Ethnobotanical study of the Chơ Ro minority in Dong Nai Culture and Nature Reserve, Vietnam

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Research

Abstract

Background: The Chơ Ro ethnic community in Dong Nai Culture and Nature Reserve has diverse traditional knowledge of plants, but it has disappeared at an alarming rate for various reasons.

Methods: An ethnobotanical study was conducted from March to June 2022 in Ly Lich 1 hamlet, Phu Ly commune, through semi-structured interviews and field surveys involving seven key informants. The aim was to compile an inventory of useful plants utilized by the local community. Additionally, focus groups were employed to identify priority species based on community perception.

Results: A total of 118 taxa, belonging to 57 plant families, were identified as being utilized by the community across eight main categories. Among these, food comprised the largest group, accounting for 66.0% of total use reports, with various plant parts being utilized. Using three techniques of the Participatory Rural Appraisal (PRA) approach, including free-listing, direct ranking, and pair-wise ranking, it was determined that *Gnetum gnemon* L. and *Lasia spinosa* (L.) Thwaites were the most important species for the Chơ Ro people. Consequently, distribution maps for these species within the study site were created based on field surveys.

Conclusions: The study's findings contribute significantly to the preservation of Chơ Ro's indigenous knowledge and provide essential data for biodiversity conservation and the sustainable development of local resources.

Keywords: Ethnobotany; Chơ Ro; Indigenous knowledge; Priority species

Background

Since the 1960s, there has been a growing recognition among scientists of the significance of integrating indigenous knowledge with modern scientific knowledge and giving greater attention to indigenous knowledge in socio-economic development (Dinh 2019, Vu 2015). Initially termed "Indigenous technical knowledge," this knowledge system refers to the accumulated, refined knowledge of indigenous communities within specific geographical areas, developed through historical practices, interactions, and engagement with the environment (Howes & Chamber 2016). Passed down through generations via memory, oral tradition, hands-on experience, and social practices, indigenous knowledge spans various sectors crucial to local livelihoods, including agriculture, healthcare, education, community organizing, and natural resource management (Dinh 2019, Le 2002).

Indigenous knowledge studies are diverse in Europe and North America, analyzing various aspects of the local community's perception of the surrounding world (McElwee 2010). Particularly, the topic of indigenous knowledge about living things, especially plants, has formed an independent science "Ethnobotany" to refer to the study of plants used by primitive and aboriginal people (Balick 1996). Over the last thirty years, ethnobotany has been conducted fairly vigorously, as shown by a significant increase in the number of articles in specialized journals. In addition to fundamental studies that synthesize and systematically compile the knowledge of indigenous communities about plant use (Cahill 2003, Estrada *et al.* 2007, Guarrera 2006), new approaches have emerged as scientists focused on the improvement of their methodological rigor or the development of supporting techniques that enable results to answer a previously posed hypothetical question (Stepp 2005). These techniques provide greater insights than merely compiling a list of beneficial plants, from which persuasive conclusions can be drawn. They also serve as a foundation for recommendations in resource management projects or research on bioactive secondary plant compounds.

In Vietnam, studies frequently focus on the application of indigenous knowledge in forest management and protection (Pham & Hoang 2009), prediction and response to climate change (Nguyen 2017), or exploitation of a certain resource, particularly wild edible and medicinal plants (Dang & Duong 2013). For example, Vu *et al.* (2019) conducted a study on the plants used by the La Ha ethnic group as wine yeast in Son La province. They also documented several species listed in Vietnam's Red Book (2007) requiring protection in the Northern region (Vu *et al.* 2019). In the same year, Dinh carried out a study on the indigenous knowledge about forest plants that hold value as food sources for the S'tiêng people in Cat Tien National Park. The study included an assessment of the exploitation status of plant species based on the UI index; thereby leading to the proposal of conservation options for species in the Southern region (Dinh 2019). In recent times, research on indigenous knowledge regarding the use of medicinal plants has become quite popular, reflecting a growing interest in understanding traditional healing practices (Dam *et al.* 2020, Nguyen *et al.* 2020, Tran *et al.* 2019). However, most of them predominantly focus on the specific value of plants rather than exploiting other aspects of the interrelationships between local people and natural resources.

Chơ Ro is one of Vietnam's 53 ethnic minorities, encompassing approximately 29,520 individuals. They mainly reside in the Southeast region, with a significant concentration in Dong Nai Province (accounting for about 56.5% of the total population of this group) (Ethnic Committee & General Statistics Office of Vietnam 2020). As of 2015, approximately 150 Chơ Ro households reside in Phu Ly commune, Dong Nai Province. They congregate in Ly Lich 1 hamlet alongside other ethnic groups, such as Kinh, Hoa, Mường, Tày, Nùng, and Khmer (Huynh 1999, Tran 2015). In this area, the Chơ Ro community primarily engages in agriculture, complemented by the harvesting of forest plants for both sale and personal use, such as wild vegetables, bamboo shoots, and mushrooms (Huynh *et al.* 2013). Over a while, they have accumulated extensive knowledge in utilizing forest plants for various purposes, including food, spices, household items, and production tools. Consequently, these practices are regarded as the cultural and experiential heritage of numerous generations deeply connected to the forest and nature within the Chơ Ro community (Huynh 1999, Truong *et al.* 2013).

Nowadays, the life of Chơ Ro people in the region is gradually towards modernization accompanied by increased cultural and economic interactions with other ethnic groups. These acculturations pose significant challenges to the preservation and development of the indigenous knowledge of the Chơ Ro people today (Huynh 1999, Huynh *et al.* 2013) besides the fact that they still have no own writing system and the loss of biodiversity resources due to overexploitation (Sa 2020). Documenting indigenous knowledge is considered an essential task for ethno-disciplines due to the benefits it contributes, such as basic drug research and development, preservation of cultural heritage, and maintenance of biological diversity especially in the present context of species extinction at an unprecedented rate. The decline in biological diversity is closely linked to the loss of cultural diversity, particularly among traditional and indigenous communities (Weldegerima 2009). Hence, the Chơ Ro community in Ly Lich 1 hamlet was chosen for the current study to explore and preserve the knowledge of utilizing indigenous plants within the Chơ Ro ethnic community in the Dong Nai Culture and Nature Reserve (DNCNR). The objectives of the present study were: to document the traditional knowledge of plants used by the Chơ Ro ethnic group in DNCNR and to identify priority species according to local people's perceptions.

Materials and Methods

Study area

Dong Nai Culture and Nature Reserve with a total area of 100303 ha (67903 ha of forestry land and 32400 ha of water surface - Tri An Lake) is located in the northern part of Vinh Cuu District, Dong Nai Province. Established in early 2004, the reserve boasts varied topography, descending from the north to the south and from the east to the west. The north features high hills and steep slopes, with an average altitude ranging from 100-200 m, with the highest peak at 368 m and the lowest at 20 m. Meanwhile, the south is characterized by low hills and semi-plains, occupying a significant portion of the area (Nguyen & Nguyen 2016). The average annual temperature is from 25^0C to 27^0C and the average annual rainfall is also relatively high from 2000-2800 mm/year. The rainy season typically begins in May and concludes in October, comprising approximately 85-90% of the annual rainfall. The period from November to April of the following year is considered the dry season (Phung *et al.* 2016). The Reserve is considered one of 16 special-use forests in the Southeast region with diverse and abundant flora and fauna (Nguyen & Tran 2020). The main vegetation types present in the Reserve are evergreen broad-leaved forests, semi-deciduous evergreen forests, broad-leaf mixed bamboo forests, and bamboo forests derived from the two former ecosystems due to human impacts such as wood exploitation, deforestation for agriculture, and war chemicals. A total of 1558 plant species belonging to 166 families and 95 orders of 6 phyla have been recorded here with Fabaceae having the most species (132 species). Additionally, 33 rare plant species have been documented (Department of Natural Resources and Environment of Dong Nai Province 2018).

Ly Lich 1 hamlet, part of Phu Ly commune in Vinh Cuu District, is situated to the north of the DNCNR (Figure 1).

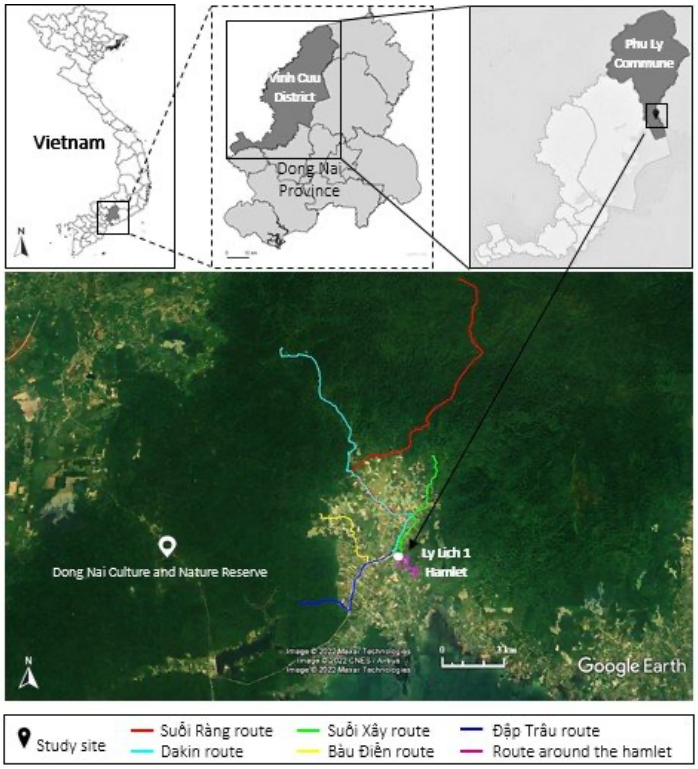

Figure 1. Study site and research routes in Dong Nai Province, Vietnam
Source: Map data © 2022 Google

Field study and ethnobotanical data collection

The field study was carried out from March to June 2022 at Ly Lich 1 hamlet where the Chơ Ro minority gathered. Before conducting the study, approval was obtained from the Dong Nai Culture and Nature Reserve. This included written consent from the Reserve, allowing for contact with the indigenous community and collection of plant samples within the area.

Ethnobotanical data and plant specimens were collected through semi-structured interviews and field surveys conducted with Chơ Ro key informants who were knowledgeable in plant use, following the methods described by Martin (1995) and Nguyen (2006). These informants were chosen as representatives to provide information about the plants used in the community's daily life, selected through snowball sampling (Guo *et al*. 2022, Sedgwick 2013). The first informant was introduced by the community and government officials. She was the oldest child of the former head of the community. At the end of the interview, she recommended other key informants who had close relationships with the forest for subsequent interviews, and they, in turn, recommended other potential informants. A list of preliminary questions was prepared for the semi-structured interviews, while additional questions emerged during the interviews depending on the key informant's knowledge and experience.

The field walk with key informants was conducted simultaneously with the semi-structured interviews. The survey routes were determined based on the key informants' experience, as they are familiar with the plants in the area where they have resided for an extended period. Another criterion for route design was to ensure coverage of various habitat types within the study area, including shorter routes around residential areas, to obtain a comprehensive understanding of plant resources and the knowledge of species used in the study area (Le & Nguyen 2016, Nguyen 2006). Information about plants by the key informants, such as their uses, habitat, distribution, and characteristics, was recorded during the field trip.

Plant collection and identification

All plants reported by key informants were collected and labeled with a code, local name, date, place of collection, and use value (Nguyen 2008). Simultaneously, photos of the landscape and plants were taken to aid in plant identification and to compile ethnobotanical data on locally useful plants.

The plants were identified in the field and verified by Dr. Nguyen Xuan Minh Ai, a botanist and the author, through a comparative analysis of morphological characteristics of reproductive organs and vegetative organs with those documented in botanical references, including “An illustrated flora of Vietnam” (Pham, 1999), “Checklist of plant species of Vietnam” (Vietnam National University-Hanoi 2001), Flora of Cambodia, Laos and Vietnam (Aubréville 1960), The plant list of Dong Nai Culture and Nature Reserve (http://www.dongnaireserve.org.vn). Nomenclature was cross-referenced using World Flora Online (https://wfoplantlist.org/plant-list) and Tropicos® (https://www.tropicos.org/), while the common names were followed by the book “An illustrated flora of Vietnam” (Pham 1999).

