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Original article

Using quantitative indices to evaluate the cultural importance of food and nutraceutical plants: Comparative data from the Island of Bali (Indonesia)

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ABSTRACT

Different quantitative indices were proposed to determine the cultural importance of ethnobotanically valuable plants in order to develop a tool for the evaluation of immaterial cultural heritage. These indices were applied to an ethnobotanical survey of food and nutraceutical plants traditionally consumed in Bali, Indonesia. The uses of the plants were grouped into 6 use categories. The Cultural Food Significance Index (CFSI), use value (UV), relative frequency of citation (RFC), relative importance (RI), cultural value (CVs), and informant consensus factor (ICF) were calculated for a list of plants cited by fifty informants in different traditional villages on the island. This evaluation of the cultural importance of plants through different indices produced interesting variations. *Colocasia esculenta* (L.) Schott came highest in the preference ranking for RFC, UV and CVs. *Arenga pinnata* (Wurmb) Merr. was in first place for CFSI and RI. *Artocarpus heterophyllus* Lam., *Lablab purpureus* (L.) Sweet and *Cinnamomum burmanni* (Nees & T. Ness) Blume were also high in the CFSI, RI, and CVs. The ICF results revealed a well-defined food tradition. The combined use of these indices, as opposed to any single index, makes it possible to quantify the role that a given plant plays within a particular culture.

1. Research aims

This paper compares six culturally important indices proposed in the literature, in order to assess both the cultural significance for traditional ethnobotanical knowledge (TEK) of plant species in a relevant area, and the suitability of such indices for the identification of cultural conservation needs. For the comparison, we used data concerning food and nutraceutical plants traditionally consumed in Indonesian Island of Bali.

2. Introduction

Ethnobotany falls within the "knowledge and practices concerning nature and the universe", which constitute humanity's intangible cultural heritage as defined by UNESCO in 2003 [1,2]. This declaration was a fundamental step towards the recognition of all orally transmitted traditional knowledge (TK) systems as an integral part of worldwide cultural heritage in need of protection and safeguarding [3]. Many authors have stressed the urgent need of ethnobotanical documentation in order to contrast the rapid decline of TEK due to plant extinction and, above all, to the disappearance of traditional cultures [4–8].

Different ethnobotanical cultural importance indices were developed in order to establish the main parameters needed to evaluate which are the most important plants within a culture and to determine conservation requirements [9–11]. In particular, indices for use value (UV) [12], relative importance (RI) [13], relative frequency of citation (RFC) [14], cultural value (CVs) [15,16], and informant consensus factor (ICF) [17–19] seem highly relevant in quantitative ethnobotanical study.

Within the context of traditional plant use, the field of food and nutraceutical plants now seems highly relevant for ongoing efforts to improve biodiversity in food culture and food security [20–23]. It is important to document plants traditionally consumed within a particular geographical and cultural context in order to develop culturally important indices of quantitative ethnobotanical data. Such documentation is also necessary in order to understand cultural issues related to food acceptance and to develop insights

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into the investigation of phytochemical compounds [24]. A cultural food significance index (CFSI) was introduced in the field of food ethnobotanical study, taking into account seven indices, such as frequency of use, frequency of citation of species, availability, the part of the plant used, multi-functional food use, taste score appreciation, and medicinal applications [24].

Ethnobotany is particularly important in tropical countries, where local cultures are undergoing rapid changes [4–6,8], with a similar situation taking place in Europe [3]. In Indonesia, several ethnobotanical studies have, over the last few decades, focused on the use of medicinal plants [25–28]. Despite this, only a few of the ethnobotanical studies carried out across the whole South East Asia region have focused on medicinal, aromatic, and food plants [18,28–31], and only one ethnobotanical study has carried out a quantitative evaluation of biocultural diversity on the island of Bali [32].

3. Materials and methods

3.1. Study area

The study area is located on the Indonesian island of Bali, and is delimited by the islands of Lombok to the East and Java to the West [33]. Bali is extremely interesting for the study of cultural heritage due to the exceptional architectural treasures represented by its active and well-preserved Hindu temples [34], and to its unique landscape (the Subak, an irrigation system for paddy fields unique to Bali was listed as a UNESCO world heritage site in 2012) [35]. A valuable example of immaterial cultural heritage is preserved in Balinese daily life, and includes rituals, traditional medicines, and local foods [23,36,37], but the problem of cultural erosion in this area seems to be increasing, as observed in a previous contribution [8].

