Cultural importance indices of some useful plants of Ambala district, Haryana, India

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Abstract

Measuring the "importance" of plants and vegetation to people is a central concern in quantitative ethnobotany. A common tool to quantify otherwise qualitative data in the biological and social sciences is an index. Relative cultural importance (RCI) indices such as the "use values" developed by Prance *et al*. (1987) and Phillips and Gentry (1993a, 1993b) are applied in ethnobotany to calculate a value per folk or ethnobotany of a plant taxon. These approaches can provide data amenable to hypothesis-testing, statistical validation, and comparative analysis. Keeping in view the importance of quantitative ethnobotany for the first time ethnobotanical data was collected from the study area and cultural importance index of 41 plant species was calculated.

Key Words: 1.Quantitative ethnobotany, 2.cultural importance index, 3.traditional knowledge.

Introduction

The quantitative Ethnobotany deals with measuring of importance of plants and vegetation to the people. For, the first time the term 'Quantitative Ethnobotany' was coined by Prance *et al*. (1987), since from that period there has been increasing interest for incorporating the traditional ethnobotanical data with quantitative research methods and interpretation of results. The main factor of using these studies is the relative importance of different plants to humans by intricate the different cultural indices.

There have been different methods of calculating significance of plants developed by various researchers, and considerable advances have been made through the development and application of relative importance indices that produce numerical scales or values per plant taxon (Alexiades & Sheldon 1996, Kvist *et al.* 1995, Lykke *et al.* 2004, Martin 2004, Phillips & Gentry 1993a, 1993b, Phillips *et al.* 1994, Phillips 1996, Prance *et al.* 1987, Reyes-García *et al*. 2006a, Turner 1988).Turner (1988) defined the cultural significance index as the sum of different values obtained for each use of a plant based on quality of use, intensity of use and exclusivity of use. Pieroni (2001) created a specific cultural food significance index (CFSI) for wild food plants depending upon frequency of quotation of the species, availability, the part of plant used and its medicinal use. Silva *et al*. (2006) simplified the equations by considering the degree of consensus among informants.

In order to obtain a more objective index, Phillips and Gentry (1993a) modified the index of Prance *et al.* (1987) by including the number of informants citing a given plant-use. Their use value (UV) index for species "s" is defined by the following formula (simplified by Rossato *et al.* 1999 and Albuquerque *et al.* 2006).

$$UVs = \sum Ui/N$$

where Ui is the number of different uses mentioned by each informant i and N is the total number of informants interviewed in the survey. In their original formulation, Phillips and Gentry (1993a) also considered the number of times that each informant referred to a given species and the denominator was Ns, i.e., the total number of informants interviewed for species "s." Recently, Reyes-García *et al.* (2006) proposed using an integrated index called "total value" to estimate the significance of plant species for

humans. This "cultural value" multiplicative index takes into consideration frequency of citation and versatility of the species and its formula is explained in the Material and Methods section of this study. Keeping in view the importance of quantitative ethnobotany efforts were made to calculate the quantitative data of Ambala district, Haryana. This is the first attempt from this area.

Material and Methods

Survey Area

Ambala district (30°21'45"N and 76°48'54"E) lies on the north-eastern edge of state Haryana (India) bordered in South-East by Yamuna Nagar district, in south by Kurukshetra and in west lies Patiala and Ropar district of Punjab (Fig1). The Shivalik Range of Solan and Sirmaur districts of Himachal Pradesh bound the Ambala district in the North and North- East. The height from the sea level is 264 metres. It has an area of 1568.85 sq. kms. The climate of Ambala is very hot in summers and markedly cold in winters. May and June can be really hot with the temperature soaring to over 48°C,while in winter it can be as low as -1°C. Average annual rainfall is 1076 mm, out of which 70% rainfall is received during the month of July to September and the remaining during December to February.

