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Floristic Inventory and Ethnobotany of Wild Edible Plants in Cebu Island, Philippines

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ABSTRACT

The study discussed the diversity, utilization, socio-economic value and threats associated to the wild edible plants (WEPs) in Cebu Island, Philippines. Semi-structured interview, field observations and pairwise ranking were utilized to generate responses from purposively-selected informants living in three mountain communities in Cebu: Mt. Kapayas, Catmon, Nug-as Forest Reserve, Alcoy and Cantabaco Forest, Toledo. The study recorded a total of 168 edible plant species belonging to 111 genera and 97 families. Majority of plant habits of the recorded plants were trees (42.94%), herbs (30%) and shrubs (14.71%). The recorded use of WEPs include food, medicine, construction/technology, beverage, forage, food coloring and condiments where 30% of the informants suggest the marketability of the WEPs and 14.7% of the WEPs were reported as alternative food source. Test for use diversity showed significant difference in the uses of WEPs in the three sites ($X^2 = 2.46$, $\alpha = 0.05$). Pairwise-ranking results indicated that selective cutting for construction and technology, natural disaster and agricultural expansion are key threats to WEPs in these areas. The study suggests 1) public awareness and community-based management at all levels to lessen threats, 2) further investigation on nutritive and socio-economic values; and 3) investigation of pharmacological profiles to evaluate medicinal benefits.

Keywords: wild edible plants, ethnobotany, alternative food source

INTRODUCTION

Wild edible plants (WEPs) are any plant in which some parts are eaten by either human or animals and are thriving without any human intervention. Besides human consumption (Teklehaymanot & Giday, 2010), the next important contribution of WEPs to local communities are their underlying traditional knowledge systems (Kuhnlein et al., 2006), as source of additional income (Shumsky, 2011), as source of nutraceuticals and medicine (Rasingam,

2012) and even processed food production and enterprise (Chua-Barcelo, 2014). Studies conducted in several countries showed reports of their own WEPs (Tardio et al., 2005; Cruz et al., 2013; Zhang et al., 2016; Erskine et al., 2015). In the Philippines, one of the most comprehensive monograph on food and fruit-bearing fruit species found in the country described their detailed phenotypic characters, ecology, distribution, nutritional value and main uses (FAO, 1984). Recent literatures in the last 15 years listed WEPs at a more localized level, such as indigenous food plants in Ilocos Norte (Antonio et al., 2011) and Agusan del Sur (Arquion et al., 2015); indigenous crops and wild plants in Southern Palawan (Bernadas & Peralta, 2017) as well as edible wild fruits in Benguet (Chua-Barcelo, 2014).

In the province of Cebu, local communities, parataxonomists as well as foresters from the Department of Environment and Natural Resources (DENR) have reported encounters, collection and consumption of WEPs in the province, and some attempted to propagate them for domestic consumption (Colis & Abrenaga, 2017). However, the history of recorded wild edible plants in Cebu is still deficient, particularly form the most recent literature. To date, there are few studies in the Philippines that mentioned the presence of WEPs in Cebu (Merill, 1903; Brown, 1920; Merill, 1923-1926; FAO, 1984; Madulid & Agoo, 1992; Madulid, 2001; Lim, 2015). For example, in WH Brown's 1920 book, he recorded 19 species of wild food plants grown in Cebu which formed a baseline literature of the wild species in the province.

Cebu is the 9th largest island in the country. It has a forest cover composed of mostly mountainous, rugged with depressed peaks creating mountain ranges (Paguntalan et al., 2015). Unfortunately, the continuing forest destruction in the province narrowed the remaining forest to less than 1% of its total land area (Mallari et al., 2001; DENR-FMB, 2010) along with deforestation, quarrying, mining, environmental pollution, land conversion and mismanaged solid wastes (Paguntalan et al., 2015). If these forests are facing threats, then wild edible plants from these forests face the same set of environmental challenges. Previous research has shown that wild edible plants located within protected areas (PAs) in Cebu's landscape are somewhat protected from overconsumption and overharvesting (Abaquita, 2015) because of its inaccessible location and difficulty of terrain (Lucresio Son, personal communication, 2017). The major challenge now is that the WEPs found outside Cebu's identified key biodiversity areas (KBAs) are at risk of losing. Pursuing this floristic study will significantly contribute to the existing literature on WEPs, and may provide awareness on what WEPs we can

utilize as alternative food source particularly in the far-flung communities. This study may identify which WEPs served as alternative food source in times of food crisis, so it opens an area of research for relieving hunger in rural and possibly urban communities.

OBJECTIVES OF THE STUDY

The study aimed to determine the diversity, uses, threats, role in food security and socio-economic value of wild edible plants in the island of Cebu, Philippines.

