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Quantitative Evaluation of Ethnobotanicals from Dang District, South Gujarat

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ABSTRACT

In the present communication we are trying to report the socio-cultural valuation of the available Phyto-resources from the Dang district, South Gujarat. Quantitative techniques have been used in ethnobotany to compare the uses and the cultural importance of different plant taxa. Researchers have developed several indices to estimate the significance of plant species for humans. We used interview and observational data concerning plants traditionally used by tribal people of south Gujarat. Individual data 'event' is collected and segregated in pre-defined use categories. It was then processed separately. Different indices such as User report (UR), Frequency of citation (FC), Number of uses (NU), Cultural importance index (CI), Relative frequency of citation (RFC), and Relative importance index (RI) were calculated. We found a low correlation between the practical and the cultural values of species: some species rarely used were frequently mentioned in interviews, whereas some species frequently used were rarely mentioned in interviews. Indices of cultural and practical value measure different dimensions of the importance of plant species to society. From the present study we found that *Moringa oleifera* is the most used plant species in the study area.

Keywords: Ethnobotany, ethnobotanyR, CVI, Dangs, RCI

INTRODUCTION

Humans seek unity, diversity and simplicity when classifying and explaining the reality and is always true in terms of science. Traditional knowledge is a scientific discipline having its ontogeny in human history and culture. Everyone attributes value to ethnobotany including researchers in the field of biodiversity, conservation, and management of natural resources. There are number of problems in understanding the ethnobotanical valuation at all levels. It must be calculated in terms of social-natural hierarchy thus, the value to ethnobotany requires action on our part. The World Health Organization (WHO, 2019) has estimated that 80% population of developing countries relies upon traditional medicine mostly, plant drugs for their primary health care needs. "Quantitative ethnobotany," is coined by Prance *et al*. (1987), and traditional compilation-style of ethnobotanical studies by incorporating quantitative research

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methods in data collection, processing, and interpretation of results (Hoft *et al*., 1999). A growing interest in qualitative ethnobotany in the last few decades has led researchers to develop new quantitative methods and apply them for plant-human relationship. These types of studies suggest the enhanced relationship of indigenous people as well as plant resources and their livelihood (Berlin *et al*., 1973; Moerman, 1986; Etkin, 1988). These analyses are of great importance in planning and managing a specific community including natural resources prevailing in that area and applied to investigate local important resource exploitation.

Various indices can be used as a proxy for cultural and social benefits to evaluate relative importance of plants in each culture by quantitative techniques. Some authors have developed indices based on the researcher's subjective allocation of the importance of each use and constructed their use value index as a sum of uses for every species, using a value of 1 for major uses and 0.5 for minor uses to obtain a more objective index. The cultural significance index (CSI) is the sum of different values obtained for each use of a plant as defined by Turner (1988). Stoffle *et al*. (1990) added a variable to measure present use. This index has been modified by Phillips and Gentry (1993) by including the number of informant's citation for a given plant-use. Over and above, similar approaches have been widely used by many different authors (Byg and Balslev, 2001; Gomez-Beloz, 2002; La Torre and Islebe, 2003; Da Cunha and Ulysses, 2006).

By and large it is expected from common people to conserve resources that are most important to them, in contrast to resources perceived as less useful (Garibaldi and Turner 2004). Specific cultural food significance index (CFSI) for wild food plants has been suggested by Pieroni (2001). Garibay-Orijel *et al*. (2007) have utilized a slightly altered CFSI for evaluating edible mushrooms in Mexico. A third group of authors has estimated the economic value of forest goods for different ethnic groups (Hecht *et al*., 1988; Godoy *et al*., 2002; Albuquerque *et al*., 2006).

The most popular index is based on "informant consensus" - the degree of agreement among the different people interviewed concerning the use of a given resource. Recently, Moerman (2007) used a similar analysis for the medicinal flora used by native peoples of North America, providing a critical perspective on this "informant consensus analysis" for the detection of medicinal plants with pharmacologically active products. Phillips (1996), in a review of ethnobotanical techniques, pointed out that procedures based on "informant consensus" tend be more objective as they are designed to eliminate investigator bias in attributing relative importance to a given plant. The frequency of citation for a useful plant taxa has been suggested and utilized by some researchers (Ladio and Lozada 2001; Bonet and Vallès 2002; Lozada *et al*., 2006). For others, the frequency of citation specifically refers to each plant-use considered (Bonet *et al*., 1992; Bonet and Vallès 2003; Camejo-Rodrigues *et al*., 2003; Pardo-de-Santayana *et al*., 2005; Pieroni *et al*., 2005; Tardío *et al*., 2005). To do so, we rely on the information about wild plants traditionally used in study area. What is lacking are the studies that merge the different approaches to allow for a more comprehensive valuation of the importance of plants species for human societies. Our goal in this article is to take a first step in this direction.