Bali still has several aga (indigenous) villages, i.e. villages inhabited by families whose ancestors have lived in Bali for many generations. These inhabitants belong to Bali's aga ethnic group, and identify strongly with Hindu religious customs and traditions. Their economy is based on agriculture and wild natural resources. The ages of settlements vary (from the 11th to 14th century) [34], and are typically composed of two to five thousand inhabitants [33]. Building styles and social customs reflect traditional Balinese culture [34]. TEK data was collected in 13 Bali aga villages located between 242 and 1187 m above sea level. Most villages are found at higher altitudes, and this is probably connected to a reduced impact from tourism, which is concentrated mainly in coastal areas (Fig. 1).

Bali's traditional culture is based on the selling of agricultural products, such as green vegetables, fruit, beans, and the staple food of rice [33]. Cultivated plants, which have played an important role in the local food economy, are represented by *Oryza sativa* L., *Manihot esculenta* Crantz, *Ipomoea batatas* (L.) Lam., *Luffa acutangula* (L.) Roxb., *Musa paradisiaca* L., *Artocarpus heterophyllus*, *Carica papaya* L., and *Salacca zalacca* (Gaertn.) Voss. These plants have long represented the main food source for locals. Bali's traditional food and nutraceutical culture includes a wide variety of plants that are gathered in forests or grown in home gardens and on farmland [23,29,31,33].

3.2. Data collection

Ethnobotanical information was obtained through semi-structured interviews with 50 informants (ages ranged between 14 and 76 years old) using the snowball method [8,38,39]. Most of the informants (90%) were male, reflecting the predominant role of men in Bali's traditional culture, especially in rural areas. A detailed analysis of the factors (e.g., age, gender, education level, occupation, monetary earning, geographical, and socio-economic characteristics) affecting differences in traditional knowledge of plant uses in the surveyed villages is provided in Sujarwo et al. [8].

Before each interview, prior informed consent was requested and international codes of ethics, as presented in Rosenthal [40], were observed throughout the study. After obtaining consent, various strata of informants (according to their occupation, such as: civil servants, farmers, village leaders, religious leaders, and others) were interviewed. For underage informants, consent was obtained beforehand from their parents. At least four informants per village were interviewed. Interviews were conducted in both Balinese and Indonesian. Informants were asked to provide, from memory, a list of traditional food and nutraceutical plants cultivated and consumed in their village. The informants were also asked to specify the following information for each plant mentioned: which part of the plant was used, how that plant part was used, its perceived availability, the frequency of use of the species, taste appreciation, and its medicinal properties when eaten [24].

All of the plants cited were collected with the assistance of the informants and identified by the first author with the help of professional experts from Bali Botanical Gardens. Voucher specimens were deposited at Bali Botanical Gardens' Herbarium Hortus Botanicus Baliense. The scientific nomenclature of plants used in this paper follows internationally approved checklists [41].

All detailed information on food and nutraceutical uses was recorded as freely given by informants before being sorted into the following six food and nutraceutical use categories: (1) vegetables, (2) edible fruits, (3) staple foods, (4) spices, (5) edible seeds, and (6) herbal drinks. The same plant could fall into more than one use category.

3.3. Quantitative analysis

Most indices are based on "informant consensus," i.e., the degree of agreement between interviewees [11]. Phillips [42] pointed out that these procedures tend to be more objective as they are designed to reduce bias in attributing relative importance. In this study, we have compared the importance of each species using the following six indices: cultural food significance index (CFSI), use value (UV), relative frequency of citation (RFC), relative importance (RI), cultural value index (CVs), and informant consensus factor (ICF), in accordance with the suggestion that a wider and more comparative use of indices should be made in ethnobotanical studies [7].

3.3.1. Cultural food significance index (CFSI)

The cultural food significance index, proposed by Pieroni [24], elaborated with the specific aim of evaluating the cultural significance of edible plants, was calculated as:

$$\mathrm{CFSI} = \mathrm{QI} \times \mathrm{AI} \times \mathrm{FUI} \times \mathrm{PUI} \times \mathrm{MFFI} \times \mathrm{TSAI} \times \mathrm{FMRI} \times 10^{-2}$$

The formula takes into account seven indexes, which express the frequency of quotation (QI), availability (AI), frequency of use (FUI), plant parts used (PUI), multi-functional food use (MFFI), taste score appreciation (TSAI), and the food-medicinal role (FMRI) [24,43,44].

