>Acacia catechu</i> (Linn.f.) Willd            | Khair              | T | MD, TR, ES |
| <i>Acacia nilotica</i> L.                        | Babool             | T | TR, FL     |
| <i>Albizia chinensis</i> (Osborne) Merr.         | Siris              | T | MS         |
| <i>Albizia julibrissin</i> Durazz.               | Bhondir            | T | TR         |
| <i>Albizia lebbek</i> Benth.                     | Kala siris         | T | TR, FL     |
| <i>Albizia odoratissima</i> Benth.               | -                  | T | TR         |
| <i>Albizia procera</i>                           | Safed siris        | T | TR         |
| <i>Mimosa pudica</i> Linn.                       | Lajwanti           | H | MD         |
| <i>Mimosa himalayana</i> Gamble                  | Alay               | S | MD         |
| <b>Moraceae</b>                                  |                    |   |            |
| <i>Broussonetia papyrifera</i> L. Herit. ex Vent | Paper Malburry     | T | FD, ES     |
| <i>Ficus bengalensis</i> Linn.                   | Bargad             | T | TR, ES     |
| <i>Ficus carica</i> Linn.                        | Anjir              | T | TR, MS     |
| <i>Ficus elastica</i> Roxb.                      | Rubber             | T | TR         |
| <i>Ficus hispida</i> L.f.                        | Gobla              | T | FD, MS     |
| <i>Ficus palmata</i> Forsk.                      | Khemri             | T | FD, MS     |
| <i>Ficus racemosa</i> Linn.                      | Gular              | T | FD, MS     |
| <i>Ficus religiosa</i> Linn.                     | Pipal              | T | ES         |
| <i>Ficus roxburgii</i> Wall.                     | Timal              | T | TR         |
| <i>Garuga pinnata</i> Roxb.                      | Kharpat            | T | TR, FD     |
| <i>Morus alba</i> L.                             | Tatri              | T | MS         |
| <b>Myrsinaceae</b>                               |                    |   |            |
| <i>Ardisia solanacea</i> Roxb.                   | Bhatmal            | S | MD         |