METHODS

Study Area

The occupation of the population are mainly farmers, traders and government employees. Gujarat is the only state in India with a maximum number of biogeographic zones.

It encompasses 4 of the total ten bio-geographic regions in India (Rodgers, 2000). The plant diversity of Gujarat is quantitatively, and qualitatively rich as it has many families, genera, and species (Kumar *et al*., 2013). It has poor forest cover (9.62% forest land of its geographical area) but has rich biodiversity (Gujarat Forest Statistics, 2020). The forest areas all along the eastern boundary of the state are predominantly inhabited by tribal population, spread over eight districts, viz, Dang, Valsad, Surat, Bharuch, Vadodara, Panchmahals, Sabarkantha and Banaskantha (Umadevi, 1988). The tribal population forms about 15 percent 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 economic and ethnobotanical important, most of which are used by tribal people (Reddy 1987; Umadevi *et al*., 1989; Kumar and Desai, 2014).

Data Collection

Extensive field work and survey was done during the year 2018-2020 by making many field trips of 2-3 days duration in different seasons. During the field visits specimens were collected, identified with the help of available literature, and properly processed through standard methods. During the field visit information was collected from tribal medicinal man, 'vaidu', 'bhagat', 'bhuva', etc. by using semi structured questionnaire. This is the original and ancient knowledge, which was not documented systematically at micro level earlier. Every informant was interviewed separately and response from each informant is called as an 'event'. After the collection of data, it has been segregated in pre-defined use categories (Table 1). Every use has been given the value according to the use of that specific species by the tribal people. After interviewing informants and collecting the data, various ethnobotanical indices i.e. User report (UR), Frequency of citation (FC), Number of uses (NU), Cultural importance index (CI), Relative frequency of citation (RFC), and Relative importance index (RI) were calculated to understand the valuation and importance of plants growing around these tribal villages (Hoffman and Gallahar, 2007; Oza *et al*., 2021). An R package called 'ethnobotanyR' is used to calculate indices and interpret the data (Whitney, 2019).

Table 1. Use categories for subject wise allocation of data

Use categories
1. Medicine
2. Construction
3. Technology
4. Human Food
5. Fodder
6. Firewood
7. Symbolic
8. Ornamental
9. Veterinary
10. Others

Data Analysis

A statistical approach to generalist knowledge in a study community requires random (not haphazard or opportunistic) selection of participants and sufficient sample size. Participants should be interviewed in isolation from others in the community to satisfy the requirement of statistical independence. In other cases, specialized knowledge of a few "key informants" (Abbasi *et al*., 2013) or elders is sought, and low sample size will likely preclude robust statistical analysis. In general, research conditions are sub-optimal (bearing little resemblance to assumptions of research proposals) and trade-offs usually must be made between statistically robust data and what is logistically or culturally feasible. Keeping this approach in mind we have selected 25 key informants and 30 most used plant species from the study area for further analysis (Table 2). The key informants were selected based on their experience and age. Because the traditional knowledge is passed down from one generation to the other it was assumed that the elders of the tribe would be more suited for further analysis. Most used plant species were selected based on the User report index. We have selected the plants which were having UR values more than 20.

Table 2. List of selected plant species for data analysis

No.	Species name	Family
1	*Abrus precatorius* L.	Leguminosae
2	*Aegle marmelos* (L.) Corrêa	Rutaceae
3	*Amorphophallus commutatus* (Schott) Engl.	Araceae
4	*Andrographis paniculate* (Burm.f.) Nees	Acanthaceae
5	*Asparagus racemosus* Willd.	Asparagaceae
6	*Azadirachta indica* A. Juss.	Meliaceae
7	*Blumea lacera* (Burm.f.) DC.	Asteraceae
8	*Calotropis procera* (Aiton) Dryand.	Apocynaceae
9	*Colocasia esculenta* (L.) Schott	Araceae
10	*Curculigo orchioides* Gaertn.	Hypoxidaceae
11	*Dioscorea bulbifera* L.	Dioscoreaceae
12	*Enicostema axillare* subsp. *littorale* (Blume) A.Raynal	Gentianaceae
13	*Gloriosa superba L.*	Colchicaceae
14	*Lawsonia inermis* L.	Lythraceae
15	*Madhuca longifolia* var. *latifolia* (Roxb.) A.Chev	Sapotaceae
16	*Mangifera indica* L.	Anacardiaceae
17	*Moringa oleifera* Lam.	Moringaceae
18	*Ocimum sanctum* L.	Lamiaceae
19	*Pongamia pinnata* (L.) Pierre	Leguminosae
20	*Portulaca oleracea* L.	Portulacaceae
21	*Ricinus communis* L.	Euphorbiaceae
22	*Saccharum officinarum* L.	Poaceae
23	*Senna tora* (L.) Roxb.	Leguminosae
24	*Syzygium cumini* (L.) Skeels	Myrtaceae
25	*Tacca leontopetaloides* (L.) Kuntzes	Taccaceae
26	*Tamarindus indica* L.	Leguminosae
27	*Terminalia arjuna* (Roxb. ex DC.) Wight & Arn.	Combretaceae
28	*Tridax procumbens* (L.) L.	Asteraceae
29	*Vitex negundo* L.	Lamiaceae