All voucher specimens were deposited in the Pham Hoang Ho Herbarium (PHH), Department of Ecology and Evolutionary Biology, University of Science, Vietnam National University-Ho Chi Minh City.

Priority plant species in the community

Tools of the PRA method were used in group discussions to identify important plant species from the Chơ Ro community’s point of view and participants’ perception of threats to the species (N’Danikou *et al.* 2011, Narayanasamy 2009, Nguyen 2018, Paul 2006).

A total of 11 Chơ Ro people were interviewed, regardless of gender, age, occupation, or income. This group comprised seven key informants identified initially and four other indigenous Chơ Ro members from the community. The informants who participated in the step were willing to share their ideas because they maintained their habits of going to the forest, unlike most others who either lacked interest in wild plants or were too shy to express their thoughts. The selection of these additional participants also followed the snowball method.

In reality, both women's and men's perceptions are influenced by diverse factors, leading to variations in lifestyles, needs, experiences, and priorities between the two genders (Paul 2006). Therefore, gender analysis was conducted at the beginning of the group discussion to find out the point of view of the community’s important plants between men and women.

A preliminary focus group discussion with 11 Chơ Ro informants was held to clarify the discussion's purpose and disseminate the planned content. Subsequently, they were split into two groups: the male group (6 people) and the female group (5 people). These groups remained consistent throughout the remaining interviews. Each participant was shown a set of images of 118 plant species that had been identified by key informants during field surveys. They were then asked to select the species they considered significant and to provide explanations for their choices. Utilizing this free listing method, a record of important species and the criteria for choosing these species were compiled. Additionally, the priority of species was determined in part by how frequently the plant was mentioned by the informants. The process of focus group interviews used to select priority species based on local people's perceptions is presented in Figure 2.

Figure 2. Group discussion with local informants for priority species selection

The direct ranking method was also utilized to identify priority species. In this process, two participant groups were asked to select their priority species based on scoring criteria established during the free listing step (Narayanasamy 2009). Previous studies have indicated that results obtained from these approaches may vary depending on the community's perception. Therefore, the results obtained through both methods were compared to validate the identification of important species according to the community's perspective.

While a list of significant species was identified using previous methods, it proved to be excessively lengthy. Subsequently, the pair-wise ranking method was employed to select the most preferred species. The steps were performed as follows: each pair of plant species was presented, and the group of 11 participants voted on which plant they considered more important, assigning it a score of "1", while the less important species received a score of "0". In cases where the two compared plants were considered equally important, both were allocated a score of "1/2". The priority plants were then sorted based on their scores (Narayanasamy 2009, Paul 2006).

Data analysis

Priority plant species: reasons for selection, gender analysis

A use-report was calculated whenever an informant mentioned the use of a plant species or its parts for a specific purpose. The Spearman's non-parametric rank order test was employed to analyze the correlation in the order of priority species recorded from the free-listing and pair-wise ranking methods. The relationship between factors influencing the selection of priority species was assessed using Spearman's correlation coefficient test. The Mann-Whitney test was utilized to ascertain differences in the selection of factors between male and female groups.

Investigating the current status of important plant species within the community

Several important species, which obtained the highest ranking from the pair-wise ranking method, were selected for further study of their current status. Data gathered on habitat, distribution location, and conservation status changes over the past five years, along with the factors contributing to these changes. Field surveys continued along existing routes, with adjustments made based on additional information provided by the group to assess the relative status of these species.

The conservation status of plants was recorded by referring to the data from IUCN Red List Vietnam's Red Book, Checklist of plant species of Vietnam (2001-2005), and Decree No. 06/2019/ND-CP.

Results

Diversity of plants used by the local community

A total of 06 survey routes were established for field trips to collect information on native plants with key informants, of which 05 routes were in the forests, including Suối Ràng (23 km long), Dakin (16.26 km), Đập Trâu (7.16 km), Suối Xây (6.23 km), Bàu Điền (6.67 km) and one short route were around residential area representing roadside and garden habitat (Fig. 1). From semi-structured interviews conducted in conjunction with field surveys along the six routes mentioned above, 118 plant taxa used by the Chơ Ro ethnic community in daily life were recorded (Table 1). Of these, 96 taxa were identified at the species level, belonging to 96 genera, 57 families, 36 orders, 5 classes, and 4 phyla. The remaining 19 taxa were identified to genus and 3 taxa to family.

At the family level, based on the distribution of the number of taxa among 57 families, the following cases were recorded: 1 taxon, 2 taxa, 3 taxa, 4 taxa, 5 taxa, 6 taxa, and 8 taxa. Among these, 30 out of 57 families had only one taxon (accounting for 52.6% of the total number of families). The Rubiaceae and Arecaceae families were the two most frequently mentioned by local people, each with 8 taxa.

Indigenous knowledge of plant

Categories of plant use

In light of the literature regarding the taxonomy of plant use groups among indigenous peoples, as explored by researchers like Signorini *et al.* (2009), Pegu *et al.* (2013), Senbeta *et al.* (2013), and Guo *et al.* (2022), the present study recorded eight primary categories of use provided by local plant resources to the community, resulting in 356 recorded use-reports. These encompass alimentary, beverage, material (for building or handicraft), technique (utilized as tools in traditional manufacturing processes), ornaments (for landscape beautification), culture/social (linked to community activities), poison (with both beneficial and harmful applications), and medicine (for human use). Excluding the medicine group, which falls outside the scope of the present study, the alimentary group exhibited the highest number of used taxa, with 56 taxa and 63 use-reports, followed by the beverage group with 55 taxa and 66 use-reports (Table 2).

Alimentary

The culinary tradition of the Chơ Ro community possessed a diverse array of ingredients, with numerous plants serving as essential elements in their cuisine. Among these, most plants were utilized as ingredients for daily meals (34/56 taxa). They were consumed directly, such as eaten raw or processed through methods like frying, grilling, boiling, or cooking in soup, to prepare dishes like **canh bồi** (a kind of traditional soup) and **đọt mây nướng** (grilled young shoot of rattan). These dishes were prepared with daily frequency and also featured as traditional foods during community festivals (the **Sayangva** festival). Additionally, some plants were dried for long-term preservation; for example, young shoots of *Gigantochloa* sp. were cut into small pieces (about 20 cm long) and sun-dried.

Table 1. List of plants traditionally used by the Chơ Ro people

Family	Science name/herbarium code	Chơ Ro's name (local name in Vietnamese)	Life form	Habitat	Use category	Parts used	Preparation method
Acanthaceae	*Cyclacanthus coccineus* S.Moore /PHH1005588	Pai la ooc (Trường sơn đỏ)	Tree	Forest	Daily food (A)	Young shoots	Traditional soup
					Beverage (B)	Flowers	Fresh nectar
					(Me)		
	Pseuderanthemum crenulatum (Wall. ex Lindl.) Radlk. /PHH1005536	Pai la pâu (Mồng tơi rừng lá lớn)	Tree	Forest	Daily food (A)	Young shoots	Traditional soup*
	Sp1. /PHH1005637	(Mồng tơi rừng lá dài)	Tree	Forest	Daily food (A)	Young shoots	Traditional soup
	Thunbergia annamensis R.Ben /PHH1005589	La plo (Trường sơn trắng)	Tree	Forest	Daily food (A)	Leaves	Traditional soup
					(Me)		
Anacardiaceae	*Mangifera* sp. /PHH1005639	Xơ dít bri	Tree	Forest	Fruit (A)	Fruits	Raw edible
					(Me)		
Ancistrocladaceae	*Ancistrocladus tectorius* (Lour.) Merr. /PHH1005510	Xe pơ đôm	Vine	Forest Garden	Beverage (B)	Stems	Alcohol maceration
					Building (Ma)	Leaves	Stilt houses roof
					(Me)		
	Sageraea elliptica (A.D.C) Hook. & Thoms. /PHH1005579	Xơ la troong (Xoong mây)	Tree	Forest	Handicraft (Ma)	Stems	Make a crossbow frame
					Handicraft (Ma)	Stems	The straight, solid stem is used as a pepper pestle
					Building (Ma)	Leaves	Stilt houses roof
	Uvaria sp. /PHH1005518	La chưn heng (Dẻ láng)	Tree	Forest	Traditional alcohol (B)	Leaves	Chop, crush, then dry, mix, and finely grind with rice
					Cigarette roll (T)	Leaves	Fresh leaves are used for wrapping tobaco
					(Me)		
Apocynaceae	*Willughbeia edulis* Roxb. /PHH1005587	Xe xá (Dây gùi)	Vine	Forest Garden	Fruit (A)	Fruits	Raw edible
					(Me)		

	Wrightia dubia (Sims) Spreng. /PHH1005649	Xơ lòng mứt	Tree	Forest	Handicraft (Ma)	Stems	Use a Y-shaped branch to make a slingshot body
					(Me)		
Araceae	*Aglaonema simplex* (Blume) Blume /PHH1005540	(Trường sinh)	Herb	Forest	Decoration (O)	Flowers	Beautiful flowers used for decoration
					Ornamental plant (O)	Whole plant	Plants gathered from the forest are subsequently planted in a home garden
	Homalomena occulta (Lour.) Schott /PHH1005527		Herb	Forest	Beverage (B)	Tubers	Alcohol maceration
					(Me)		
	Lasia spinosa (L.) Thwaites /PHH1005562	(Mướp gai)	Vine	Forest Garden	Daily food (A)	Young shoots	Boil/vegetable soup/ fermented
					(Me)		
	Rhaphidophora sp. /PHH1005515	Xe ka ốp la mác	Vine	Forest	Traditional alcohol (B)	Leaves/ Stems	Chop, crush, then dry, mix, and finely grind with rice
					(Me)		
	Pothos scandens L. /PHH1005512	Xe ka ốp quay (Chân rết lá nhỏ)	Vine	Forest	Traditional alcohol (B)	Leaves/ Stems	Chop, crush, then dry, mix, and finely grind with rice
					(Me)		
Arecaceae	*Arenga caudata* (Lour.) H.E.Moore /PHH1005620	Re ngan (Mây rả)	Shrub	Forest	Handicraft (Ma)	Stems	Knit bamboo baskets
					Building (Ma)	Stems	Stilt houses floor
	Calamus godefroyi Becc. /PHH1005630	Re la xôi (Mây nước)	Vine	Forest	Daily food (A)	Young shoots	Traditional soup/grilled
					Building (Ma)	Leaves	Stilt houses roof
	Calamus poilanei Conrard /PHH1005539	Re xa bôm (Mây xông bột)	Vine	Forest	Handicraft (Ma)	Stems	Bamboo basket bases
	Calamus rudentum Lour. /PHH1005618	Trek tum bon (Mây săn đá)	Vine	Forest	Daily food (A)	Young shoots	Traditional soup
					Handicraft (Ma)	Stems	Bamboo basket bases
					(Me)		
	Calamus tetradactylus Hance /PHH1005621	Re laik (Mây các)	Tree	Forest	Daily food (A)	Young shoots	Traditional soup/grilled
					Handicraft (Ma)	Stems	Bamboo baskets
	Caryota urens L. /PHH1005522	Xiêng xung	Tree	Forest Garden	Daily food (A)	Young shoots	Traditional soup

