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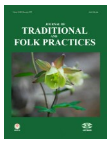

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An eco-sociological analysis of useful climbers of family Convolvulaceae Juss.

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Abstract

Climbing plants are the most important part of the forest ecosystem as well as they are also useful for humans in numerous ways. We have conducted the present study to identify and evaluate the relationship between the traditional cultural practices and livelihood uses of climbing plants and their uses through calculating different ethnobotanical indices. Different quantitative techniques have been used in ethnobotany to compare the uses and the cultural importance of different liana species in a society. We have used ethnobotany methods such as in-depth interviews, participant observation, walk-in-the-woods, semi-structured questionnaires and focus groups to collect the data of plants traditionally used by tribal people from Gujarat, India. Information about 24 plant species belonging to family Convolvulaceae were recorded. Analysis of quantitative ethnobotanical indices shows that among the 24 species selected for the study *Ipomoea aquatica* Forssk. has the highest values and *Ipomoea alba* L., shows the lowest values, which indicate the species as widely used by the tribal people for different purposes. The study suggests that the traditional cultural uses for plants may be a way for the conservation of biodiversity in the rapidly declining forests of the state.

Keywords: Cultural importance, EthnobotanyR, *Ipomoea,* Liana

1. Introduction

Climbing plants are important constituents of forest ecosystems and are contributing to many vital aspects of forest dynamics, structure and composition (Isnard and Silk, 2009). Their occurrence has been reported in more than 133 families of angiosperms (Gentry, 1992). Climbing plants differ from trees and shrubs in several characteristics most notable is the mechanical properties of the stem (Isnard *et al.,* 2003; Rajput and Gondaliya, 2017). The climbing plants are found ecologically and economically as one of the important floristic elements, particularly in tropical and subtropical regions. However, the climbing species are most understudied among the various habit forms and their studies are neglected by most researchers. They are usually considered a nuisance by foresters and are generally cut down in any silvicultural managed forests (Sarvalingam and Rajendran, 2015). Climbing plants play very crucial roles in forest communities and ecosystem dynamics (Nabe-Nielsen, 2001). Many climbing plants are also widely used by people, especially those living in rural areas, as an important source of food, medicine and cultural purposes (Bongers *et al.*, 2005; Muhwezi *et al.*, 2009). Apart from food and medicine, many climbing plants are important sources of Non-Timber Forest Products (NTFPs) used for different domestic purposes, including furniture, fuel wood, rope making, etc. (Shackleton and Shackleton, 2004).

Family Convolvulaceae widely referred to as 'morning glories/bindweed family', as the flowers in most of the members remain open from morning to the afternoon. The majority of the convolvulaceae members are climbers. The taxonomic explanation of Convolvulaceae was first given by de Jussieu (1789), considering it as a family. It comprises 12 tribes and around 1650 species (Austin and Huáman, 1996; Kattee, 2020) widely distributed, most diverse in the tropical, subtropical and temperate regions of both hemispheres. In Gujarat, the family is represented by approximately 11 genera, 47 species and 4 varieties (Shah, 1978). Members of this family are important as sources of food, drugs, ornamentals, etc.

Ethnobotany is an interdisciplinary field exploring the relationship between plants and humans (Birhanu *et al.,* 2015). The empiric age old wisdom on the intimate relationship between humans and plants has come to us through surviving traditions. The study of such a knowledge system based on the direct relationship with the plants is multidisciplinary and interdisciplinary in nature. Tapsell *et al.* (2006) explained that medicinal plants had been used throughout ancient human history. Most of the tribal villages have 1 or 2 local practitioners of traditional medicines or a particular family of traditional medicine, locally known as '*bhagats* or *vaid'* (Joshi *et al.*, 2013). These practitioners have acquired the knowledge (mostly oral or non-codified) for treating patients, mostly from the family's elders, which passes from generation to generation. As a result of their experience, they are skilled to locate the correct plant among the many plant species found around them to cure various illnesses (Abbink, 1995; Punjani, 2010).

