Ethnobotany of Selected Philippine Indigenous Fruit Tree Species in CALABARZON, Philippines

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Abstract

The wealth of indigenous food resources in the Philippines is not adequately documented in published literature. Consequently, an ethnobotanical investigation was conducted to provide baseline information regarding the traditional and current uses of seven Philippine indigenous fruit tree species (IFTS) in Region IV-A (CALABARZON), namely, Katmon (Dillenia philippinensis), Bitongol (Flacourtia rukam), Kalumpit (Terminalia microcarpa), Tibig (Ficus nota), Lipote (Syzygium polycephaloides), Binayuyu (Antidesma ghaesembilla), and Libas (Spondias pinnata). The study utilized structured and key informant interviews with 264 informants selected through snowball sampling. Citations were analyzed using ethnobotanical indices: Relative Frequency of Citation (RFC), Use Reports (UR), Use Value (UV), and Informant Consensus Factor (ICF). The URs were grouped into three use-categories—dietary, medicinal, and practical—with more specific sub-categories under each. The most widely identified IFTS in the region was F. nota (RFC = 79%, UR = 145), with utilization dominated by practical purposes (UR = 78). Conversely, D. philippinensis yielded the highest UR (246) across all use-categories region-wide. Most of the UR for F. nota and D. philippinensis came from the province of Rizal. All selected IFTS, except F. nota, were primarily recognized for dietary uses, particularly as fresh fruits. Medicinal uses were cited with high consensus (ICF ≥ 0.75) for A. ghaesembilla, F. nota, and D. philippinensis. The research revealed that while some IFTS were widely recognized and utilized in specific provinces, others remain poorly known and underutilized, indicating varied levels of local knowledge. Nonetheless, the study documented the existing local importance and uses of the selected IFTS in Region IV-A.

***Keywords**:* indigenous food systems, Philippine fruit tree species, underutilized indigenous species

1. Introduction

Indigenous food systems in the Philippines are as diverse as the variety of life forms and natural resources in the country's ecosystems. These systems typically include various wild edible plants (WEPS), indigenous fruit tree species (IFTS), and other edible non-timber forest products (NTFPs) that are integrated into an interactive network of local knowledge and collective production-consumption activities, among other components. Regrettably, the opportunity to utilize the country's vast biodiversity to achieve food security continues to be overlooked, as discourses, markets, and institutions remain highly focused on urbanized food systems (Davila, 2018).

Among the indigenous food resources and WEPS are several Philippine IFTS, such as Katmon (*Dillenia philippinensis* Rolfe), Bitongol (*Flacourtia rukam* Zoll and Moritzi), Kalumpit (*Terminalia microcarpa* Decne), Tibig (*Ficus nota* (Blanco) Merr.), Lipote (*Syzygium polycephaloides* (C.B.Rob.) Merr.), Binayuyu (*Antidesma ghaesembilla* Gaertn.), and Libas (*Spondias pinnata* (L.f.) Kurz). Coronel (2011) listed these species as the country's underutilized indigenous fruit-bearing species. *D. philippinensis* and *S. polycephaloides* are endemic to the Philippines, while the others are native to Southeast Asia. Furthermore, the selected IFTS have either not been evaluated or have been classified under the least concern (LC) category of the IUCN 2022-2, except for the endemics: *S. polycephaloides*, which is classified as endangered, and *D. philippinensis*, which is listed under the near threatened category (Energy Development Corporation [EDC], 2020; 2021).

Current literature reveals that phytochemicals and bioactive compounds are present in all the selected IFTS, making these fruits a nutrient-dense food option for rural and forest-dependent communities (Arquion *et al*., 2015; Barcelo *et al*., 2017; Jose and De Guzman, 2017; Latayada *et al*., 2017; Macahig *et al*., 2011; Mapatac, 2015; Mondal *et al*., 2021; Ragasa *et al*., 2016; Santiago *et al*., 2007; Santiago *et al*., 2020; Tiranakwit *et al*., 2023; Vallesteros *et al*., 2023; Yu *et al*., 2020). Despite their potential, these IFTS remain underappreciated, as no strategic programs have been implemented to promote their national recognition and sustainable utilization.

In the past decade, several ethnobotanical investigations have been conducted to survey and document wild plants used by indigenous and forest-dependent communities in various parts of the country, including the Cordilleras, Agusan del Sur, Ilocos Norte, Palawan, South Cotabato, Sarangani, Sultan Kudarat,

Guimaras, Cebu, Bataan, and Bukidnon (Arquion *et al*., 2015; Buenavista *et al*., 2022; Chua-Barcelo, 2014; Maghirang *et al*., 2018; Ong and Kim, 2017; Rosales *et al*., 2018; Tantengco *et al*., 2018). These studies have successfully identified hundreds of WEPS with dietary, ethnomedicinal, and multiple uses acclaimed in various parts of the country. However, Region IV-A has not been surveyed for its indigenous food systems. With its diverse ecosystems and communities, Region IV-A is equally important to analyze regarding its state of indigenous food systems and ethnobotanical knowledge. The region is a testament to the wealth of biodiversity and, consequently, indigenous food resources and traditional knowledge, evidenced by the presence of more than 20 key biodiversity areas, 14 critical watersheds, 12 watershed forest reservations, six protected landscapes, one national park, and one ASEAN Heritage Park (Philippine Forestry Statistics, 2022; Conservation International Philippines *et al*., 2006; 2009). Region IV-A also hosts a diverse population, comprising forest-dependent communities deeply connected to traditional knowledge and practices and urbanized areas where interactions between traditional and modern food systems occur.

The study surveyed communities in the vicinities of Mt. Palay-Palay-Mataas na Gulod Protected Landscape (MPP-MNGPL), Mt. Makiling Forest Reserve (MMFR), UP Sierra Madre Land Grants (UPSMLG), Mt. Banahaw-San Cristobal Protected Landscape (MBSCPL), Quezon Protected Landscape (QPL), Mt. Sembrano, Mt. Malarayat Forest Reserve, Mt. Gulugod Baboy, Mt. Batulao, Mt. Manabu, Mt. Daraitan, the Pamitinan Protected Landscape (PPL), and Maulawin Spring Protected Landscape (MSPL).