					Building (Ma)	Leaves	Stilt houses roof
					Decoration (O)	Leaves	Wedding gate decoration
					Spiritual (C)	Stems	Stem is sharpened into a chopstick-like shape and placed on the head of the bed to ward off evil spirits, helping children sleep with fewer startles
					(Me)		
	Daemonorops jenkinsiana (Griff.) Mart. /PHH1005581	Xiêng pnuc	Vine	Forest	Daily food (A)	Young shoots	Traditional soup/grilled
					Handicraft (Ma)	Stems	Bamboo basket rim
					Wrapping item (C)	Leaves	Used as wrappers for glutinous rice cakes
					(Me)		
	Licuala spinosa Wurmb /PHH1005631	Xiêng xa (Mật cật)	Tree	Forest	Daily food (A)	Young shoots	Traditional soup/grilled
					Handicraft (Ma)	Leaves/ Stems	Dry leaves are utilized for making brooms, while stems are employed in crafting chopsticks
					Wrapping item (C)	Leaves	Used as wrappers for glutinous rice cakes
Asparagaceae	*Peliosanthes teta* Andrews /PHH1005507	Ban lết (Sâm lùn)	Herb	Forest	Daily food (A)	Flowers	Stir-fry with beef
					Traditional alcohol (B)	Roots	Chop, crush, then dry, mix, and finely grind with rice
	Dracaena elliptica Thunb. & Dalm. /PHH1005514	Xơ cun á (Sâm cao)	Tree	Forest	Traditional alcohol (B)	Tubers/ Leaves	Chop, crush, then dry, mix, and finely grind with rice
					Beverage (B)	Tubers	Alcohol maceration
					(Me)		
Athyriaceae	*Diplazium esculentum* (Retz.) Sw. /PHH1005600	Pai toi (Rau co)	Fern	Forest Garden	Daily food (A)	Young shoots	Vegetable soup/stir-fry with garlic/boil
					(Me)		
Cardiopteridaceae	*Gonocaryum lobbianum* (Miers) Kurz /PHH1005537	Xơ la pút kho (Cuống vàng)	Tree	Forest	Traditional alcohol (B)	Leaves/ Barks	Chop, crush, then dry, mix, and finely grind with rice

					(Me)		
Chrysobalanaceae	*Parinari anamensis* Hance /PHH1005608	Xơ ti	Tree	Forest	Fruit (A)	Fruits	Raw edible
Clusiaceae	*Garcinia celebica* L. /PHH1005646	Xơ xin rat (Bứa)	Tree	Forest	Daily food (A)	Leaves	Young leaves are used to cook sour soup with fish
					Fruit (A)	Fruits	Raw edible
					Detoxifying plant (P)	Leaves	Soaking leaves with tubers of *Dioscorea hispida* helps to remove white secretions from the tubers.
Commelinaceae	*Commelina* sp. /PHH1005560	Xe ca lắp (Dây đốt sống)	Herb	Forest	Traditional alcohol (B)	Leaves/ Stems	Chop, crush, then dry, mix, and finely grind with rice
					(Me)		
Compositae	*Blumea lacera* (Burm.f.) DC. /PHH1005657	Cải tô	Herb	Forest Garden	Daily food (A)	Leaves/ Flowers	Vegetable soup (cooked with cabbage)/boil/raw edible
					Vegetables (A)	Leaves	Raw edible
Costaceae	*Cheilocostus speciosus* (J.Koenig) C.D.Specht /PHH1005628	Chao pum	Herb	Forest	Daily food (A)	Leaves	Raw edible (served with pancakes)
					(Me)		
Cucurbitaceae	*Momordica charantia* L. /PHH1005570	Khổ qua rừng	Vine		Daily food (A)	Leaves/ Fruits	Vegetable soup/boil
					(Me)		
	Trichosanthes cochinchinensis (Lour) M. Roem /PHH1005595	Xe buôn tô (Mướp khỉ)	Vine	Forest Garden	Daily food (A)	Whole plant	Vegetable soup
					(Me)		
Cycadaceae	*Cycas* sp. /PHH1005546	(Xuân tuế)	Cycad	Forest Garden	Daily food (A)	Young shoots	Stir-fry/stew
					Ornamental plant (O)	Whole plant	Plants gathered from the forest are subsequently planted in a home garden
					(Me)		
Dilleniaceae	*Tetracera scandens* (L.) Merr. /PHH1005584	Xe piêng cuôi (Dây chiều)	Vine	Forest	Handicraft (Ma)	Leaves	Apply rubbing motion onto the tool that needs sharpening.
					(Me)		
Dioscoreaceae	*Dioscorea cirrhosa* Lour. /PHH1005551	Bum chre	Vine	Forest	Beverage (B)	Tubers	Dry, cook with tea
					Handicraft (Ma)	Stems	Weave to make ropes, brocades, scarves
					(Me)		

	Dioscorea hamiltonii Hook.f. /PHH1005623	Puôm chụp (Củ chụp)	Vine	Forest	Daily food (A)	Tubers	Vegetable soup/boil
	Dioscorea hispida Dennst. /PHH1005569	Cô pluoi (Củ nần)	Vine	Forest	Starch (A)	Tubers	Soak in water (with *Garcinia celebica*'s leaves), wash 3 times a day to remove the latex completely ad then boil
Dipterocarpaceae	*Vatica odorata* (Griff.) Symington /PHH1005648	Làu táu	Tree	Forest	Traditional alcohol (B)	Stems	Chop, crush, then dry, mix, and finely grind with rice
Ebenaceae	*Diospyros maritima* Blume /PHH1005616	Xơ pro (Vàng nghệ)	Tree	Forest Garden	Handicraft (Ma)	Stems	Machete handle
					Fish-poison (P)	Leaves/ Stems/ Fruits	Crush the plant parts and deposit them into ponds or rivers. Fish will either float to the surface or leap onto the edge
					(Me)		
Euphorbiaceae	*Claoxylon indicum* (Reinw. ex Blume) Hassk. /PHH1005634	Xe yoong ruốt (Chân voi)	Tree	Forest	Daily food (A)	Leaves	Cook vegetable soup/stir-fry
					(Me)		
	Croton argyratus Bl. /PHH1005534	La vro ca tơ (Tráng ngực bự)	Tree	Forest	Traditional alcohol (B)	Leaves	Chop, crush, then dry, mix, and finely grind with rice
					(Me)		
	Croton poilanei Gagnep. /PHH1005565	Xơ cam plum la quay (Cù đèn lá nhỏ)	Tree	Forest	Traditional alcohol (B)	Leaves/ Barks	Chop, crush, then dry, mix, and finely grind with rice
					(Me)		
	Croton sp. /PHH1005573	La ca com pleu (Cù đèn lá lớn)	Tree	Forest	Traditional alcohol (B)	Leaves/ Barks	Chop, crush, then dry, mix, and finely grind with rice
					Beverage (B)	Barks	Dry, alcohol maceration
					(Me)		
	Mallotus peltatus (Geiseler) Müll.Arg. /PHH1005652	(Trà nhỏ)	Tree	Forest	Beverage (B)	Leaves	Dry, cook with tea
	Mallotus sp. /PHH1005663	Xơ chaau (Tầm ron)	Tree	Forest	Handicraft (Ma)	Stems	Cut the stem into suitable pieces and then strip its bark to create yarn for tying utensils (basket)
Fagaceae	*Castanopsis* sp1. /PHH1005549	Xơ ta rơ (Bảy thừa)	Tree	Forest	Traditional alcohol (B)	Leaves/ Barks	Chop, crush, then dry, mix, and finely grind with rice
	Castanopsis sp2. /PHH1005511	La xơ múp (Dẻ lông)	Tree	Forest	Traditional alcohol (B)	Leaves	Chop, crush, then dry, mix, and finely grind with rice
					(Me)		

Gentianaceae	*Fagraea fragrans* Roxb. /PHH1005656	Xơ ta trâu	Tree	Forest	Traditional alcohol (B)	Barks	Chop, crush, then dry, mix, and finely grind with rice
Gnetaceae	*Gnetum formosum* Markgr. /PHH1005559	Xe cót vo (Gấm trắng)	Tree	Forest	Daily food (A)	Fruits	Once the fruit turns red, it is roasted or grilled
					Beverage (B)	Stems	Chop the stem to release the flowing water, suitable for refreshing drinking
					Handicraft (Ma)	Stems/ Barks	Make crossbow
	Gnetum gnemon L. /PHH1005567	La biếp	Tree	Forest Garden	Daily food (A)	Leaves	Stir-fry with beef/vegetable soup and traditional soup
					Daily food (A)	Fruits	Grill
					(Me)		
Irvingiaceae	*Irvingia malayana* Oliv. ex A.W.Benn. /PHH1005610	Xơ ta nia	Tree	Forest	Handicraft (Ma)	Stems	Ax handle
Lamiaceae	*Callicarpa* sp. /PHH1005538	Xe po ka tơ quay (Tráng ngực nhỏ)	Shrub	Forest	Traditional alcohol (B)	Leaves	Chop, crush, then dry, mix, and finely grind with rice
	Gmelina elliptica Sm. /PHH1005547	Xe cop (Dây cổ rùa)	Vine	Forest	Beverage (B)	Stems	Chop the stem to release the flowing water, suitable for refreshing drinking
					Handicraft (Ma)	Stems	Make crossbows
					Beverage (B)	Stems	Alcohol maceration
	Vitex negundo var. *cannabifolia* (Siebold & Zucc.) Hand.-Mazz. /PHH1005578	(Xơ hap) Cây háp	Tree	Forest	Beverage (B)	Leaves	Dry, cook with tea
Lardizabalaceae	*Sargentodoxa cuneata* (Oliv.) Rehder & E.H.Wilson /PHH1005566	(Huyết rồng)	Vine	Forest	Traditional alcohol (B)	Leaves/ Barks	Chop, crush, then dry, mix, and finely grind with rice
					Beverage (B)	Stems	Alcohol maceration
					(Me)		
Lecythidaceae	*Barringtonia macrostachya* (Jack) Kurz /PHH1005516	Xơ pnook	Tree	Forest	Vegetables (A)	Leaves	Raw edible (serve with pancakes
					(Me)		
Leeaceae	*Leea indica* (Burm. f.) Merr. /PHH1005593	Xơ tô con (Lá rối)	Shrub	Forest	Daily food (A)	Leaves	Raw edible or serve with pancakes, grilled meat
					Building (Ma)	Leaves	Stilt houses roof
Leguminosae	*Bauhinia* sp. /PHH1005528	Xe piêng pú	Vine	Forest	Daily food (A)	Leaves	Use young leaves to cook sour soup
					Cigarette roll (T)	Leaves	Fresh leaves are used for wrapping tobaco

	Mimosa pudica L. /PHH1005664	Xinh oát (Mắc cỡ)	Herb	Forest Garden	Beverage (B)	Whole plant	Make tea with fresh or dried plants
					(Me)		
Lygodiaceae	*Lygodium subareolatum* Christ. /PHH1005574	Xe cà lắp	Vine	Forest	Traditional alcohol (B)	Leaves	Chop, crush, then dry, mix, and finely grind with rice
					(Me)		
Malvaceae	*Colona scabra* (Sm.) Burret /PHH1005617	Xơ tuuk (Tầm phốc)	Tree	Forest Garden	Handicraft (Ma)	Leaves	Combining dry leaves with the sap of *Dipterocarpus alatus* to create a torch
					Handicraft (Ma)	Bark	Strip the bark into yarn to tie utensils
					Wrapping item (T)	Leaves	Large leaves are used to cover the alcohol yeasts during fermentation
	Grewia sp. /PHH1005624	Xe pnhao la mak (Nhao lá lớn)	Shrub	Forest Garden	Seasoning (A)	Leaves	Dry leaves, grind them with rice, and incorporate them into the soup to enhance sweetness.
	Pterospermum acerifolium (L.) Willd. /PHH1005653	La ni gron	Tree	Forest	Betel (C)	Young shoots	Fresh shoots are used with betel
						Fruits	Raw edible
	Scaphium macropodum (Miq.) Beumee ex K.Heyne /PHH1005577	Pley dơ	Tree	Forest Garden	Beverage (B)	Seeds	Water immersion
					(Me)		
Marantaceae	*Stachyphrynium repens* (Körn.) Suksathan & Borchs /PHH1005530	Po roong (Ngải lơ cái, sâm đất)	Shrub	Forest	Traditional alcohol (B)	Roots/ Stems	Chop, crush, then dry, mix, and finely grind with rice
					(Me)		
	Donax cannaeformis (G.Forst.) K. Schum. /PHH1005635	Xơ la tiên	Herb	Forest	Handicraft (Ma)	Stems	The stems are stripped into fibers to weave baskets and mats
	Schumannianthus dichotomus (Roxb.) Gagnep. /PHH1005602	Xơ run ta	Herb	Forest	Handicraft (Ma)	Stems	The stems are stripped into fibers to weave baskets and mats
					(Me)		
Melastomataceae	*Melastoma osbeckioides* Guillaumin /PHH1005557	Xơ tooc tang quay (Mua lá nhỏ)	Tree	Forest	Traditional alcohol (B)	Whole plant	Chop, crush, then dry, mix, and finely grind with rice
					(Me)		
	Melastoma saigonense (Kuntze) Merr. /PHH1005592	Xơ tóoc tang (Mua lá lớn)	Tree	Forest	Fruit (A)	Fruits	Raw edible