Fig.1-Map of Haryana showing Ambala forest District

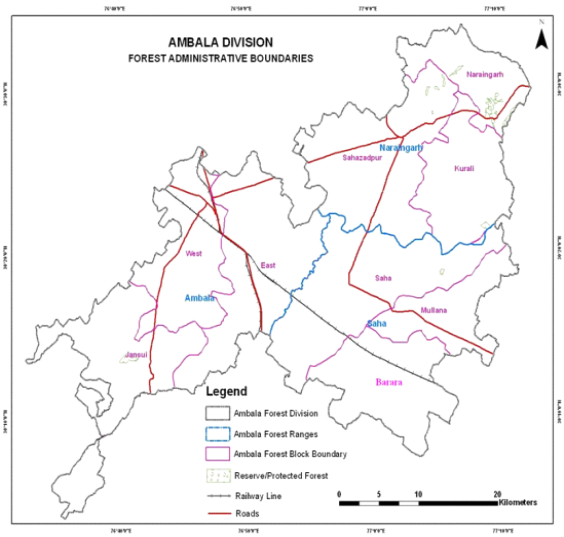

Fig. 2 - Map of Ambala district showing Division

Ethnobotanical Methodology

An ethnobotanical survey was conducted in the study area between 2011 to 2012 to compile the knowledge of plants that were used by the local people's. Information was obtained through 119 people (age range of 35–93 years, mean age 68 years). Open questions were asked about the plants used in the area. The information about plants used, local name, part used, and its uses was collected from traditional healers, vaidhyas, hakims, tribes and older rural people. Different uses of plants are classified into various categories, like medicinal, human food, fuel, fodder and other miscellaneous uses (Table 1).

Table 1: Number of use-reports (UR) and Percentage of use-categories

Categories (Codes)	Number of UR	Percentage
Medicinal (MED)	901	43.25

Human food (HF)	383	18.38
Firewood (FW)	79	3.79
Animal food (AF)	86	4.12
Others (OTH)	634	30.43
Total	2083	99.97

Data Analysis

All the ethnobotanical indices are calculated on the basis of ethnobotanical information i.e. "use of species s in the use category u mentioned by informant i." The event resulting from the combination of these three variables has been defined as a use-report (UR; Kufer *et al.* 2005). In a particular survey that yields NS species (s1, s2,...,sNS), with a total number of use-categories NC (u1, u2,..., uNC) and N informants (i1, i2,..., iN), URsui can reach the value of 1 when a combination exists or 0 when this combination is not mentioned. For studying the cultural importance of plants, one of the most commonly used tools is the total number of use-reports (UR) for each species, i.e., fixing the variable s. This can be mathematically expressed as:

$$URs = \sum_{u=u_1} \sum_{iN} URui$$

First, we sum the UR of all the informants (from i1 to iN) within each use-category for that species (s); i.e., the number of informants who mention each use-category for the species. Second, we sum all the UR of each use-category (from u1 to uNC).

In this paper, we compared the importance of each species using the following four indices: relative frequency of citation (RFC), relative importance index (RI), cultural value index (CV), and cultural importance index (CI).

Relative Frequency of Citation (RFC):

This index is obtained by dividing the number of informants who mention the use of the species, also known as frequency of citation (FC), by the number of informants participating in the survey (N).

$$RFCs = FCs/N$$

Relative Importance Index (RI):

Developed by Pardo-de-Santayana (2003a), this index takes into account only the use-categories—

$$RIs = \frac{RFCs(max) + RNUs(max)}{2}$$

where RFCs(max) is the relative frequency of citation over the maximum, i.e., it is obtained by dividing FCs by the maximum value in all the species of the survey and RNUs(max) is the relative number of use-categories over the maximum, obtained dividing the number of uses of the species obtained dividing the number of uses of the species by the maximum value in all the species of the survey by the maximum value in all the species of the survey.

Cultural Value Index (CV):

This index, developed by Reyes-García *et al.* (2006), is calculated using the following formula.

$$CVs = NUs/NC \times FCs/N \times URui/N$$

where the first factor is the relationship between the number of different uses reported for the species ("ethnospecies" in the original work) and the total number of use-categories considered in the study (NUs divided by NC). The second factor is the relative frequency of citation of the species (previously defined). Finally, the third factor is the sum of all the UR for the species (defined at the beginning of this section), i.e., the sum of number of participants who mentioned each use of the species, divided by N. These three factors are then multiplied together.

Cultural Importance Index (CI):

The cultural importance index (CI) is defined by the following formula.

$$CI = \sum_{U=U_1}^{U_{NC}} \sum_{i=i_1}^{i_N} UR_{ui/N}$$

This index, ---- -----1 factor of the previously defined CV index, also can be seen as the sum of the proportion of informants that mention each species use.