30	*Ziziphus jujuba* Mill.	Rhamnaceae

RESULTS AND DISCUSSION

An ethnobotanical survey conducted to record the ethnobotanical knowledge of tribal people and their health and livelihood security in 21 villages of south Gujarat. A total of 85 informants belonging to the two different tribal groups namely the Kukanas or Kunbis and Dhodiya from different villages with 72 and 13 informants respectively interviewed. From the total participated informants' percentage of man and woman was 76.47% and 23.53% respectively. The traditional uses of native and useful plant species, that are categorized into different use categories. During this study, 156 plant species recorded belonging to 61 different angiosperm families. Habit is dominated by tree species which contributed more than 36% of 156 total plant species followed by herbs 29.48%, shrubs 21.80%, vines 6.41%, climber 5.12%, lianas 0.65%, respectively. Highest useful plants recorded from the Euphorbiaceae family with nine (5.77%) useful species. 33 families were found to be the lowest with only 1 (0.65%) useful plant species in each family. Among 156 plant species recorded *Vitex negundo* was the most cited species by 35 informants. Other than this, 59 plant species found to be least cited having one informant citation each. Plant diversity found higher in Lachhkadi village as compared to other villages. From the total plant species recorded, 99 species found abundant in the study area. Among the 30 selected species for the analysis *Moringa oleifera* has the highest user report value (UR), highest cultural importance index (CI). *Azadirachta indica* and *Moringa oleifera* has been cited in the eight use categories and *Andrographis paniculata* has been cited in only three use categories by the informants. *Colocasia esculenta* has the lowest cultural importance index (CI) and. *Terminalia arjuna* has the lowest relative frequency of citation (Table 3).

Correlation between these different indices was calculated to check whether these indices are related with each other or not. We found perfect positive correlation (1) between UR & CI and also between FC & RFC. This explains that as the number of user report increases the value of cultural importance index also increases. Frequency of citation and relative frequency of citation are also interrelated. We found low correlation (0.349115) between number of uses (NU) and relative frequency of citation (RFC). This shows that RFC is least related with how many times a plant is cited in a particular use category. We found moderate correlation between rest other indices (Table 4).

Table 3. Calculated values of indices (UR- User report, FC- Frequency of citation, NU- Number of uses, CI- Cultural importance index, RFC- Relative frequency of citation, RI- Relative importance index)

No	Species name	Basic Values			Indices		
		UR	FC	NU	CI	RFC	RI
1	*Abrus precatorius* L.	52	25	5	2.08	1	0.812
2	*Aegle marmelos* (L.) Corrêa	90	25	6	3.6	1	0.875
3	*Amorphophallus commutatus* (Schott) Engl.	118	25	8	4.72	1	1
4	*Andrographis paniculate* (Burm.f.) Nees	40	24	3	1.6	0.96	0.667
5	*Asparagus racemosus* Willd.	69	25	5	2.76	1	0.812
6	*Azadirachta indica* A. Juss.	73	25	8	2.92	1	1
7	*Blumea lacera* (Burm.f.) DC.	74	25	5	2.96	1	0.812
8	*Calotropis procera* (Aiton) Dryand.	60	25	5	2.4	1	0.812
9	*Colocasia esculenta* (L.) Schott	22	18	3	0.88	0.72	0.547