There have been different approaches regarding the measurement and valuation of plant taxa in ethnobotany (Hoffman and Gallaher, 2007). Some earlier researchers (Turner, 1988; Stoffle *et al.*, 1990; Pieroni, 2001) have developed indices based on their subjective allocation of the importance of each use *viz*., Cultural significance index (CSI), Cultural importance index (CI), etc.

It was hypothesized that the tribal people of the study area would be the holders of traditional/cultural knowledge about plant uses and practices. By following different methods of ethnobotany, we could learn from the tribal people about the livelihood and spiritual and cultural significance of plants. The research followed this hypothesis with the broad aim of assessing local plant use and cultural importance. The present investigation is an outcome of a collaborative exercise between the researchers and the tribal inhabitants of the study area aimed at producing outcomes directly relevant to the conservation of biodiversity and traditional knowledge.

2. Materials and methods

2.1 Study area

Gujarat is a state with significant number of biogeographic zones. It encompasses four of the total ten bio-geographic regions in India (Umadevi *et al.,* 1989). Gujarat's plants, particularly liana diversity are quantitatively and qualitatively rich as it has many families, genera and species. It has poor forest cover (less than 10% forest land of its geographical area) but has rich biodiversity (Anonymous, 1991). The forest areas along the eastern boundary of the state are predominantly occupied by tribal population, spread over eight districts, *viz.,* Dang, Valsad, Surat, Bharuch, Vadodara, Panchmahal, Sabarkantha and Banaskantha (Umadevi, 1988). The tribal population forms about 15% of the total population of the state. Different studies on tribal communities of Gujarat have revealed that out of 2000 plant species occurring in Gujarat, 760 are medicinal and 450 are economical and ethnobotanically important (including lianas), most of them are used by tribal people (Reddy, 1987; Umadevi *et al*., 1989; Kumar and Desai, 2014).

Gujarat, with its rich floral diversity in various forest and non-forest areas, holds rich natural wealth of medicinal plants particularly climbers here in this study. The presence of a sizeable strength of ayurvedic pharmaceuticals and the popularity of a wide range of traditional ethnobotanical practices reveal evidence of the rich medicinal flora of Gujarat, especially in the local village and tribal belt of the State. Existing documentation on medicinally and ecologically important plants of the State is surveyed by number of earlier workers (Joshi *et al*., 1980; Nirmal Kumar *et al.*, 2000; Nirmal Kumar *et al.*, 2004; Modhvadia, 2009; Odedra, 2009; Thakor, 2009; Patel *et al.*, 2010) not in terms of taxonomic studies, but in terms of compiled information on ecological status of medicinal lianas and their uses by local society.

2.2 Data collection

Data collection was conducted during the year 2018 to 2020, covering different seasons. Seven field trips were conducted, each of 2 to 3 days duration in different seasons. During the field visits, plant specimens were collected, identified with the help of Flora of the Presidency of Bombay (Cooke, 1908) and Flora of Gujarat (Shah, 1978) and processed adequately through standard methods. Herbarium of voucher specimens were deposited in the BARO Herbarium, Department of Botany, The Maharaja Sayajirao University of Baroda, Vadodara. Special notes on the ethnobotany were noted.

The work also included a preliminary meeting with local elders and community leaders, followed by fieldwork, observation and collection. Ethnobotanical methods such as in-depth interviews, participant observation (Kremen *et al.*, 1998; Prance *et al.*, 1987; Reyes-Garcia *et al.*, 2007), walk-in-the-woods (Phillips and Gentry, 1993), semi-structured questionnaires and focus groups (Quinlan, 2005) were all employed in the data collection. The research set out to learn all the possible details about the use and harvest of regional plants, including cultural, spiritual and conservation practices. Sixteen key informants (Abbasi *et al.*, 2013) between the ages of 24 and 65 were selected and interviewed separately. These include village wise men, experienced informants, elderly people, head man of the hamlets, tribal medicine men (*vaidya'*, '*bhagat'* and '*bhuwa'*), etc. These people are the only source of information about the local plant names and their ethnobotanical uses. This is the original and ancient knowledge, which was not documented systematically at the micro level earlier, but several ethnobotanical workers have been working on this subject for the last few decades (Jain, 2020).

