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Traditional Knowledge of Wild Edible Plants with Special Emphasis on Medicinal Uses in Southern Shan State, Myanmar

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စာတမ်းအကျဉ်း

မြန်မာနိုင်ငံသည် ဇီဝမျိုးစုံမျိုးကွဲများ ပေါကြွယ်ဝသည့် နိုင်ငံတစ်ခုဖြစ်ပါသည်။ သဘာဝသီးပင်စားပင်များနှင့်ပတ်သက်၍ လူမှုရုကွဖေဒရှုထောင့်မှ လေ့လာခြင်းအားဖြင့် သဘာဝအပင်များ ထိန်းသိမ်းကာကွယ်ရေးတွင် အထောက်အကူပြုနိုင်သည့် ကိန်းဂဏန်း အချက်အလက်များ ရရှိနိုင်မည်ဖြစ်ပါသည်။ ယခုသုတေသနလုပ်ငန်းအား ရှမ်းပြည်နယ် တောင်ပိုင်းရှိ ကျေးရွာ(၃) ရွာမှ အပင်နှင့်ပတ်သက်၍ နားလည်ကျွမ်းကျင်သူ (၁၉)ဦးအား ၂၀၁၅ ခုနှစ် ဇွန်လနှင့် ဇူလိုင်လများတွင် လေ့လာမေးမြန်း တင်ပြထားပါသည်။ ထို့ပြင် အုပ်စုဖွဲ့ ဆွေးနွေးခြင်းများအား ၂၀၁၆ ခုနှစ် နှင့် ၂၀၁၇ ခုနှစ် များတွင်ဆောင်ရွက်ခဲ့ပြီး ဒေသခံများ၏ သဘာဝသီးပင်စားပင်များနှင့် ပတ်သက်သည့် ရိုးရာအသိပညာများအား လေ့လာခဲ့ပါသည်။ အပင်မျိုးစိတ်များတိကျ မှန်ကန်စွာ ခွဲခြားနိုင်ရေးအတွက် DNA နည်းပညာဖြင့် မျိုးခွဲခြင်း လုပ်ငန်းများကို ဆောင်ရွက်ခဲ့ပါသည်။ သုတေသနလုပ်ငန်း၏ ရလာဒ်အဖြစ် သဘာဝသီးပင်စားပင်မျိုးစိတ်(၈၃)မျိုးအား မှတ်တမ်းတင်နိုင်ခဲ့ပါသည်။ ၎င်းသဘာဝသီးပင်စားပင်များအနက်မှ မျိုးစိတ် (၁၈) မျိုးမှာ ဆေးဘက်ဝင်အပင်များအဖြစ် အသုံးပြုလျက်ရှိပါသည်။ သဘာဝသီးပင်စားပင်များမှာ ကျေးလက်နေ ပြည်သူများ၏ လူမှုဘဝကို များစွာအထောက်အကူပြုလျက်ရှိပြီး ထိုအပင်များနှင့် ပတ်သက်သည့် ရိုးရာ အသိပညာများအား ထိန်းသိမ်းရန် လွန်စွာအရေးကြီးသည့် လုပ်ငန်းစဉ်တစ်ခု ဖြစ်ပါကြောင်းတင်ပြအပ်ပါသည်။

Traditional Knowledge of Wild Edible Plants with Special Emphasis on Medicinal Uses in Southern Shan State, Myanmar

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Abstract

Background: Myanmar is one of the hot spots of biodiversity and rapidly developing country. Floristic research of Myanmar is an urgent issue, and ethnobotanical study of wild edible plants (WEPs) will provide us new information on natural plant resources.

Method: Ethnobotanical data were collected in three villages with different historical background in Southern Shan State, Myanmar. Total of 19 key informants were interviewed and specimens were collected in the fields with participation of key informants in June-July 2015. Group discussions were organized during 2016 and 2017 to reinforce the information on use of WEPs. DNA barcoding was used to facilitate species identification.

Results: A total of 83 species from 44 families of angiosperms were recorded as WEPs. Most of the species were used as wild vegetables (47 species) followed by the fruits and nuts (31 species). Eighteen WEPs were consumed as foods for medicines. The differences in use of WEPs between the communities of the villages were observed. The age class of 30-39 years was more familiar to the environment where they could collect WEPs and had more knowledge of WEPs than the elder groups. The use of *Elaeocarpus floribundus* for edible oil is very interesting tradition.

Conclusion: WEPs play important role in the livelihood of local communities. The indigenous society maintained traditional knowledge on the WEPs. Historical background, land use system and surrounding vegetation could have effects on the variation of the traditional uses of WEPs. Increasing awareness on the importance of WEPs will encourage the conservation of traditional knowledge of indigenous population.

Keywords: Wild edible plants, Medicinal plants, DNA barcode, Ethnobotany, Myanmar

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1. Introduction

Wild edible plants (WEPs) are defined as plant species collected in the wild to be consumed as food or drink. Although important nutrients for human beings are available from WEPs, it was argued that the use of WEPs is decreasing in urban style cooking [1, 2]. Being an important source of energy and micronutrient, WEPs can increase the diversification of human diets [3, 4]. WEPs are also important food sources during the time of famine when normal food supply was disrupted [2]. Nowadays, humans have focused on a limited number of plant species for staple food, neglecting the importance and usefulness of WEPs. It can lead to global food shortage and also to the knowledge erosion about WEPs [5, 6]. Documentation of WEPs is important for identification of food sources from the surrounding environment and WEPs are serving as gene pool for genetic improvement of crops to have higher productivity, disease resistance and compatibility to global climate change [7]. WEPs also have potential for development of new crops through domestication [8]. Moreover, nutritional and medicinal properties of WEPs are increasingly recognized [9–11]. The traditional uses of plant resources and life styles of rural communities have been changed in accordance with the change of subsistence farming/hunting and gathering to profit oriented agricultural systems [9]. The local food tradition is a kind of cultural expressions, and a loss of traditional knowledge of WEPs implies a loss of cultural identity [12].