Table 2: Cultural importance index of all use categories:

Species	Medicinal	Human food	Fuel	Fodder	Other	CI
Sisymbrium irio L.	0.05	0.06				0.11
Cleome viscosa L.	0.15	0.05				0.65
Clitoria ternatea L.	0.14					0.14
Crateva nurvala Buch.-Ham.	0.15					0.15
Datura metel L.	0.18					0.18
Desmodium triflorum (L.) DC.	0.16					0.16
Emilia sonchifolia Emilia sonchifolia (L.) DC.	0.08					0.08
Corchorus capsularis L.	0.03	0.05			0.08	0.16
Trimfetta rhomboidea	0.02			0.04	0.10	0.16
Tylophora indica (Burm. *f.*) Merr.	0.23					0.23

Butea monosperma (Lam.) Taub.	0.08				0.18	0.26
Prosopis chilensis (Molina) Stuntz			0.31	0.09	0.10	0.50
Terminalia arjuna (Roxb. ex DC.) Wight & Arn.	0.28					0.28
Terminalia chebula Retz.	0.41					0.41
Terminalia belerica (Gaertn.) Roxb.	0.43					0.43
Bombax ceiba L.		0.05			0.06	0.11
Moringa oleifera Lam.	0.09	0.23		0.11	0.10	0.53
Acacia nilotica (L.) Delile	0.09	0.37	0.18		0.18	0.82
Albizzia lebbek Benth.	0.18				0.14	0.32
Alysicarpus vaginalis (L.) DC.	0.18					0.18
Bauhinia racemosa Lam.	0.08					0.08
Lawsonia inermis L.	0.10				0.60	0.70
Ludwigia perennis L.	0.06					0.06
Glinus lotoides L.	0.07					0.07
Plumbago zeylanica L.	0.10				0.14	0.24
Oxystelma esculentum (L. *f.*) Sm.	0.30					0.30
Boerhavia diffusa L.	0.41				0.14	0.55
Barleria prionitis L.	0.25					0.25
Clerodendrum indicum (L.) Kuntze	0.07				0.08	0.15
Polygonum plebeium R. Br.	0.08	0.05				0.13
Abrus precatorius L.	0.07				0.14	0.22
Achyranthes aspera L.	0.38					0.38
Argemone mexicana L.	0.12					0.12
Calotropis gigantea (L.)	0.41					0.41

Dryand.						
Calotropis procera (Aiton) Dryand.	0.61					0.61
Coronopus didymus (L.) Sm.	0.06					0.06
Cynodon dactylon (L.) Pers.	0.15			0.41		0.56
Eclipta prostrata (L.) L.	0.34					0.34
Malva parviflora L.	0.11					0.11
Ocimum americanum L.	0.71					0.71
Pergularia daemia (Forssk.) Chiov.	0.12					0.12
Ranunculus sceleratus L.	0.10					0.10
Sesamum indicum L.	0.14	0.40			0.18	0.72
Vitex negundo L.	0.60					0.60
Digera muricata (L.) Mart.	0.20					0.20
Amaranthus viridis L.		0.40		0.40		0.80
Chenopodium album L.		0.43		0.28		0.71
Ficus racemosa L.	0.03	0.61				0.64
Streblus asper Lour.	0.02	0.34				0.36

Table 3: Evaluation of useful plants using four quantitative indices. List of the first 20 species following the CI index and plant ranking, based on each index.

Species	**Basic values**			**Indices**				**Ranking**			
Species	FC	UR	NU	CI	RI	RFC	CV	CI	RFC	RI	CV
Acacia nilotica (L.) Delile	90	94	4	0.82	1	0.81	0.79	1	1	1	1
Amaranthus viridis L.	74	76	2	0.80	0.66	0.68	0.43	2	6	3	7
Sesamum indicum L.	79	82	3	0.72	0.81	0.72	0.70	3	2	4	2
Oxystelma esculentum (L. *f.*) Sm.	77	78	1	0.71	0.55	0.71	0.44	4	3	12	5
Chenopodium album L.	77	79	2	0.71	0.68	0.71	0.40	5	4	5	8
Lawsonia inermis L.	76	78	2	0.70	0.67	0.70	0.03	6	5	7	16