3.3.2. Use value (UV)

The use value index (UV), which was first proposed by Prance et al. [12], indicates the relative importance of species known locally. Its value is based on the number of uses and the number of people that cite a given plant, and has been widely used within the ethnobotanical community to indicate the species that are considered most important by a given population [9–12].

It was calculated using the following formula [11,14,45,46]:

$$\mathrm{UV} = \Sigma U_{\mathrm{i}}/N$$

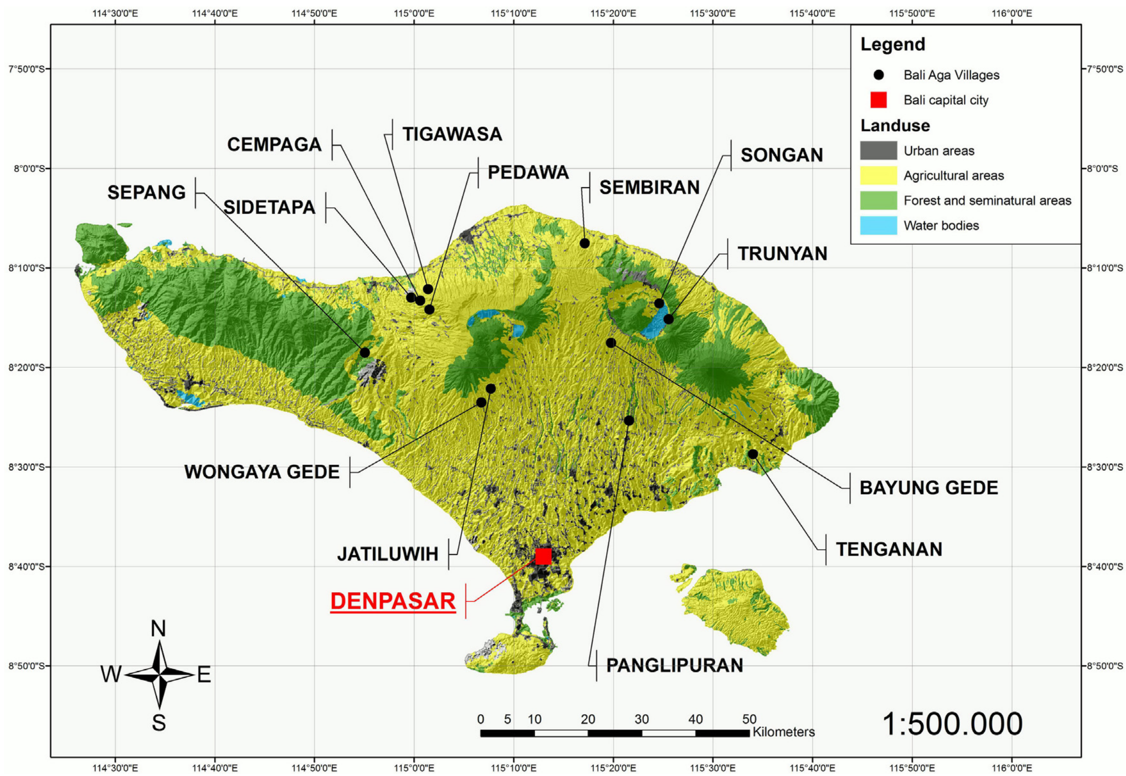

Fig. 1. The Island of Bali and the location of the study area.

where U_i is the number of uses mentioned by each informant for a given species, and N is the total number of informants.

3.3.3. *Relative frequency of citation (RFC)*

This index, proposed by Tardío and Pardo-de-Santayana [14], shows the local importance of each species, and it is a result of the frequency of citation (FC, the number of informants mentioning the use of the species) divided by the total number of informants (N), without considering the use categories [14,47].

$$\mathrm{RFC} = \mathrm{FC}/N$$

This index varies from 0, where nobody refers to the plant as useful, to 1 in the unlikely case that all the informants would mention the use of the species.