The wealth of WEPS, particularly IFTS, and indigenous food systems in the country is not fully reflected in the published information. As a result, the extent of nationwide utilization of WEPS and IFTS is also limited. Conversely, the ethnobotanical studies cited above indicate that information regarding indigenous food resources is limited in published literature, but is widespread in knowledge among local communities. Furthermore, none of the studies focused exclusively on the ethnobotany of IFTS. Thus, a survey of local knowledge and traditional practices was conducted to gather information that could be used to advance sustainable development and optimize underutilized natural resources, especially Philippine IFTS. This study provides baseline information on the traditional and current uses of seven selected Philippine IFTS: Katmon (*Dillenia philippinensis*), Bitongol (*Flacourtia rukam*), Kalumpit (*Terminalia microcarpa*), Tibig (*Ficus nota*),

Lipote (*Syzygium polycephaloides*), Binayuyu (*Antidesma ghaesembilla*), and Libas (*Spondias pinnata*).

2. Methodology

2.1 Study Areas

The ethnobotanical investigation was carried out in Region IV-A, Philippines. This region is also known as "CALABARZON," a portmanteau of the names of its constituent provinces: Cavite, Laguna, Batangas, Rizal, and Quezon. According to the Philippine Forestry Statistics, Region IV-A has a total forest cover of around 272,564 hectares, with 50% being open forests and 42% closed forests (Forest Management Bureau [FMB], 2022).

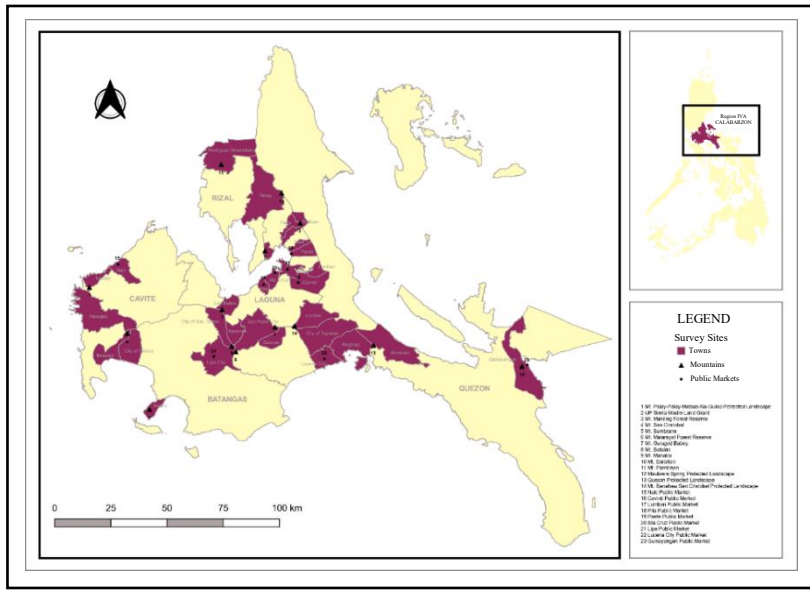

Figure 1. Location map of survey sites in Region IV-A, Philippines

The region is home to several forest ecosystems and local communities, including those within the Mt. Palay-Palay-Mataas na Gulod Protected Landscape (MPP-MNGPL), Mt. Makiling Forest Reserve (MMFR), UP Sierra Madre Land Grant (UPSMLG), Mt. Banahaw-San Cristobal Protected Landscape (MBSCPL), Quezon Protected Landscape (QPL), Mt. Sembrano,

Mt. Malarayat Forest Reserve, Mt. Gulugod Baboy, Mt. Batulao, Mt. Manabu, Mt. Daraitan, the Pamitinan Protected Landscape (PPL), and Maulawin Spring Protected Landscape (MSPL). The communities residing around the forests, particularly those that depend on them, were strategically selected for this ethnobotanical survey. Other surveyed sites include the public markets in the towns of Naic in Cavite; Cavinti, Lumban, Pila, Paete, San Pablo, and Santa Cruz in Laguna; Lipa in Batangas; and Lucena and Guinayangan in Quezon. The location of the study sites is illustrated in Figure 1.

2.2 Ethnobotanical Data Collection

Key informant and structured interviews were conducted in the region from March 2022 to June 2023. The selected key informants were residents of CALABARZON who are of legal age and possess demonstrated knowledge of indigenous fruits and plants. Individuals under 18 years old were excluded from the study, while elderly participants over 60 years old were included, provided they could participate meaningfully in the interviews. Informants typically included individuals with direct and practical knowledge, such as upland dwellers, hunters, gatherers, fruit vendors, community elders, and traditional or herbal medicine practitioners. The selection process utilized snowball sampling, relying on community-based referrals to identify knowledgeable individuals.

A total of 264 informants were selected. No fixed sample size was set per province, as the approach focused on gathering diverse insights from across Region IV-A. The data collected is not intended to serve as a statistically representative sample of the regional population. In the interviews, informants were asked about their familiarity with the selected IFTS and the uses they associate with each (Figure 2). Interviews were conducted in various appropriate settings, depending on informant availability and preference, including community gathering spaces, forest trails, public markets, and households. Responses were primarily recorded through notetaking guided by a structured data sheet. Before each interview, the study's objectives were explained, and informed consent was obtained through the informant’s signature on the data sheet, indicating voluntary participation.

Before data collection, the interview questionnaire underwent pilot testing to ensure its clarity, relevance, and appropriateness for the target communities. Although the study did not undergo formal ethics review by an institutional review board, ethical considerations were maintained throughout the research

process, including informed consent, voluntary participation, and respect for privacy. At the time of the study, a formal research ethics review process had not yet been established at the host institution; instead, the researchers secured the necessary permits from barangay local government units and obtained informed consent from all participants prior to data collection.

Figure 2. Key informant and structured ethnobotanical interviews conducted in Region IVA, Philippines

2.3 Ethnobotanical Data Analysis

2.3.1 Use categories of the selected indigenous fruit tree species

The uses cited by the informants were organized into three categories: dietary, medicinal, and practical uses, with a total of 20 subcategories (Table 1). Dietary uses include the application of IFTS for food. Preserved fruits pertain to the use of fruits in sweetened, jammed, candied, and/or fermented forms. The flavoring subcategory refers to the use of IFTS as acidulants or souring agents, sauces or condiments, or as an additional flavoring for both beverages and dishes. The production of juice or wine directly from the IFTS constitutes the beverage subcategory. The medicinal uses were categorized based on the reported diseases targeted by the IFTS. For instance, renal diseases relate to reports concerning kidney-related illnesses such as urinary tract infections, while dermatological value includes using IFTS to treat wounds and skin diseases. Lastly, practical purposes involve using the selected IFTS for various applications, such as fodder, fertilizer, fuel, and soil and water conservation.