Myanmar is one of the hotspots of biodiversity [13, 14] and rapidly developing country. Clarification of flora of Myanmar is an urgent issue and ethnobotanical study will provide us new information on natural plant resources [15, 16]. A total 135 ethnic groups are officially recognized in Myanmar [17]. These indigenous people regard natural resources as essential to their culture and well-being [18], but they are not really interested in the conservation of natural resource. Furthermore, local communities are rarely allowed to participate in decision making process concerning with impact of ecosystem changes, and their dependence on plant resources is not adequately considered in formulating the strategies of rural development [19]. In Myanmar, quite a few researches have been carried out on ethnobotany mostly emphasizing on medicinal and financial value[20–23].

The field researches were carried out in three villages each with different historical backgrounds, namely Eden, Myin Ka, and Pin-sein-pin located in western part of Southern Shan State (Table 1 and Fig. 1). Southern Shan State is situated on the Shan plateau, which rises to the east from the central basin of Myanmar and is occupying the eastern half of the country. The average elevation of the plateau is about 900 m. The average annual precipitation is between 1900 mm and 2000 mm, and the average daily temperature is 22 ºC [24]. The ethnic groups residing in the study area are *Danu*, *Taung-yoe*, *Shan*, *Bamar*, *Pao*, *Kayan* and *Kayin*. Majority in Myin Ka and Pin-sein-pin villages are *Danu* and *Taung-yoe*.

Major ethnic group in Eden village is *Kayan*. According to the folklore of the villagers, old Myin Ka village was established in *Bagan* Era (9th -13th century) one mile away from current village location. In the late 19th century, the old village was destroyed because of ethnic conflicts in the area, and was moved to the current location. The villagers of Eden village migrated from Kaya State because of civil war in their former area, and established the village in 1990.

This study focused on the local communities in Southern Shan State to document their traditional knowledge and practices on WEPs. In the present study, DNA barcoding technique was used to facilitate species identification. DNA barcoding is a microgenomic identification system by analyzing a short, standard DNA region that is universally present in the target lineages [25, 26]. With help of DNA barcoding techniques, species identification can be facilitated in the ethnobotanical study [27, 28] and the floristic study of unexploited tropical region [29]. A total of 83 species from 44 families of angiosperms have been documented as wild edible plants in the study area. The indigenous societies, who were living in an area for a long time, could have much more traditional knowledge of WEPs.

Table 1. Basic information of the three villages studied

	Myin Ka	Pin-sein-pin	Eden
Establishment	Before late 19th century (Moved from nearby old village, one mile away).	Early 19th century	1990
Location	N: 20°34´54.3", E: 96°34´52.7"	N: 20°58´54.3", E: 96°37´54.9"	N: 19°55´31.9", E: 96°25´58.1"
Above sea level	1422 m	1736 m	353 m
Habitat	Evergreen forest	Evergreen forest	Deciduous forest
Linear distance to the nearest town	6 miles to Kalaw, Shan State	5 miles to Pindaya, Shan State	25 miles to Tatkone, Mandalay Division
Population/Households	563/140	535/127	410/68
Ethnic Group	Majority: Taung-yoe, Danu Minority: Bamar, Shan	Majority: Danu Minority: Bamar, Pao	Majority: Kayan Minority: Kayin, Bamar
Religion	Buddhism	Buddhism	Christian and Buddhism
Public Facility	One library, one primary school, one buddhist monastery	One primary school, one library, one kindergarten	One middle school, one church, one monastery, one kindergarten

Subsistence	Rice cultivation (ca. 60 acres) Cultivation of vegetables and fruits: ginger, cabbage, cauliflower, egg plants, tomato, chili, chayote, carrot, orange, avocado, pear (ca 150 acres)	Plantation of tea leaves, *Ju*, pea, cabbage, potato	Cultivation of turmeric, chili, banana, hill rice Collection of bamboo shoots and other forest products
Home garden products	Ginger, orange, avocado, pear	Tea leaves	Mango, banana, jack fruit
Live stock	Buffalo, chicken, cattle, pig	Cattle, chicken	Pig, chicken
Drinking water	Natural springs (connected with pipe line)	Collection of rain water with collection tanks	Natural springs (connected with pipe line)
Electricity	From national grid	No electric supply	Small hydropower generators constructed on the stream

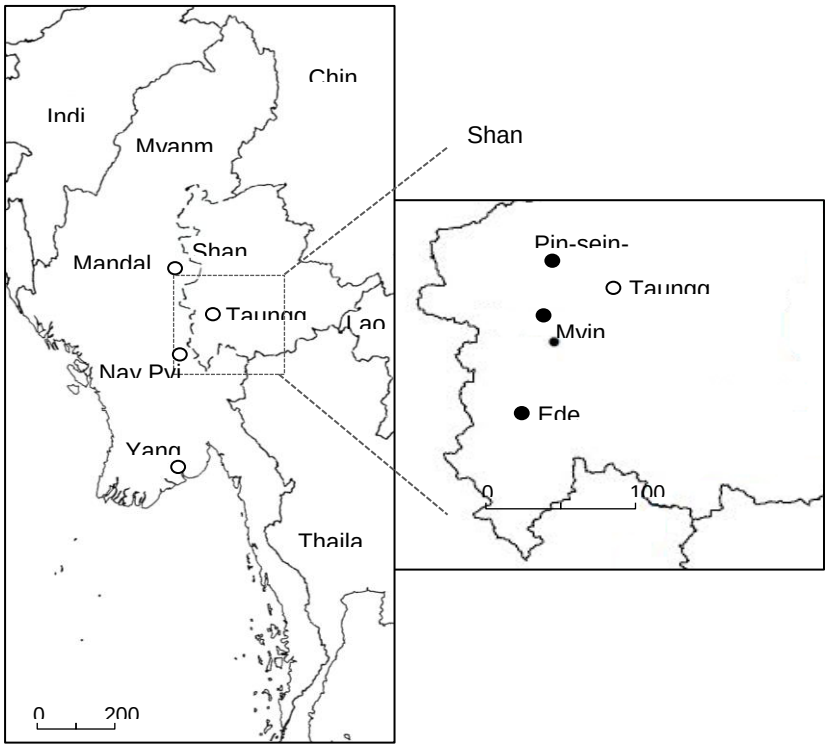

Figure 1. Map of study area

2. Material and Methods

Interviews and collection of plant specimens

First, meetings were organized with villagers and explained the objectives of the research. Consent was taken before carrying out ethnobotanical survey. The ethical guidelines of the International Society of Ethnobiology were strictly obeyed [30].