10	*Curculigo orchioides* Gaertn.	42	25	3	1.68	1	0.688
11	*Dioscorea bulbifera* L.	60	25	5	2.4	1	0.812
12	*Enicostema axillare* subsp. *littorale* (Blume) A.Raynal	38	22	4	1.52	0.88	0.69
13	*Gloriosa superba L.*	32	18	6	1.28	0.72	0.735
14	*Lawsonia inermis* L.	72	25	5	2.88	1	0.812
15	*Madhuca longifolia* var. *latifolia* (Roxb.) A.Chev	106	25	6	4.24	1	0.875
16	*Mangifera indica* L.	122	25	7	4.88	1	0.938
17	*Moringa oleifera* Lam.	134	25	8	5.36	1	1
18	*Ocimum sanctum* L.	85	25	6	3.4	1	0.875
19	*Pongamia pinnata* (L.) Pierre	79	25	7	3.16	1	0.938
20	*Portulaca oleracea* L.	93	25	5	3.72	1	0.812
21	*Ricinus communis* L.	56	24	4	2.24	0.96	0.73
22	*Saccharum officinarum* L.	119	25	7	4.76	1	0.938
23	*Senna tora*(L.) Roxb.	116	25	7	4.64	1	0.938
24	*Syzygium cumini* (L.) Skeels	92	25	6	3.68	1	0.875
25	*Tacca leontopetaloides* (L.) Kuntzes	72	25	5	2.88	1	0.812
26	*Tamarindus indica* L.	125	25	7	5	1	0.938
27	*Terminalia arjuna* (Roxb. ex DC.) Wight &Arn.	25	18	4	1	0.72	0.61
28	*Tridax procumbens* (L.) L.	43	25	4	1.72	1	0.75
29	*Vitex negundo* L.	65	25	4	2.6	1	0.75
30	*Ziziphus jujuba* Mill.	104	25	8	4.16	1	1

Table 4 - Correlation table between different calculated indices

	UR	FC	NU	CI	RFC	RI
UR	1					
FC	0.603366	1				
NU	0.809743	0.349115	1			
CI	1	0.603366	0.809743	1		
RFC	0.603366	1	0.349115	0.603366	1	
RI	0.87816	0.646928	0.940419	0.87816	0.646928	1