Table 1. Classification of cited uses into use categories

Use Category	Subcategory	Specific Use Reports
Food	Fresh Fruits	Consumed as raw fruits
	Preserved Fruits	Jam, sweetened, candied, or fermented
	Flavoring	Used as souring agent for dishes or beverages, and sauce or condiment
	Vegetable	Cooked as vegetable dish, predominantly with coconut milk
	Beverage	Juice or winemaking using IFTS parts
Medicinal	Cardiovascular Issues	Anemia (iron-deficiency), hypertension, and blood-related issues
	Renal Diseases	Kidney-related illnesses, and urinary tract infections (UTI)
	Respiratory Illnesses	Cough, colds, flu, and asthma
	Gastrointestinal Issues	LBM, diarrhea, stomach/gas pain, hernia, hemorrhoids, and stomach ulcers
	Dermatological Concerns	Wounds, eczema, and hair loss among other skin diseases
	Neurological Issues	Headache, numbness, and panic
	Musculoskeletal Problems	Arthritis and feet-related concerns
	Other Health Concerns	Fever, diabetes, management of high uric acid and cholesterol levels, edema, and detox purposes
Practical	Fodder	Feed for farm animals such as pigs, carabaos, cattle, and goats
	Fertilizer	Organic matter to enhance soil fertility
	Handicraft	Made into toys and other crafts
	Shampoo	Hair cleaning
	Wood	Harvesting for timber
	Fuel	Conversion into charcoal
	Soil and Water Conservation	Protection of supporting ecosystem services

2.3.2 Determination of ethnobotanical indices

The ethnobotanical data gathered were analyzed using the following ethnobotanical indices from Shaheen *et al.* (2017) and Tantengco *et al.* (2018): Relative Frequency of Citation (RFC), Use Reports (UR), Use Value (UV), and Informant Consensus Factor (ICF).

Every time an informant cites their familiarity with a species, it counts as one citation. The ratio of participants able to cite familiarity with each species to the total number of informants in the study is expressed as the RFC (Equation 1). A higher RFC indicates greater recognition of the species but does not always correspond to a higher UR and UV.

$$RFC = \frac{Number\ of\ citations}{N} \quad (1)$$

where N is the total number of informants in the ethnobotanical survey.

On the other hand, use Reports (UR) refer to the number of times an informant mentions a particular use for the species. In this study, each use report is specific to a plant part. In other words, the same use for two different plant parts—for example, flavoring with the leaves and flavoring with the fruits—constitutes two distinct use reports.

Meanwhile, UV is the ratio of the total number of UR per species to the total number of informants interviewed; it is determined using Equation 2. UR and UV may indicate wide utilization (if values are close to one) or under-utilization (if the values are close to zero). These may also suggest the relative importance of the species for the surveyed communities.

$$UV = \frac{Nur}{N} \tag{2}$$

Where Nur is the total number of all use reports and N = the total number of informants in the ethnobotanical survey.

Lastly, the ICF, determined using Equation 3, indicates the agreement or consensus of the informants regarding the cited uses. In this study, ICF values greater than 0.75 are considered an indication of strong agreement among informants. In contrast, values from 0.50 to 0.75 indicate moderate agreement, values lower than 0.50 indicate weak agreement, and values of 0.00 indicate no agreement, respectively.

$$ICF = \frac{Nur - Nt}{Nur - 1} \tag{3}$$

where Nur is the total number of all use reports; Nt = the number of species used for the particular use category.

Data processing and analysis were conducted using Microsoft Excel. For each of the selected IFTS, the UR, UV, and RFC were computed. The UR was further classified into the use categories and subcategories, as discussed in Section 2.3.1. ICF was calculated for each use category and subcategory to assess the level of agreement among informants. This process systematically compared ethnobotanical knowledge and utilization patterns across the selected IFTS region.

3. Results and Discussion

3.1 Socio-demographic Characteristics of Informants

The interviewed group predominantly consisted of individuals aged 41 to 60 years (54%) and had a relatively balanced representation of male (47%) and female (53%) informants. Geographically, the informants were spread across the provinces of Region IV-A, with 11% from the province of Cavite, 15% from Laguna, 19% from Rizal, 27% from Quezon, and 28% from Batangas. Furthermore, the informants' most common income source was farming, fishing, or both. The socio-demographic characteristics of the group are presented in Table 2.

Table 2. Socio-demographic characteristics of the informants of the ethnobotanical survey

Statistic	Number of respondents (*n*)	Percentage (%)
Province		
Cavite	29	10.98
Laguna	39	14.77
Batangas	75	28.41
Rizal	51	19.32
Quezon	70	26.52
Sex		
Male	141	53.41
Female	123	46.59
Age		
20 to 40 years old	49	18.56
41 to 60 years old	143	54.17
Above 60 years old	71	26.89
Unknown	1	0.38
Educational Attainment		
None	2	0.76
Elementary Level	38	14.39
Elementary Graduate	66	25.00
High School Level	29	10.98
High School Graduate	72	27.27
College Level	25	9.47
College Graduate	30	11.36
Vocational Graduate	2	0.76
Source of Income		
Farming or fishing	99	37.50
Peddling	69	26.14
Non-government sectors	37	14.02
Government	27	10.23
Unemployed	22	8.33
Eco-tourism	10	3.79

3.2 Uses of the Selected Philippine Indigenous Fruit Tree Species

Overall, the results of the present study proved the relevance of Eleazar's call in 2012 to advance the promotion of IFTS to the national level because while the selected IFTS are nationally underutilized, they have locally acclaimed uses and importance. Findings revealed a strong agreement among the informants regarding the dietary use of all selected IFTS except *F. nota*, whose utilization is primarily practical. This survey's most widely used plant parts were fruits (UR = 929) and leaves (UR = 118). The most prevalent purpose for flavoring was as a souring agent or acidulant. The most consistently reported use of the selected IFTS was the consumption of fresh fruits, particularly for *F. rukam* (ICF = 0.97), *D. philippinensis* (ICF = 0.95), *S. polycephaloides* (ICF = 0.94), and *T. microcarpa* (ICF = 0.94). Except for *S. polycephaloides* and *T. microcarpa*, which were found to have only dietary uses, all species have multiple uses.