METHODOLOGY

Study Area

Cebu Province (10°31' N, 123°88' E) ranks 9th as the largest island in the country and is positioned at the centre of Philippine Islands (Paguntalan & Jakosalem, 2008). It covers an area of 4,944 km2 which is composed of 44 municipalities and 6 component cities. The province receives the Type IV climate which distributional rainfall is uniform in the whole province with 263.10 m of average rainfall (Fernando et al., 2009). Selected localities (Fig. 1) were purposively selected based on reported species richness of wild edible plants (Colis, 2017), and are briefly described as follows:

Mt. Kapayas, Catmon, Cebu (10° 38' 54.1574" N 123° 58' 12.5606" E). Mt. Kapayas is situated in the municipalities of Catmon and Carmen with a forest cover of over 60 hectares in 2002. The mountain houses indigenous trees namely: *Sindora supa*, *Ficus* sp, *Artocarpus sericarpus* and *Heritiera sylvatica*. In 2014, the remaining forest was reclassified into a secondary growth forest. Cantabaco Forest, Toledo City, Cebu (10.3116° N, 123.7350° E). Cantabaco Forest, a mixed primary and secondary growth forest, is situated in Barangay Cantabaco, Toledo City, Cebu. It has a total land cover of 3,670 km2 comprising 14 sitios. The area is rich in limestone rock formation, forming a unique assemblage of karst vegetation. Nug-as Forest Reserve, Alcoy, Cebu (9° 42' 46.3108" N 123° 27' 6.5671" E). Nug-as Forest Reserve is situated centrally in Boljo-on and Alcoy encompassing five barangays. It has a total cover of 12 km2 of secondary growth forest and the largest surviving forest in Cebu. The limestone forest is mostly dominated by *Ficus* spp and *Syzygium* spp., agriculture, tree plantations, and scrubland surround the area (Paguntalan et al., 2015).

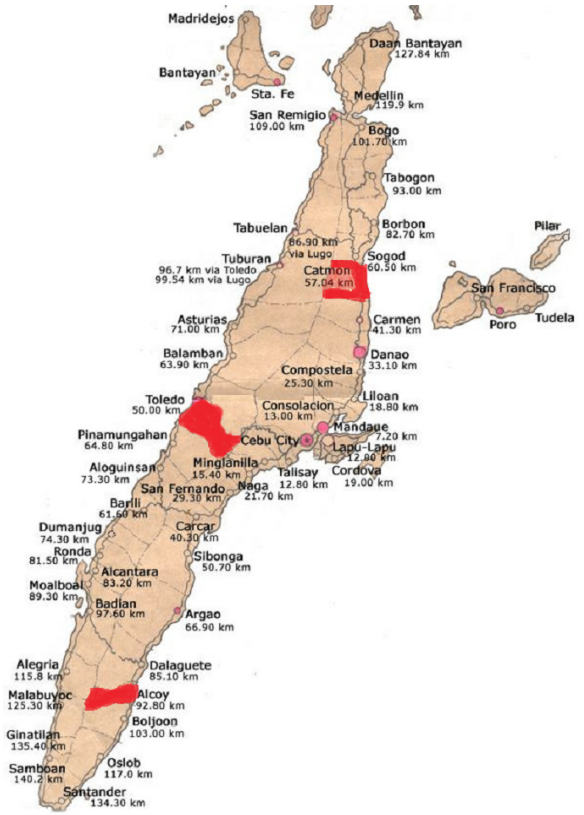


Fig. 1 Map of Cebu province showing the three study sites (red shaded regions): Mt. Kapayas, municipality of Catmon (top), Barangay Cantabaco, Toledo City (center), and Nug-as forest, municipality of Alcoy (bottom). Retrieved from https://pasarelapr.com/detail/map-of-cebu-province-17.html

Key Informants

Snowball technique was used in choosing the key informants (KI) which include primarily the elderly people considered as permanent residents of the locality for more than 20 years. From these initial list of elderly informants, they mentioned people who are knowledgeable of WEP as well as local traditional herbalist or healers (locally called bisayang mananambal) which are also included in the list of potential KIs.

Data Gathering Procedure

Preliminary information on the availability of WEPs in the selected localities was gathered through informal interviews from local foresters and parataxonomists in the province, and who happened to visit these areas in the last 10 years. This study utilized a rapid rural appraisal (RRA) approach using a semi-structured questionnaire to gather data from the key informants. Key informants were selected to have an adequate knowledge on wild edible plants on their area. The study was conducted in the last quarter of 2017, and the first quarter of 2018. Questions asked focused on the WEP's local name, edible parts and its uses, WEPs consumed as alternative foods and can be sold, threats and their corresponding conservation status. After the interview and upon agreement with the informant, the mentioned plants' edible parts were collected and photographed (DENR, Wildlife Gratuitous Permit No. 2017-16). Voucher specimens were identified and were deposited at the Cebu Normal University Herbarium (CNU-H). Identification of the plants' nomenclature referred to the Dictionary of Philippine Plant Names (Madulid 2001), listing of edible fruits in the Philippines (Coronel, 2011) as well as online plant databases (Pelser et al., 2011).

Data Analysis

Specific data analysis tools were used to gather data about the percentage of utility, use similarity and the factors that threaten wild edible plants. Chi-square test of homogeneity was used to measure the percentage of general functionality of the wild edible plants among the three study sites. It determined the number of plant species reported as useful among the studied communities under various use categories. Pairwise ranking was employed to figure out the ranking of the threats to wild edible plants.

RESULTS AND DISCUSSION

Floristic Inventory

A total of 168 plant species categorized to 111 genera and 67 families were reported as edible plants consumed by the locals (see Fig. 2 for some photographs of WEPs in Cebu). The Family Moraceae (11) showed the greatest number of edible species followed by Gramineae and Arecaceae (both 6), Cucurbitaceae and Fabaceae having (both 5), Anacardiaceae, Leguminosae, Lamiaceae, and Poaceae (all 4). Among the genera, Ficus (5) has the highest number of species,

followed by Artocarpus (4), Ipomoea, Citrus and Musa (all 3). The diversity of the taxonomic groups, families, genera, species, life forms and plant parts used are shown in Tables 1 and 2. Forty-two percent of the plants are trees, 28% are herbs, 15% are shrubs, 10% are vines and 3% are grass.