3.3.4. *Relative importance (RI)*

The relative importance index (RI) takes into account both the number of informants who mention the useful species and the different uses for it, and is defined by the following formula [11,13]:

$$\mathrm{RI} = \mathrm{NUC} + \mathrm{NT}$$

where NUC is the number of use categories (e.g., vegetables, edible fruits, herbal drinks) of a given species divided by the total number of use categories of the most versatile species, and NT is the number of types of uses (e.g., vegetable soups, mixed vegetables, ripe fruit, for the treatment of cough, diarrhea, heartburn, hypertension, infections, and rheumatic pain) attributed to a given species divided by the total number of types of uses attributed to the most important taxon.

3.3.5. *Cultural value (CVs)*

This index takes into account the use categories, and is defined by the following formula [15,16,19]:

$$\mathrm{CVs} = \mathrm{UCs} \times \mathrm{ICs} \times \Sigma\mathrm{IUCs}$$

where UCs is the total number of uses reported for a species divided by the total number of use categories. ICs is the number of informants who listed a species as useful divided by the total number of informants. $\sum$IUCs is the number of informants who mentioned each use of the species divided by the total number of informants.

3.3.6. *Informant consensus factor (ICF)*

This index, which was first proposed by Trotter and Logan [48], is used to test homogeneity of knowledge. It was calculated using the following formula [17–19]:

$$\mathrm{ICF} = [\mathrm{Nur} - \mathrm{Ns}]/[\mathrm{Nur} - 1]$$

where Nur is the number of use-reports for a particular use category and Ns is the number of species used for a particular use category by all informants. This index varies from 0, where informants disagree on the species to be used within all use categories, to 1 where relatively few species are used by a large proportion of people [19].

4. Results

All 136 food and nutraceutical plants with results from the different indices and the number of informants and citations for each plant are provided in Electronic Supplementary Material (ESM). Table 1 shows the top 20 plant species for each index. Table 2 shows informant the consensus factor for ethnobotanical information. Such tables demonstrate a high variation of cultural values, depending on the different point of view adopted in the various indices.

Table 1
Ranking of the top 20 plant species considered to be most important for the community of Bali aga villages, based on five quantitative measures of relative importance.

CFSI	UV	RFC	RI	CVs
Arenga pinnata	*Colocasia esculenta*	*Colocasia esculenta*	*Arenga pinnata*	*Colocasia esculenta*
Artocarpus heterophyllus	*Arenga pinnata*	*Manihot esculenta*	*Lablab purpureus*	*Arenga pinnata*
Lablab purpureus	*Cinnamomum burmanni*	*Artocarpus heterophyllus*	*Colocasia esculenta*	*Cinnamomum burmanni*
Colocasia esculenta	*Piper betle*	*Musa paradisiaca*	*Artocarpus heterophyllus*	*Artocarpus heterophyllus*
Cinnamomum burmanni	*Manihot esculenta*	*Blumea balsamifera*	*Cinnamomum burmanni*	*Piper betle*
Piper betle	*Artocarpus heterophyllus*	*Ipomoea batatas*	*Piper betle*	*Lablab purpureus*
Paederia foetida	*Lablab purpureus*	*Arenga pinnata*	*Antidesma bunius*	*Manihot esculenta*
Zingiber officinale	*Musa paradisiaca*	*Dioscorea hispida*	*Luffa acutangula*	*Musa paradisiaca*
Blumea balsamifera	*Blumea balsamifera*	*Cinnamomum burmanni*	*Syzygium polyanthum*	*Blumea balsamifera*
Kaempferia galanga	*Ipomoea batatas*	*Alstonia scholaris*	*Paederia foetida*	*Ipomoea batatas*
Syzygium polyanthum	*Paederia foetida*	*Psidium guajava*	*Artocarpus elasticus*	*Dioscorea hispida*
Curcuma longa	*Dioscorea hispida*	*Piper betle*	*Kaempferia galanga*	*Alstonia scholaris*
Antidesma bunius	*Alstonia scholaris*	*Carica papaya*	*Averrhoa bilimbi*	*Psidium guajava*
Luffa acutangula	*Psidium guajava*	*Moringa oleifera*	*Curcuma longa*	*Carica papaya*
Alstonia scholaris	*Carica papaya*	*Cajanus cajan*	*Morus australis*	*Antidesma bunius*
Centella asiatica	*Luffa acutangula*	*Diplazium esculentum*	*Sauropus androgynus*	*Paederia foetida*
Ipomoea batatas	*Moringa oleifera*	*Centella asiatica*	*Nicolaia speciosa*	*Cajanus cajan*
Carica papaya	*Cajanus cajan*	*Sechium edule*	*Morus alba*	*Diplazium esculentum*
Manihot esculenta	*Diplazium esculentum*	*Zingiber montanum*	*Zingiber officinale*	*Luffa acutangula*
Averrhoa bilimbi	*Syzygium polyanthum*	*Musa balbisiana var. brachycarpa*	*Tamarindus indica*	*Moringa oleifera*