The ethnobotanical data were first collected from 19 key informants who were selected for their reputation being specialist on the use of WEPs. The information on WEPs was gathered from interviews and fieldworks. Ages of key informants ranged from 30 to 57 years with one female informant. All key informants were farmers. The field surveys were carried out in June-July 2015, and voucher specimens and the leaves for DNA analysis were collected. During the field surveys, the vernacular name, growth habitat and folk use of each species were recorded. Interview and field sampling were carried out with an individual informant to avoid the incorporation of the knowledge from other villagers. Voucher specimens were deposited in the herbaria of Makino Botanical Garden (MBK), Japan, and Forest Research Institute (RAF), Myanmar.

After getting ethnobotanical data from the key informants, group discussions were organized again in 2106 and 2017. Apart from the 19 key informants, additional 23 informants were invited for group discussions. Therefore, a total of 42 villagers participated in this project, including 5 female informants. A total of 13, 12 and 17 informants participated in group discussions from Eden, Myin Ka and Pin-sein-pin villages, respectively. Age of all informant ranges from 23 to 82 years, including 37 farmers, one small shop owner, one forester and three herbalists. We also gathered information of WEPs with the method of " walk-in-the-wood" [31] together with a group of informant.

DNA barcoding and species indentification

Total DNA was extracted from dried leaf tissue by a CTAB Method. Approximately 20 mg of dried leaf tissue were grinded in a 2 mL microcentrifuge tube using TissueLyser (Qiagen, Hilden, Germany). The sample was incubated with 2xCTAB solution at 65°C for 30 min. After chloroform (chloroform:isoamylalcohol = 24:1) treatment for 30 min, the mixture was centrifuged for 10 min at 3000 rpm. Aqueous layer was transferred to a new 1.5 mL microcentrifuge tube and then the DNA was precipitated with ethanol. The pellet was dissolved with TE buffer. PCR amplification of *rbcL* region followed the procedure of CBOL Plant Working Group [32]. The rbcLa_F and the rbcLa_R were used as primers. For the PCR reaction GoTaq Green Master Mix (Promega, Madison, WI, USA) was used. Amplification was performed in a TaKaRa PCR Thermal Cycler Dice Touch (Takara, Kusatsu, Japan) programmed for one cycle of 95°C for 5 min, 30 cycles of 95°C for 30 sec, 55°C for 30 sec, 72°C for 1 min, and one cycle of 72°C for 5 min. The PCR products were resolved by electrophoresis in 1.0% agarose gels stained with GelGreen (Wako, Osaka, Japan). DNA fragments were recovered using the Wizard SV Gel and PCR Clean-up System (Promega, Madison, WI, USA) according to the manufacturer's instructions. Cycle sequencing was

performed using BigDye Terminator v3.1 Cycle Sequencing Kit and ABI 3130 Genetic Analyzer (Thermo Fisher Scientific, Waltham, MA, USA).

The Basic Local Alignment Search Tool (BLAST) program was used as a tool to search for similar DNA sequences from the database of the National Center for Biotechnological Information (NCBI). Among the compared sequences, the species with the most similar sequences were used as a guidance for species identification. The final identification of specimens were determined by cross referencing with specimens housed at MBK, as well as the type specimen images on the website of JSTORE Global Plants (https://plants.jstor.org), and online herbarium catalog of the Royal Botanic Gardens, Kew (https://www.kew.org/herbcat/navigator.do). The plant descriptions were consulted in the Flora of China and Flora of Thailand. The scientific names for species were assigned in accordance with The Plant List (http://www.theplantlist.org). The use of WEPs and medicinal plants were classified into categories according to the standards developed by Royal Botanic Gardens, KEW [33].

3. Results

Diversity of Wild Edible Plants in the study area

A total of 153 specimens were collected as WEPs from the three villages in this study. 138 specimens were identified to the species level and consisted of 83 species. A total of 83 species from 44 families of angiosperms were identified as wild edible plants. Araceae, Fabaceae and Moraceae were the major families with the largest number of species (5 species). Zingiberaceae, Asteraceae, Myrtaceae and Rutaceae were followed with four species. Ethnobotanical data such as vernacular names, collection sites and folk uses are listed in Table 2. Among the 83 species, most of species are indigenous in Myanmar, but two species, *Annona cherimola* and *Coffea arabica*, are escaped from plantations, and four species, *Alternanthera philoxeroides*, *Bassia scoparia*, *Bidens biternata* and *Oxalis latifolia*, are naturalized from abroad.

Table 2. The numbers of WEPs recognized by each key informant

Age	Eden		Myin Ka		Pin-sein-pin	
	Informant	No. of WEPs recognized	Informant	No. of WEPs recognized	Informant	No. of WEPs recognized
30-39	A	12	F*	21	M	22
			G	28	N	7
			H	30		
40-49	B	11	I	12	O	8

	C	17	J	13	P	9
	D	5			Q	10
50-59	E	6	K	9	R	18
			L	13	S	11
Mean ± SD		10.2 ± 4.9		18.0 ± 8.4		12.1 ± 5.6

*: female

Leaves, fruits and seeds are consumed as food in the most species. Although villagers collected WEPs for their own consumption, nine species, *Lasia spinosa*, *Cheilocostus speciosus*, *Telosma cordata*, *Markhamia stipulata*, *Oroxylum indicum*, *Acacia concinna*, *Acacia pennata* subsp. *kerrii*, *Archidendron jiringa* and *Phyllanthus emblica* were collected for selling at local markets. Villagers also used some of the WEPs other than food as mentioned below.