					(Me)		
	Memecylon lilacinum Zoll. & Moritzi /PHH1005611	Xơ ploong la quay	Tree	Forest	Handicraft (Ma)	Branches	Make brooms
						Bark	Insert a piece of bark into the knife's neck, positioned between the blade and the handle, to enhance the stability of the handle
	Memecylon confertiflorum Merr. /PHH1005520	Xơ plon	Tree	Forest	Handicraft (Ma)	Branches	Make brooms
Meliaceae	*Aglaia grandis* Korth. ex Miq. /PHH1005662	Xơ bưn đeng (Ba khía)	Tree	Forest	Daily food (A)	Fruits	Cook sour soup
					Traditional alcohol (B)	Fruits	Raw edible
	Sandoricum koetjape (Burm.f.) Merr. /PHH1005612	Xơ tech	Tree	Forest	Daily food (A)	Fruits	Cook sour soup/ barbecue soup (including green and ripe fruit)
					Fruit (A)	Fruits	Raw edible with chili salt
	Sp8. /PHH1005661	Xơ cúc	Tree	Forest	Accessory for Traditional wine processing (T)	Leaves	Utilized for stuffing into the mouth of the wine jar to prevent residue from floating up
					Fruit (A)	Fruits	Raw edible
Menispermaceae	*Cyclea barbata* Miers /PHH1005529	Xe dâng sâm	Vine	Forest	Vegetables (A)	Leaves	The leaves are crushed with water to make jelly.
					(Me)		
	Limacia triandra Miers (unresolved name) /PHH1005580	La nhao xe (Lá nhao dây)	Vine	Forest Garden	Seasoning (A)	Leaves	Dry leaves, grind them with rice, and incorporate them into the soup to enhance sweetness
					(Me)		
Moraceae	*Ficus chartacea* (Wall. ex Kurz) Wall. ex King /PHH1005552	Xơ la pray (Sung nhí)	Tree	Forest	Fruit (A)	Fruits	Raw edible
					(Me)		
	Ficus simplicissima Lour. /PHH1005586	Xơ la quy	Tree	Forest	Fruit (A)	Fruits	Raw edible with spicy salt
					(Me)		
	Ficus sp. /PHH1005632	Xe pum (Trầm hương)	Vine	Forest	Spiritual (C)	Stems	Place the dried stems onto the charcoal to produce aromatic smoke
Myrtaceae	*Syzygium jambos* (L.) Alston /PHH1005641	Xơ cam pruut (Mận rừng)	Tree	Forest	Fruit (A)	Fruits	Raw edible

					Traditional alcohol (B)	Leaves	Chop, crush, then dry, mix, and finely grind with rice
Orchidaceae	*Cymbidium aloifolium* (L.) Sw. /PHH1005622	La pree	Parasite	Forest Garden	Ornamental plant (O)	Whole plant	Plants are collected from the forest and then hang it on another tree
Pandanaceae	*Pandanus urophyllus* Hance /PHH1005590	Chiếc la mac (Dứa lá dài)	Shrub	Forest	Beverage (B)	Fruits	Alcohol maceration
					Handicraft (Ma)	Leaves	Make arrow tails
						Leaves	Strip the leaves into small threads to knit mats
					(Me)		
	Pandanus humilis Lour. /PHH1005519	Chiếc la quay (Dứa nhí)	Tree	Forest	Beverage (B)	Roots	Chop the root to release the flowing water, suitable for refreshing drinking
Passifloraceae	*Passiflora foetida* L. /PHH1005627	Xe nhãn lồng	Vine	Forest Garden	Daily food (A)	Young shoots	Make soup/boil
					(Me)		
Phyllanthaceae	*Baccaurea ramiflora* Lour. /PHH1005582	Xơ pay xát (Dâu gia)	Tree	Forest	Fruit (A)	Fruits	Raw edible
	Baccaurea sp. /PHH1005640	Xơ pley xát	Tree	Forest	Fruit (A)	Fruits	Raw edible
Piperaceae	*Piper* sp. /PHH1005591	Xe pnu (Trầu ké)	Parasite	Forest	Betel (C)	Leaves	Raw edible
Poaceae	*Bambusa procera* A.Chev. & A.Camus	Xơ tưn ngươu	Shrub	Forest	Daily food (A)	Stems	The stems are thinly sliced to use in soups or stir-fries.
					Handicraft (Ma)	Stems	Knit bamboo baskets
					Handicraft (Ma)	Branches	Sharpened into the handle of a machete or knife
					Handicraft (Ma)	Stems	Make chopsticks
					Building (Ma)	Stems	Stilt houses floor
					Cooking tool (T)	Stems	Hollow stems are utilized as containers for cooking various foods such as rice, soup, and meat
	Gigantochloa sp. /PHH1005633	Hum	Shrub	Forest	Dried food (A)	Stems	Slice thinly and dry
					Handicraft (Ma)	Stems	Knit chicken cage

					Building (Ma)	Stems	Stilt houses floor
	Schizostachyum aciculare Gamble /PHH1005619	Xơ plao	Shrub	Forest	Handicraft (Ma)	Stems	Make knife handle, thresher tube
Polypodiaceae	*Drynaria quercifolia* (L.) j.Smith /PHH1005558	Po túc (Rồng ráng)	Parasite	Forest	Traditional alcohol (B)	Leaves/ Stems	Chop, crush, then dry, mix, and finely grind with rice
					Ornamental plant (O)	Whole plant	Plants are collected from the forest and then hang it on another tree
					(Me)		
Primulaceae	*Ardisia solanacea* (Poir.) Roxb. /PHH1005542	Cham cham uôi	Tree	Forest Garden	Vegetables (A)	Leaves	Raw eadible (with unrefined salt)
					(Me)		
Rhamnaceae	*Ziziphus funiculosa* Buch.-Ham. ex Wall. /PHH1005625	Xe ptau pepro (Táo rừng)	Vine	Forest	Fruit (A)	Fruits	Edible ripe fruits
					(Me)		
Rubiaceae	*Benkara fasciculata* (Roxb.) Ridsdale /PHH1005508	Xơ da nao proo	Tree	Forest	Traditional alcohol (B)	Roots	Chop, crush, then dry, mix, and finely grind with rice
					(Me)		
	Canthium horridum Blume /PHH1005658	Xơ da măng ia (Mắt cu)	Tree	Forest	Handicraft (Ma)	Stems	Make chopsticks
	Hedyotis sp. /PHH1005594	Yong ta tách (Chân vịt đất)	Herb	Forest	Traditional alcohol (B)	Whole plant	Chop, crush, then dry, mix, and finely grind with rice
	Ixora dongnaiensis Pierre ex Pit. /PHH1005550	Xơ bông trang quyp (Bông trang cao)	Tree	Forest	Traditional alcohol (B)	Leaves	Chop, crush, then dry, mix, and finely grind with rice
					Ornamental plant (O)	Whole plant	Plants gathered from the forest are subsequently planted in a home garden
	Lasianthus chrysoneurus (Korth.) Miq. /PHH1005548	La yoong ta quay (Chân vịt lá nhỏ)	Tree	Forest	Traditional alcohol (B)	Leaves	Chop, crush, then dry, mix, and finely grind with rice
					(Me)		
	Psychotria adenophylla Wall. /PHH1005509	Xơ romach xcau (Mật gấu)	Shrub	Forest	Traditional alcohol (B)	Leaves	Chop, crush, then dry, mix, and finely grind with rice
					(Me)		
	-Sp2. /PHH1005650	(Cơm nguội trắng)	Tree	Forest	Daily food (A)	Flowers	Vegetable soup
					Traditional alcohol (B)	Leaves	Chop, crush, then dry, mix, and finely grind with rice

Rutaceae	*Clausena anisata* (Willd.) Hook.f. ex Benth. /PHH1005541	(Cơm nguội, Hồng bì rừng)	Tree	Forest	Fruit (A)	Fruits	Raw edible
					Traditional alcohol (B)	Leaves	Chop, crush, then dry, mix, and finely grind with rice
					(Me)		
	Melicope pteleifolia (Champ. ex Benth.) T.G. Hartley /PHH1005535	La niên (Ba chia lá nhỏ)	Tree	Forest	(Me)		
	Murraya alata Drake /PHH1005533	(Cơm nguội hồng)	Tree	Forest	Fruit (A)	Fruits	Raw edible
					(Me)		
	Zanthoxylum nitidum (Roxb.) DC. /PHH1005543	Xe ca tanh (Dây xưng)	Shrub	Forest	Fish-poison (P)	Stems	Crush the stems and deposit them into ponds or rivers. Fish will either float to the surface or leap onto the edge
					(Me)		
Sapindaceae	*Glenniea thorelii* (Pierre) Leenh. /PHH1005513	(Cơm nguội đen)	Tree	Forest	Traditional alcohol (B)	Leaves	Chop, crush, then dry, mix, and finely grind with rice
					(Me)		
	Nephelium sp. /PHH1005642	Xơ co xum	Tree	Forest	Fruit (A)	Fruits	Raw edible
	Xerospermum glabratum Pierre non Raldk /PHH1005654	(Trường đỏ)	Tree	Forest	Fruit (A)	Fruits	Raw edible
Simaroubaceae	*Eurycoma longifolia* Jack /PHH1005523	Xơ bá chứng	Tree	Forest Garden	Beverage (B)	Roots	Alcohol maceration
					(Me)		
Solanaceae	*Solanum ferox* L. /PHH1005643	Pley xit (Cà ung)	Herb	Forest Garden	Daily food (A)	Fruits	Sour soup/ pound with fish sauce
					Wrapping item (T)	Leaves	Large leaves are used to cover the alcohol yeasts during fermentation
Theaceae	*Camellia flava* (Pit.) Sealy /PHH1005572	Xơ ung dục	Tree	Forest	Beverage (B)	Flowers/ Leaves	Dry, cook with tea
						Roots/ Stems	Alcohol maceration
					(Me)		
URTICACEAE	*Pouzolzia* sp. /PHH1005598	Ai ya plo (Rau dòi trắng)	Herb	Forest Garden	Daily food (A)	Young shoots	Vegetable soup/stir-fry with garlic/boil
					(Me)		

	Pouzolzia zeylanica (L.) Benn. /PHH1005601	Pai ya pro (Rau dòi đỏ)	Herb	Forest Garden	Daily food (A)	Young shoots	Vegetable soup/boil
					(Me)		
Violaceae	*Rinorea anguifera* Kuntze /PHH1005553	Xơ lo pa (Lòng mót)	Tree	Forest	Traditional alcohol (B)	Leaves	Chop, crush, then dry, mix, and finely grind with rice
					Handicraft (Ma)	Stems	Knife handles
					Cigarette roll (T)	Leaves	Wrapping or flavoring for tobacco
Zingiberaceae	*Alpinia conchigera* Griff. /PHH1005563	(Củ riềng)	Herb	Forest	Seasoning (A)	Tubers	Cook with meat and fish to enhance flavor
					Traditional alcohol (B)	Tubers	Chop, crush, then dry, mix, and finely grind with rice
					(Me)		
	Amomum schimidtii (K.Schum.) Gagnep. /PHH1005647	Nàng nàng	Herb	Forest	Children's toy (C)	Tubers	Round, small tubers are selected for gun bullets.
					(Me)		
	Amomum sp. /PHH1005575	Pley rêu	Herb	Forest	Traditional alcohol (B)	Tubers	Chop, crush, then dry, mix, and finely grind with rice
					Beverage (B)	Fruits/ Tubers	Alcohol maceration

Use category: A = Alimentary, B = Beverage, C = Culture/Social, Ma = Material, Me = Medicine, O = Ornament, P = Poison, T = Technique.