Table 1. Classification of wild edible plants according to taxon and plant habits

	Taxon				Plant Habit				
Plant Groups	Families	Genus	Species	Unknown	H	S	T	V	F
Angiosperm	64	108	164	25	48	32	68	17	
Gymnosperm	1	1	1				1		
Pteridophytes	2	2	3	1					3
Total	67	111	168	26	48	32	69	17	3

Plant habit legend: H=herb; S=shrub; T=tree; V=vine; F=ferns

Among the three study sites, Cantabaco Forest has the most recorded WEPs (115), followed by Mt. Kapayas (99), and Nug-as Forest Reserve (88). The abundance of plant families proves the richness and variety of the species in the areas. From direct observation, the informants were able to live inside the Cantabaco Forest that makes it accessible for them to utilize these wild plants. Mt. Kapayas has the densest and thickest forest cover but most live on the foot of the mountain but can hardly gather the wild edibles from the mountain. The Nug-as Forest is a protected forest so there were no human inhabitants inside the forest. The quantity and variety of recorded plants were limited by the distance and accessibility of the people from them.

Table 2. Diversity of plant parts used within the taxonomic groups

	Plant Parts Used											
Plant Groups	Fr	Le	Ba	St	Ro	Se	Fl	YS	Bu	FlBu	FrBu	Tr
Angiosperm	79	62	7	35	13	3	5	8	4	1	2	16
Gymnosperm								1				
Pteridophytes								3				
Total	79	62	7	35	13	3	5	12	4	1	2	16

Fr=Fruit; Le=Leaves; Ba=Bark; St=Stem; Ro=Roots; Se=Seeds; Fl=Flower; YS=Young Shoots; Bu=Bud FlBu=Flower Bud; FrBu=Fruit Bud; Tr=Trunk

Informants also noted that most wild edibles can only be gathered in the innermost portion of the forests, and accessibility to these areas are oftentimes problematic due to thick vegetation, frequent sightings of venomous reptiles and absence of clear pathways. In fact, some informants reported that some wild edibles are not familiar to them because they are not successfully cultivated under human habitation (Arquion et al., 2015).

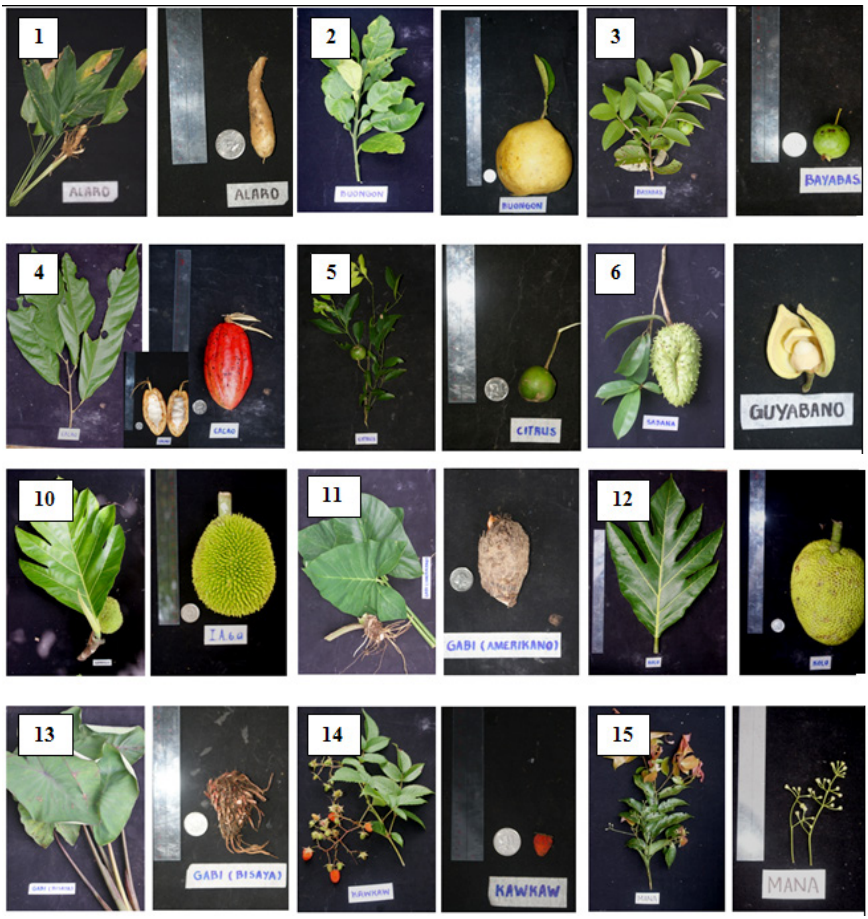
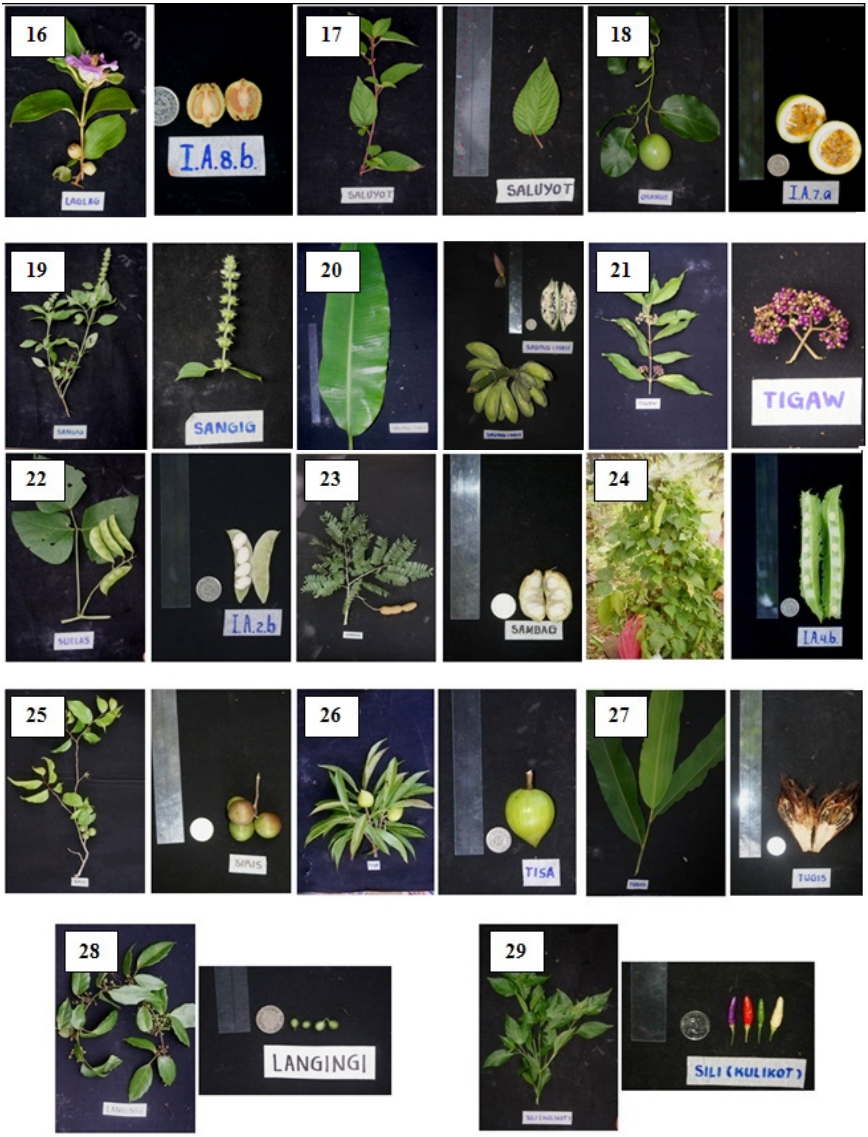