2.3. Data analysis

Designing appropriate use categories is essential to any ethnobotanical study (Hoffman and Gallaher 2007). Ethnobotanical knowledge was expressed in many ways, e.g., medicine, food, spiritual practices, stories, legends, folklore, rituals and customary laws. Therefore, making indices that fit well to the community involved in creating use report categories based on the fundamental questions that were asked and the diversity of answers that were received.

After the collection of data, it has been segregated into pre-defined use categories (Table 1). Every use has been given value according to the use of that specific species by the tribal people. It is essential that methods and experimental design replicate studies that have already been performed to identify similarities and differences in the use of native species (Belovsky *et al.*, 2004; Albuquerque *et al.*, 2006). Therefore, the "use values" indices developed by Prance *et al.* (1987) and further developed by Phillips and Gentry (1993) form the foundation of the quantitative ethnobotanical methods employed in this investigation, which also include the cultural importance index (CI) (Tardio and Pardo-de-Santayana, 2008), the frequency of citation (FC) and number of uses per species (NU).

The "Use Report" (UR), which occurs when a species is mentioned, is being used for certain defined use category (Tardio and Pardo-de-Santayana, 2008). The maximum possible number of UR per species for this survey is 160 (respondents (N = 16) multiplied by use categories (UC = 10)). Frequency of Citation (FC) represents the total number of people who mention the use of the species. The maximum value for FC equals the number of respondents (N = 16). Number of uses per species (NU) is the total number of different use categories in which an individual species was mentioned. The maximum value for NU equals the number of use categories (NC = 10). These quantitative values can also be used to find and index for the Cultural importance (CI) of the species. After interviewing informants and collecting the data, various ethnobotanical indices were calculated to understand the valuation and importance of plants growing around these tribal villages. An R package called 'ethnobotanyR' (Whitney, 2021) was used to calculate indices and interpret the data. After calculating the various indices of these 24 plant species, radial plot (Plate 1) and flow graph (Fig. 1) were generated for easy understanding and better visualization of the data.

Table 1. Researcher defined use categories

Sl. No.	Use category	Total uses reported	Percentage (%)
1	Medicinal	26	19.70
2	Construction	6	4.55
3	Technology	6	4.55
4	Human food	22	16.67
5	Fodder	17	12.88
6	Firewood	19	14.39
7	Ornamental	20	15.15
8	Veterinary	5	3.79
9	Commercial	5	3.79
10	Symbolic use	6	4.55