Across the five provinces of CALABARZON, *D. philippinensis* had the highest UR (246) and UV (0.93) while *F. nota* obtained the highest RFC (79%). Informants from Batangas, Quezon, and Rizal consistently reached very strong agreement on the dietary use of *F. rukam*, with Batangas exhibiting the highest citation and consensus for its consumption as fresh fruits and moderate consensus on its medicinal use for gastrointestinal issues. *T. microcarpa* was also widely known in Batangas, Quezon, and Rizal, typically consumed fresh or preserved, and used as flavoring. The province of Quezon stood out for its unique recognition of *F. nota* leaves as a vegetable, with a very strong consensus—this use was not commonly found in other provinces. Despite having fewer overall citations, *S. pinnata* was uniformly cited across all provinces for its use as a flavoring agent. This suggests a shared culinary application of the species, even among communities with differing usage patterns.

Varying levels of consensus were found for several medicinal uses of *D. philippinensis*, *F. rukam*, *F. nota*, and *A. ghaesembilla,* while practical uses were more localized. Decoction of parts of interest was the most common mode of preparation for those used for medicinal purposes. In Cavite, while medicinal and practical citations were generally low, there was a notably strong agreement on using *F. nota* as fodder, making it a unique local use not commonly found in other regional provinces. Rizal informants, by contrast, cited a wider range of practical and medicinal uses, including *F. nota* for headache relief and *A. ghaesembilla* for hypertension and renal issues,

showing strong agreement. The documented variations suggest localized knowledge systems that reflect environmental, tradition, and plant availability differences. Such findings highlight the importance of considering regional dynamics in documenting and promoting the use of IFTS.

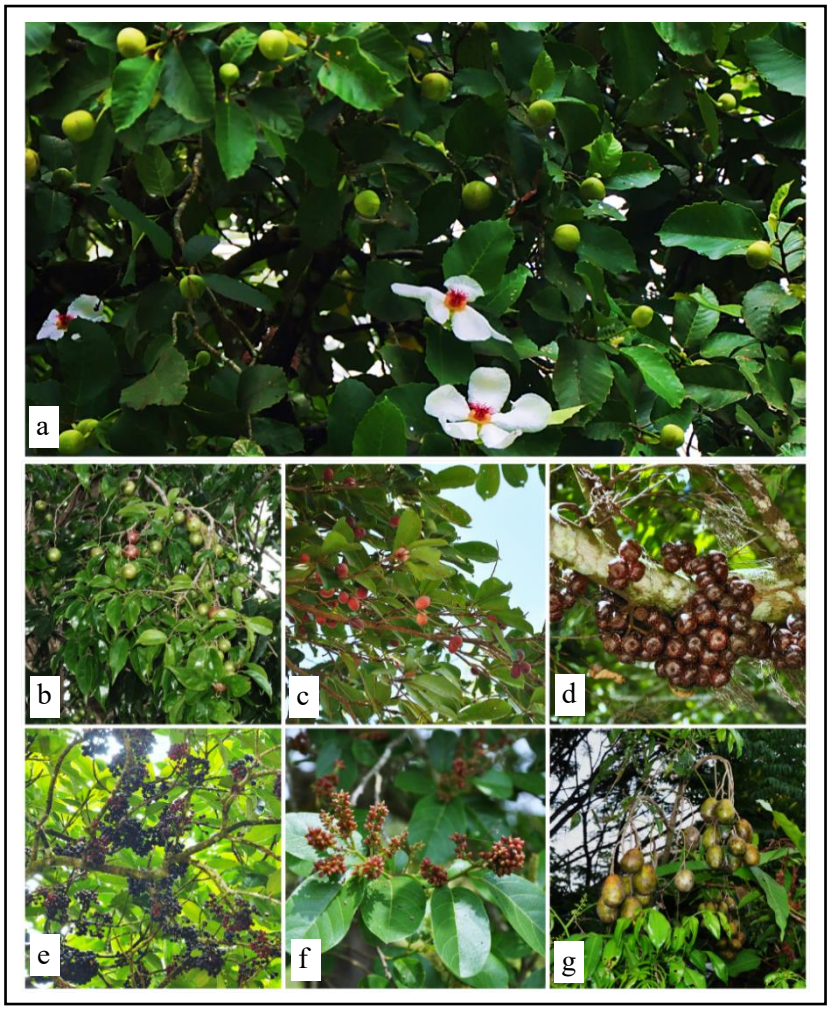

Figure 3. Photos of selected indigenous fruit tree species: *Dillenia philippinensis* Rolfe (a), *Flacourtia rukam* Zoll & Moritzi (b), *Terminalia microcarpa* Decne. (c), *Ficus nota* (Blanco) Merr. (d), *Syzygium polycephaloides* (C.B. Rob.) Merr. (e), *Antidesma ghaesembilla* Gaertn. (f), and *Spondias pinnata* (L.f.) Kurz (g).

Figure 3 presents the photos of the IFTS selected in this study. Tables 3 to 4 summarize the reported and acclaimed uses of the selected IFTS in Region IV-A, Philippines. Acclaimed uses refer to use categories in which the informants achieved a certain level of agreement, specifically those with ICF values exceeding zero (0). The succeeding sections further elaborate the specific uses of every IFTS across all categories.

Table 3. Summary ranking of the Use Values (UV) and Relative Frequencies of Citation (RFC) of the selected IFTS in Region IV-A, Philippines

Species	Common Name/s cited by informants	UV	UV Rank	RFC	RFC Rank
Dillenia philippinensis Rolfe	Katmon Gilay-gilay (Cavite)	0.93	1	61%	3
Flacourtia rukam Zoll & Moritzi	Bitongol Siruwel (Batangas) Mansanitas (Batangas, Cavite, Laguna) Cherry (Batangas, Laguna, Quezon) Seryales (Batangas) Soriales (Laguna) Usisa (Laguna, Quezon)	0.87	2	75%	2
Terminalia microcarpa Decne	Kalumpit Alagat (Ilocos)	0.58	3	53%	4
Ficus nota (Blanco) Merr.	Tibig Tiang (Batangas)	0.55	4	79%	1
Syzygium polycephaloides (C.B. Rob.) Merr.	Lipote	0.53	5	47%	5
Spondias pinnata (L.f.) Kurz	Libas	0.34	6	28%	7
Antidesma ghaesembilla Gaertn.	Binayuyu Kabugbog (Batangas and Quezon) Tubo-tubo (Laguna)	0.33	7	38%	6

Table 4. Reported uses of selected Philippine indigenous fruit tree species by locals of Region IV-A, Philippines