Figure 2. Photograph of some of the Wild Edible Plants in Cebu Island
1: *D. canniformis* G. K. S.(common donax), 2: *C. maxima*(pomelo),
3: *P. guajava* L.(guava), 4: *T. cacao* L.(cacao), 5: *C. aurantium L.*(sour orange),
6: *A. muricata* L.(soursop), 7: *S. tora* L.(sickle pod), 8: *A. carambola* L.(granati),
9: *C. longa* L.(turmeric),10: *A. camansi* B.(breadnut), 11: *C. esculenia* L.(taro),
12: *A. altilis*(breadfruit), 13: *C. esculenia* L.(taro),
14: *R. fraxinofolius*(wild strawberry), 15: *C. mindanaense* E.(cinnamon).


16
I.A.8.b.
17
SALUYOT
SALUYOT
18
I.A.7.a
19
SANGIG
20
21
TIGAW
22
I.A.2.b
23
SAMBAG
24
I.A.4.b
25
26
TISA
27
28
LANGINGI
29
SILI (KULIKOT)

16: *M. malabathricum* L.(malabar melastome), 17: *C. olitorius* L.(red jute), 18: *P. edulis* S.(passion fruit), 19: *O. asilicum* L.(sweet basil), 20: *M. rosacea*(botoan banana), 21: *C. candicans* B. H.(malabar hoary), 22: *P. lunatus* L.(lima bean), 23: *T. indica* L.(tamarind), 24: *P. tetragonolobus* L. DC.(wing bean), 25: *F. jangomas* L. R.(coffee plum), 26: *P. campechiana*(egg fruit), 27: *Hornstedtia* spp.(fairy fruit), 28: *C. trifolia* L. D.(three-leaf cayratia), 29: *P. scutellarioides* L. R. Br.(tabasco pepper).

Different wild edibles are eaten based on what is considered as palatable edible parts. The most cited edible part is the fruit (79), followed by leaves (62), stem (35) and trunk (16) (Figure 3a). In terms of the mode of preparation of these plants, most plants are eaten raw (47%). The percentage of the wild edibles' modes of preparation is shown in Figure 3b. Of the 47% identified plants prepared through cooking, thirty-seven (37) plants were boiled as part of vegetable soup or as stir-fried dish. *B. alba* L. (spinach vine) and *H. rosa sinensis* L. (shoe black plant) are vegetable soup ingredient, fruits of *S. edule* J. S. (sayote), *P. tetragonolobus* L. DC. (karbansus) and *M. charantia* L (paliya), leaves of *I. batatas* L. L. (kamote) and *I. aquatica* (kangkong) are stir-fried with garlic and onion with either egg or meat, *A. camansi* B. (breadnut), and *D. villosa* (wild yam) are steam-cooked, and, *M. esculenta* (cassava) and 'bot/batang' are prepared as snack, turned into puto (steamed rice cake) or as ingredient in binignit (thick sweet soup with sticky rice and coconut milk). There are more native dishes that are prepared with the different parts and different modes of preparation of the wild edibles. These plants have sustained local communities with staple, supplementary and alternative food sources (Antonio et al., 2011).