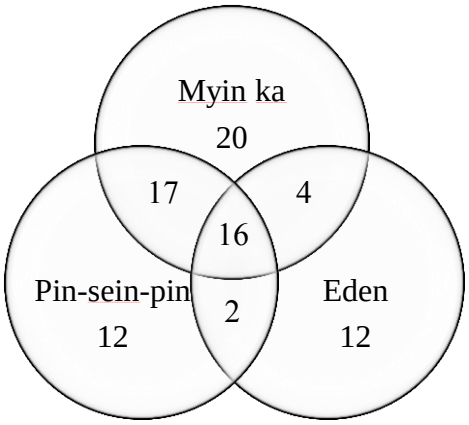

Figure 2. Number of species used in each village

Wild Edible Plants used in each village

In total, 34, 57 and 47 species were using as WEPs in Eden, Myin Ka and Pin-sein-pin villages, respectively (Fig. 2). Among the 16 species used in all three villages, five species have different local names. *Phyllanthus emblica* had different local names in all three villages. *Colocasia esculenta* and *Ficus semicordata* had the same name in Myin Ka and Pin-sein-pin villages, but different name in Eden village. Although *Acacia pennata* subsp. *Kerrii* had the same local name in all three villages, this species has two local names in Eden village. *Solanum torvum* had the same local name in Eden and Myin Ka villages, but different name in Pin-sein-pin village. Among the 17 species used in common by Pin-sein-pin and Myin Ka villages, 12 species had the same local name, but five had different names in two

villages. All two species commonly used in Pin-sein-pin and Eden villages had different names. Among the four species used in common in Eden and Myin Ka villages, three species had the same name. Most of the species had a single vernacular name, however, five species had two of three local names. *Physalis angulata* and *Leea indica* were used without local names in Eden village. The difference of ethnic groups could be the main reason for using different local names to same species. The three villages situated in different township, and there is no social relationship between the villages. This is also another reason for using different local names.

Eden village has less number of shared species with other two villages. Most of species documented in this study from the families Ebenaceae, Elaeagnaceae, Elaeocarpaceae, Fagaceae, Lamiaceae, Lauraceae, Myricaceae, Rosaceae, Rubiaceae and Rutaceae were used in Myin Ka nad Pin-sein-pin villages, but not in Eden village. On other hand, most of species from the families Burseraceae, Lythraceae and Sapindaceae were used only in Eden village. The average number of species recognized by a single key informant was different between three villages (Table 3). The key informants from Myin Ka village reported more number of species (average of 18.0 species per a key informant) than Eden and Pin-sein-pin villages (average of 10.2 and 12.1 species, respectively). The amount of knowledge on WEPs was also different between the age classes of key informants in the study area. Usually, the aged transfers the farming activities and knowledge of WEPs to the younger generations in the study area. However, the age class of 30-39 years reported more WEPs than the elder groups. It was found by the interviews that the age class of 30-39 years was much more familiar to the environment where they could collect for WEPs. Number of species reported as WEPs by more than two key informants in Eden, Myin Ka and Pin-sein-pin villages were 8 (33.3% of total species reported by all key informants in Eden), 29 (56.9%) and 15 (40.5%) species, respectively. This result indicates more share knowledge of WEPs within the community of Myin Ka village.

Use of WEPs

A total of 47 species from 25 families were used as vegetables. All five species in Araceae were used as wild vegetable. According to the interviews with villagers, the most preferred species used as wild vegetables were *Phyllanthus emblica*, *Rotheca serrata* and *Docynia indica*. *P. emblica* and *R. serrata* were also used as medicinal plants in the study area. In addition to the wild collection, the villagers planted *P. emblica* in their home garden for their own consumption. *Lasia spinosa* and *Cheilocostus speciosus* were important seasonal foods for the cash income of the local people. The villagers seasonally collected these two species from the wild and sold in the local markets. Because customers preferred these two species as wild plants, the villagers do not cultivate them for markets. Tender leaves of *Acacia concinna* were used as vegetable, but the decoction of fruits of *A. concinna* is traditionally and popularly used as shampoo in Myanmar. Stems and bulbs of *Amorphophallus purpurascens* and *A. cf. muelleri* were used as vegetables, and the sliced

bulbs were preserved after sun-dried. The bulbs of these species were boiled, peeled and pounded to make konjac, 'Wa-u' in Myanmar.

A total of 31 species from 23 families were used as fruits and nuts. Species in Myrtaceae, Moraceae and Sapindaceae were frequently used as fruit plants. The most preferred fruit plants were *Docynia indica*, *Ficus semicordata*, *F. auriculata*, *Myrica esculenta* and *Archidendron jiringa*. In addition to the wild collection, small scale planting of *Docynia indica* was observed not only for fruits but also for the fuel wood. Boiled seeds of *A. jiringa* are a traditional food in the area, and it is also a source of income for the villagers.Four plants species from three families were used as spices and condiments in traditional curry. The dry powder of rhizome from *Curcuma* cf. *amada* was used in various traditional dishes. Freshly pounded rhizome of its was used as spice. Leaves of *Cinnamomum tamala*, *Laurus* cf. *nobilis* and *Zanthoxylum armatum* were used in traditional curry for flavor. *Z. armatum* is also used as spice in Yunnan, nearest Province of China to Myanmar [34].

The seeds of *Elaeocarpus floribundus* were used to extract vegetable oil in Myin Ka village. The vegetable oil was used locally, but it was not produced for commercial scale. It is interesting that extracts of leaves of *E. floribundus* showed significant activities against CEM-SS cancer cells [35].

The whole plants of *Oxalis latifolia* were eaten by children as snack in Myin Ka Village. The plants were growing naturally in home compounds. It is a perennial weed and originated from Central and South America [36]. From the other two villages, no species as children snack were reported.