Species	Family	RFC	UV	Parts Used	Use Category*	UR	ICF
Dillenia philippinensis Rolfe	Dilleniaceae	61%	0.93	Fruit	Dietary	206	0.97
					Fresh Fruit	133	0.95
					Flavoring	66	0.92
					Medicinal	35	0.82
					Dermatological	9	0.75
					Practical	5	-
					Shampoo	4	1.00
				Fruit + Roots + Bark	Medicinal Respiratory	19	0.67
Flacourtia rukam Zoll & Moritzi	Flacourtiaceae	75%	0.87	Fruit	Dietary	208	0.97
					Fresh Fruit	188	0.97
					Preserved	10	0.33
					Flavoring	8	0.29
				Fruit + Leaves	Medicinal Gastrointestinal	18 9	0.65 0.38
				Stem	Practical	4	-
					Charcoal	3	0.50
Terminalia microcarpa Decne	Combretaceae	53%	0.58	Fruit	Dietary	139	0.96
					Fresh Fruit	95	0.94
					Preserved	39	0.84
				Stem	Practical	7	0.17
					Wood	6	0.4
Ficus nota (Blanco) Merr.	Moraceae	79%	0.55	Fruit	Dietary	22	0.82
					Fresh Fruit	21	0.70
					Practical	78	0.94
					Fertilizer	15	0.93
					Handicraft	40	0.97
				Leaves	Medicinal	27	0.77
					Neurological	6	0.8
				Leaves + Fruit	Dietary Vegetable	12	1.00
					Practical Fodder	22	1.00
					Medicinal Renal	7	0.33
				Whole Tree	Practical	6	1.00
					Soil and Water Conservation	6	1.00
Syzygium polycephaloides (C.B. Rob.) Merr.	Myrtaceae	47%	0.53	Fruit	Dietary	128	0.95
					Fresh Fruit	100	0.94
					Flavoring	19	0.72
Spondias pinnata (L.f.) Kurz	Anacardiaceae	28%	0.34	Fruit	Dietary	84	0.93
					Fresh Fruit	17	0.63
					Flavoring	10	0.44
				Leaves	Dietary Flavoring	55	0.91
Antidesma ghaesembilla Gaertn.	Phyllantaceae	38%	0.33	Fruit	Dietary	60	0.90
					Fresh Fruit	56	0.89
				Leaves + Bark	Medicinal Renal	25 13	0.75 0.67

*RFC = Relative Frequency of Citation region-wide, UR = Use Reports, UV = Use Value *Only UR with ICF>0 were listed.*

Compared to other ethnobotanical studies across the Philippines, the present findings from Region IV-A align with and diverge from previous reports. For instance, the dietary and medicinal uses of *D. philippinensis* observed in Quezon and Rizal provinces are consistent with those documented in Aurora and Zamboanga (Barcelo and Barcelo, 2020). On the other hand, the limited recognition of *S. pinnata* in Region IV-A contrasts with its reported culinary and medicinal applications in Bicol (Mondal *et al.*, 2021). Likewise, *F. nota*, although often perceived as undervalued, was reported by Southern Tagalog dairy farmers as a fodder source and recognized by the Manobo Tribe of Agusan del Sur as a traditional medicine (Arquion *et al.*, 2015; Asaad *et al.*, 2006). These earlier accounts are consistent with the present study's high number of use reports for its practical applications—including as fodder—and the strong informant consensus around its medicinal uses in Region IV-A. The succeeding subsections provide more detailed species-specific discussions.

Overall, the results underscore regional variations in IFTS utilization. This analysis highlights the diverse trajectories of IFTS knowledge and usage in different parts of the country and reinforces the value of localized ethnobotanical surveys in informing broader conservation and utilization strategies.

3.2.1 Katmon (*Dillenia philippinensis* Rolfe)

Among the selected IFTS, *D. philippinensis* had the highest UV (0.93) and UR (246) in the entire region. Consumption of *D. philippinensis* as fresh fruits was its most acclaimed use (UR = 133, ICF = 0.95), while a strong consensus (UR = 66, ICF = 0.92) was also noted for the use of its fruits as flavoring. The use of *D. philippinensis* as flavoring, particularly as acidulant for local dishes like *sinigang* (a well-known sour soup dish in the Philippines), was highest in Rizal. The same dietary uses of *D. philippinensis* were also documented by previous researchers, such as Coronel (2011), Lim (2012), and Barcelo and Barcelo (2020), among others. Several attempts to develop such dietary uses were made by Artes *et al.* (2016), Wagan *et al.* (2017), and Tappy *et al.* (2019), who explored the potentials of processing *D. philippinensis* fruits into juice, jelly, and instant *sinigang* powder, all of which were highly acceptable based on the sensory evaluation conducted by the authors.

The results of this study were consistent with a previously documented traditional medicinal use of *D. philippinensis* for treating cough. Reports pertaining to the use of fresh fruits or the decoction of their roots or bark to

treat respiratory health concerns, such as cough, colds, and asthma. These medicinal uses were moderately agreed upon region-wide (ICF = 0.67). Lim (2012) and Barcelo and Barcelo (2020) also documented the use of the IFTS for treating cough, but with a specific cough syrup made by mixing *D. philippinensis* fruit juice and sugar. In Zamboanga and Aurora, the IFTS is used for gastrointestinal and renal illnesses, such as diarrhea and UTI (Barcelo and Barcelo, 2020). However, there were little to no reports for such uses in Region IV-A. This study documented the use of a poultice made from mashed fresh or charred *D. philippinensis* fruits as a topical relief for skin diseases and hair loss. Informants from the province of Rizal mostly cited and strongly agreed upon this use. While there were earlier reports regarding the use of *D. philippinensis* for hair loss and dandruff treatment, this particular mode of application is unique. It has never been documented in other studies. Interestingly, Yu *et al*. (2020) analysis showed that *D. philippinensis* fruits are rich in antioxidants and, thus, useful as traditional poultices for skin health and wound healing. Furthermore, several phytochemical studies showed that the leaf and fruit extracts of *D. philippinensis* are rich in bioactive compounds (Barcelo *et al.*, 2017; Macahig *et al.*, 2011; Yu *et al.*, 2020). Bioactive compounds exhibit potential for pharmaceutical applications and offer nutritional benefits.

Lastly, *D. philippinensis* fruits also have a renowned practical use as hair shampoo (UR = 4, ICF = 1.00). This was reported in Laguna and Rizal and by other studies (Lim, 2012; Macahig *et al.*, 2011; Barcelo and Barcelo, 2020).