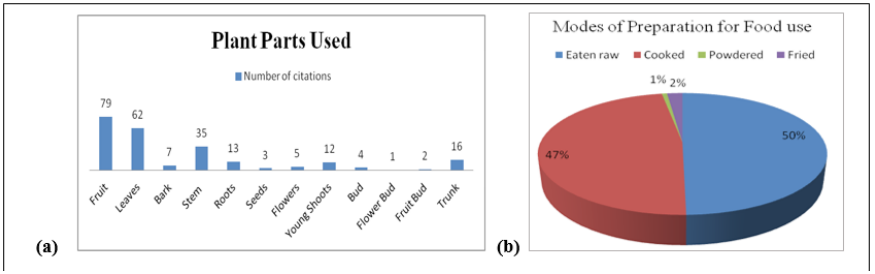


Figure 3. Status of use of the most commonly used wild edible plant based on (a) number of citations of plant parts used, (b) the different modes of preparation for the consumption of WEPs as food use.

Medicinal WEPs

During the recording of the wild edibles, there were several instances that they were mistakenly identified as medicinal plants because they are consumed as food and at the same time, commonly used in the practice of traditional medicine (Chua-Barcelo, 2014). It is important to take note that the main mode of preparing these WEPs used as medicine plants is through decoction which could be associated with greater concentration and extraction of active compounds (Adnan et al., 2010; Chiarucci et al., 2011), thus, increasing its medicinal effectiveness (Morilla et al., 2014).

Of the 168 plants cited in Cebu, 74 plants are also used as traditional medicine and their traditional ethnomedicinal uses are shown in Table 3 results show that *Annona muricata* L. (11) has the greatest number of medicinal uses. There were plants that could be used as an antidote for hangover, blood vomiting, dandruff, pain after giving birth, teething, and poisoning (Miano et al., 2011). Few plants could also cure serious diseases such as cancer, hypertension, kidney diseases, ulcer, UTI, and blindness in cow. The majority of mentioned illnesses and corresponding healing properties of WEPs were not yet elucidated either *in vitro* or *in vivo* studies but the experiences and beliefs of traditional healers have stood the test of time (Srithi et al., 2009). The aspect on dual use of WEPs could be potentially explored, and such compounded benefit will increase awareness level, and may translate into sound plant conservation efforts in the future (Ong & Kim, 2016; Prigge et al., 2005).

Table 3. Some medicinal wild edible plants and their traditional uses

Scientific name	Local Name/ English Common name	Ailments treated
Theobroma cacao L	Cacao/ Cacao	hypertension, headache
Chrysophyllum cainito L	Caimito/ star apple	stomachache, diarrhea, famish
Psidium guajava L.	Bayabas/ Guava	wounds, diarrhea, poisoning
Eleusine indica L. G.	Bila-bila/ Wire grass	kidney disease, cancer, tumor
Adonidia merrilliii B. B.	Bunga/ Manila palm	mouth sore, flatulence
Curcuma longa L.	Duwaw or tuwaw/ Turmeric	arthritis, bruises, cancer, relapse
Ficus selatica R. ex H.	Dakit/ Rubber fig	cancer, teething, chest pain
Blumea balsamifera L.	Gabon/ Blumea camphor	cough, UTI, cancer, headcolds
Annona muricata L.	Guyabano/ Soursop	heartburn, feet boils, stomachache, arthritis, hypertension, relapse, diabetes, ulcer, cancer, goiter, kidney disease
Artemisia vulgaris L.	Hilbas/ Mugwort	colds, cough, headcolds
Artemisia vulgaris L.	Hilbas/ Mugwort	cough, asthma, cancer, colds
Coleus blumei B.	Mayana/ Coleus	boils, relapse, toothache, wounds
Ipomoea batatas L. L.	Kamote/ sweet potato	heartburn, anemia
Tinosphora rumphii B.	Panyawan/ Heavenly elixir	diabetes, stomach ache
Dioscorea spp	Kubong/ Wild edible yam	blindness in cow
Muntingi acalabura L.	Mansanitas/ Cherry tree	diarrhea, famish

Multiple Uses of WEPs

WEPs were not only reported for their potential traditional medicinal benefits, but also its utility as animal feeds, as condiment and food seasoning, as beverage, as food coloring agents, as raw materials for construction and furniture-making (Table 4). Among the WEPs listed in the table, batuan (*Garcinia morella*) and native turmeric (*Curcuma longa*) ranked first, with the greatest number of multiple uses, with *Garcinia* being used as food, condiment, for construction and as medicine while turmeric being commonly used as condiment, as tea beverage, as food coloring and traditional medicine. These multiple use values are also reported by Chua-Barcelo (2014) for Benguet fruits and Arquion et al. (2015) for indigenous plants of Agusan del Sur, in southern Philippines.