CFSI: cultural food significance index; UV: use value; RFC: relative frequency of citation; RI: relative importance; CVs: cultural value index.

Table 2
Informant consensus factor (ICF) for ethnobotanical information given by the 50 Balinese informants.

Use categories	Number of use-reports	Number of species	Informant consensus factor (ICF)
Vegetables	722	53	0.93
Edible fruits	340	45	0.87
Staple foods	182	10	0.95
Spices	87	8	0.92
Edible seeds	50	4	0.94
Herbal drinks	369	47	0.88

4.1. Cultural food significance index (CFSI)

The cultural food significance index (CFSI) values varied considerably from one species to another, with a minimum of 0.11 and a maximum of 1797.12. When considering the values of this index it was, according to Pieroni [24], possible to classify the cited plants into six groups: species with very high significance (CFSI = 300 and over), with high significance (CFSI = 100–299), moderate significance (CFSI = 20–99), low significance (CFSI = 5–19), very low significance (CFSI = 1–4) and negligible significance (CFSI < 1). These groups vary in size, with the majority of plants belonging to the very low significance group (Fig. 2).

The group with very high significance (CFSI = 300+) was comprised mainly of edible fruits and seeds that are used in different preparations (*A. pinnata*, *A. heterophyllus*, and *L. purpureus*), with three other species (*Colocasia esculenta*, *Cinnamomum burmanni*, and *Piper betle* L.), which are known for the use of their leaves in vegetable soups and herbal drinks. The species included in this first category are those with the widest range of uses and those to which medicinal properties are attributed. The inner stems of *A. pinnata* are edible when boiled, and are considered a staple food, a root decoction is used for urolithiasis, and their fruits are boiled and eaten as snacks. The taste score of this plant is generally good and it scores high for parts used.

The species included in the group with high significance (CFSI = 100–299) are typically used medicinally, as spices, or as cooked vegetable. The leaves of *Paederia scandens* L. are cooked and added to vegetable soups. A decoction of the leaves of this plant is used to treat fever and to stimulate the appetite. A decoction of *Blumea balsamifera* (L.) DC. leaves is used to treat diarrhoea, fever, heartburn, and constipation. The group also includes the commonly used spices: *Zingiber officinale* Roscoe, *Kaempferia galanga* L., *Syzygium polyanthum* (Wight) Walp., and *Curcuma longa* L.

The group with moderate significance (CFSI = 20–99) consists of species that are used mainly as medicines or vegetable source. Normally they are used after basic preparation. These plants include the medicinal (*Alstonia scholaris* (L.) R. Br., *Centella asiatica* (L.) Urb., *Averrhoa bilimbi* L., *Hibiscus rosa-sinensis* L., *Sauropus androgynus* (L.) Merr., *Orthosiphon aristatus* (Blume) Miq., *Z. montanum* (J. Koenig) Link ex A. Dietr., *Andrographis paniculata* (Burm. f.) Nees, *Spondias pinnata* (L. f.) Kurz), vegetables (*Luffa acutangula*, *I. batatas*, *Carica papaya*, *Musa paradisiaca*, *Manihot esculenta*, *Sechium edule* (Jacq.) Sw., *Morus australis* Poir., *Moringa oleifera* Lam.), and a few fruit species (*Punica granatum* L., *Antidesma bunius* (L.) Spreng., *S. samarangense* (Blume) Merr. & L.M. Perry). This group also includes the most frequently used staple food species, *Dioscorea hispida* Dennst.

The group with low significance (CFSI = 5–19) was comprised of vegetables, edible fruit and seed, medicine, staple foods, and spices. Good taste scores were reported for many of these species, but their multi-functional food use and parts used are generally very low.