The UV extent of the species is the highest in the region despite its relatively lower RFC, revealing that the gap between species awareness and species utilization is less in the case of *D. philippinensis*. The study suggests widespread familiarity, multipurpose use, and cultural integration of *D. philippinensis* across CALABARZON. Unlike other IFTS with more localized or underutilized applications, *D. philippinensis* exhibits both broad recognition and consistent use, reducing the gap between species awareness and utilization. Given its already well-established role in local food systems, future research could focus on optimizing value-adding opportunities such as processing, storage, and sustainable use. In addition, deeper pharmacological studies and clinical validations of its traditional medicinal uses could strengthen its potential for functional food and pharmaceutical development.

3.2.2 Bitongol (*Flacourtia rukam* Zoll & Moritzi)

Other common names of *F. rukam* or Bitongol cited in the region include *cherry*, *mansanitas*, and *seryales*. Informants from Batangas also know it by the name *siruwel*, while those from Quezon also know the IFTS as *usisa*. *F. rukam* is recognizable by its fruits, which are usually rolled between the palms before consumption to remove its acrid taste, and by its boles, which bear long and thick thorns. *F. rukam* obtained the second highest UV (0.87) and RFC (75%) region-wide, with most citations from Batangas.

The dietary use (UR = 208, ICF = 0.97) of *F. rukam* is its most acclaimed use category, with the following subcategories: consumption of fresh fruits (UR = 188, ICF = 0.97); preserved fruits in sweetened and fermented forms (UR = 10, ICF = 0.33); and flavoring (UR = 8, ICF = 0.29). A study revealed the same dietary uses, including sweetened *F. rukam* fruits for pies (Ragasa *et al.*, 2016). However, the fermentation of *F. rukam* fruits was a unique manner of utilization that has not been mentioned in the literature.

Informants reported several medicinal uses for *F. rukam*. However, they only reached a consensus, albeit weak (UR = 9, ICF = 0.38), on using the decoction of its leaves and fruit for gastrointestinal concerns such as diarrhea and gas pains. This medicinal use was also documented by Ragasa *et al.* (2016), along with its roots being used in a decoction taken by women after childbirth and applying the juice from its leaves to treat inflamed eyelids. Informants from Region IV-A did not report the latter medicinal uses. Although there is a dearth of studies in the Philippines, Ragasa *et al.* (2016) isolated chemical compounds from *F. rukam* and found that it exhibited several bioactive properties, confirming its traditional medicinal uses. It is also worth noting that other *Flacourtia* species were also found to contain bioactive compounds (Nendissa, 2023; Sasi *et al.*, 2018; Saxena and Patel, 2010). The other *Flacourtia* species studied were *F. indica* of India and Sri Lanka, *F. jangomas*, and *F. inermis*, which was introduced in the Philippines in the 1980s (Magdalita *et al.*, 2015). These species are commercially referred to as *Indian plum*, *governor's plum*, *lovi-lovi*, or *tome-tome*.

F. rukam stems are also made into charcoal (UR = 3, ICF = 0.5) because the thorns on their boles pose a hazard to people, prompting the need for removal.

3.2.3 Kalumpit (*Terminalia microcarpa* Decne.)

T. microcarpa ranked third among the seven selected IFTS in UV (0.58). It is most known in Quezon, and its use is mostly dietary. The consumption of fresh (UR = 95, ICF = 0.94) and preserved (UR = 39, ICF = 0.84) *T. microcarpa* fruits was the most common use category. Preserved *T. microcarpa* fruits range from being sweetened or jammed, candied, and fermented, with the former being the most prevalent. There were reports on using fruits as flavoring for lambanog (palm wine), but UR in this category was too few to reach a region-wide consensus.

Results showed that among the utilization options that Sanchez *et al*. (1976) developed, *T. microcarpa* fruit jam is the only widely adopted use in Region IV-A. The investigation failed to capture the utilization of *T. macrocarpa fruits as wine* or dehydrated treats in the surveyed region. However, it is essential to note that this finding is not definitive, as locals might have acquired knowledge of preserving *T. microcarpa* fruits as jam through traditional knowledge instead of directly adopting the published procedures in Sanchez *et al.* (1976).

While there were reports of medicinal uses for *T. microcarpa*, these citations were highly varied and inconsistent, resulting in an ICF of zero. This indicates that there was no agreement among informants regarding a specific medicinal application of the species. Such outcomes may reflect either a decline in traditional medicinal knowledge for this species or a lack of widespread medicinal use in the study area. Despite this, *T. microcarpa* remains relevant as a nutrient-dense food option. As reported by Santiago *et al.* (2020), the species is rich in essential nutrients and possesses notable antioxidant activity, supporting its value in promoting dietary diversity and nutritional health.

During the peak of the logging industry in the Philippines, *T. microcarpa* was known as a valuable construction and furniture wood species. Results showed that the species remains a well-known timber source with several UR although there is weak agreement on this region-wide (UR = 6, ICF = 0.40).

3.2.4 Tibig (*Ficus nota* (Blanco) Merr.)

The case of *F. nota* presents an interesting contrast between species familiarity and actual use. Although it was the most identified IFTS by informants in the region (RFC = 79%), its UV (0.55) was relatively low. The species is known

by the surveyed locals and in literature alike as one of "little value" (Reyes, 2015). This suggests that while most locals can recognize and name the species, its dietary and practical uses are limited. The low popularity of *F. nota* as a food source appears to be shaped by negative perceptions of its edibility—often cited were the fruit's unappealing appearance, presence of insects, and perceived toxicity. These cultural perceptions, along with limited culinary applications, have likely constrained its broader use.

Dietary uses for *F. nota* were very few, with lesser UR and ICF than other categories and other IFTS in this study (UR = 34, ICF = 0.82). The consumption of fresh *F. nota* fruits (UR = 21, ICF = 0.70) and the cooking of its shoots as vegetables simmered in coconut milk or *ginataan* (UR = 12, ICF = 1.00) were reported but were mostly confined to Quezon and Batangas. Reyes (2015) also mentioned the cooking of *F. nota* shoots as vegetables and the consumption of fresh fruits with sugar. The lack of dietary uses for *F. nota* was often attributed to the poisonous appearance of the fruits, the presence of insects, and its unpalatability for many. Ong and Kim (2017) also noted that *F. nota* fruits were known by the Ati people of Guimaras Island as "edible but intoxicating."