* The traditional soup, **canh bồi**, is prepared using a variety of wild plants cooked together with finely ground rice.

Beverage

It can be seen that in terms of the number of taxa used, the beverage was at the second position with 55 taxa mentioned although it had more use-reports than those of the alimentary group (66 use-reports compared with 63). Among these, traditional alcohol comprised over half of the species used for this group (31 taxa). The process of making alcohol using rice as the primary ingredient, along with 31 plant taxa listed in Appendix 1, encompasses the following stages (Figure 3):

Preparing ingredients: Plant materials were cut into small pieces, dried, and pounded with rice soaked overnight in a large stone mortar.

Preparing the yeast cake: The mixture was compressed into pellets and incubated with rice husk and leaves of *Colona scabra* (Sm.) Burret (the main ingredient) or *Solanum ferox* L. (an alternative) for about a week. Afterward, it was left to dry completely in the sun for another two weeks. Finally, the yeast cakes were grilled over a fire and the outer skin scraped off.
Making alcohol: Rice and husk were mixed at a ratio of 1:1 or 1:2, depending on each person's experience. The rice was cooked, and then yeast was added and mixed well before placing the mixture in a jar.

Figure 3. Traditional alcohol-making process
1-3: Gather and prepare ingredients.
4-7: Follow the steps to make yeast cake **bánh men rượu**.
8-9: Proceed with making rice and wine.
10: A finished pot of wine **rượu cần**.

Materials

This was the group in third position with 30 taxa used and 43 use-reports. Most of the plants were used for handicrafts (baskets, mats, crossbows, or brooms) (Table 2). **Gùi**, a kind of traditional basket frequently utilized by the local people to bring small items such as food, water, cook utensils, ... when they worked in the fields or to store harvested products, made from several species *Arenga caudata* (Lour.) H.E.Moore*, Bambusa procera* A.Chev. & A.Camus, *Calamus poilanei* Conrard and *Calamus rudentum* Lour.. Building materials were mostly used for thatching the roof (*Ancistrocladus tectorius* (Lour.) Merr.) and floor covering (*Bambusa procera* A.Chev. & A.Camus) of stilt houses (Figure 4).

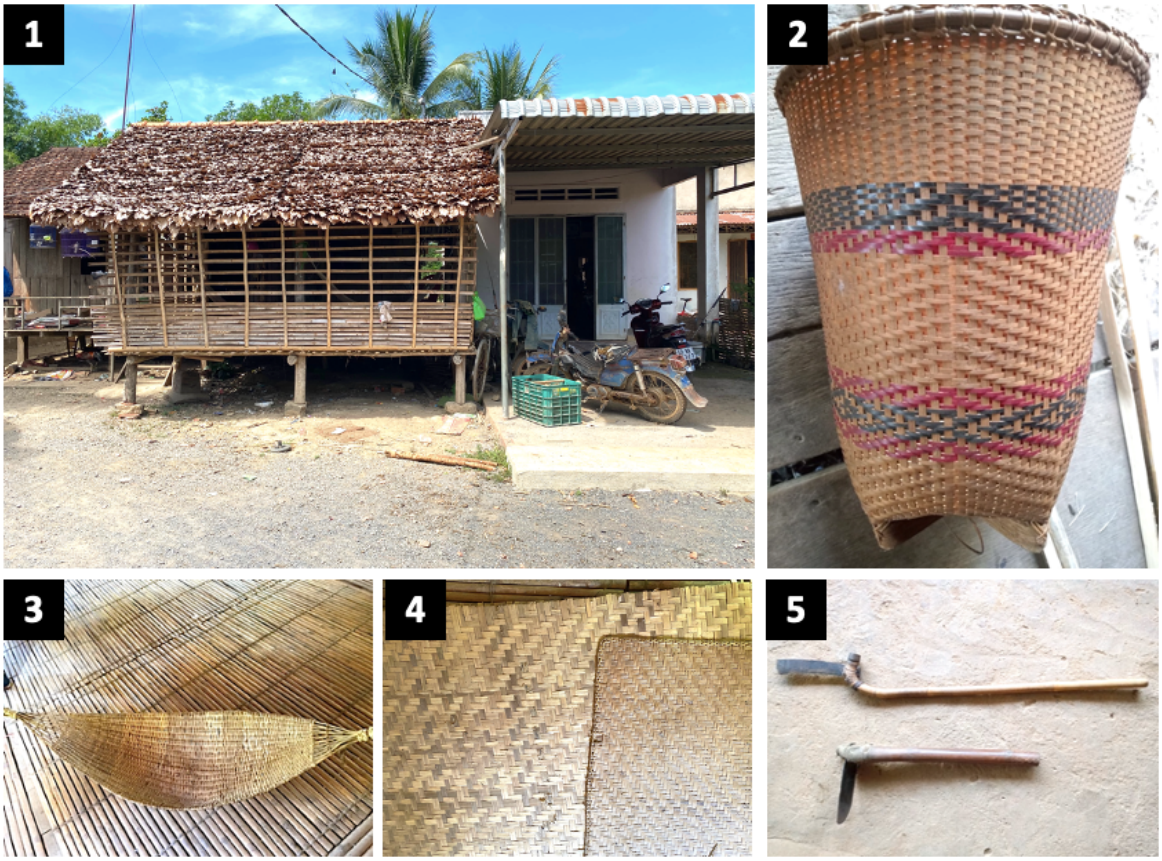

Figure 4. Utensils made from plants of the Chơ Ro people
1 - Stilt house **nhà sàn** with a roof made from *Ancistrocladus tectorius* (Lour.) Merr leaves, house frame from *Bambusa procera* A.Chev. & A.Camus and floor from *Bambusa procera* A.Chev. & A.Camus or *Gigantochloa* sp.
2 - Basket **gùi** is crafted from the stems of *Calamus* spp.
3 - Hammock **võng** is woven from the trunk of *Arenga caudata* (Lour.) H.E.Moore
4 - Agricultural tools **chà gạc** and **cù quéo** are made from the stem of *Bambusa procera* A.Chev. & A.Camus

Ornament

The group of ornamental plants accounted for a relatively low proportion compared with the previous category of uses, consisting of 6 taxa and 7 use-reports, with the main purpose of being ornamental plants or decoration, as exemplified by the following taxa: *Cycas* sp., *Cymbidium aloifolium* (L.) Sw., *Aglaonema simplex* (Blume) Blume, *Ixora dongnaiensis* Pierre ex Pit..

Cultural and social activities

Cultural and spiritual activities have been maintained in the community, despite only six taxa being mentioned in seven use-reports for these purposes. For instance, *Caryota urens* L. was believed to possess the power to avert evil influences or bad luck, *Ficus* sp. was used to make incense for traditional festivals, connecting present individuals to their ancestors, *Pterospermum acerifolium* (L.) Willd. was employed as a substitute for betel leaves, and *Amomum schimidtii* (K.Schum.) Gagnep. was used in crafting children's toys.

Poison

This group only had three species with five used-reports used for two purposes, fish-poison and detoxification. For example, *Garcinia celebica* L. leaves are soaked with the tubers of *Dioscorea hispida* Dennst. to neutralize the poison secreted by pus. If this step is not completed, consuming it could lead to intoxication, coma, and in severe cases, prove fatal.

Table 2. Main categories of plant use reported by the Chơ Ro people

First category (Total taxa[1], Total use-reports)	Second category	Description	Number of taxa[2]	Use-reports
Alimentary (56 taxa, 63)	Daily food	Local cuisine such as traditional soup and fried, grilled, boiled cuisines	34	36
	Fruit	Fresh fruits	18	18
	Vegetable	Sources of fiber (raw, unprocessed)	4	4
	Seasoning	Add flavor to food	3	3
	Dried food	Food is dried for long-term storage	1	1
	Starch	Sources of starch instead of rice	1	1
Beverage (45 taxa, 66)	Traditional alcohol	Utilized as initiators for fermenting rice alcohol	31	43
	Beverage	Refreshing drinks from tile sap of several vines and creepers, tea substitutes, water immersion, alcohol maceration, fresh nectar	18	23
Material (30 taxa, 43)	Handicraft	Items for knitting baskets, mats or making crossbows, brooms	26	35
	Building	Used for thatching roof and floor covering of traditional stilts	8	8
Technique (9 taxa, 10)	Wrapping item	Used to wrap the yeast cake of traditional alcohol or traditional cake	4	4
	Cigarette roll	Making cigarette roll or flavoring tobacco	3	3
	Accessory for traditional wine processing	Utilized for stuffing into the mouth of the wine jar to prevent residue from floating up	1	2
	Cooking tool	Used to replace kitchen utensils in forest trip	1	2
Ornament (6 taxa, 7)	Ornamental plant	Wild plants with beautiful flowers or leaves planted in home garden	5	5
	Decoration	Used as the decorative flower and decorative item	2	2
Culture/ Social (6 taxa, 7)	Betel	Used as betel leaf	2	3
	Spiritual	Used as the apotropaic plant (repelling bad spirits) or for incense-making	2	2
	Ritual/Festival	Used in a particular festival occasion	1	1
	Children's toy	Used as a toy for children	1	1
Poison (3 taxa, 5)	Fish-poison	Used to paralyze or suffocate the fish	2	4
	Detoxifying plant	Detoxification of poisonous plant	1	1
Medicine (65 taxa, 159)		Medicinal uses for humans	65	159

[1] One species can be used for different purposes. For example, species A was used to make traditional beverages or to enhance the flavor (seasoning), or wrap something. Therefore, the total number of taxa used was more than 118 taxa cited by informants.

[2] Total taxa were calculated based on the number of taxa used in the main category of use without replication. For instance, if species A was utilized for two purposes within the same "alimentary category" - such as daily food and vegetables - it was counted as one case in the formula for "total taxa".

Beneficial plants: life forms and parts used

Life forms

Of the 118 plant taxa, they belonged to eight different life forms, including woody, vines, herbaceous, shrubs, epiphytes, creepers, ferns, and cycads (International Union for Conservation of Nature 2013). Among these, the woody plant group comprised the highest number of taxa (62 out of 118 taxa, accounting for 52.5%) and was also the life form utilized for the most purposes, present in 6 out of the 8 groups of uses. The second is the group of vines with 23 taxa, accounting for 13.6% of the total life forms and 21.6% of the group of uses. The group of life forms ferns and cycas have the least amount and

value of use with 1 taxa (0.9% of the total life forms) and contribute only 0.7 and 1.4% of the total taxa used, respectively in groups of uses.

Plant parts used

When examining the plant parts utilized by the community, a diversity of 12 groups was observed during the data collection process, including leaves, stems, fruits, young shoots, tubers, whole plants, bark, roots, flowers, branches, seeds, and latex. Among these, leaves emerged as the most frequently used plant part, with the highest frequency of occurrence in taxa (57 out of 231 taxa used, accounting for 24.7% of all plant parts utilized). Furthermore, leaves were utilized across all use groups. In contrast, branches, seeds, and latex were the least common parts, with only one taxon per part being utilized (Figure 5). Of the 57 taxa with leaves used, 26 taxa were used in the beverage group (accounting for 34.2% of all use groups), 13 taxa in the alimentary group (17.1%), 9 taxa in the material group (11.8%), 8 taxa as techniques (10.5%), 16 taxa have medicine value (21.1%), 2 taxa are used as poisons (2.6%), and only 1 taxon each for ornament and social purposes (1.3%) (Figure 6). Representative species include *Ancistrocladus tectorius* (Lour.) Merr., *Ardisia solanacea* (Poir.) Roxb., *Barringtonia macrostachya* (Jack) Kurz, *Camellia flava* (Pit.) Sealy, *Colona scabra (Sm.) Burret*, *Pandanus urophyllus* Hance, *Rinorea anguifera* Kuntze, *Sageraea elliptica* (A.D.C) Hook. & Thoms., *Tetracera scandens* (L.) Merr..