Cleome viscosa L.	21	23	2	0.65	0.37	0.19	0.06	7	20	18	14
Ficus racemosa L.	69	71	2	0.64	0.63	0.63	0.62	8	7	8	3
Calotropis procera (Aiton) Dryand.	67	68	1	0.61	0.50	0.61	0.08	9	8	13	12
Vitex negundo L.	65	66	1	0.60	0.61	0.60	0.07	10	9	9	13
Cynodon dactylon (L.) Pers.	61	63	2	0.56	0.59	0.56	0.50	11	10	11	4
Boerhavia diffusa L.	60	62	2	0.55	0.61	0.55	0.23	12	12	10	11
Moringa oleifera Lam.	62	66	4	0.53	0.84	0.57	0.44	13	11	2	6
Prosopis chilensis (Molina) Stuntz	55	58	3	0.50	0.68	0.50	0.30	14	13	6	10
Terminalia belerica (Gaertn.) Roxb.	47	48	1	0.43	0.38	0.43	0.04	15	14	16	15
Terminalia chebula Retz.	45	46	1	0.41	0.40	0.41	0.03	16	15	15	17
Calotropis gigantea (L.) Dryand.	45	46	1	0.41	0.37	0.41	0.03	17	16	17	18
Achyranthes aspera L.	41	42	1	0.38	0.35	0.38	0.03	18	17	19	19
Eclipta prostrata (L.) L.	37	38	1	0.34	0.33	0.34	0.02	19	18	20	20
Streblus asper Lour.	39	41	2	0.36	0.47	0.36	0.34	20	19	14	9

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CI=cultural importance, RFC=relative frequency of citation, RI=relative importance, CV=cultural value, FC=frequency of citation, UR=number of use-reports, NU=number of uses.

Results and discussion:

Cultural importance of each use category to the total cultural importance index of 41 species in the Ambala district has been calculated. It shows that out of total 41 species *Acacia nilotica* (L.) Delile has the highest citations (FC= 90) and is the most culturally significant according to the CI index. It has a CI index value of 0.82. As the table 3 indicate it is mainly used as a human food (CI= 0.37) and has other uses such as for fuel and fodder (CI=0.18). The second species used frequently was *Amaranthus viridis* L. (CI=0.80) it is mainly used as a human food and fodder with CI value of 0.40. *Sesamum indicum* L. ranks third with (CI=0.72) it is used in 3 out five used categories and mainly used as a human food (CI=0.40) followed by medicinal and other traditional uses. *Oxystelma esculentum* (L. *f.*) Sm. and *Chenopodium album* L. has same CI values i.e. 0.71 but *Chenopodium album* L. is used in two use categories as compare to *Oxystelma esculentum* (L. *f.*) Sm. which is mainly used as medicines.

Comparisons with other indices:

Table 3 shows the different value of other indices such as RI, RFC, CV and CI which indicate the ranking of different plants based on each index and of their three basic values of the study i.e. frequency of citations, number of use-reports and number of uses for each species. Frequency of citation indicate only the spread of knowledge of useful plants where as number of use-reports (other indices) indicate the

multiplicity of use. There are appreciable differences in species ranking related for the different indices. In comparison with all indices value *Acacia nilotica* (L.) Delile rank the first position because of higher number of citations and use categories and multiplicity of uses.

CV index plcace *Sesamum indicum* L. in second because of higher multiplicity of uses where as it is third and fourth position according to CI and RI index. *Cynodon dactylon* (L.) Pers. is in eleventh position when number of informants i.e FC index is considered and to the 4th on the basis of RI index

Some extensively used species such as *Cleome viscosa* L. (mentioned by 21 informants) but few uses (medicinal and human food) are underestimated when using CV and and RI indices, reaching to fourteenth and eighteenth position, respectively, instead of the seven with the CI index. *Moringa oleifera* Lam. is also excessively used in according to diversity of uses as a result of the RI and CV indices. It ranks second and sixth instead of thirteenth based on the CI index because it has higher multiplicity of uses and the species was mentioned in a higher number of use categories.

As states earlier quantitative methods in ethnobotany as a way of improving the traditional compilation-style by obtaining data using in-depth, semi-structured interviews and calculating different indices in statically analysis of cultural significant of plants used by the local people in the region. This kind of cultural significant index measures knowledge about the use of plant by the local people (passive knowledge) which works better than those involving free-list ancient methods.

The cultural importance index (CI) is an efficient tool for highlighting those species which are based on informant consensus that also consider the diversity of uses. Followed by other indices such as RI, RFC, and CV which also consider the multiplicity of uses and number of use informants in each use category. This is a first attempt from the study area for collecting and compiling the traditional knowledge of local people in quantitative ethnobotany. The different indices were calculated in order to understand the cultural significance of plant species from the study area. *Acacia nilotica* (L.) Delile rank the first position because of higher number of citations and use categories and multiplicity of uses which indicate that this plant species has higher ethnobotanical importance in the region.

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