Table 4. Some wild edible plants and their multiple, traditional uses

Scientific name	Local name/ Common name	F	Af	Cn	B	Co	Fc	M
Persea americana M.	Abukado/ Avocado	✓				✓		✓
Echinochloa stagnina	Balili/ Hippo Grass		✓					
Dioscorea divaricata	Balyakag/ "wild yam/ Chinese yam"	✓						✓
Garcinia morella G. D.	Batwan/ Batuan	✓		✓		✓		✓
Psidium guajava L.	Bayabas/ Guava	✓						✓
Heterospathe sibuyanensis	Bil-is/ Sagisi palm	✓				✓		
Theobroma cacao L.	Cacao/ Cacao	✓		✓				✓
Chrysophyllum cainito L.	Caimito/ Star apple	✓				✓		✓
Citrus aurantium L.	Sitrus; kandiss; dalandan or sankist/ Sour Orange	✓		✓				✓
Curcuma longa L.	Duwaw or tuwaw/ Turmeric			✓	✓		✓	✓
Averrhoa blimbi L.	Iba/ Bilimbi	✓		✓				
Plectranthus amboinicus L.	Kalabo/ Oregano							✓
Solanum habrochaites	Kamatis (ihas)/ Wild Tomato	✓		✓				✓
Ipomoea batatas L.	Kamote/ Sweet potato	✓			✓			✓
Coffea arabica L.	Kape/ Arabian coffee	✓		✓				
Cayratia trifolia L.	Langi-ngi/ Three-Leaf Cayratia	✓	✓					✓
Cocos nucifera	Lubi/ Coconut	✓		✓		✓		
Ficus virens	Malakopa/ White fig	✓	✓					
Mingifera indica	Mangga/ Mango	✓				✓		✓
Muntingi acalabura L.	Mansanitas/ Aratiles, Cherry tree	✓						✓
Artocarpus heterophyllus L.	Nangka/ Jackfruit	✓				✓		✓
Musa acuminata subsp. errans B. R.V.V.	Pakol/ Botoan Banana	✓	✓					✓
Sandoricum koetjape B. M.	Santol/ Lolly fruit	✓				✓		✓
Bixa orellano L.	Shuetes/ Lipstick Tree						✓	✓
Capsicum frutescens L.	Sili Kuliko/ Tabasco pepper	✓		✓				✓
Vitex parviflora J.	Tugas/ Small-flower Chaste Tree		✓			✓		✓

Legend: F=food; Af=animal forage; Cn=condiment; B=beverage; C=construction; Fc= food coloring; M=medicine

Local communities from the three study sites reported that the leaves of *Colocasia esculenta* L. (Gabi) can be used as an ingredient to vegetable dishes or for medicinal uses via decoction; its stem or stalk can be a vegetable ingredient; its tubers are steam-cooked or as food ingredient. *Bixa orellano* L. (Shuetes) was traditionally used as lipstick (FAO, 2009) and today it is still used to add coloring to the food. Their stimulant beverages were the ground seeds of wild *Coffea arabica* L. and *Theobroma cacao* L. for hot coffee and hot chocolate drink, respectively. Some fruit-bearing trees are also used as construction materials or raw material for handicraft industries, such as Sagisi palm, jackfruit and mango, to name a few. These plants not only provide additional income for the local people but also create crafts that could add adornment in their homes (Abaquita, 2013).

Chi square Test and Use Diversity

Analysis of the plant distribution of the wild edible plants showed which recorded plants are unique in one area, or common in other areas. Among the three sites, Cantabaco Forest has the highest number of unique plants while Nug-as, Alcoy has the lowest recorded unique WEPs. In terms of use diversity, Cantabaco forest, Toledo City has the greatest number of plants in terms of use variety. Analysis of use diversity of the wild edibles showed seven different uses. The X^2 value for the Chi-square test of homogeneity (X^2 = 2.46; df= 6; α= 0.05) indicated that there is a significant difference in the uses reported as wild edibles by the three study areas (Table 5).

Table 5. Chi-square test of homogeneity results on WEPs

	Food	Medicine	Forage	Beverage	Condiment	Construction	Food Coloring	Row Total	X^2
Alcoy	68.5	29.0	4.7	3.6	6.6	3.6	1.1	117.0	
Catmon	80.8	34.3	5.5	4.2	7.8	4.2	1.3	138.0	
Toledo	100.7	42.7	6.8	5.2	9.7	5.2	1.6	172.0	**2.46**
Column Total	250.0	106.0	17.0	13.0	24.0	13.0	4.0	427.0	

The significant differences in use diversity among the three study sites may be due to species richness in all three sites. For instance, some sitios situated near the top of the Cantabaco hills rely heavily on available plants in the forest and for several generations, their ancestors were noted to have maximized the use of these plants for several purposes. In terms of its use as alternative medicine, communities from this hill passed on the tradition of collecting and utilizing

medicinal plants that are edible, and these people were reported to visit the clinic only in extreme medical conditions because of the risk of going down the hilly landscape (Geraldine Fajardo, personal communication, 2017). Species richness is a direct way to analyze plant use diversity (Lardio et al., 2007). Cebu possesses rich diversity (Paguntalan & Jakosalem, 2007) most especially on the three sites which are considered to be dipterocarp forests possessing species-rich families (Primack, 2016). Availability of this species richness and diversity plays an important role in creating a local knowledge of the plants in human populations (Phillips & Gentry, 1993; Nolan, 1998).