Stems were the second most commonly utilized part within the community, with 55 out of 231 taxa used (constituting 23.8% of all plant parts used). They were employed in 7 different use groups, excluding ornamental purposes. Unlike leaves, stems were primarily utilized as materials, accounting for 31% of all use groups, followed by their use in beverages (15.5%), alimentary, social, and poison categories (5.8% each), and techniques (1.4%). Certain species utilized typical stem parts, such as *Amomum schimidtii*, *Bambusa procera* A.Chev. & A.Camus, *Calamus poilanei* Conrard, *Caryota urens* L., *Ficus* sp., *Pothos scandens* L. and *Zanthoxylum nitidum* (Roxb.) DC.. Additionally, there were 27 taxa with fruit utilized (constituting 11.7% of all parts used), primarily focused on the alimentary group (75.9% of all groups). Examples included *Mangifera* sp., *Pterospermum acerifolium* (L.) Willd., *Sandoricum koetjape* (Burm.f.) Merr., *Xerospermum glabratum* Pierre non Raldk.

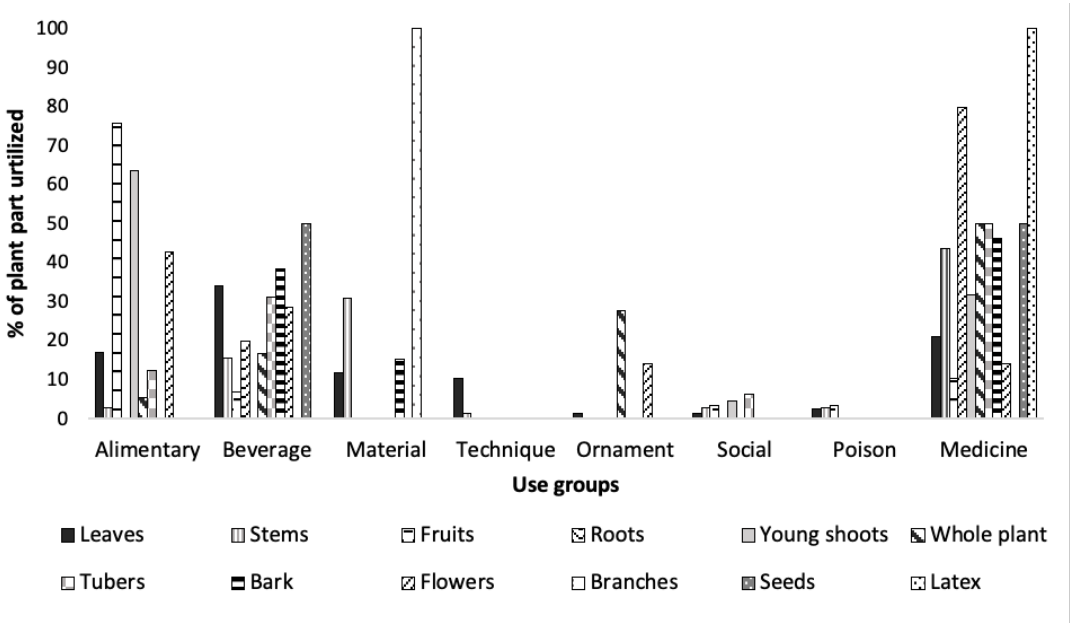

Figure 5. Plant parts utilized in eight use groups

Important plants of Chơ Ro community

It was found that although there have been some changes in the lifestyle and daily activities in the present community, their interest and linkage to forest resources are still quite strong. Several studies have shown that communities often do not rate the roles of the plants that they use equally, but rather have "major" and "minor" species. These different classifications are often determined according to the value that the species provides, which may be mentioned as commercial value, cultural value, spiritual value or social value (N'Danikou *et al*. 2011). Local people choose priority species based on criteria that were different from those proposed by the conservative projects, which often focused on parameters of rarity or endemism. Therefore, in this study, some tools of the PRA technique were used to identify important plant species from the perspective of the Chơ Ro community, and also compare the differences in species selection in men and women.

Select priority species according to different techniques

Priority species, considered important from the viewpoint of each group, were recorded using the free-listing technique. This resulted in 61 out of 118 taxa chosen in the male group and 49 out of 118 in the female group. The list was condensed to ensure that at least two taxa were mentioned for each group. The results showed that 30 taxa were selected by the male

group and 23 by the female group, with 37 plant taxa considered important by both interview groups. Subsequently, the fifteen taxa with the highest ranking were selected for comparison between the two techniques (Appendix 2).

The limitation of the free-listing method is that is impossible to determine the important ranking among species because there is no basis for ranking although the informants still somewhat distinguish the priority levels among the selected species. To establish a ranking among species, the direct ranking technique is used, in which individuals are asked to choose important species and assign scores from 0 to 4 for each criterion used to select the important species, which reasons for selection have been recorded through the free- listing technique (0: no features being evaluated, 1: least important to 4: very important).

The results recorded 37 species considered important for the men's group and 23 species for the women's group, with 17 species common to both groups. In this approach, instead of people selecting important species based on one or a few specific factors (usually two) as in the free-listing method, species are chosen based on the evaluation of multiple criteria (seven criteria), leading to a significant difference in the quantity and composition of important species between the two techniques.

The comparison was conducted on the highly ranked species for each method, specifically in the free-listing method, 15 species were ranked by the number of mentions, and in the direct ranking method, 16 species were selected based on the SCV value (Appendix 2, Appendix 3). In particular, between the two methods, there were only 6 species in common out of a total of 25 species compared, namely *Gnetum gnemon* L., *Lasia spinosa* (L.) Thwaites, *Bambusa procera* A.Chev. & A.Camus, *Passiflora foetida* L., *Calamus poilanei* Conrard, and *Eurycoma longifolia* Jack, but the ranking orders of these species were different between the two techniques (Table 3). With the free-listing technique, *Gnetum gnemon* L. and *Lasia spinosa* (L.) Thwaites were identified as the two most important species due to their roles as traditional food ingredients and medicinal plants (Appendix 2). However, in the direct ranking method, they were ranked 7th and 8th, respectively. This discrepancy in ranking can be attributed to the evaluation being based on multiple selection criteria rather than relying on a single or the most important criterion (Appendix 3). In reality, local people tend to use the latter approach to choose important species for them instead of considering multiple factors. For example, *Gnetum formosum* Markgr. and *Schumannianthus dichotomus* (Roxb.) Gagnep., although ranked high in the direct ranking method (1st place, SCV = 35), did not appear in the free-listing list because there were no prerequisite features for people to choose as priority species (Table 3). Therefore, in the next step, a pairwise ranking of the top 15 important species according to the free-listing method will be conducted to see if there is consensus in the decisions among the informants between the two applied techniques. The Spearman's non-parametric rank order test was performed, and the results showed a significant positive correlation in the selection order of the top 15 important species between the free-listing and pairwise ranking techniques (rho = 0.747, p = 0.001<0.05). Thus, *Lasia spinosa* (L.) Thwaites and *Gnetum gnemon* L. were concluded to be the two most important species in the Chơ Ro community (Table 4).

The results of Spearman's non-parametric rank order test indicated a positive significant correlation in the order of 10 important species between the free-listing and pair-wise ranking methods (rho = 0.642, p = 0.045<0.05).

Table 3. Comparison of the priority species between free-listing and direct ranking method

Free-listing		**Common species (Ranking)**			**Direct ranking**	
Species	Ranking	Common species	Free-listing	Direct ranking	Species	Ranking
D. jenkinsiana	3	*G. gnemon*	1	7	*G. formosum*	1
D. hamiltonii	3	*L. spinosa*	2	8	*S. dichotomus*	1
S. ferox	5	*B. procera*	6	5	*P. urophyllus*	3
A. caudata	7	*C. poilanei*	7	6	*A. tectorius*	3
Grewia sp.	7	*P. foetida*	7	10	*L. spinosa*	9
S. macropodum	11	*E. longifolia*	10	15	*Gigantochloa* sp.	11
E. longifolia	11				*G. lobbianum*	11
D. esculentum	13				*Lithocarpus* sp.	13
A. conchigera	14				*C. urens*	14
M. charantia	14				*L. triandra*	15

The priority species selection factors of the community

There were seven reasons given by group discussion participants for choosing species that were important to them, including it is an (important) ingredient for preparing traditional dishes, alcohol often has spiritual meaning (hereinafter referred to as cultural value), it has health care or disease treatment uses (medicinal value), it is a source of supporting income because it can be sold (economic value), it has many uses (multi-use), it is easy to process, it is a raw material for household and housing utensils and it is widely distributed in nature, easy to harvesting (easy access) (Appendix 3).

When analyzing the above factors, it can be seen that people's choice of priority species can be based on one decisive (most important) criterion for them or it can be a combination of several factors. For example, the species *Solanum ferox* L. was chosen by 11/11 members because it is the main ingredient of traditional dishes and cannot be replaced by any other species. Similar to *Lasia spinosa* (L.) Thwaites, the species was chosen for its versatility: it can be used as food or medicine to support the treatment of liver disease and can also be sold.

The relationship between factors was tested using Spearman's correlation coefficient test (Table 5). Cultural values exhibited significant associations with most other factors in 4 out of 6 pairs of comparisons, with positive correlations observed with the “multi-use” factor (p = 0.312) and negative correlations with the “easy to use'” (p = -0.225), “medication” (p = -0.240), and “easy to access” (p = -0.226) factors. Conversely, the “economic value” factor showed a unique positive relationship solely with the “multi-use” factor (p = 0.312).

Table 5. Correlation matrix of criteria used for selecting priority species by the Chơ Ro people

Criteria	Easy to process	Medicine	Accessible	Culture	Economy	Multi-use	Material
Easy to process	-						
Medicine	0.165	-					
Accessible	-0.153	-0.017	-				
Culture	-0.225*	-0.240*	-0.226*	-			
Economy	0.071	0.214	-0.187	0.198	-		
Multi-use	0.039	0.272*	-0.066	0.312*	0.310*	-	
Material	-0.163	-0.390*	0.039	0.192	-0.013	0.263*	-

*$p < 0.05$

Gender analysis in selecting priority species

The analysis of gender perspectives on the selection of important species was carried out based on the results of the free-listing method because it was consistent with the selection trends of people in the study area. The results showed that there was no difference in the number of species selected between the male and female groups, with the average number of plants selected being 13±3 and 14±3, respectively. However, there were more or less differences in the selected species composition.

In the list of important species, 15/37 species have received consensus for selection in both genders. Among them, there are four most mentioned species, ranked in order: *Gnetum gnemon* L., *Lasia spinosa* (L.) Thwaites, *Daemonorops jenkinsiana* (Griff.) Mart. and *Dioscorea hamiltonii* Hook.f.. As for the species *Diplazium esculentum* (Retz.) Sw., it was only mentioned by the male group with a high ranking (3) and was not recommended by the female group. The common species that received consensus were largely attributed to their cultural, economic, or medicinal value, as indicated in Table 6.

In addition to the above 15 similar taxa, over 15 taxa were chosen exclusively by the male group, while not being listed by the female group. Conversely, the remaining seven taxa were solely proposed by the female group. Among the species selected by only one group, the majority were utilized as ingredients by the male group or were regarded as components for traditional dishes and medicine within the female group (Table 6).

The difference in selecting important species recorded between male and female groups may be due to their preference for selecting a certain criterion. When considering the percentage of total mentions for each criterion in each gender, the results showed that cultural factors account for the most in both genders, 41.7% for men and 40.0% for women, respectively (Figure 5). However, the male group showed more interest in the criteria "making materials" and "easy to use" while the female group focused on the "multi-use" factor. This can be explained based on the nature of the work each group undertakes. For example, building houses or making production tools is considered closely related to men, so plants that are used as materials will be the subject of great interest for men. In addition, men also prioritize species with simple uses because they often do not have the patience for elaborate preparations. As for women, their preferred plant source is herbaceous species that grow around their living area, such as wild vegetables that are eaten daily or are beneficial to health and can be used in the family or sold. Therefore, plants with "multi-use" value will be of more interest to women. However, in general, there are no significant differences in the selection of factors between male and female groups. The results of the Mann-Whitney test also show that there is no difference in the selection of important species between the two sexes (p-value > 0.05).