Species that have low availability, low multi-functional food use, low parts used, and low food-medicinal role, are grouped in this class (very low significance with CFSI = 1–4). There are 44 species in this group. The taste score appreciation is good for some species, such as *S. cumini* (L.) Skeels, *Annona muricata* L., *Manilkara zapota* (L.) P. Royen, *Rubus rosifolius* Sm., *Mangifera caesia* Jack, *Annona squamosa* L., *Sandoricum koetjape* (Burm. f) Merr., and *Persea americana* Mill. These species are well known for their fruits.

The group with a negligible significance rating (CFSI < 1) includes all of the species that scored low on availability and parts used, had a very limited range of uses, and had no recognized medicinal properties. This group contains most of the plants that were reported by two informants.

4.2. Use value (UV), relative frequency of citation (RFC), relative importance (RI), cultural value (CVs), and informant consensus factor (ICF)

The mean value of the number of informants for each multiple use species was 10.52 (± 11.48) representing 21.04% of all the interviewees, but there was a relatively high variation between the

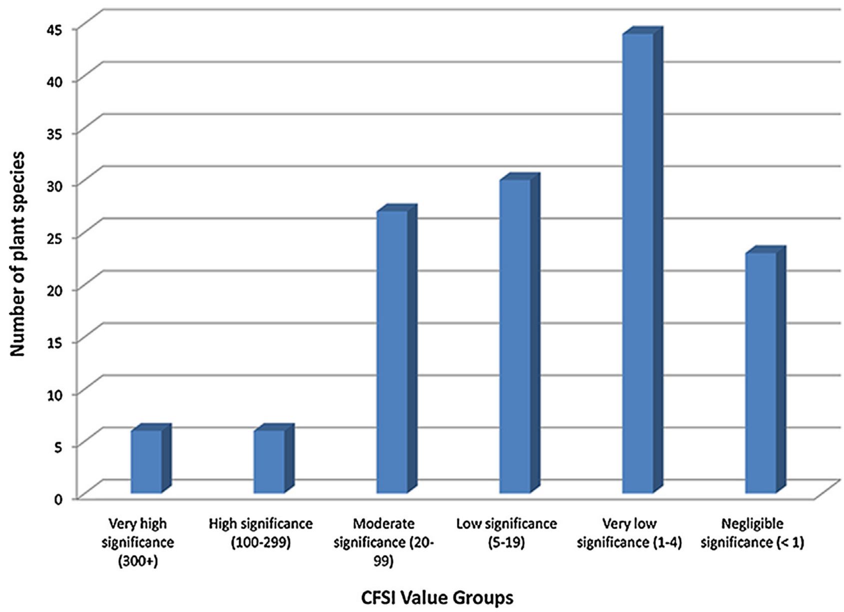

Fig. 2. Number of plant species for each CFSI group.

number of informants for each species. Only thirteen species were cited by more than 30 informants (9.56%). The mean value for number of citations for a given plant was 12.97 (± 16.05), that is to say that, on average, a given species was cited 12.97 times (0.74% of all citations). In this case, only fifteen species were cited by more than 30 times (11.03%).

On average, this study revealed that, in general, the cultural values of the plants cited as useful was low, as suggested by the UV (0.26 ± 0.32), RFC (0.21 ± 0.23), and CVs (0.03 ± 0.09) indices. In addition, the mean value of RI (0.82 ± 0.31) indicated that the most versatile taxon (*A. pinnata*, RI = 2.0) was 2.5 times more relevant than 106 other species. Nevertheless, some plants still possess a relevant and shared cultural value. ICF values ranged between 0.88 and 0.95. This data indicated that informants tend to agree on the species to be used within all use categories. Moreover, Fig. 3 shows values for CFSI, UV, RFC, RI, and CVs at intervals of 10%, demonstrating that the majority of cited plants were in the groups with low and very low significance values, and only a few plants had high and very high cultural values. This comparison also shows how the relative cultural value of plants is estimated differently from one index to another.

5. Discussion

Qualitative ethnobotanical data, such as lists of used plants, are insufficient to clarify the specific role played by a given species within a given ethnic group. Cultural importance indices make it possible to quantify the role that a given plant plays within a particular culture, and CFSI is used to evaluate and classify these plants according to their respective cultural significance [24].