The different methods of preparation of vegetable for traditional dishes are as follow: (i) *Hin*, the most common traditional food, is prepared by boiling together the vegetable with edible oil, fermented fish and salt into a semi-liquid dish; (ii) *Akyaw* is prepared by frying the vegetable together with salt, spices, chili, and fermented fish; (iii) *Athote* is prepared by mixing raw or boiled vegetable with pounded fried groundnut, salt and chili; (iv) *Atoe* is a raw salad eating together with fermented fish, or with fermented beam; (v) *Hincho* is a soup prepared by boiling the vegetable together with fermented fish and salt. Most of the WEPs were directly used as vegetable dishes without any pretreatments with the exception that the bulbs of *Amorphophallus purpurascens* and *A. cf. muelleri* were boiled, peeled and pounded before preparing traditional dishes. Most of the fruits, which were consumed as snack food, were eaten fresh without any preparation. The fresh fruits of *Ficus racemosa* were preserved by soaking in salty water. The petiole of *Colocasia esculenta* and the fruits of *F. semicordata* were pickled and consumed as a fermented food like pickles.

Use of WEPs as Medicine

A total of 18 WEPs from 15 families were used as medicine (Table 4). Among these species, 11 species were consumed as food for medicinal uses, and seven species were

prepared as main ingredient for traditional medicine. *Dichrocephala integrifolia*, *Plantago major* and *Laggera alata* were rarely used as food in the study area, however, these species were traditionally consumed as food for medicinal use. In the study area, the shoots and leaves of *D. integrifolia* were prepared as soup and consumed as postpartum tonic for mother. It is also reported as a valuable medicinal plant for treatment of Alzheimer [37]. The young leaves of *P. major* were traditionally prepared as salad and consumed for hypertension and food poison. It is reported that the extract from *P. major* has anti-fungal activity [38]. The shoots of *L. alata* were fried with eggs, consumed for swollen body. Isochloregenic acid A from *L. alata* is reported as a potential candidate for anti-hepatitis B drug [39].

It is reported that *Rotheca serrata* is mainly used as medicinal plant in other area [40]. However, *R. serrata* was mainly consumed as wild vegetable in the study area and also used for digestive system disorders. The young leaves of *Celastrus paniculatus* were prepared as traditional soup and consumed as a dietetic food. The food is not used for a particular ailment. However, the villagers believe that the soup is for good health. The use of this species was recorded in their traditional song, expressing that the plant is highly recommended for traditional soup. The fruits of *C. paniculatus* are consumed orally as vermifuge by the locals living around Popa Mountain Park, Myanmar [41]. It was reported that the extract from *C. paniculatus* can inhibit the growth of breast cancer cells [42].

Table 3. List of identified WEPs used by villagers in this study

Taxon	**Village* and vernacular name**	**Use**	**Voucher number (Collection site*)**
Araceae			
Amorphophallus purpurascens Kurz ex Hook.f.	E, M, P: Wa-u	Food: stem and bulb as vegetable: young stem cooked as vegetable, bulb boiled and grounded to make konjac (Wa-u)	Thant Shin (abbreviate as TS hereafter) 0618 (P)
Amorphophallus cf. *muelleri* Blume	E, M, P: Wa-u	Food: stem and bulb as vegetable: young stem cooked as vegetable, bulb boiled and grounded to make konjac (Wa-u)	TS0728/1 (E)
Arisaema erubescens (Wall.) Schott	M, P: Wa-u-pho	Food and Medicine: stem and bulb as vegetables, bulb boiled and eaten for constipation	TS0284 (M); TS0599 (P)
Colocasia esculenta (L.) Schott	E: Pain-ga-nan; M, P: Pai	Food and Medicine: petiole fermented, petiole as vegetable, petiole prepared soup with *Kin*-	TS 0040, S0137, TS0277 (M)

		pun-chin, Sue-pote and Zayit; sap used externally for allergy caused by insects	
Lasia spinosa (L.) Thwaites	E, M: Za-yit	Food: tender shoot cooked as soup, cooked with fish, boiled shoot as salad with fish paste	TS0757 (E)
Costaceae			
Cheilocostus speciosus (J.Koenig) C.D.Specht	E, M: Pha-lan-taung-hwa	Food and Medicine: shoot fried with vegetable oil and other ingredients, cooked for soup, cooked with bamboo shoot and meat, decotion of whole plant taken orally for dysentery	TS0037 (M); TS0732 (E)

Smilacaceae			
Smilax gagnepainii T.Koyama	M: Sue-yit-sein; P: Sue-yit	Food: shoots fried as vegetable, cooked soup, green salad	TS0617 (P)
Zingiberaceae			
Alpinia nigra (Gaertn.) Burtt	M: Gon-min	Food: pith as vegetable	TS0278 (M)
Curcuma aromatica Salisb.	M: Mar-lar-pu	Food and Medicine: buds as vegetable, paste of rhizome used externally over injury	TS0210/1 (M)
Curcuma cf. *amada* Roxb	M: Ba-thae-kaw	Food and Medicine: dry powder of rhizome consumed orally for flatulence, pounded fresh rhizome as spice in traditional curry, rhizome sliced and dry and made powder, and used as spice in curry	TS0068 (M); TS0727 (E)
Amaranthaceae			
Alternanthera philoxeroides (Mart.) Griseb.	M, P: Shwe-kana-phot, Ka-na-phot	Food and Medicine: shoot for salad, consumed for body swollen	TS0366 (P)
Amaranthus viridis L.	M: Hin-nu-nwe	Food: tender leaves as vegetable	TS0020 (M)
Bassia scoparia (L.) A.J.Scott	M: Ta-byat-se	Food: shoots and tender leaves as vegetable	TS0019 (M)
Anacardiaceae			
Mangifera sylvatica Roxb.	E: Taw-tha-yat	Food and Construction: fresh fruits pounded as salad with other ingredients, sliced fresh fruits for sour taste	TS0809 (E)
Annonaceae			
Annona cherimola Mill.	M, P: Aw-le	Food: fruits edible	TS0043 (M)
Apiaceae			
Centella asiatica (L.) Urb.	E, M, P: Myin-kwar	Food and Medicine: tender leaves as salad, paste of leaves prepared lotion for sore throat, cold infusion	TS0165, TS0293 (M)

		of leaves as eye drop	
Oenanthe cf. *javanica* (Blume) DC.	M: Za-lae	Food: tender leaves as salad, cooked as traditional curry	TS0138, TS0166 (M)
Apocynaceae			
Telosma cordata (Burm. f.) Merr.	E, M, P: Gwe-tauk	Food and Medicine: tender leaves for soup with chicken, consumed food as medicine for alcohol dependence	TS0190 (M)
Araliaceae			
Macropanax dispermus (Blume) Kuntze	P: Tha-yat-kin, Ka-la-kin	Food, Construction, Fuelwood and Medicine: shoot as vegetable dish and salad, food consumed for retention of gasses in bowel	TS0590, TS0619, TS0645 (P)