|                                                |                    |   |            |
|------------------------------------------------|--------------------|---|------------|
| <i>Embelia robusta</i> Roxb.                   | Gaia               | S | MD         |
| <b>Myrtaceae</b>                               |                    |   |            |
| <i>Syzygium cumini</i> (Linn.) Skeels.         | Jamun              | T | TR, MS     |
| <b>Nyctaginaceae</b>                           |                    |   |            |
| <i>Boerhavia diffusa</i> L.                    | Punarnava          | H | MD         |
| <i>Celosia argentia</i> L.                     | Sarwari            | H | MS         |
| <b>Oleaceae</b>                                |                    |   |            |
| <i>Nyctanthes arbortristis</i> L.              | Harsingar          | T | ES, FL     |
| <b>Onagraceae</b>                              |                    |   |            |
| <i>Oenothera rosea</i> (L.) Herit. ex Aiton    | -                  | H | MD         |
| <b>Oxalidaceae</b>                             |                    |   |            |
| <i>Oxalis corniculata</i> L.                   | Tinpatia           | H | MD, MS     |
| <b>Papaveraceae</b>                            |                    |   |            |
| <i>Argemone maxicana</i> L.                    | Satyanashi         | H | MD         |
| <b>Pedaliaceae</b>                             |                    |   |            |
| <i>Sesamum indicum</i> Linn                    | Til                | H | MD         |
| <b>Pinaceae</b>                                |                    |   |            |
| <i>Abies pindrow</i> Royle                     | Morinda            | T | FL, TR     |
| <i>Cedrus deodara</i> (Roxb. ex D. Don) G. Don | Deodar             | T | TR         |
| <i>Picea smithiana</i> (Wallich) Boiss.        | Roi                | T | MS, FL     |
| <i>Pinus roxburgii</i> Sarg.                   | Chir               | T | TR, MS     |
| <i>Pinus wallichiana</i> A. B. Jackson         | Kail               | T | TR         |
| <b>Plumbaginaceae</b>                          |                    |   |            |
| <i>Plumbago zeylanica</i> Linn.                | Chitrak            | H | MD         |
| <b>Poaceae</b>                                 |                    |   |            |
| <i>Apluda mutica</i> L.                        | Charol             | H | FD         |
| <i>Arundinella nepalensis</i> Trin             | Bichhla            | H | FD         |
| <i>Arundo donax</i> Linn.                      | Naldura            | H | ES         |
| <i>Chloris dolichostachya</i>                  | Paneri             | H | FD         |
| <i>Chrysopogon fulvus</i> (Spr.) Chiov.        | Bhuri              | H | FD         |
| <i>Chrysopogon serrulatus</i> Trin.            | Golden Beard Grass | H | FD         |
| <i>Cynodon dactylon</i> (Linn.) Pers.          | Doovghas           | H | FD, ES     |
| <i>Dendrocalamus strictus</i> Nees.            | Bans               | S | TM, FD     |
| <i>Deshmostachya bipinnata</i> (Linn.) Stapf.  | Dav, Kush          | H | MS         |
| <i>Digiteria</i> sp.                           | -                  | H | FD         |
| <i>Eliliopsis binata</i> (Retz.)               | Bhabhar ghas       | H | FD, ES, MS |
| <i>Heteropogon contortus</i> (L.) P. Beauv.    | Kumeria            | H | FD         |
| <i>Imperata cylindrica</i> Linn.               | Siru pula          | H | FD, ES, MS |
| <i>Oplismenus compositus</i> L.                | Dumdobra kukaria   | H | FD         |
| <i>Phragmites karka</i> Trin.                  | Narkul             | H | MD         |
| <i>Polypogon fugax</i> Nees ex Steudal.        | -                  | H | FD         |
| <i>Saccharum munja</i> Roxb.                   | Muni               | H | ES, MS     |
| <i>Saccharum spontaneum</i> L.                 | Kans               | H | FD, ES, MS |
| <i>Vetiveraia zizaniodes</i> (L.)              | Khus               | H | FD, ES, MS |
| <b>Polygonaceae</b>                            |                    |   |            |
| <i>Polygonum capitatum</i>                     | Kaflya             | H | MS         |
| <i>Polygonum hydropiper</i> L.                 | -                  | H | MD         |
| <i>Polygonum plebeium</i> R. Br.               | Dondya             | H | MS         |
| <i>Rumex hastatus</i> D. Don                   | Chilmora           | H | MD         |
| <i>Rumex nepalensis</i> Sprengel               | Khatura            | H | MS, MD     |
| <b>Portulacaceae</b>                           |                    |   |            |
| <i>Portulaca oleracea</i> Linn.                | Badinoni           | H | MD         |
| <b>Primulaceae</b>                             |                    |   |            |
| <i>Anagallis arvensis</i>                      | Krishan-neel       | H | MD         |
| <b>Proteaceae</b>                              |                    |   |            |