In this study, very high CFSI values generally occurred for categories with a wide range of multi-functional food use and for those of prominent medicinal foods, while taste appreciation score and part used seemed to play a subordinate role. This data supports the conclusion that nutritional factors have played a central role in the choice of food sources, in their acceptance, and in their popularity [24,49].

The limited use categories shown for edible seeds and plants used as spices can be explained by the relatively low frequency of citation, low availability, and by a lower frequency of use. In the indigenous societies of the Bali aga villages, the availability factor has certainly influenced food choices [24,50]. Changes in land use were observed and this was identified as a cause of the decline of *Garcinia dulcis* (Roxb.) Kurz, *Garcinia parvifolia* (Miq.) Miq., *Citrus maxima* (Burm.) Merr., *Maranta arundinacea* L., *Anamirta cocculus* (L.) Wight & Arn., *Dacrycarpus imbricatus* (Blume) de Laub., *Ficus drupacea* Thunb., and *Casuarina junghuhniana* Miq. Some of these fruit plants were regularly sold in the traditional market twenty years ago, but today imported fruits tend to have substituted local fruits and these can now be found in every shop [23,29,31].

Many of the food and nutraceutical plants obtained in this study are considered tasty and their taste appreciation is never low. Elderly people tend to appreciate their flavour and see this as a sign of medicinal properties [51]. This quantitative analysis provides an interesting starting point for further developments in comparative studies in other tropical areas, in particular the South East Asia region. Such a quantitative approach could specify the acceptance or rejection of foods by humans [24,49].

With regard to CFSI in general, the correspondence between the rankings obtained from the amount of informants interviewed in this study and RFC was foreseeable, because the RFC index is directly dependant on the number of informants that mention the use of a given species (FC) [47]. The UV index places more emphasis on species that have many uses, even if these uses are only known to a few people [11,52,53], and consequently the position of many plants was different in this list compared to the list based on RFC. The ranking was also different for the RI index, which emphasises those plants that have the greatest absolute number of uses [11]. A slightly different ranking of species was found based on the CVs index. This index takes into account not only the spread of use (number of informants), but also the versatility of a plant, i.e. the diversity of its uses and their importance [19].

Table 1 also shows that fifteen species were absent in the RFC classification, and eleven species were absent in the UV classification. This is because the calculation of RI gives more importance to species with a greater number of uses, but does not take into consideration the number of people that cite these uses [11]. *Manihot esculenta* ranked second when only the number of informants (50) and RFC (1.0) were taken into account, whereas it ranked fifth for both UV (1.0) and number of citations (50). Interestingly, this species did not appear on the RI-20 list, because many