Socio-economic significance of WEPs

Majority of the informants are lumad or natives to the area and their personal experience invariably contributed their awareness and knowledge of the plants, particularly on their varying socio-economic significance (Table 6). Among the listed importance of WEPs to communities, provision as food and nutrition topped the list, followed by its utility as animal feedstuff. The pattern of citations reported by informants from three sites agrees with the study of Antonio et al. (2011) in Ilocos Norte. WEPs used on rituals received the lowest citations because only a few of them still practice rituals or believe in diwatas or deities and other tuo-tuos or superstitions. As reported, these plants were harvested from wild or cultivated in their backyard to lessen financial expenses on food and others (i.e. beverage, animal feedstuff). These suggest that WEPs has penetrated the effective actions and values of the informants, and has given them a direct reliance on any manner (Ong & Kim, 2016; Prigge et al., 2005).

Table 6. Informants' perception of WEPs importance

Importance*	Total citations	Average
Growing/collecting could provide additional household income	75	62.5
Growing/collecting could provide employment to household members	84	70
Provide more food to the family	113	94.2
Provide nutrition	109	90.8
Ornamental or has aesthetic value	89	74.2
Medicinal	79	65.8
Animal feedstuff	90	75
Used in rituals	31	25.8
Has cultural value	68	56.7

Legend: On the average value, >75 = strongly agree, <75 and >50 = agree, <50 and >25 = moderately disagree, <25 = disagree; (*) multiple responses possible

Marketability of WEPs in the study areas

Only 30% among the informants agreed that 10.69% (18 plant species) of the recorded WEPs can be sold in the market and may provide a substantial source of income. The plants *D. allata* (wild yam) and *C. esculenta* L (taro) are the most cited marketable plants on the three study sites. Since the plants were harvested from the wild and most of consumers do not recognize its appearance, majority of the local sellers of WEPs stroll and sell their gathered products only on nearby neighbor houses, while few display their plants in front of their sari-sari store.

Stems from the plants of *B. alba* L. (spinach vine), *G. gnemon* L. (bago), *I. aquatic* (kangkong), *C. olitorius* L. (red jute), *I. batatas* L. L. (sweet potato) or also called as gai sa kamote, are among the WEPs sold in small bundles ranging from five pesos (P5) to fifteen pesos (P15) (Table 7). Few WEPs were also reported to be sold in kinilo or by using measurement units (i.e. kilograms, grams) to quantify the available resources into proportionate prices. This is due to the fact that harvests are inconsistently few, and irregularly available, and thus, whatever good harvest there is that could be marketable, are being sold by the household. The remaining crops are often set aside for family consumption, or made into barter with neighbors for other available food crops (Raquel Lombrino, personal communication, 2017).

Another marketable plant species is the *C. frutescens* L. (Tabasco pepper) which is sold in small plastic packets with price ranging from one (1) peso to five (5) pesos. Plants gathered for construction use also supported and boosted the livelihood of the native people and marginal farmers. Plants such as *C. rotang* (rattan) and *C. rumphiana* (Albert palm or fish tail) have been reported to be declining in number as a result from the uncontrolled collection and increased demands as furniture raw materials and ornamental foliage, respectively. This leads to the diminishing number of the said plants as mentioned from the few informants in Cantabaco Forest (GCSFHESE, 2012). The marketability potential of these plants could be harnessed for income generation. They also need to be economically-evaluated and documented to optimize utilization and prevent threats such as overexploitation (Prigge et al., 2005).

Table 7. WEPs being sold in the three (3) study sites and provides extra income to households

Scientific name	Local name	Parts used
Basella alba L.	Alugbati	leaves
Dioscorea esculenta L.B. C.	Apali	tuber, leaves
Gnetum gnemon L.	Bago	young shoots
Manihot esculenta	Balanghoy	tuber
Dioscorea divaricata	Balyakag	tuber
Alocasia macrorrhiza L.	Biga	tuber, stem
-	*Bot or batang	tuber
-	*Butig	tuber, leaves
Chrysophyllum cainito L	Caimito	fruit
Heritiera littoralis D.	Dum-on	fruit
Colocasia esculenta L	Gabi (ihas)	tuber, stalk, leaves
-	*Hagmang	tuber
Ipomoea batatas L. L.	Kamote	tuber, young shoots, leaves
Moringa oleifera L.	Kamunggay	leaves
Ipomoea aquatica	Kangkong	leaves
Carica papaya L.	Kapayas	fruit, leaves
Schefflera odorata B. M. & R.	Lima-lima	tuber
Zingiber officiale R	Luy-a	tuber
Musa paradisiaca L.	Saging	fruit, fruit bud
Corchorus olitorius L.	Saluyot	leaves
Sandoricum koetjape B. M.	Santol	fruit
Capsicum frutescens L.	Sili Kulitkot	fruit, leaves, tuber
Dioscorea villosa	ube	young shoots

(*) WEPs with unverified scientific names

Wild edible plants (WEPs) as alternative food sources

Of the 170 informants, 87.5% reported to have used WEPs as alternative food sources. Alternative foods are used when preferred or normally consumed foods are not accessible and in circumstances where food shortages dominate. Some WEPs (25 plant species = 14.7%) are consumed as food sources. The leading causes of food shortages in the 3 study sites were drought and heavy rainfall due to their high elevation, and the dependence of their staple food sources on agricultural crops which are the ones mostly affected by natural disasters. The effects of natural disaster are inevitable especially to open environments (i.e. agricultural farms, coconut plantations).