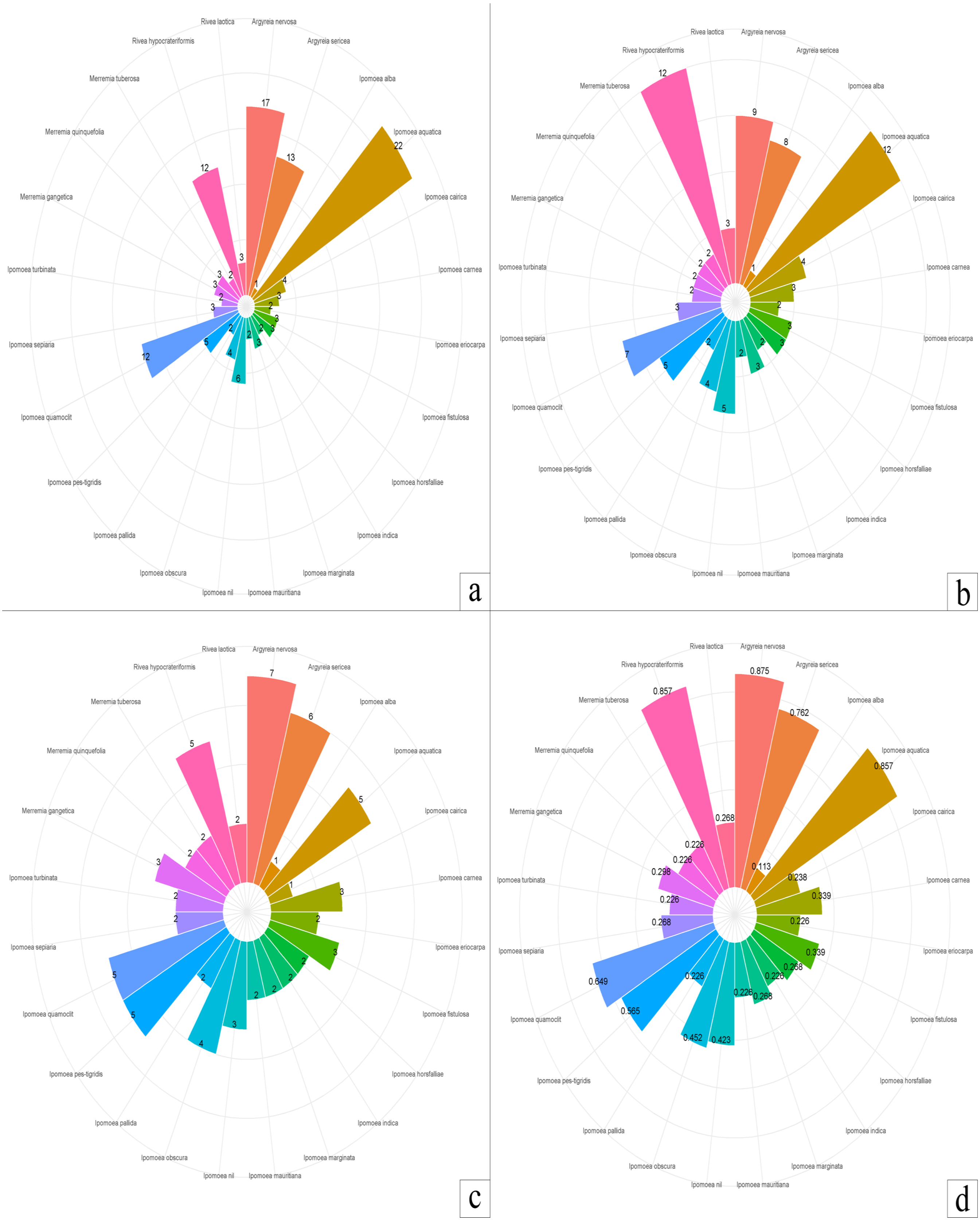

Plate 1.a.Radial plot of use report; b. Radial plot of frequency of citation; c. Radial plot of number of uses; d. Radial plot of relative importance index