Asteraceae			
Bidens biternata (Lour.) Merr. & Sherff	P: Hlan-kwa	Food: shoot as vegetable	TS0563 (P)
Crassocephalum rubens (Juss. ex Jacq.) S.Moore	E: Nu-su; P: Taw-bi-zat	Food: shoot as vegetable, tender leaves for salad	TS00684 (P); TS0776 (E)
Dichrocephala integrifolia (L.f.) Kuntze	M: Sein-zar-myat-lone	Food and Medicine: shoots and tender leaves for soup, food consumed as medicine at postpartum period for mother	TS0038 (M)
Laggera alata Nanth.	M, P: La-thar-ba-pyin	Food and Medicine: shoots fried with eggs, good for swollen body, the whole plant as wristband for back pain, leaves extract used over knife injuries	TS0078 (M)
Bignoniaceae			
Markhamia stipulata (Wall.) Seem.	E: Ma-lwa	Food and Construction: boiled flower as salad with fish paste, fried as vegetable	TS0735 (E)
Oroxylum indicum (L.) Kurz	E, M, P: Kyaung-shar	Food and Medicine: flowers and fruits for vegetable dish, fruits as salad, farmented fruit, boiled and pounded fruits as salad with other ingredients, young leaves prepared salad, and consumed orally for tinnitus	TS0105 (M); TS0743 (E)
Burseraceae			
Protium serratum (Wall. ex Colebr.) Engl.	E: Kadi	Food and Construction: fruits eaten fresh	TS0704 (E)
Celastraceae			
Celastrus paniculatus Willd.	M, P: Taung-bort-lu-lin	Food and Medicine: tender leaves prepared for soup, diet food for healthy life	TS0230 (M)
Combretaceae			
Terminalia bellirica (Gaertn.) Roxb.	E, M, P: Thit-seint	Food: seeds eaten fresh	TS0702 (E)

Cucurbitaceae			
Marah macrocarpa (Greene) Greene	M: Kin-mon-tee	Food: fruits as vegetable	TS0094 (M)
Momordica subangulata Blume	M: Taw-hin-khar	Food and Medicine: fruits and leaves as vegetable, consumed as appetizer	TS0114, TS0276 (M)
Ebenaceae			
Diospyros kaki L.f.	M: Tae, Tel; P: Tel	Food: ripe fruits edible	TS0142 (M)
Elaeagnaceae			
Elaeagnus griffithii Servettaz	P: Mat-lwat, Myat-lu	Food: ripe fruits edible	TS0359, TS0480 (P)
Elaeocarpaceae			
Elaeocarpus stipularis var. siamensis (Craib) Coode.	M: Sein-se-ba-lu	Food: ripe fruits edible	TS034 (M)
Elaeocarpus floribundus Blume	M: Sein-sar-blue-pan	Food and Fuellwood: seeds used to extract edible oil, seed edible	TS0183 (M)
Fabaceae			
Acacia concinna (Willd.) DC.	E, M; Kin-mon-chin	Food and Shampoo: decoction of fruits for shampoo, tender leaves prepared soup with bean, prepared salad, fried with fish paste	TS0139 (M)
Acacia pennata subsp. kerrii I.C.Nielsen	E: Sue-pote, Sue-pote-kyi; M, P: Sue-pote	Food: tender leaves cooked as soup, cooked with fish, cook with meat, fried with egg, vegetable dish	TS0736 (E)
Archidendron jiringa (Jack) I.C.Nielsen	E, M, P: Da-nyin	Food: boiled seeds	TS0710, TS0811 (E)
Bauhinia purpurea L.	E: Swe-daw; P: Kha-lat	Food: tender leaves as soup with potato	TS0419 (P); TS0856 (E)
Bauhinia variegata L.	P: Kha-la	Food: leaves as salad. seed edible as pulses	TS0629 (P)
Fagaceae			
Lithocarpus lindleyanus (Wall. ex A.DC.) A.Camus	M: Thit-al-sein	Food and Constructiion: roasted seed edible	TS0240 (M)

Lamiaceae			
Rotheca serrata (L.) Steane & Mabb.	M: Yin-byar; P: Hin-byar, Hin-khar	Food and Medicine: tender leaves and flowers as vegetable and salad, young leaves consumed as salad for retention of gasses in bowel, and diarrhea, cream of rhizome used as lotion on abdomen for retention of gasses in bowel, roots fermented together with jaggery and consumed orally for loss of sleep	TS0005, TS0082, TS0209, TS0279 (M); TS0387, TS00494, TS0591, TS0606 (P)
Lauraceae			
Cinnamomum tamala (Buch.-Ham.) T.Nees & Eberm.	P: Thit-kya-poe	Food and Medicine: leaf for spice in traditional curry, dry bark powder consumed orally as blood tonic, dry leaf powder used as inhalant at postpartum period for mother	TS0678 (P)
Laurus cf. *nobilis* L.	M, P: Lae-lu	Food: leaves for spices	TS0483 (P)
Lythraceae			
Duabanga grandiflora (DC.) Walp.	E: Ga-zaw	Food and Construction: fruits edible	TS00716 (E)
Melastomataceae			
Osbeckia nepalensis Hook. f.	P: Shar-pyar-tee	Food: fruits edible	TS00631(P)
Moraceae			
Ficus auriculata Lour.	M: Ka-ohn, Kaung-oat-tee, Tha-phan; P: Pha-owl	Food: ripe fruits edible	TS0042, TS0110, TS0182 (M); TS0461(P)
Ficus racemosa L.	E, M, P: Tha-phan	Food: ripe fruit edible, fresh fruits soaked in salty water, pounded leaves as paste, tender leaves as salad, leaves cooked with potato	TS00148 (M)
Ficus semicordata Buch.-Ham. ex Sm.	E, M, P: Ka-dut; P: Tha-phan	Food and Fuelwood: ripe fruit edible, fresh fruits fermented for food, tender	TS0071, TS00131, TS00172 (M); TS0474 (P); TS0788