|                                                |                |    |            |
|------------------------------------------------|----------------|----|------------|
| <i>Grevillea robusta</i> A. Cunn.              | Silver aak     | T  | TR         |
| <b>Papilionaceae</b>                           |                |    |            |
| <i>Astragalus candolleanus</i> Royle           | Rudravanti     | H  | MD         |
| <i>Butea monosperma</i> (Lamk) Taub.           | Dhak           | T  | TR, MD     |
| <i>Dalbergia sissoo</i> Roxb.                  | Shisham        | T  | TR         |
| <i>Desmodium triflorum</i> (L.) DC.            | Kandaliya      | H  | MD         |
| <i>Millettia auriculata</i> Baker              | Gauj           | Cl | FD, MS     |
| <i>Mucuna prurita</i> Hook.                    | Kaircha        | Cl | MD         |
| <i>Ougeinia oojeinensis</i> (Roxb.) Hochr.     | Sandan         | T  | TR, FD     |
| <b>Ranunculaceae</b>                           |                |    |            |
| <i>Ranunculus sceleratus</i> L.                | Jaldhania      | H  | MD         |
| <i>Thalictrum foliolosum</i> DC.               | Mamiri         | H  | MD         |
| <b>Rhamnaceae</b>                              |                |    |            |
| <i>Zizyphus oenoplia</i> (Linn.) Mill          | Makoy          | S  | MD, FL     |
| <i>Zizyphus mauritiana</i> (Lam.) Burm.f.      | Ber            | S  | FL, ES, MS |
| <i>Zizyphus nummalaria</i> (Burm. f.) W. & A.  | Jharber        | S  | FL, FD     |
| <i>Zizyphus xylopyra</i> Willd.                | Bhander        | T  | FD, MS     |
| <b>Rosaceae</b>                                |                |    |            |
| <i>Fragaria nubicola</i> Lindley ex Lacaita    | Gand-Kaphal    | H  | MS         |
| <i>Potentilla cuneata</i> Wallich ex Lehm.     | -              | H  | MD         |
| <i>Potentilla polyphylla</i> Wallich ex Lehm.  | -              | H  | MD         |
| <i>Prinsepia utilis</i> Royle                  | Bhekar         | S  | MS         |
| <i>Prunus cerasoides</i> D. Don.               | Panya          | T  | MD         |
| <i>Pyracantha crenulata</i> (D. Don) M. Roemer | Ghangharu      | S  | MD         |
| <i>Rosa moschata</i> Mill.                     | Kujoi          | S  | MS, MD     |
| <i>Rubus ellipticus</i> Sm.                    | Hisalu         | S  | MD, MS     |
| <i>Rubus niveus</i> Thunb.                     | Bhera          | S  | MS, MD     |
| <i>Sorbaria tomentosa</i> (Lindley) Rehder     | Bhiloka        | S  | ES, MS     |
| <b>Rubiaceae</b>                               |                |    |            |
| <i>Adina cordifolia</i> Hook. f.               | Haldu          | T  | TR, ES     |
| <i>Mitragyna parvifolia</i> (Roxb.) Korth      | Phaldu, kaim   | T  | TR, ES     |
| <i>Hymenodictyon excelsum</i> Wall.            | Bhulan         | T  | FD, ES     |
| <i>Wendlandia exserta</i> DC.                  | Bathua         | T  | MS         |
| <b>Rutaceae</b>                                |                |    |            |
| <i>Aegle marmelos</i> (Linn.) Corr.            | Bel            | T  | MD, FD, ES |
| <i>Glycosmis mauritiana</i> (Lamk.) Tanaka     | Bannimbu       | S  | MD         |
| <i>Hesperethusa crenulata</i> (Roxb.) Roem.    | Kathbel        | T  | TR, FL     |
| <i>Murraya koenigii</i> (Linn.) Spr.           | Karipatta      | S  | MD         |
| <i>Zanthoxylum armatum</i> DC.                 | Timru          | S  | MD         |
| <b>Samydaceae</b>                              |                |    |            |
| <i>Casearia tomentosa</i> Roxb.                | Chilla         | T  | MS         |
| <b>Sapindaceae</b>                             |                |    |            |
| <i>Dodonaea angustifolia</i> L.f.              | Wilayti Mehndi | S  | MD, MS     |
| <i>Scheichera oleosa</i> (Lour.) Oken          | Kusum, Gosum   | T  | TR, FD, ES |
| <b>Scrophulariaceae</b>                        |                |    |            |
| <i>Bacopa monnieri</i>                         | Brahmi         | H  | MD         |
| <i>Verbascum thapsus</i> Linn.                 | Gidar tamaku   | H  | MD         |
| <b>Simaroubaceae</b>                           |                |    |            |
| <i>Ailanthus excelsa</i> Roxb.                 | Maharukh       | T  | TR         |
| <b>Solanaceae</b>                              |                |    |            |
| <i>Datura metal</i> Linn.                      | Dhatura        | S  | MD         |
| <i>Datura suaveolens</i> H. & B.               | Dhatura        | S  | MD         |
| <i>Physalis minima</i> L.                      | Tulatipati     | H  | MS         |
| <i>Solanum anguivi</i> L.                      | Barhanta       | S  | MD         |
| <i>Solanum indicum</i> L.                      | Bhut-Kataia    | S  | MD         |



