QUANTITATIVE INDICES - USE VALUE, FAMILY USE VALUE AND SHANNON WIENNER INDEX - APPLIED ON MEDICINAL PLANT USE DATA COLLECTED FROM FOUR INDIGENOUS TRIBES OF WAYANAD DISTRICT, WESTERN GHATS, INDIA.

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Abstract : The present study was an attempt to record the quantitative medicinal plant use data by four indigenous tribes– *Kattunaikkan, Mullakuruman, Adiyan* and *Kuruchiyar*- of Wayanad District, Kerala, India. Quantitative indices such as Use value (UV), Family use value (FUV), Shannon Wienner index, Simpson index and Berger Parker index were used to understand the preferences and consensus existing among the informants regarding medicinal plant use. A total of 565 user reports were collected from the fifteen informants belonging to the four socio-cultural groups during the study period. Mention of each use of a species with respect to a disease was treated as a separate event and considered as a user report. Among the 63 families from which the informants cited 565 uses, eighteen families which scored a FUV more than 1 and 42 species which recorded a UV more than 0.25 were enumerated in this study. Shannon Wienner index, Simpson index and Berger Parker index were also calculated.

IndexTerms -. Quantitative indices- Use value-Family use value- Shannon Wienner index-Kerala- Western Ghats.

I. INTRODUCTION

The richness of plant diversity in any area is not evaluated by the number of species occurring there, but by the intensity of associations and dependence of the indigenous communities on that plant wealth and, respect for this knowledge helps in conservation [1]. Modern people are alienated from environment so that we consider it as a place to visit or hike trough, while most indigenous tribes treat environment as a natural extension of themselves [2]. Wayanad is a hilly district within Kerala state towards the southernmost end of India, with the highest percentage of tribal population recorded so far within the state. Quantitative techniques in ethnobotanical data inventorying has never been attempted in the study area earlier, though documentation of data regarding edible plants [3, 4] used by different tribes and mere listing of medicinal plants used by individual tribes has been done [5, 6]. The present study was an attempt to record the quantitative data regarding medicinal plant use by four predominant tribes– *Kattunaikkan, Mullakuruman, Adiyan* and *Kuruchiyar*- of Wayanad District, Kerala. Quantitative indices such as Use value (UV), Family use value (FUV), Shannon Wienner index, Simpson index and Berger Parker index were used to understand the preferences and consensus existing among the informants regarding medicinal plant use. When one considers the fast pace of modernisation and acculturation exposing these traditional communities to modern methods of medicine and lifestyles, this study is the urgent need of the hour.

II. METHODOLOGY

1. STUDY AREA

Wayanad is a hilly terrain district in the southernmost state of India, Kerala and lies between North latitude 11° 90' and 11° 49' and East longitude 75° 80' and 76° 35'. It is bounded on the East by Nilgiris and Mysore districts of Tamil Nadu and Karnataka states respectively, on the North by Coorg district of Karnataka state, on the South by Malappuram district and on the West by Kozhikkode and Kannur districts of Kerala state. The altitude of Wayanad varies from 700 to 2,100 metres above mean sea level with 787 hectares under forest cover.

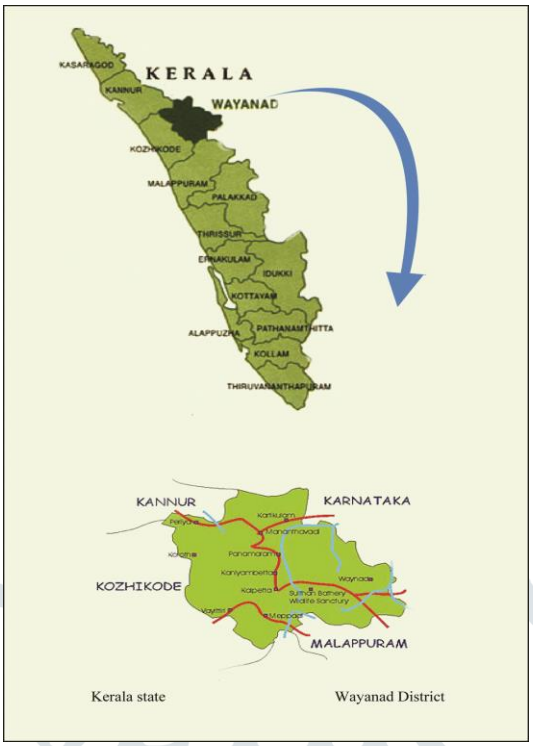

Figure1.Study Area.