		leaves for soup	(E)
Ficus virens Aiton	M, P: Nyaung-chin	Food: leaves and shoots for soup and salad	TS0140 (M)
Maclura fruticosa (Roxb.) Corner	P: Sue-sein	Food: shoot as vegetable for soup and salad	TS0478 (P)
Myricaceae			
Myrica esculenta Buch.-Ham. ex D. Don	M: Kata-pho	Food: ripe fruits edible	TS0058, TS0109, TS0180 (M)
Myrtaceae			
Psidium guajava L.	E: Mar-la-kar	Food: fruits eaten fresh	TS0760 (E)
Syzygium cumini (L.) Skeels	E, M, P: Tha-pyay	Food and Construction: ripe fruits edible	TS0215 (M)
Syzygium oblatum (Roxb.) Wall. ex A.M.Cowan & Cowan	E, M, P: Tha-pyay	Food and Construction: ripe fruits edible	TS0253 (M)
Syzygium pycnanthum Merr. & L.M.Perry	E, M, P: Tha-pyay	Food, Construction and Fuelwood: ripe fruits edible	TS0104 (M); TS0615 (P)
Oleaceae			
Anacolosa clarkii Pierre	M: Tay-pin	Food: fruits edible	TS0259 (M)
Oxalidaceae			
Oxalis latifolia Kunth	M: Mu-chin	Food: children eat all parts of plants	TS0024 (M)
Phyllanthaceae			
Antidesma acidum Retz.	E: Kim-ma-lin	Food: fruits and leaves as vegetable	TS0795 (E)
Bischofia javanica Blume	M: Yae-pa-done	Food: shoots for salad, young leaves as vegetable	TS0041, TS0074 (M)
Phyllanthus emblica L.	E: Zepyu; M: Se-sar; P: Se-shar	Food, Fuelwood and Medicine: fruits pounded as salad, boiled fruits pounded and prepared salad, consumed as food for hypertension, fruits eaten fresh for over bleeding, fruits roasted and consumed as food for cough	TS0033, TS0052, TS00213, TS0185, TS00280 (M); TS0351, TS0670 (P); TS0806 (E)
Plantaginaceae			

Plantago major L.	M: A kyaw-baung-tha-thaung	Food and Medicine: tender leaf for salad, leaf heated on fire to become wilted, and touch on abscess and boils, paste of leaves used as bandage for broken legs, young leaves prepared as salad, consumed as food for toxaemia and hypertension; paste of entire plant used over abscess	TS0089 (M)
Primulaceae			
Embelia ribes Burm.f.	M, P: Kan-pa-lar	Food: leaves as salad and soup, tender leaves and buds boiled and eaten with fish sauce	TS0175 (M)
Rhamnaceae			
Ziziphus incurva Roxb.	P: Sue-kauk	Food: fruits edible	TS0688 (P)
Rosaceae			
Docynia indica (Wall.) Decne.	M, P: Pin-sein	Food and Fuelwood: fruits eaten fresh, cooked as soup, pounded with chili as side dish	TS0032, TS0133, TS0168, TS0204 (M); TS0399, TS0429, TS0513, TS 0588, TS0638 (P)
Rubiaceae			
Coffea arabica L.	P: Coffee	Food: roasted seed for coffee	TS0519 (P)
Wendlandia budleioides Wall. ex Wight & Arn.	M, P: Thit-ne	Food and Construction: tender leaves for salad	TS0085 (M)
Wendlandia tinctoria (Roxb.) DC.	M, P: Thit-ni	Food and Fuelwood: tender leaves as vegetable	TS0176 (M)
Rutaceae			
Casimiroa cf. *edulis* La Llave	M, P: Tha-gyar-tee	Food: fruits edible	TS0044 (M)
Clausena excavata Burm.f.	M: Pyin-thaw-sein	Food: tender leaves as raw salad	TS0069 (M)
Murraya koenigii (L.) Spreng.	P: Pyin-taw-thein	Food: tender leaves as raw salad	TS0543 (P)
Zanthoxylum armatum DC.	M: Mike-cup	Food: tender leaves ingredient to beef curry	TS0030 (M)

Salicaceae			
Casearia graveolens Dalzell	E: Phan-khar	Food and Construction: fruits eaten fresh	TS0801(E)
Sapindaceae			
Choerospondias axillaris (Roxb.) B.L.Burtt & A.W.Hill	E: Del-cline	Food: fruits edible	TS0765 (E)
Dimocarpus fumatus (Blume) Leenh.	E: Taw-kyat-mauk	Food: fipe fruits edible	TS0803 (E)
Spondias pinnata (L. f.) Kurz	E: Gwe	Food: fruits eaten fresh	TS0812 (E)
Schoepfiaceae			
Schoepfia fragrans Wall.	P: Byauk-ole-kyi	Food: fruits edible	TS0610 (P)
Solanaceae			
Physalis angulata L.	E: no name	Food: fruits eaten fresh	TS0756 (E)
Physalis pubescens L.	P: Taw-kha-yan-chin	Food: fruits eaten fresh	TS0477 (P)
Solanum torvum Sw.	E, M: Kha-yan-ka-zot; P: Ka-zot	Food: fruits as vegetable	TS0186 (M); TS0737 (E)
Theaceae			
Camellia taliensis (W.W.Sm.) Melch.	M, P: Taw-la-phat	Food: tender leaves for salad	TS0112 (M); TS0339 (P)
Schima wallichii Choisy	M: Thit-yar	Food and Constructiion: shoots as vegetable	TS0086 (M)
Urticaceae			
Dendrocnide basirotunda (C.Y .Wu) Chew	E: Tha-phan	Food: ripe fruits edible	TS0780 (E)
Vitaceae			
Leea indica (Burm. f.) Merr.	E: no name; M: Pait-chin	Food: shoot as vegetable	TS0226 (M); TS0805 (E)