Informants revealed that *I. batatas* (sweet potato), *S. odorata* (five fingers), *C. esculenta* (taro), *D. esculenta* (Asiatic yam), 'hagmang', *D. divaricata* (Chinese yam), *A. macrorrhiza* L (biga) and 'butig', are among the WEPs that were used by the informants as an alternative substitute for rice. The fruits of *C. cainito* L (star apple) and *C. papaya* L. (papaya), and leaves of *B. alba* L. (spinach vine)

and *M. oleifera* L. (horse radish) among others, are used as alternative option to traditional viand.

Pairwise ranking and threats to wild edible plants from the three study areas

Wild edible plants are also exposed to various forms of threats. Threats to WEPs are analyzed through pairwise ranking for all of the three study areas (Figure 4). Data show that irresponsible human activities and forest utilization are the main threat to WEPs diversity. Selective cutting for construction and technology yielded the highest recorded threat, where the informants noted as the main source of income as well as for their own consumption. Natural disaster, such as storm and landslide, was considered the second threat because of their favorable location (i.e. mountaintop elevation). The third threat, agricultural expansion and land conversion, was commonly observed because they need to undergo farming for food generation and income generation (Morilla et al., 2014).

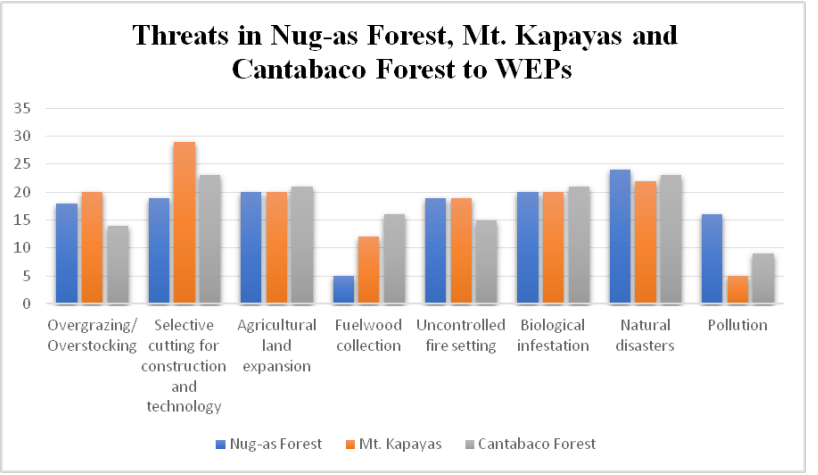


Figure 4. Overall pairwise ranking results of the environmental threats found in three study sites

All other threats arose due to the informants' activities themselves which they needed to do for their own livelihood activities. They also mentioned that selective cutting or collection for fuel wood or charcoal is strictly restricted but they still do it on minimal basis. Threats of WEPs were mainly anthropogenic activities. If consequences to these are widely known and people are well-aware

of these WEPs in their area, they would refrain from doing anything that would result to the lose the plants and its germplasm.

WEPs conservation status

Ethno-ecological knowledge assessment on threats to WEPs and conservation concerns showed that most of the wild plants' availability is still at a normal state, however, these must not be taken for granted because some are at risk of losing. Ignorance to the benefits of wild plants has also been a common sight. For example, only 1 out of the 44 respondents from Cantabaco Forest knows that *Dioscorea* spp. (Wild edible yam) not only possesses anti-inflammatory activity (Mollica et al., 2013) but also cures animal blindness (Obsidial, 2017; pers. comm. Dec. 2016). Lack of awareness for this plant species has diminished its value and now its availability is also on the verge of being eliminated in the area.

Aside from anthropogenic threats and natural disasters, actions on mitigating such threats were said to be operational. Around 40% of the informants have witnessed some conservation efforts from the LGU, agricultural agencies and universities. They reported that these agencies conduct programs and activities that raised awareness on the significance of these plants. It also showed that 85.83% of the informants were willing to help in growing these plants and 89.17% of them were ready to help in their conservation. The presence of threats to WEPs has not generated any kind of urgency in plant conservation. Moreover, the willingness of the people in preserving them only heightens immediate action for their conservation as part of Cebu's flora.

CONCLUSION

The wild edible plants in Cebu are rich and diverse. WEPs manifest tangible economic values to small communities, thus, evaluation on their trade potentials as horticultural crops can contribute to alternative sources of income and employment. These plants also provided food in times of scarcity. Their potential in relieving food crisis in these small communities may prove good alternative options to lessen food crisis in bigger communities if disseminated and propagated. Although there are existing threats to their diversity in the wild, increased awareness on their use value and their sustainable harvesting may potentially influence communities' perspective on how to manage these limited resources. Persistent effort to disseminate the potential benefits that WEPs may provide will be the first step to capacitate communities to be involved in the propagation, utilization and conservation of wild edible plants.

RECOMMENDATIONS

Results of this study, particularly on the aspect of floristics and use value may be utilized as benchmark information to investigate further the genetic diversity of WEPs. As we brace ourselves against potential impacts of climate change to our food security, we need to ensure that resilient crops such as WEPs are available, in the event that our staple food will not be sufficient enough to feed local communities. Their distribution in the wild and adaptation to varying ecological landscapes are essential avenues for future research so that we can understand which of these WEPs can occupy wide or narrow ranges of habitats. Habitat suitability data may be used further to investigate which WEPs can be naturally grown in urban landscapes, and identify those that are adaptable to urban habitats. Investigating the WEPs' bioactive compounds, pharmacological properties and heat shock proteins are interesting avenues for future research which are essential knowledge base to help us fully maximize the benefits of WEPs to human lives in particular, and the environment, in general.

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