Table 4. The list of priority species identified by the pair-wise ranking technique

	G. gnemon	*L. spinosa*	*D. hamiltonii*	*S. ferox*	*B. procera*	*P. foetida*	*C. poilanei*	*A. caudata*	*E. longifolia*	*S. macropodum*	Score	Pair-wise ranking	Free-listing ranking
G. gnemon	-	0	0.5	1	1	1	1	1	1	1	**7.5**	**2**	**1**
L. spinosa	1	-	1	1	1	1	1	1	1	1	**9**	**1**	**2**
D. hamiltonii	0.5	0	-	1	1	0	1	1	1	1	6.5	3	3
S. ferox	0	0	0	-	0	0.5	1	1	0	0	2.5	9	4
B. procera	0	0	0	1	-	0	1	1	1	0	4	5	5
P. foetida	0	0	1	0.5	1	-	0.5	1	1	1	6	4	6
C. poilanei	0	0	0	0	0	0.5	-	0.5	1	1	3	6	6
A. caudata	0	0	0	0	0	0	0.5	-	0	0	0.5	10	6
E. longifolia	0	0	0	1	0	0	0	1	-	1	3	6	9
S. macropodum	0	0	0	1	1	0	0	1	0	-	3	6	9

Table 6. Priority species selection by gender

Common species - 2 groups	Species - 1 group	
	Male	Female
Gnetum gnemon L.	*Diplazium esculentum* (Retz.) Sw.	*Alpinia conchigera* Griff.
Lasia spinosa (L.) Thwaites	*Ancistrocladus tectorius* (Lour.) Merr.	*Momordica charantia* L.
Daemonorops jenkinsiana (Griff.) Mart.	*Barringtonia macrostachya* (Jack) Kurz	*Dracaena elliptica* Thunb. & Dalm.
Dioscorea hamiltonii Hook.f.	*Pseuderanthemum crenulatum* (Wall. ex Lindl.) Radlk.	*Uvaria* sp.
Solanum ferox L.	*Gonocaryum lobbianum* (Miers) Kurz	*Castanopsis* sp.
Bambusa procera A.Chev. & A.Camus	*Gmelina elliptica* Sm.	*Camellia flava* (Pit.) Sealy
Calamus poilanei Conrard	*Drynaria quercifolia* (L.) J.Smith	*Pouzolzia zeylanica* (L.) Benn.
Arenga caudata (Lour.) H.E.Moore	*Gnetum formosum* Markgr.	
Grewia sp.	*Sageraea elliptica* (A.D.C) Hook. & Thoms.	
Scaphium macropodum (Miq.) Beumee ex K.Heyne	*Willughbeia edulis* Roxb.	
P. foetida L.	*Cyclacanthus coccineus* S.Moore	
E. longifolia Jack	*Schumannianthus dichotomus* (Roxb.)	
C. urens L.	*Sandoricum koetjape* (Burm.f.) Merr.	
Limacia triandra Miers	*Cymbidium aloifolium* (L.) Sw.	
Gigantochloa sp.	*Claoxylon indicum* (Reinw. ex Blume) Hassk.	

Challenges of individual plant specifications

The threatened status (if any) of plant species used by the Chơ Ro community was determined based on the following documents: IUCN Red List (2022), Decree 06/2019/Goverment, and the Red Book of Vietnam (2007).

The results showed that there were 33 species of different conservation status, comprising 29 species listed in the IUCN Red List (2022), 3 species in Decree 06/2019/Goverment, and 2 species in The Reed Book of Vietnam (2007) (Appendix 4). Among these, 5 species, including *Dioscorea hamiltonii* Hook.f. classified as Near Threatened, *Gnetum gnemon* L., *Lasia spinosa* (L.) Thwaites, *Scaphium macropodum* (Miq.) Beumee ex K.Heyne, and *Caryota urens* L. categorized as Low Concern, were identified as significant from the perspective of the Chơ Ro community.

Among the 29 plant species listed on the IUCN Red List (2022), one species was categorized as Critically Endangered (CR): *Camellia flava* (Pit.) Sealy; three species were classified as Near Threatened (NT): *Aglaia grandis* Korth. ex Miq., *Calamus godefroyi* Becc., and *Dioscorea hamiltonii* Hook.f.; while the remaining were mostly species of Least Concern (LC). The Vietnam Red Book (2007) included one species classified as Endangered (EN), *Calamus poilanei* Conrard, with the remaining species, *Peliosanthes teta* Andrews, categorized as Vulnerable (VU). According to Decree 06/2019/Government, three endangered species were classified in group IIA, with one species coinciding with the Vietnam Red Book (2007) - *Calamus poilanei* Conrard. The other two species were *Cycas* sp. and *Cymbidium aloifolium* (L.) Sw. (Appendix 4).

Status of two important plant species in Chơ Ro communities

From the list of 15 plant taxa important to the Chơ Ro community in Phu Ly commune, two taxa had the highest priority order and were also included in the IUCN Red List (2022): *Lasia spinosa* (L.) Thwaites and *Gnetum gnemon* L. were selected for the investigation of distribution status and threats to the species (if any) (Figure 7).

As per local opinion, the presence of *Gnetum gnemon* L. in the environment remains unchanged, while *Lasia spinosa* (L.) Thwaites has notably decreased compared to five years ago. This decline is primarily attributed to the significance of their utility and partially to over-exploitation by both local residents and individuals from other areas. The species *Gnetum gnemon* L. demonstrates rapid growth in forest habitats, with leaves being the predominant part utilized. People commonly incorporate them into daily dishes like vegetable soup and stir-fried beef, as well as traditional cultural dishes like beef soup. Consequently, the utilization of plant resources for this species by people does not exert a significant impact. In contrast, *Lasia spinosa* (L.) Thwaites grows exclusively in areas with water or moisture, exhibiting relatively slow growth. In addition to utilizing its young buds as a food source, the species also produces valuable tubers. These tubers are utilized as medicinal herbs and are harvested for commercial purposes, contributing to the overexploitation of the species. However, through interviews with local people, it has been found that some individuals remain mindful of the sustainable use of forest resources. For instance, when it comes to *Gnetum gnemon* L., they prioritize utilizing its leaves for food, which also supports medicinal purposes, rather than solely focusing on the stems for medicinal use. As for *Lasia spinosa* (L.) Thwaites, they do not exploit the entire population; instead, they utilize only a portion of it and leave the remainder to allow the species to recover. This demonstrates that the indigenous plant knowledge of the Cho Ro people not only highlights diversity but also underscores sustainability in the utilization of plant resources within the study area.

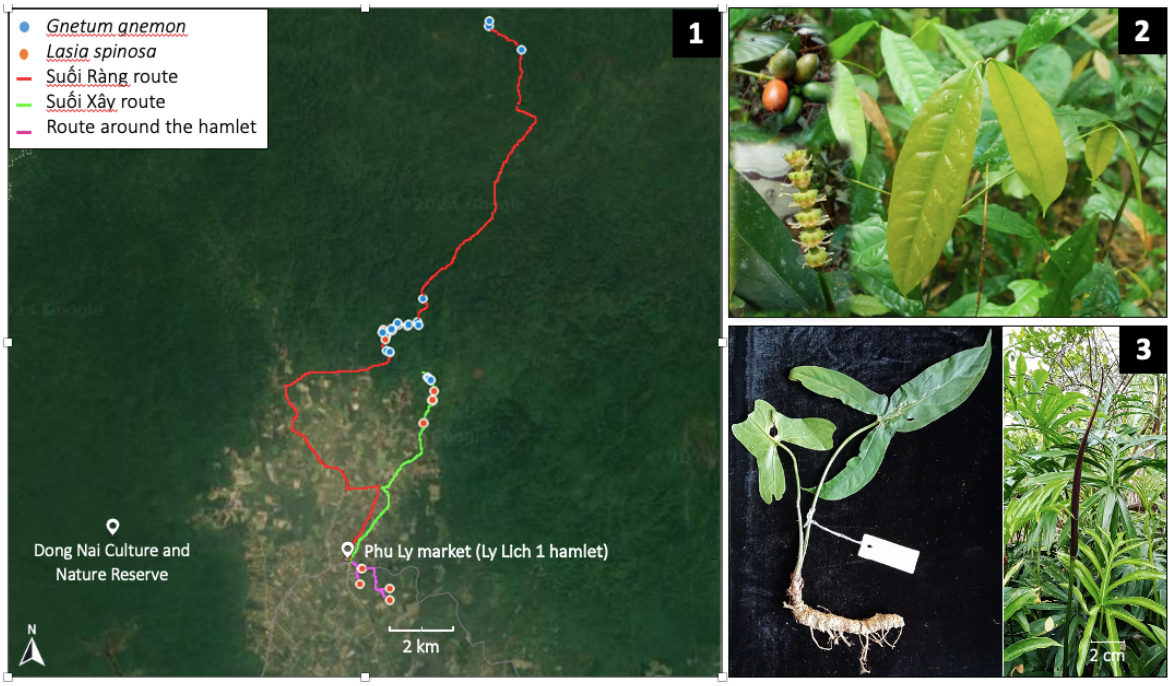

Figure 7. Distribution map of the two most priority species
1 - The distribution of the species was recorded along three survey routes
2 - The species *Gnetum gnemon* L.
3 - The species *Lasia spinosa* (L.) Thwaites

Discussion

Diversity of plants used by the local community

The comparison of taxa recorded from the current study with those of DNCNR indicated a significant contribution from the taxa composition used by the Chơ Ro people to the flora of the area. Specifically, at the species level, 118 taxa were reported compared to a total of 1558 taxa for the entire area (representing 7.6% of the total species); at the genus level: 97/665 (14.6%); at the family level: 57/166 (34.3%); and at the phylum level: 4/6 (66.7%). Thereby, it can be seen that the knowledge of plant species among the Chơ Ro ethnic community is quite extensive across different taxonomic levels within the DNCNR. When considering the distribution of 118 taxa in the environment, it is found that the majority of taxa are naturally distributed in forest habitats or nearby residential areas. However, there were only 25 species that people brought from the forest to cultivate in their home gardens, primarily because they held certain values for them, often serving as staples for daily dishes or as ornamental items; for instance *Colona scabra* (Sm.) Burret, *Cymbidium aloifolium* (L.) Sw., *Diplazium esculentum* (Retz.) Sw., *Eurycoma longifolia* Jack, *Grewia* sp., *Lasia spinosa* (L.) Thwaites, *Momordica charantia* L., *Schumannianthus dichotomus* (Roxb.) Gagnep., *Solanum ferox* L..

A comparison with a prior study, which recorded 234 plant species utilized for non-timber forest products by various ethnic groups within the DNCNR area, reveals that the number of plant species employed by the Chơ Ro people in this study accounts for over 50% of the total species utilized by all ethnic groups in the same region (Nguyen & Nguyen, 2017). The study also documented the uses of species from two phyla, Cycadophyta and Gnetophyta, which were not previously mentioned in Nguyen's study.

Category of plant uses

Among eight use groups, alimentary is the most popular category cited by Chơ Ro people. In this study, 31 taxa were initially identified in this group, which was compared to those recorded in Nguyen's study conducted in the same area five years ago (Nguyen 2018), including *Aglaia grandis* Korth. ex Miq., *Ardisia solanacea* (Poir.) Roxb., *Baccaurea* sp., *Barringtonia macrostachya* (Jack) Kurz, *Calamus godefroyi* Becc., *Calamus rudentum* Lour., *Caryota urens* L., *Claoxylon indicum* (Reinw. ex Blume) Hassk., *Clausena anisata* (Willd.) Hook.f. ex Benth., *Croton argyratus* Bl., *Cyclacanthus coccineus* S.Moore, *Cyclea barbata* Miers, *Dioscorea hamiltonii* Hook.f., *Dioscorea hispida* Dennst., *Ficus chartacea* (Wall. ex Kurz) Wall. ex King, *Ficus simplicissima* Lour., *Garcinia celebica* L., *Gnetum formosum* Markgr., *Leea indica* (Burm. f.) Merr., *Limacia triandra* Miers, *Mangifera* sp., *Murraya alata* Drake, *Pouzolzia zeylanica* (L.) Benn., *Pseuderanthemum crenulatum* (Wall. ex Lindl.) Radlk., *Solanum ferox* L., *Thunbergia annamensis* R.Ben, *Trichosanthes cochinchinensis* (Lour) M. Roem, *Willughbeia edulis* Roxb., *Xerospermum glabratum* Pierre non Raldk, and *Ziziphus funiculosa* Buch.-Ham. ex Wall.. The prevalence of edible plants was

also found in other studies involving useful plants collected in home gardens in Southwestern Uganda, where 54% of use-reports were attributed to food among 14 different use categories (Whitney *et al.* 2018).