2. DATA COLLECTION

Fifteen informants, mainly healers and elders belonging to the four prominent socio-cultural communities – *Mullakuruman, Kuruchiyar, Kattunaikkan, and Adiyan* who were full time professionals in this field and widely accepted in their areas as well as other too, representing all regions were put to semi-structured interviews with pre arranged appointments lasting 2-3 hour duration followed by a transect walk to their natural environment from where they gathered plants. Follow up interviews were made at regular intervals covering all seasons from November 2008 to December 2014. The age of the informants varied from 36 years to 84 years. Except two, all of them were males. Informants were asked to spell out the remedies for the diseases and how they used them. The information regarding the use a particular species for a specific disease was treated as one user report. For each species, its local name, part used method of use and conservation strategies were recorded. Prior informant consent was collected from all individuals regarding knowledge sharing. Some informants restrained from disclosing the method of using as they believed that it may loose its effect if made public. Live specimens for scientific identification were also collected during these walks.

3. QUANTITATIVE PARAMETERS STUDIED

a. USE VALUE (UV)

Use value [7] gives an idea about which species are considered most important by a community. It is calculated using the formula

$$UVs = \sum Us/N$$

UVs = Use Value for the species 's'.

$\sum Us$ = Sum of the uses mentioned for a species 's'.

N = Total number of informants.

Informant Use Values are high when there are many use-reports for a plant, implying that the plant is important; it approaches zero when there are few reports related to its use.

b. Family Use Value (FUV)

This index calculates the use value of a family and was first formulated by Phillips and Gentry [8].The index was calculated using the formula.

$$FUV = \sum UVs/N\,S. \quad [9]$$

Where,

FUV = Family Use Value.

$\sum UVs$ = Sum of the Use Values of all the species quoted from a family.

NS = Total number of species quoted from the family.

c. SHANNON-WIENER INDEX (H')

One of the most enduring of all diversity measures is the Shannon- Weiner index which lay emphasis to the species richness component of diversity [10].

The index is based on the rationale that diversity or information in a natural system can be measured in a similar way to the information contained in a code or message. It assumes that the individuals are sampled from a large population and all species are represented in the sample. It is also called as the Shannon index.

Shannon-Wiener index is calculated using the formula

$$H' = \sum pi\, Ln\, pi$$

Where *pi* is the proportion of individuals of the *ith* species. In quantitative ethnobotany, it is modified as the proportion of informants who cited the *ith* species, or the proportion of citations for the *ith* species. In this study, the proportion of informants were taken.

Evenness is given by the formula

$$J' = \frac{H'}{Hmax}$$ [10]

J' = Evenness.

H' = Shannon index.

H max = H'/Ln S.

S = Total number of species.

d. SIMPSON INDEX (D)

In contrast to Shannon index, Simpson index gives emphasis to the dominance or evenness measures of diversity rather than to species richness [10].It is one of the earliest and best known dominance measures. Simpson [11] gave the probability of any two individuals drawn at random from an infinitely large community belonging to the same species as

Simpson index $D = \sum pi^2$

Where *pi* is the proportion of the individual in the *i* th species.

The form of this index for a finite community is given by the formula

$$D = \sum \frac{ni(ni-1)}{N(N-1)}$$

Where *ni* is the number of individuals in the *ith* species and *N* is the total number of individuals. Here in this experiment *ni* stands for the number of citations for the *ith* species and *N* is the total number of citations. As D increases the diversity decreases. It is highly weighted towards the most abundant species in the sample, while it is less sensitive to the species richness. Simpson index is considered as one of the most meaningful and robust measures available. The reciprocal of D, $\frac{1}{D}$ is the most widely used form of Simpson index since the value of the measure will increase in this case and the assemblage will become more even. Evenness is calculated by the formula:

Evenness $E\left(\frac{1}{D}\right) = \frac{1/D}{S}$

Where

D is the Simpson index

S is the number of species.

e. BERGER PARKER INDEX (D)

The Berger Parker Index is an intuitively simple dominance measure [12] and is extremely easy to calculate. It expresses the proportional abundance of the most abundant species. The Berger Parker Index is given by the formula:

Berger Parker index $ad = \frac{Nmax}{N}$

Where *N max* is the number of individuals in the most abundant species and here it is the number of citations for the most quoted species. *N* is the total number of individuals and here it is the total number of citations.As with the Simpson index, the reciprocal of Berger Parker index may also be adopted so that an increase in the value of index accompanies an increase in diversity and a reduction in dominance.