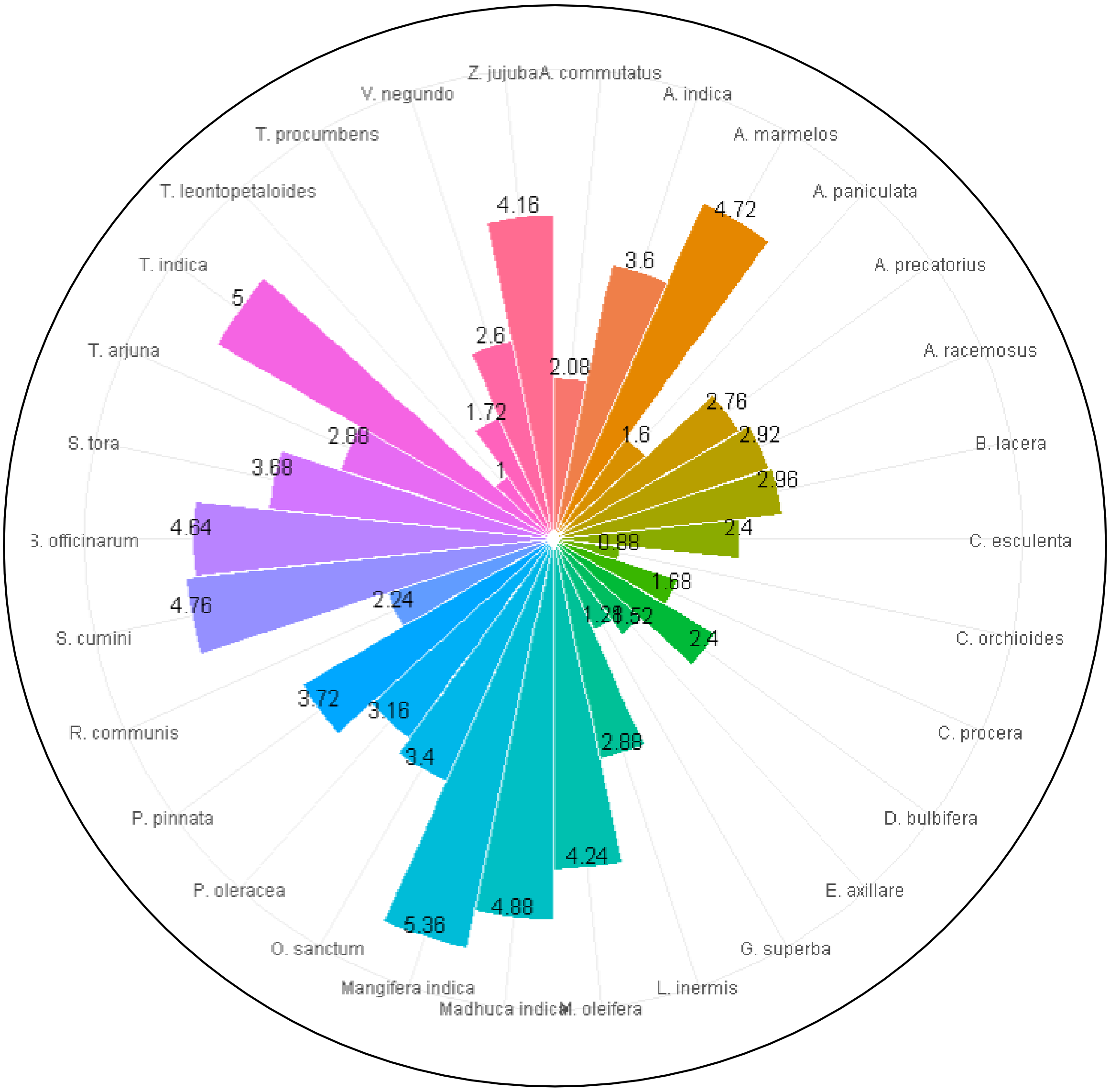

Figure 1. Radial plot of Cultural Importance Index

Ethnobotany deals with past and present interrelationships between human cultures and plants. The investigation of the cultural values of plant species plays a significant role to modern medicine, farming, pharmaceutical, and nutraceuticals industrial sectors of society. Wild edible plants play an important socio-economic role as medicines, foods, dyes, poisons, shelter, fibers, and religious and cultural ceremonies (Hoffman and Gallahar 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).

South Gujarat is the rich source of wild, edible, medicinal, veterinary, and commercial plants. The inhabitant tribal uses different parts of plants for curing various types of diseases which are locally available. In case of any illness, village people mostly contact their local medical practitioner to whom they call Vaidya (traditional herbal healer); Vaidya is a person who has inherited the traditional local knowledge of curing various ailments from his ancestors and others by using only plants and plant products. There are one or two such types of individuals in every village community. Several plants have been used in case of one disease according to their availability in the region. *Gloriosa superba* which is Endangered in Western

Ghats (Kirtikar and Basu 1935), it has veterinary properties their tuberous root used to cure swollen animal breast. *Curculigo orchioides* is an endangered herb which is popularly known as "Kali Musli", their tuberous root use to cure putrid animals and leaves use to cure breast lump of animals. Most of the wild plants especially leafy vegetables, fruit yielding plants, tuberous and rhizomatous plants can be easily grown in the back yards of houses and home gardens. Beside the household consumption as supplementary food by the tribal people, some wild plants like *Carissa congesta*, *Dioscorea bulbifera*, *D. pentaphylla* and other plants parts are marketable and provide opportunity to earn additional income. The rootstock of *Asparagus racemosus* used as food as well as medicinal remedies that can treat jaundice, fever, increases the weight and memory. The tribal people use some of the edible plants like *Celosia argentea*, *Portulaca oleracea, Amorphophallus commutatus, Moringa oleifera, Terminalia arjuna, Syzygium cumini*, *Enicostema axillare* as medicine.

CONCLUSIONS

Although the inventory of medicinal plants for Indian subcontinent is initiated long back. Tadvi (2015) earlier, have given passing reference for ethnobotanical aspect of forest wealth of south Gujarat. The study area and surrounding nearby area has been worked out earlier but only documentation of plant list and their usage known to common man has been reported. However, we could not find any past report on quantification of ethnobotanical per se and its socio-cultural importance in the rural society. So, in the present report we have tried to support the base line data with quantitative analysis of ethnobotanicals and its socio-cultural valuation. After applying quantification indices basic values as well as 3 basic indices, radial plot of CI has been presented (Figure 1). Our preliminary investigation on parts of the Dang district, South Gujarat and gathered information from 85 informants depict quite close relationship with cultural and societal knowledge prevailing in the area. By and large, we have also noticed about more than 50% species (18) known to the science since time immortal as author citation of these plants depicts there are no nomenclatural changes in these important medicinal plants. The detail societal knowledge and the scientific knowledge about these plants is warranted to understand the efficacy of locally available plants and its value.

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AUTHOR CONTRIBUTION

KKO & AT: Field work and data collection; SKG: writing and editing manuscript; VMR: Conceptualization of work and Interpretation of data.

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CONTENTS

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