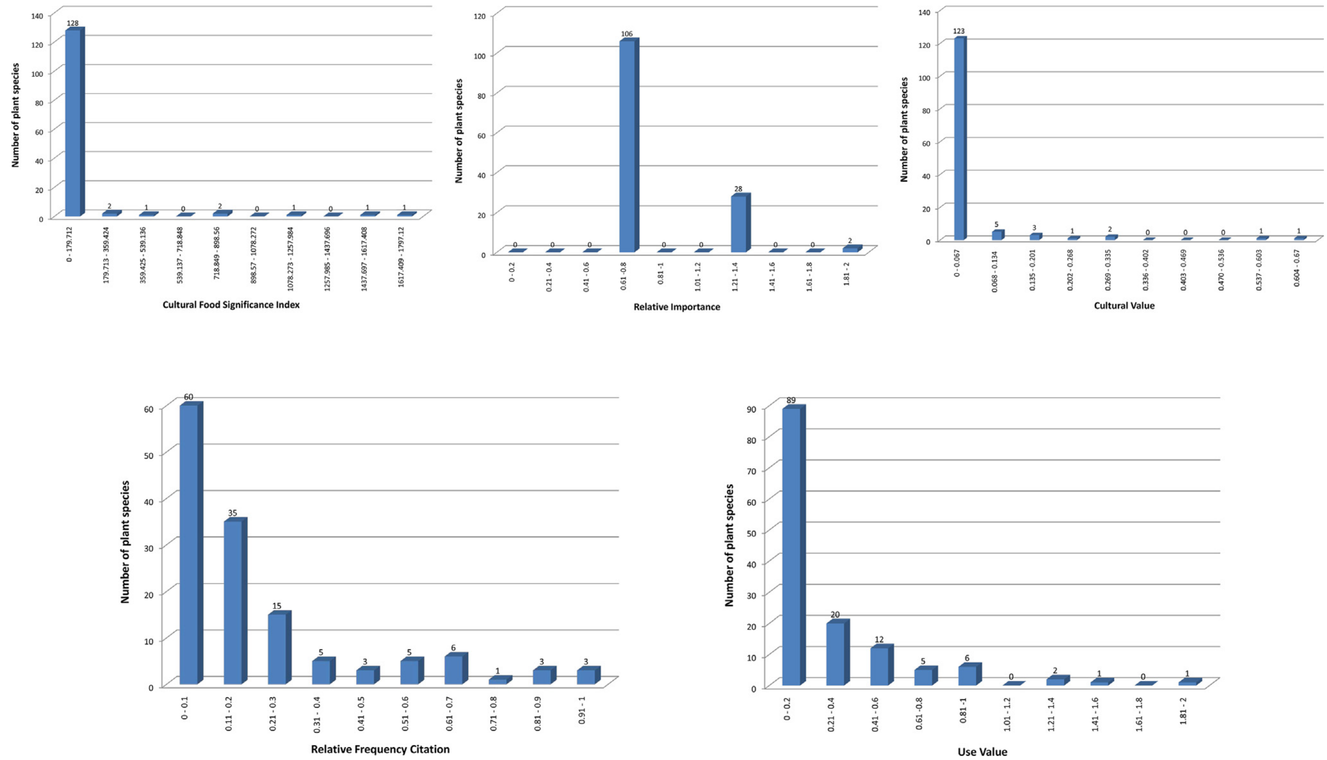

Fig. 3. Ten percent interval values of cultural food significance index (CFSI), use value (UV), relative frequency of citation (RFC), relative importance (RI), and cultural value index (CVs).

informants only attributed one use category to it, and the RI index only applies to species with a significant number of uses, independent of the number of informants that cite it [47]. *A. elasticus* Reinw. ex Blume, *Morus australis*, *Sauropus androgynus*, *Nicolaia speciosa* (Blume) Horan., *Morus alba* L., and *Tamarindus indica* L. were included in the RI-20 list, but not in the other index lists, possibly due to the high number of use categories attributed to them [47].

The highest ICF values were observed for use categories related to staple foods, edible seeds, and spices, but less than 11 species were recorded in each category: e.g., *A. pinnata* for staple foods, *Euchresta horsfieldii* (Lesch.) Benn. for edible seeds, and *S. polyanthum* for spices. This finding suggested that there is a well-defined selection criterion for these use categories [18,54].

The results from Agung's study [32] of quantitative ethnoscience in Bali show that over-use of resources was the principle factor among those, which have a negative impact on the conservation of biocultural diversity. One of the most common approaches has been to associate use value with questions of conservation, based on the idea that the most important species will suffer the greatest harvesting pressure [11,55]. Results from this study could, therefore, be analysed further and integrated into future policies regarding Balinese indigenous knowledge in relation to the cultural importance of food and nutraceutical plants, as part of the conservation of the unique cultural heritage of the island.

6. Conclusions

Cultural importance indices make it possible to quantify the role that a given plant plays within a particular culture. Such indices produced interesting variations according to the different parameters that they took into account. The cultural food significance index (CFSI) quantifies all ethnobotanical data collected; the use value (UV) index emphasises species that have many uses, even if these uses are only known to a few people; the relative importance (RI) index emphasises those plants which have the greatest absolute number of uses, and also covers richness of use; the relative frequency of citation (RFC) index highlights shared information; cultural values (CVs) highlight the breadth of uses of a plants, such as the breadth of the groups of informants; finally the informant consensus factor (ICF) is useful for testing the homogeneity of knowledge. The cultural value of a plant then needs to be estimated through a multi-parameter approach that takes into account different factors and indices. In the study area, *C. esculenta* obtained the highest number of preferences for RFC, UV and CVs. *A. pinnata* was in first place for CFSI and RI. *A. heterophyllus*, *L. purpureus* and *C. burmanni* were also high in the CFSI, RI, and CVs. ICF results revealed a well-defined food tradition. We believe that our study will provide a higher quality of information on how and why people use plants, and will contribute to the conservation of biological and cultural diversity.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.culher.2015.06.006.

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