III. RESULT AND DISCUSSION

All the four socio-cultural groups studied, believed that diseases are caused by supernatural influences of their own ancestral spirits or traditional deities as a curse for their own misdeeds, or due to sorcery from enemies. They had their own magico-religious rituals for getting rid of them and their own traditional healer entrusted with the power to do it for them. Herbal formulations are only a part of these rituals and they commonly believe that the magical power entrusted with the traditional healer is the major reason for cure. A total of 565 user reports were collected from the fifteen informants belonging to the four socio-cultural groups during the study period. User reports regarding 165 species from 63 different families were recorded.

Out of the 565 citations collected on 165 species, 42 species recorded use value more than 0.25 and are listed below in the Table 1. *Pterospermum rubiginosum* from Sterculiaceae family ranked first in the Use Value table with a Use Value of 1.47. *Thottea siliquose* from Aristolochiaceae family and *Curcuma longa* from Zingiberaceae family ranked second and third with Use values 1.13 and 1.07 respectively. Species with high use value indicate that the species is frequently quoted by the informants and hence is more important to the socio-cultural group which quoted it.

Table 1.List of the 42 species which recorded Use Value more than 0.25in the survey.

Sl . No.	family	species	Use value	Used by	Used for
1	Sterculiaceae	*Pterospermum rubiginosum* Heyne ex Wight & Arn..	1.47	KT, KU, MK, AD	Bone fracture
2	Aristilochiaceae	*Thottea siliquosa* (Lam.) Ding Hou.	1.13	KT, KU, MK, AD	Stomach ache
3	Zingiberaceae	*Curcuma longa* L.	1.07	KT, KU, MK, AD	Antiseptic
4	Euphorbiaceae	*Briedelia stipularis* (L.) Blume	0.93	KT, KU, MK, AD	Mouthsore, aphrodisiac
5	Menispermaceae	*Coscinium fenestratum* (Gaertn.) Colebr.	0.93	KT, KU, MK, AD	Diabetes
6	Apiaceae	*Hydrocotyle javanica* Thunb.	0.87	KT, KU, MK, AD	Polio
7	Musaceae	*Musa paradisiaca* L.	0.87	KT, KU, MK, AD	Stomach ache
8	Selaginellaceae	*Selaginella lepidophylla* (Hook. & Grev.) Spring	0.87	KT, KU, MK, AD	Vaginal discharge
9	Menispermaceae	*Diploclisia glaucescens* (Blume) Diels.	0.80	KT, KU, MK, AD	Back pain
10	Piperaceae	*Lepianthes umbellata* (L.) Rafin.	0.80	KT, KU, MK, AD	Piles
11	Musaceae	*Musa acuminata* Colla.	0.80	KT, KU, MK, AD	Kidney stone
12	Euphorbiaceae	*Croton persimilis* Muell.	0.73	KT, KU, MK, AD	Inflammation
13	Menispermaceae	*Cyclea peltata* (Lam.) Hook.	0.73	KT, KU, MK, AD	Skin lesions
14	Mimosaceae	*Entada rheedi* Spreng	0.73	KT, KU, MK, AD	Back pain
15	Rutaceae	*Naringi crenulata* (Roxb.) Nicolson	0.73	KT, KU, MK, AD	Scabies
16	Pittosporaceae	*Pittosporum neelgherrense* Wight & Arn.	0.73	KT, KU, MK, AD	Snake bite
17	Euphorbiaceae	*Homonia riparia* Lour.	0.67	KT, KU, MK, AD	Diuretic
18	Anacardiaceae	*Lannea coromandelica* (Houtt.) Merr.	0.67	KT, KU, MK, AD	Wound healing
19	Rutaceae	*Toddalia asiatica* (L.) Lam.	0.60	KU, MK	Gynaecological Problems
20	Liliaceae	*Asparagus racemosus* Willd.	0.53	KU, AD	Neural problems
21	Caesalpiniaceae	*Caesalpinia bonduc* (L.) Roxb.	0.53	KU	Stomach ache
22	Lecthidiaceae	*Careya arborea* Roxb.	0.53	KT, KU, MK, AD	Stomach ache