|                                                |               |   |        |
|------------------------------------------------|---------------|---|--------|
| <i>Solanum nigrum</i> L.                       | Makoi         | H | MD     |
| <i>Solanum surratense</i> Burm. f.             | Kantakari     | S | MD     |
| <i>Solanum virginianum</i>                     | -             | S | MD     |
| <i>Withania somnifera</i> Linn                 | Asgandha      | S | MD     |
| <b>Sterculiaceae</b>                           |               |   |        |
| <i>Helicteres isora</i> L.                     | Kapasi        | S | MD, MS |
| <i>Pterospermum acerifolium</i> Willd.         | Kanakchampa   | T | FD     |
| <b>Tamaricaceae</b>                            |               |   |        |
| <i>Tamarix dioica</i> Roxb.                    | Jhau          | S | MS     |
| <b>Tiliaceae</b>                               |               |   |        |
| <i>Grewia optiva</i> Drum.                     | Bhimal        | T | FD, MS |
| <i>Triumfetta rhomboidea</i> Jacq.             | Chiki         | H | MD     |
| <b>Typhaceae</b>                               |               |   |        |
| <i>Typha elephantina</i> Roxb.                 | Patera        | H | MS     |
| <b>Ulmaceae</b>                                |               |   |        |
| <i>Holoptelia integrifolia</i> (Roxb.) Planch  | Papari/ Kanju | T | TR     |
| <i>Celtis australis</i> L.                     | Khirak        | T | TR, FD |
| <b>Urticaceae</b>                              |               |   |        |
| <i>Boehmeria platyphyla</i> D. Don             | Khaksha       | S | MD     |
| <i>Boehmeria rugulosa</i> Wedd.                | Genthi        | T | MS     |
| <i>Debregeasia longifolia</i> (Burm. F.) Wedd. | Tushiari      | S | MD     |
| <i>Gerardinia diversifolia</i> (Link) Friis    | Bichchhu      | S | MD, MS |
| <i>Pouzolzia hirta</i> (Roxb.) Hassk.          | Atainyaa      | H | MD     |
| <i>Streblus asper</i> Lour                     | Dahia         | T | MD, FL |
| <i>Urtica dioica</i> Linn.                     | Bichhubooti   | S | MD, MS |
| <b>Verbenaceae</b>                             |               |   |        |
| <i>Callicarpa macrophylla</i> Vahl.            | Daia          | S | MD     |
| <i>Clerodendrom viscosum</i> Vent.             | Bhant         | S | MD     |
| <i>Clerodendrom serratum</i> Spreng            | Banbahri      | S | MD     |
| <i>Lantana camera</i> L.                       | Kurrii        | S | FL     |
| <i>Tectona grandis</i> Linn.                   | Sagaun        | T | TR     |
| <i>Vitex negundo</i> L.                        | Nirgundi      | S | MD     |

**Abbreviations:** T-Tree; S-Shrub; H-Herb; Cl-Climber; MD-Medicinal; FD-Fodder; TR-Timber; FL-Fuel; ES-Ecological/ environmental specific and MS- Miscellaneous value

#### 4. Discussion

It will be pertinent to mention that the present study conducted for the assessment of riparian floral diversity in its medicinal and economical roles along the Bhagirathi-Ganga River (downstream to upstream) at ten selected spots during 2005-07. This is the first of its kind made within our country in general and alternative in partial. Gangwar *et al.* (2009) made a detailed survey in Darma valley of Kumaun Himalaya and documented some floral species which are consumed by Bhotias for medicinal and economic purposes. Another study elucidated 102 medicinal plants of Kumaun Himalaya are used by local people to cure different diseases (Gangwar *et al.*, 2010).

It is important to note that 73.19% documented species were found being used for one purpose while 23.19% for two and 3.62% for three purposes. For instance, *Lannea coromandelica*, *Anogeissus latifolia*

etc. are being used for timber and fodder while *Eliliopsis binata*, *Imperata cylindrica* etc. are having values of fodder, soil binder and miscellaneous. Number of species like *Azadirachta indica*, *Centella asiatica*, *Rauwolfia serpentina*, *Cannabis sativa*, *Terminalia bellerica*, *Embilica officinalis*, *Plumbago zeylanica*, *Thalictrum foliolosum*, *Pyracantha crenulata*, *Rubus ellipticus*, *Zanthoxylum armatum*, *Verbascum thapsus*, *Withania somnifera*, *Vitex negundo* etc. were noted for highly medicinal value.