Due to such perceptions, the most cited uses of *F. nota* were confined to practical uses. The most acclaimed practical use was under the handicraft subcategory, specifically when fashioned into kids' toys (UR = 40, ICF = 0.97). The use of *F. nota* fruits as toys was also mentioned by Reyes (2015). In Rizal, the *F. nota* fruits were often used for fertilizer (UR = 15, ICF = 0.93). On the other hand, the use of the same for fodder (UR = 22, ICF = 1.00) was highest in Cavite. Asaad *et al.* (2006) had endorsed the utilization of *F. nota* as ruminant feed, highlighting the tanniferous properties of *F. nota* leaves that render it a cost-effective yet functional component in fodder. There was a strong consensus (UR = 6, ICF = 1.00) on the regulating ecosystem service of the species, specifically for soil and water conservation.

F. nota has various medicinal reports, making it rank as the second highest UR (27) and ICF (0.77) among all species in terms of medicinal use. Despite the number of reports, only the use of *F. nota* leaves as a topical relief for headache (UR = 6, ICF = 0.80), and the consumption of the decoction of its fruits or leaves to treat renal illnesses, particularly UTI (UR = 7, ICF = 0.33), reached a considerable consensus among informants in Region IV-A. The medicinal value of *F. nota* is not confined to Region IV-A, as it is also used by the Manobos of Agusan del Sur as an alternative medicine (Arquion *et al.*,

2015). Studies further revealed that *F. nota* is rich in bioactive compounds and exhibits antibacterial and antimicrobial activity against various pathogens (Mapatac, 2015; Latayada *et al.*, 2017; Arquion *et al.*, 2015).

Given its recognized medicinal properties and bioactive compounds with antimicrobial potential, future research could focus on validating and optimizing the pharmacological applications of *F. nota*. In addition, local innovations to improve the palatability and acceptability of its fruits—such as processing techniques or incorporation into functional foods—may help unlock its underutilized potential in food systems.

3.2.5 Lipote (*Syzygium polycephaloides* (C.B. Rob.) Merr.)

S. polycephaloides ranked fifth (5th) in both RFC (47%) and UV (0.53) among the seven selected IFTS. During its season, *S. polycephaloides* fruits were observed to be actively sold in the market of Lipa City in the province of Batangas (Figure 4).

Most UR (57) and highest provincial RFC of *S. polycephaloides* was documented in the province of Quezon. This may be attributed to a combination of cultural familiarity, environmental availability, and emerging local enterprise. The species is more commonly encountered in Quezon's upland and rural areas, where traditional consumption practices—such as dipping or shaking the fruits in sugar or salt—are still widely observed. Moreover, the province is home to localized initiatives promoting the value of native fruits, as seen in Guinayangan's growing interest in Lipote wine production (Figure 4).

Similar to most of the selected IFTS, the most common use for *S. polycephaloides* was the consumption of its fresh fruits. The fruits are said to acquire a more savory flavor when sugar, salt, or a combination of both is added by either shaking or simply dipping. The fruits of *S. polycephaloides* are also renowned for enhancing the flavor and color of *lambanog* (palm wine), hence the inclusion of flavoring as one of its use categories. The uses reported by Florido and Cortiguerra (2003), namely the processing of *S. polycephaloides* fruits into jam, jellies, and wine, were rarely investigated in Region IV-A. However, it is worth noting that there is an emerging appreciation for locally produced Lipote wine in Guinayangan, Quezon, albeit reaching no consensus regionally (Figure 4). Nonetheless, results reflect Quezon's openness to reviving and commercializing underutilized indigenous

fruits. This strong cultural association with *S. polycephaloides* in Quezon may explain the higher frequency of citation and broader use and knowledge compared to other provinces.

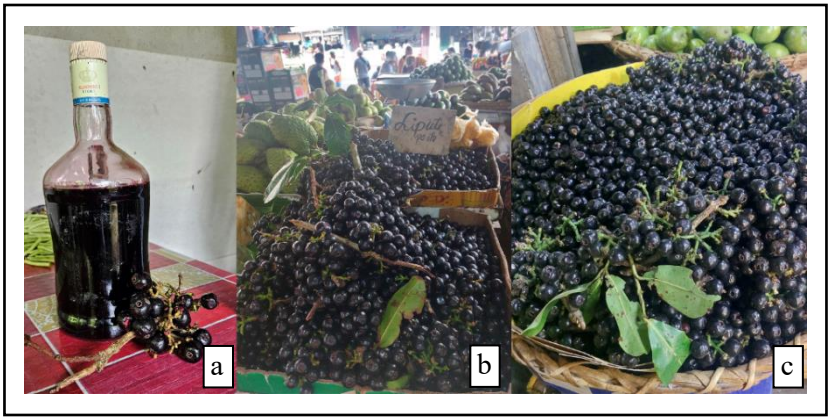

Figure 4. *S. polycephaloides* as wine and as a produce sold at a local market: Lipote wine produced and sold in Guinayangan, Quezon (a), Lipote fruits as a produce at Lipa City Public Market, Batangas

Although rich in vitamins, minerals, and antioxidants, very few reports with no consensus were observed for medicinal uses of *S. polycephaloides* in Region IV-A (Santiago *et al.*, 2007; Jose and De Guzman, 2017; Vallesteros *et al.* 2023). The same is true for the practical uses of the species.

3.2.6 Libas (*Spondias pinnata* (L.f.) Kurz)

The UV of *S. pinnata* or *hog-plum* (0.34) was second to the lowest region-wide, as there was no consensus on any other use categories except for consumption as a fresh fruit and flavoring. The most acclaimed dietary use of *S. pinnata* was flavoring with its leaves, followed by its being consumed as a fresh fruit. This case is unique in this study in the sense that the most acclaimed dietary use for other selected IFTS was the consumption of fruits instead of leaves. Similar to *D. philippinensis* fruits, the flavoring use reports for *S. pinnata* leaves were as an acidulant for local dishes such as *sinigang* and *paksiw* (a dish made by simmering fish or meat in an acidulant, usually vinegar), among other dishes. Florido and Cortiguerra (2003) also reported the use of *S. pinnata* leaves as flavoring, but with the inclusion of their use for local dishes in Bicol, in particular, *laing* and *sinanglay*. Conversely, these uses were not obtained in the present ethnobotanical study conducted in Region IV-

A. It is notable, however, that it is also in the Bicol Region, specifically in the province of Catanduanes, where a study on the optimization of *S. pinnata* leaf powder as a seasoning mix was conducted (Tapado, 2023).