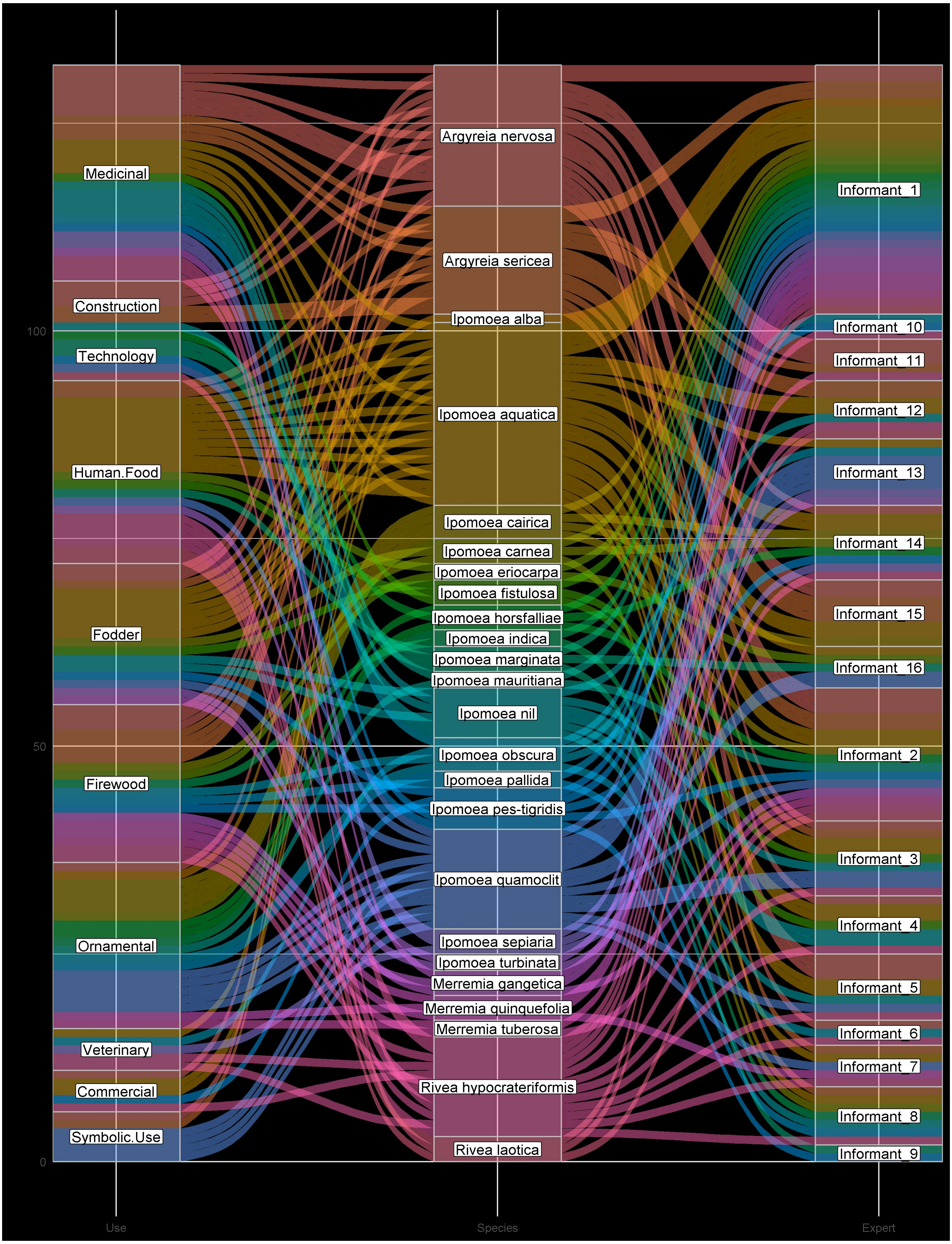

Fig. 1. Graphical representation of interrelationship between informants, species and use categories

3. Results and discussion

In total, 24 species of climbers were recorded. For the purposes of this study, use reports were grouped into 10 broad categories (Table 1). These categories represent of responses received during interviews. The most common uses were medicinal followed by human food and ornamental uses having 19.7%, 16.67% and 15.15% citation, respectively.

Veterinary and commercial use categories have the least citation of 3.79 % each. The 24 plant species with the calculated scores are described in Table 2 by botanical names and indices. *Ipomoea aquatica* Forssk, was the species mostly used by the informants and the least mentioned species was *Ipomoea alba* L., while other species have relatively lower values. Over and above, these are more popular among the tribal people as compared to the rest of the lianas.

Ethnobotany deals with interrelationships between human cultures and plants. The investigation of the cultural values of plant species plays a significant role in modern medicine, farming, pharmaceutical and nutraceuticals industrial sectors, etc. Wild edible plants play an important socio-economic role as medicines, food, dyes, poison, shelter, fibre and religious and cultural ceremonies (Hoffman and Gallaher, 2007). Relative Cultural Importance (RCI) indices are quantitative measures designed to transform the complex, multidimensional concept of "importance" into standardized and comparable numerical scales or values (Vijendra and Kumar, 2010).

This study offers the first step towards a collaborative consideration of the ethnobotany and conservation status of native plants in tribal areas and the role of tribal people living there in using and preserving the traditional knowledge of plants. This kind of traditional and cultural knowledge of the tribes and their customary practices is now seriously threatened. It needs more support from competent researchers, activists, policy makers and relevant institutions (Whitney *et al.,* 2014). Results of the present study concurred with past findings of some researchers (Joshi *et al*., 1980; Modhvadia, 2009; Thakor, 2009). Past investigations in Gujarat also found medicinal use of *Argyreia nervosa* (Burm. f.) Bojer, *I. aquatica, I. sepiaria* Koenig ex Roxb. and *Rivea hypocrateriformis* Choisy (Patel *et al.,* 2010). The data presented in this paper is first step towards understanding the ethnobotanical knowledge and cultural practices that are the heart of these tribes. It shows that the use of plants is not just about their utility but is a complementary relationship that indicates the respect and glory for the forest and plants (Whitney *et al.,* 2014).