On behalf of present study it is concluded that riparian zone along River Bhagirathi-Ganga between Haridwar to Gangotri enriched in plant diversity which also provides protection to the river banks and natural resources to the million of people resides along river banks for their livelihood. But day by day increasing anthropogenic activities like construction of dams, buildings and unmanaged tourism may cause major

threat to riparian biodiversity. So, there is an urgent need to pay sincere attention towards protection and conservation of riparian areas following regular monitoring and documentation of riparian species.

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#### References

- [1] Richardson DM, Holmes P.M, Esler KJ, Galatowitsch SM, Stromberg JC, Kirkman SP, Pysek P, Hobbs RJ. Riparian vegetation: degradation, alien plant invasions, and restoration prospects. *Diversity and Distributions*. 2007; 13: 126-139.
- [2] Groffman PM, Gold A.J, Husband TP, Simmons RC, Eddleman WR. Final report; Narrangansett Bay project; an investigation into multiple uses of vegetated buffer strips. University of Rhode Island, Kingston 1990.
- [3] Castelle AJ, Johnson AW, Conolly C. Wetland and stream buffer size requirements: A review. *Journal of Environmental Quality* 1994; 23:878-882.
- [4] Baker LA. Introduction to non-point source pollution in the United States and prospects for wetland use. *Ecological Engineering* 1992; 1:1-26.
- [5] Bertulli JA. Influence of a forested wetland on a southern Ontario watershed. In A. Champagne, ed. *Proceedings of the Ontario wetlands conference*. Federation of Ontario Naturalists and Dept. of Applied Geography, Ryerson Polytechnical Institute Toronto, Ontario; 1981: 193 Pp.
- [6] Henshaw PC, Booth DB. Re-equilibration of stream channels in urban watersheds. *Journal of the American Water Resources Association*. 2000; 36:1219-1236.
- [7] Gangwar RS, Joshi BD. Diversity of Medico-Economically important riparian flora of river Ganga at Shyampur, Dehradun. In: *Biodiversity and Environmental Management* edited Joshi et al. APH Publishing House, New Delhi 2008; 157-166.
- [8] Gangwar RS, Joshi, B.D. Some medicinal flora in the riparian zone of river Ganga at Saptrishi, Haridwar, Uttaranchal. *Himalayan Journal of Environment and Zoology* 2006; 20 (2):237-241.
- [9] Gaur RD. In: *Flora of the District Garhwal North-west Himalaya*. Transmedia Publication, Srinagar (Garhwal); 1999.
- [10] Kanjilal UN. In: *Forest flora of the Chakrata, Dehradun & Saharanpur forest division* (Foreword by Pradeep Krishen). Natraj Publisher, Dehradun 2004.
- [11] Kehimkar I. In: *Common Indian Wild Flowers*. Bombay Natural Historical Society, Oxford University Press 2000.
- [12] Sahni, K.C. (2000). In: *The book of Indian trees*. Bombay Natural Historical Society, Oxford University Press.
- [13] Polumin O, Stainton A. In: *Flowers of the Himalaya (Seventh impression)*, Oxford University Press 2005.
- [14] Gangwar KK, Deepali, Gangwar RS. Ethnomedicinal plant diversity in Kumaun Himalaya of Uttarakhand, India. *Nature and Science* 2010; 8(5): 66-78.
- [15] Jain S K, Rao RR. In: *A hand book of field and herbarium methods*. Today and Tomorrow Publishers, New Delhi 1976; 350pp.
- [16] Gangwar R S, Joshi BD, Joshi R, Singh R. Medicinal and economic plants of Darma valley consumed by Bhotias: A case study from Kumaun Himalaya, India. *Journal of Economic and Taxonomic Botany* 2009;33 (1): 67-72.
- [17] Shyam R. Thesis "A study on riparian floral biodiversity of river Ganga between Haridwar and Gangotri" submitted to Gurukul Kangri University, Haridwar 2008.

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