*: E, Eden; M, Myin Ka; P, Pin-sein-pin

4. Discussion

The chloroplast *rbcL* sequences of 71 species (85.5% of identified species) were successfully sequenced. The sequences of 53 species (71.6% of sequenced species) yielded a single haplotype from a particular species by the BLAST, whereas the remaining sequences yielded two or more haplotypes from the closely related genera. As many of the specimens

collected were of sterile plants, DNA barcoding technique facilitated the identification of the WEPs in this study.

The villagers collected most of WEPs for their own consumption. A total of nine species were collected for selling at local markets. Apart from food, 18 species were used as medicinal plants.

The differences in use of WEPs between the communities of three villages have been observed. Myin Ka village used comparatively large number of WEPs than other two villages. Myin Ka village has long history than other two villages and could inherit much more traditional knowledge about WEPs. In spite of the same major ethnic group (*Danu* people) and similar vegetation in both of Myin Ka and Pin-sein-pin villages, 33 out of 71 WEPs species were used in both of the villages, but the remaining 38 species were not in common between the two villages. These two communities have different historical background, and there was no social relationship between two villages. This may be a cause of different use of the plant resources.

The elevation of Eden village is about 350 m above sea level, while that of Myin Ka and Pin-sein-pin villages is more than 1000 m. The forests around Eden village are mostly deciduous forests, while that around Myin Ka and Pin-sein-pin villages are evergreen forests. These differences could be the causes of variation of plants used by the local communities. Moreover, Eden village is newly established by *Kayan* people migrated from Kayah state, which is different from Myin Ka and Pin-sin-pin villages established by *Danu* people in Shan State. The migrated community may be less familiar to plant resources in the new environment for them. In addition, Eden village was practicing shifting cultivation for banana plantation. Shifting cultivation could have detrimental effects on the environment, and availability of WEPs could be diminished.

The sharing of work between the family members was revealed, and the age class of 30-39 years was taking more responsibilities in collection of WEPs. Abundance of knowledge of WEPs in the younger age class and decrease of knowledge exhibited by the elder groups has been reported [43].

The results of this study indicate more shared knowledge in the community which has common land. Myin Ka village has 120 hectares of common land for watershed conservation, and all villages of Myin Ka village are accessible to the common land for collection of WEPs. While most of the land area around Pin-sein-pin village is privately own. In case of Eden village, shifting cultivation was practiced in the reserve forests where they do not have legal right for land ownership. Thus, land use and land ownership system could have effects on the sharing of knowledge of WEPs among the villagers.

Some of WEPs, such as the shoots of *Lasia spinosa* and *Cheilocostus speciosus,* have market demand as wild food. Although the boiled seeds of *Archidendron jiringa* are consumed widely in tropic, it is also found to have some toxicological effects on heart, kidney, liver and pancreas [44]. The different mode of utilization of WEPs is also observed in the study area. To the best of our knowledge, there are no reports on the use of seed oil of

E. floribundus, although its fruits are eaten raw as a wild edible fruit in Southern Asia [45]. The perception on the use of WEPs resembles to the some areas of Africa [10]. Some of the species, such as *Dichrocephala integrifolia* and *Rotheca serrata*, are used not only for nutritional purposes but also for medicinal purpose.

5. Conclusion

The rich diversity and traditional knowledge of WEPs have been documented in this study. This study indicates that WEPs play important role in the livelihood of local communities. Historical background, land use system and surrounding vegetation could have effects on the variation of the traditional uses of WEPs. The indigenous society, especially Myin Ka village, maintained more traditional knowledge on the WEPs. In addition to the food value, such as medicinal uses, WEPs become more important in the livelihood of local people. WEPs are not only important for increase of the diversity of local food consumption, but also for the income generation of the local communities. Increasing awareness on the importance of WEPs will encourage the conservation of traditional knowledge of indigenous population. Further investigation should be carried out on the nutrition value of WEPs species. Further investigations on nutrition value and pharmacological activities of the WEPs will add more value to the traditional knowledge.

Table 4. List of WEPs used as medicinal plants

Taxon	Use	Ailment
Alternanthera philoxeroides	Food as medicine	Inflamation
Arisaema erubescens	Food as medicine	Digestive system disorders
Celastrus paniculatus	Food as medicine	Nutritional Disorders
Centella asiatica	Ingredient for medicine	Respiratory system disorders; Sensory system disorders
Cheilocostus speciosus	Ingredient for medicine	Digestive system disorders
Cinnamomum tamala	Ingredient for medicine	Birth related disorders
Colocasia esculenta	Ingredient for medicine	Poison (Insect poison)
Curcuma aromatica	Ingredient for medicine	Injuries
Curcuma cf. *amada*	Ingredient for medicine	Digestive system disorders
Dichrocephala integrifolia	Food as medicine	Birth related disorders
Laggera alata	Ingredient for medicine	Inflamation; Pains; Injuries
Macropanax dispermus	Food as medicine	Digestive system disorders

Momordica subangulata	Food as medicine	Nutritional disorders
Oroxylum indicum	Food as medicine	Sensory system disorders
Phyllanthus emblica	Food as medicine	Circulatory system disorders; Respiratory system disorders
Plantago major	Food as medicine	Poison (Food poison); Skin/Subcutaneous/Cellular tissue disorders; Injuries; Circulatory system disorders
Rotheca serrata	Food as medicine	Digestive system disorders; Mental disorders
Telosma cordata	Food as medicine	Mental disorders

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