4. Conclusion

There is a constant threat to the diversity of lianas due to the unwarranted interferences from people and the traditional knowledge is often misused. There is an urgent need for improving the autonomy of tribes of Gujarat who are under considerable pressure to exploit their natural resources. A central question here is how we can preserve this traditional cultural knowledge of tribes in relation to the rapidly changing system. Various programmes, schemes and efforts are needed to enhance and secure the livelihood and conventional practices of tribes.

By and large, the information on Convolvulaceae lianas is documented at various sources, but these reports must be scientifically authenticated using modern technological tools. Therefore, such detailed studies are warranted to create an important data set and validate the local knowledge prevailing in the society. Moreover, a long-term need is important to perceive research by involving naturalists, social scientists, community people and indigenous herbalists. A significant detailed contribution from scientists and social scientists on local traditional knowledge is envisaged. Such studies will also help the common people to enhance their socio-economic status and will make them self-sustainable. In-depth analysis of the traditional herbal treatment of specific plant species is warranted to understand the importance of lianas in the day-to-day life of local inhabitants.

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Table 2. Quantitative scores for the species

Sl. No.	Scientific names	UR*	CI*	FC*	NU*	RFC*	RI*	CV*
1	*Argyreia nervosa* (Burm. f.) Bojer.	17	1.062	9	7	0.562	0.875	0.418
2	*Argyreia sericea* Dalz.	13	0.812	8	6	0.5	0.762	0.244
3	*Ipomoea alba* L.	1	0.062	1	1	0.062	0.113	0
4	*Ipomoea aquatica* Forssk.	22	1.375	12	5	0.75	0.857	0.516
5	*Ipomoea cairica* (L.) Sweet	4	0.25	4	1	0.25	0.238	0.006
6	*Ipomoea carnea* Jacq.	3	0.188	3	3	0.188	0.339	0.011
7	*Ipomoea eriocarpa* R. Br.	2	0.125	2	2	0.125	0.226	0.003
8	*Ipomoea fistulosa* Mart. ex Choisy	3	0.188	3	3	0.188	0.339	0.011
9	*Ipomoea horsfalliae* Hook.	3	0.188	3	2	0.188	0.268	0.007
10	*Ipomoea indica* (Burm.) Merr.	2	0.125	2	2	0.125	0.226	0.003
11	*Ipomoea marginata* (Desr.) Verdc.	3	0.188	3	2	0.188	0.268	0.007
12	*Ipomoea mauritiana* Jacq.	2	0.125	2	2	0.125	0.226	0.003
13	*Ipomoea nil* (L.) Roth	6	0.375	5	3	0.312	0.423	0.035
14	*Ipomoea obscura* (L.) Ker Gawl.	4	0.25	4	4	0.25	0.452	0.025
15	*Ipomoea pallida* Santapau & V.Patel	2	0.125	2	2	0.125	0.226	0.003
16	*Ipomoea pes-caprae* (L.) R. Br.	5	0.312	5	5	0.312	0.565	0.049
17	*Ipomoea pes-tigridis* L.	12	0.75	7	5	0.438	0.649	0.164
18	*Ipomoea quamoclit* L.	3	0.188	3	2	0.188	0.268	0.007
19	*Ipomoea sepiaria* Koenig ex Roxb.	2	0.125	2	2	0.125	0.226	0.003
20	*Merremia gangetica* Cufod.	3	0.188	2	3	0.125	0.298	0.007
21	*Merremia quinquefolia* (L.) Hallier f.	3	0.188	2	2	0.125	0.226	0.005
22	*Merremia tuberosa* (L.) Rendle	2	0.125	2	2	0.125	0.226	0.003
23	*Rivea hypocrateriformis* Choisy	12	0.75	12	5	0.75	0.857	0.281
24	*Rivea laotica* Ooststr.	3	0.188	3	2	0.188	0.268	0.007

** UR- Use Report; CI- Cultural Importance Index; FC- Frequency of Citation; NU- Number of Uses; RFC- Relative Frequency of Citation; RI- Relative Importance; CV- Cultural Value*

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