23	Scrophulariaceae	*Scoparia dulcis* L.	0.47	KU, MK,	Hernia, kidney stone
24	Sterculiaceae	*Helicteres isora* L.	0.40	KU, MK, KT	Neural problems
25	Rananculaceae	*Naravelia zeylanica* (L.) DC.	0.40	KT, KU, MK, AD	Headache
26	Sapindaceae	*Cardiospermum halicacabum* L.	0.33	KU, MK	Confinement
27	Apiaceae	*Centella asiatica* (L.) Urban.	0.33	KU, AD, MK	Stomach ache
28	Rutaceae	*Glycosmis pentaphylla* (Retz.) DC.	0.33	KU, MK, AD	Stomach ache
29	Lobeliaceae	*Lobelia nicotianifolia* Roth ex Roem. & Schult.	0.33	KU, MK	Skin problems
30	Icacinaceae	*Nothapodytes nimmoniana* (Graham) Mabb.	0.33	KU, MK	Cancer
31	Euphorbiaceae	*Ricinus communis* L.	0.33	KU, MK, AD	Neural problem
32	Solanaceae	*Capsicum frutescens* L.	0.27	KU, MK	Hypertension
33	Amaranthaceae	*Cyathula prostrata* (L.) Blume	0.27	KU, MK	Inflammation
34	Caryophyllaceae	*Drymaria cordata* ssp. *diandra* (Blume) Duke.	0.27	KU, MK, KT	Skin problem
35	Acanthaceae	*Justicia gendarussa* Brum.	0.27	KT, KU, MK, AD	Neural problems
36		*Leucas aspera*.	0.27		
37	Rubiaceae	*Mussaenda frondosa* L.	0.27	KU, AD	Burns
38	Lamiaceae	*Ocimum tenuiiflorum* L.	0.27	MK	Skin problems
39	Euphorbiaceae	*Phyllanthus emblica* L.	0.27	KU, MK	Hair oil
40	Fabaceae	*Pterocarpus marsupium* Roxb.	0.27	KT, KU, MK, AD	Hypertension

41	Rutaceae	*Ruta chalepensis* L.	0.27	KT, KU, MK, AD	Fever
42	Caesalpiniaceae	*Senna tora* (L.) Roxb.	0.27	KT, KU, MK	Stomach ache

*KT=*Kattunaikkan*, KU=*Kuruchiyar*, MK= *Mullukuruman* , D=*Adiyan*

Among the 63 families from which the informants cited 565 uses, based on the use value of species, Family Use Value (FUV) was calculated. The eighteen families which scored a FUV more than 1 are listed below (Table 2). The family Sterculiaceae recorded the highest FUV at 1.60. The family Acanthaceae came second in the list with an FUV at 1.50. Those families with higher FUV are more important to the socio-cultural groups studied than with families with less FUV

Table 2. List of families which quoted FUV more than 1.

Sl.No.	Family	FUV
1	Sterculiaceae	1.60
2	Acanthaceae	1.50
3	Rubiaceae	1.44
4	Aristolochiaceae	1.40
5	Caesalpiniaceae	1.40
6	Liliaceae	1.30
7	Icacinaceae	1.25
8	Malvaceae	1.25
9	Rutaceae	1.25
10	Menispermaceae	1.24
11	Euphorbiaceae	1.15
12	Lecthidiaceae	1.14
13	Lamiaceae	1.13
14	Apiaceae	1.13
15	Scrophulariacea	1.08
16	Sellaginellaceae	1.08
17	Piperaceae	1.07
18	Zingeberaceae	1.04

Shannon Wienner index was calculated to be 2.0705 and the Evenness was estimated at 0.92314. Usually this index has a normal range of 1.5 to 3.5, and rarely surpasses 4. Our value also came within the normal range at 2.0705. A higher value for Shannon-Wiener index means an increase in diversity and *vice versa*

Simpson index was estimated at 0.01021 and its reciprocal value 1/D was calculated as 97.36. The evenness E was estimated at 0.5935. As D increases the diversity decreases. It is highly weighted towards the most abundant species in the sample, while it is less sensitive to the species richness. Simpson index is considered as one of the most meaningful and robust measures available. The reciprocal of D,1/D is the most widely used form of Simpson index since the value of the measure will increase in this case and the assemblage will become more even.