S. pinnata also had the region's lowest RFC (28%), with the most citations from the province of Rizal (UR = 38, provincial RFC = 53%). Informants in Rizal commonly cited *S. pinnata* leaves as a flavoring agent in traditional sour dishes, suggesting a localized retention of culinary knowledge that may not be as prevalent in other provinces. Additionally, the province's proximity to rural uplands and peri-urban areas may facilitate greater exposure to diverse food traditions, including those brought by migrants from other regions where *S. pinnata* is more widely used. This is supported by several citations that referenced experiences and practices from home provinces outside CALABARZON, such as Samar, Capiz, Mindoro, Marinduque, and Pangasinan.

Local studies on *S. pinnata* are scarce, but foreign research is extensive, particularly in India and Sri Lanka, among others. The extent of phytochemical and pharmacological studies supporting the medicinal values of *S. pinnata*, albeit mostly foreign, and the medicinal use reports for the species in this study do not match (Mondal *et al.*, 2021). The medicinal use reports obtained in this study were very limited and were mostly about the use of the decoction of *S. pinnata* fruits for coughs and colds. There were too few reports on this subcategory to reach any regional consensus. Conversely, traditional knowledge in other countries includes the use of *S. pinnata* for treating other diseases apart from cough and colds. In India, it is traditionally used for gastrointestinal issues like diarrhea, dysentery, stomach troubles and hyperacidity, and dermatological concerns like wounds and ringworms, to name a few examples (Mondal *et al.*, 2021).

The lack of traditional knowledge regarding *S. pinnata* utilization in Region IV-A may be attributed to the potentially very sparse population of the species in the region. During the resource assessment surveys conducted by the authors in all study sites, not a single *S. pinnata* individual was documented. There was only a single *S. pinnata* regenerating stump, however, in the backyard of one of the informants from Cavite. The informant said that there were several individuals (< 3) in their backyard before, which they felled due to a lack of awareness regarding the uses and value of the IFTS. To better understand these spatial variations, future studies can verify the actual distribution and abundance of *S. pinnata* across CALABARZON and examine

whether its limited use in some provinces is linked to ecological scarcity, cultural factors, or both. This could provide valuable insight into species availability as a driver of ethnobotanical knowledge and usage.

3.2.7 Binayuyu (*Antidesma ghaesembilla* Gaertn.)

A. ghaesembilla is also known as *kabugbog* in the provinces of Batangas and Quezon, and as *tubo-tubo* in Laguna. The species had the lowest UV (0.87) region-wide. The most common use of *A. ghaesembilla* is the consumption of its fresh fruits (UR = 56, ICF = 0.89). The region's low popularity and limited reported use of *A. ghaesembilla* may be attributed to cultural unfamiliarity and underdocumentation of its traditional applications. While locally recognized under various names, its use appears to be less integrated into everyday practices compared to other IFTS. One possible explanation is the greater familiarity and preference for another species in the same genus, *A. bunius* (commonly known as *bignay*), which is more widely consumed, cultivated, and promoted for its culinary and medicinal uses. This overshadowing effect may contribute to the reduced recognition and utilization of *A. ghaesembilla* at the community level.

There were several medicinal reports for the species, but the only agreed-upon medicinal use was the consumption of the decoction of its leaves and bark to treat renal concerns, specifically UTI (UR = 13, ICF = 0.67). There were a few reports on the use of the decoction from *A. ghaesembilla* bark for the management of hypertension (UR = 3) and the decoction of its leaves for stomach pain (UR = 3), but both failed to reach any consensus among informants region-wide. The lack of consensus on most medicinal applications suggests that existing knowledge may be fragmented or fading. Tiranakwit *et al.* (2023) revealed that *A. ghaesembilla* root is also used in traditional Thai medicine for postpartum care. This medicinal use was not documented in this study but was supported by the phytochemical screening conducted by the same authors, where it was found that *A. ghaesembilla* root and stems contain considerable amounts of bioactive compounds (Tiranakwit *et al.*, 2023).

The medicinal uses reported from the present survey merit further scientific and clinical validation, especially because *A. ghaesembilla* had the least available published literature among the selected IFTS. Overall, these findings emphasize the need for further ethnobotanical studies to clarify the species' traditional roles and unlock its underexplored potential.

4. Conclusion and Recommendation

The present ethnobotanical survey revealed varying levels of local-knowledge and utilization of the selected IFTS across Region IV-A. While some species, such as *D. philippinensis* and *F. rukam*, showed high UV (0.93 and 0.87, respectively) and were well recognized in certain provinces, others, like *S. pinnata* and *A. ghaesembilla*, were found to be poorly known and underutilized. These findings highlight the uneven distribution of ethnobotanical knowledge and the need for context-specific awareness strategies to promote conservation and sustainable use of IFTS in the region.

The study demonstrated that despite national underutilization, several IFTS have significant local importance and are deeply integrated into the dietary, medicinal, and daily practices of some communities. This underscores the potential of IFTS to contribute to sustainable development, food security, and cultural preservation at the local level. Local initiatives that promote the use and value-adding of underutilized IFTS, such as the emerging *S. polycephaloides* wine production in Guinayangan, Quezon, highlight the potential of community-based enterprises in revitalizing traditional knowledge and stimulating rural economies. Similar models could be explored and supported in other provinces to encourage the sustainable utilization and sustainable use of IFTS. Strengthening such efforts through research, capacity building, and market linkage development may help elevate lesser-known species while contributing to biodiversity conservation and local livelihood enhancement.

Extending the ethnobotanical investigation to forest-dependent communities in other regions of the country is strongly recommended to provide a more comprehensive and comparative understanding of the traditional and current uses of IFTS in the Philippines. Such efforts would allow for developing a national baseline and highlight regional variations in knowledge, use, and conservation priorities. This comparative perspective is critical in informing broader yet localized strategies for sustainable utilization and promoting IFTS across the Philippines.

Future ethnobotanical research would also benefit from thoroughly documenting informants' ethnolinguistic identities and cultural affiliations, particularly in regions like CALABARZON, where diverse indigenous and ethnolinguistic groups coexist. This would help capture culturally specific

plant uses, local names, and food traditions that may be overlooked, and further enrich the understanding of indigenous food systems in the Philippines.

Further studies on the dietary and medicinal properties of the IFTS, as well as their spatial distribution and ecological abundance, are needed to validate traditional uses, optimize current means of utilization, and assess whether variations in local knowledge and utilization are shaped by species availability, cultural familiarity, or both. Equally important is developing a context-specific strategy for wider promotion, conservation, and sustainable use of IFTS in the Philippines. Such efforts are essential to fully realize the potential of these natural resources in contributing to food security, cultural preservation, and nation-building.

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