The Berger Parker Index is an intuitively simple dominance measure and, it expresses the proportional abundance of the most abundant species. The Berger parker index (d) was estimated at 0.08484 for this study.

IV. CONCLUSION

An inventory of fifteen knowledgeable tribal healers and helpers to healers from four socio-cultural groups were made and 565 user reports regarding 165 species were recorded from them. The four tribes studied had their own myths, beliefs and taboos regarding the causes for diseases and have magico- religious ritual healing methods for getting rid of them. Cited plant knowledge were categorised on the basis of use value to understand the relative importance of plants among and across socio cultural boundaries. Family use value was calculated to identify the highly valued families of plants which the informants quoted . For a better understanding on the indigenous medicinal wealth, activity guided phytochemical fractionation can be done on the prioritised species in future. Shannon Wienner index for the collected information was calculated, which can be used as a measure of biodiversity richness for a particular area. Simpson's index was calculated for the data collected which gave an idea on the evenness of knowledge distribution regarding medicinal plants among the informants. Berger Parker Index was calculated for the vegetation based on the plant use data quoted by the informants. These indices indicates an indirect measure of richness in species diversity of a particular locality based on the user reports quoted.

V. ACKNOWLEDGMENT

The corresponding author hereby acknowledges UGC for FDP assistance and DST -FIST Scheme for technical support. Also we acknowledge Mr. Salim Pichan of MS Swaminathan Research Foundation for his generous help in data collection.

VI. REFERENCES

[1] Jain, S.K. 2000. Human aspects of plant diversity. Economic botany, 54(4): 459-470.
[2] Young, K.J., 2007. Ethnobotany. Chelsea house, New York, 1-12.
[3] Hema, E.S., Sivadasan, M. and Anil Kumar, N. 2006. Studies on edible species of Amaranthaceae and Araceae used by Kuruma and Paniya tribes in Wayanad district, Kerala, Indian Ethnobotany, 18(1): 122-126.
[4] García, C.S.G., 2006. The mother – child nexus. Knowledge and valuation of wild food plants in Wayanad, Western Ghats, India. Journal of Ethnobiology and Ethnomedicine, 2(39): 1-6.
[5] Joseph, M.A. and Antony, V.T., 2012. The medicinally important Convolvulacean members used by kattunaikkan tribe of Wayanad district. Journal of Research in plant Sciences, 1 (2): 93-97.
[6] Mini, V. and Sivadasan, M., 2007. Plants used in ethno-veterinary medicine by Kurichya tribe of Wayanad district in Kerala, India. Ethnobotany, 19: 16-21.
[7] Phillips, O., Gentry, A.H., Reynel, C., Wilkin, P. and Galvez-Durand, C. 1994. Quantitative ethnobotany and Amazonian conservation. Conservation Biology, 8: 225-248.
[8] Phillips, O. and Gentry, A.H. 1993b. The useful plants of Tambopata, Peru: II. Additional hypothesis testing in quantitative ethnobotany. Economic Botany, 47: 33-43.
[9] Cadena-González, A.L., Sorensen, M. Theilade, I. 2013. Use and valuation of native and introduced medicinal plant species in Campo Hermoso and Zetaquira, Boyacá, Colombia. Journal of Ethnobiology and Ethnomedicine, 9(23): 2-34.
[10] Magurran, E.A., 2004. Measuring Biological Diversity. Blackwell Publishing Company, Malden, U.S.A.
[11] Simpson, E.H. 1949. Measurement of diversity. Nature, 163: 688.
[12] Berger, W.H. and Parker, F.L. 1970. Diversity of planktonic foraminifera in deep sea sediments. Science, 168: 1345-1347