Furthermore, upon comparing the indigenous knowledge of the Chơ Ro and S'tieng people residing in Cat Tien National Park, similarities were observed in the utilization of certain species as edible plants or traditional cultural items (Dinh 2019). For example, *Arenga caudata* (Lour.) H.E.Moore, *Calamus rudentum* Lour., *D. jenkinsiana* (Griff.) Mart., and *Gnetum gnemon* L. were all preferred species in both ethnic groups. These plants were frequently utilized in everyday dishes and served as primary ingredients in traditional soups within each ethnic group. Another example is the species *Dioscorea hamiltonii* Hook.f., which is favored by both ethnic groups. For the Chơ Ro people, this plant holds significance beyond its role as a starch supplier; it also carries cultural value as the main food of the community during the resistance war against American aggression.

The abundance of taxa used and the diverse range of uses within the food group in the indigenous knowledge of the Chơ Ro people can be attributed to their extensive time living in the forest, where food was a fundamental necessity for their survival. This finding aligns with a study on the indigenous knowledge of the Dao people in Hoa Binh Province (Ha 2010) but contrasts with the preferences of the ethnic community in Bustamante, Mexico, where most taxa were utilized for decoration (Estrada-Castillón *et al.* 2018).

Apart from the common knowledge that was perceived to be shared among key informants, there was still knowledge that showed specific characteristics for some individuals. The difference here could be the usage of plants or their preparation, and method of administration. For example, the species *Ancistrocladus tectorius* (Lour.) Merr. was mentioned by all seven key informants as the roofing material, but only few people cited it as a scorpion venom detoxification. *Camellia flava* (Pit.) Sealy was utilized as a beverage, yet informants varied in their choice of plant parts and preparation methods: some boiled leaves or flowers in water, while others soaked stems or roots in alcohol (Table 1).

Plants used for traditional alcohol, which could be a potential commercial product

A total of 35 plant taxa were identified for the production of the Chơ Ro traditional alcohol, known as **rượu cần**. This beverage, commonly found among ethnic groups in the highlands of Vietnam, is typically stored in earthenware jars and consumed using a long bamboo pipe. The traditional recipe for **rượu cần** typically involves a blend of fermented glutinous rice and various locally sourced herbs. This variation in ingredients results in unique flavor profiles, which can differ between communities and even among families within the same community.

Interviews with local people revealed that traditional knowledge regarding alcohol preparation was quite diverse. While there were commonalities in the processing methods, each individual had different preferences regarding the composition of plant species used. Some individuals specified the exact number of plants and the primary species essential for making yeast, emphasizing that the absence of certain species could significantly alter the taste of the alcohol. Conversely, others believed that all species contributed equally to the alcohol's quality. For instance, a higher quantity of *Psychotria adenophylla* Wall. and *Gonocaryum lobbianum* (Miers) Kurz will impart bitterness, while *Alpinia conchigera* Griff. will add spiciness, and *Amomum* sp. will contribute sweetness and a reddish hue to the alcohol.

It was discovered that some plants, apart from their culinary roles, were also preferred for their potential health benefits. Notably, *Peliosanthes teta* Andrews and some species of the genus Dracaena recorded in the study were also utilized for medicinal purposes by local people in Phnom Kulen National Park (Cambodia) (Walker 2017). This paves the way for a more detailed investigation of the biological activities of these species based on traditional knowledge.

While ethnic minorities may share some common knowledge, each group preserves its distinct character, as evidenced by the ingredients used in traditional beverages. The study documented 21 additional species used in the production of traditional alcohol compared to the 65 species recorded in a previous study conducted in the same area (Nguyen *et al.*, 2017). These newly recorded species include *Amomum* sp., *Benkara fasciculata* (Roxb.) Ridsdale, *Callicarpa* sp., *Castanopsis* sp1., *Castanopsis* sp2., *Commelina* sp., *Croton argyratus* Bl., *Croton poilanei* Gagnep., *Drynaria quercifolia* (L.) j.Smith, *Dracaena elliptica* Thunb. & Dalm., *Hedyotis* sp., *Melastoma osbeckioides* Guillaumin, *Pothos scandens* L., *Psychotria adenophylla* Wall., *Raphidophora* sp., *Rinorea anguifera* Kuntze, *Sargentodoxa cuneata* (Oliv.) Rehder & E.H.Wilson, *Stachyphrynium repens* (Körn.) Suksathan & Borchs*, Syzygium jambos* (L.) Alston*, Uvaria* sp. and *Vatica odorata* (Griff.) Symington. In addition, the number of plant taxa used for **rượu cần** by Chơ Ro people was much more than those used by Thái, Mường, and H'Mông (35 taxa versus 22 taxa) (Do *et al.* 2011).

The selection of important species

Our results align with previous studies' assertion that the selection of important species by local communities is influenced by factors beyond economic value (N'Danikou *et al.* 2011). For the community, the criteria for selecting species for conservation purposes encompass not only rarity but also their association with traditional culture (e.g., *Caryota urens* L., *Dioscorea hamiltonii* Hook.f., *Gnetum gnemon* L.) or economic significance (e.g., *Lasia spinosa* (L.) Thwaites, *Scaphium macropodum* (Miq.) Beumee ex K.Heyne). This highlights a disparity in the identification of species considered important for conservation between the perspectives of the community and those of conservation organizations or the government.

Therefore, future projects should avoid solely relying on market or conservation-based criteria when selecting species for preservation. It is imperative to consider the criteria utilized by the local community. This approach will ensure that conservation efforts not only protect the environment but also honor the cultural and socio-economic needs of the community.

In the present study, three techniques were used to elicit the perception of local people on valuing priority species and whether they lead to the same conclusion or not. It was found that there was a similarity in the important species selection between free-listing and pair-wise ranking methods. This implies the consensus within the community's perspective and highlights their usefulness for triangulation. Nevertheless, it is crucial to recognize that each approach has its own set of advantages and disadvantages, rendering them more suitable for specific case studies. For example, N'Danikou recommends the scoring method because of its ability to generate quantitative data, thereby enabling the application of robust statistical analyses (N'Danikou *et al.* 2011). The present study proposes an additional option: researchers should carefully consider the most appropriate approach based on their objectives and real situations. For instance, when time is limited, it is advisable to use the free-listing technique to quickly compile an extensive list of important species. This list can then be refined using specific criteria (Wong *et al.* 2002). However, it is important to note that this method does not inherently provide the ranking of importance within the selected species since respondents freely list the species they consider significant. To address this, the pair-wise ranking method can be employed afterward to achieve a more comprehensive selection. Furthermore, empirical evidence supports the suitability of this proposal for the present study, as it aligns with the local people's tendency to select their important species primarily based on one or two essential attributes of interest, rather than considering multiple criteria as in the case of direct ranking.

Conservation efforts for the community's prioritized plant species

Many of the species listed in the IUCN Redlist and the Red Book of Vietnam (Appendix 4) served as ingredients in local food preparation, with their leaves, young buds, and fruits being the primary parts utilized. Examples included *Aglaia grandis* Korth. ex Miq. (fruits), *Calamus godefroyi* Becc. (young buds), *Cheilocostus speciosus* (J.Koenig) C.D.Specht (leaves). Notably, *Lasia spinosa* (L.) Thwaites, one of the most important plants to the local people, has a relatively slow growth rate, the demand for this species is quite high because of the great value it brings to the community. It could be seen that unless the conservation strategy is considered, this resource would be depleted soon. Similar to the species *Gnetum gnemon* L., this species has important significance in the traditional cultural values of the nation as well as the use of this species has become a habit in people's lives. The problem here is that this species can only grow in forest habitats, but not in home gardens although much effort was made to cultivate it. Therefore, the actual demand for these species and the important plants in traditional alcohol production should be taken into account for future research on their physiology. This contributes to the protection and development of plant genetic resources, preserving the values of the community's traditional products as well as ameliorating the livelihoods of the local people (Nguyen 2011).

Some other species, such as *Aglaonema simplex* (Blume) Blume, *Cymbidium aloifolium (L.) Sw.*, and *Cycas* sp., were sought after for ornamental purposes despite their limited distribution in nature. Additionally, certain species, such as *Camellia flava* (Pit.) Sealy and *Dioscorea hamiltonii* Hook.f., offer roots and tubers as potential resources; however, their utilization is infrequent due to the challenges associated with their collection - *Camellia flava* (Pit.) Sealy being a large tree and *Dioscorea hamiltonii* Hook.f. having tubers buried up to 2 meters deep.

These observations underscore the importance of preserving the rare genetic resources of the Chơ Ro community and present a challenge for the DNCNR in devising strategies for the conservation and sustainable development of resources in the study area. Efforts to conserve these species are crucial for maintaining biodiversity and supporting the sustainable livelihoods of local communities.

The risk of oblivion of plant knowledge in the community

By becoming part of the modernization of the country, the quality of life for the Chơ Ro people has gradually improved, resulting in changes in both material and spiritual needs. Currently, most community members can conveniently purchase food from the local market without the need to travel far. Therefore, the frequency of visits to the forest has decreased. The individuals who still maintain the habit of forest visits are typically those aged 50 and above, while younger individuals spend the majority of their time working at factories or construction sites. This shift in lifestyle poses the risk of gradually eroding the community's traditional knowledge about plants. Furthermore, indigenous knowledge is often esoteric and susceptible to loss if not shared or documented (Vu 2007). While some individuals are willing to participate in the exchange of information, there are also cases where individuals prefer not to share, especially during in-person interviews conducted in the present study. Reasons for this reluctance may include shyness or a desire to retain the knowledge for personal use.

Conclusion

The research documented 118 plant species from 57 families and 4 phyla, demonstrating the extensive use of these plants by the Chơ Ro people in their daily lives. These plants served various purposes across eight main categories, encompassing food, beverage, materials, techniques, ornament, cultural and social activities, poison, and medicine, showcasing a rich diversity in their utilization. Additionally, the study identified 35 taxa specifically employed in traditional alcohol, suggesting

a potential avenue for commercial products. This knowledge not only reflects the characteristics of the community, as mentioned by many individuals, but it is also unique to each individual, as noted by only one person. This diversity has contributed to the rich tapestry of indigenous plant knowledge within the Cho Ro ethnic community in the survey area.
Through three different techniques, fifteen significant plants from the community's perspective were identified, distinguishing between men and women. Among these, *Lasia spinosa* (L.) Thwaites and *Gnetum gnemon* L. emerged as the two most important plant species. The results indicated that the majority of both genders prioritize species selection primarily due to their association with the community's culture. However, significant differences in species selection may still exist due to the diverse lifestyles and needs of each group. These findings provide essential information for the protection and development of plant genetic resources, preserving the valuable knowledge of the Chơ Ro people, and improving the livelihoods of local residents.

Declarations

List of abbreviations: IIA - The group is at risk of being endangered if not managed according to the Government's Decree; A - Alimentary; Ac - Accessible; B - Beverage; Cu - Culture/Social; CR - Critically endangered; DNCNR - Dong Nai Culture and Nature Reserve; Ec - Economy; EN - Endangered; Eu - Easy to use; F - Female; IUCN - International Union for Conservation of Nature; LC - Least concern; Ma - Material; Me - Medicine; Mu - Multi-use; ND-CP - Government Decree; NT - Near threatened; O - Ornament; P - Poison; PHH - Pham Hoang Ho Herbarium; PRA - Participatory Rural Appraisal; SCV - The Specific Community Value of a given species; T - Technique; UI - Use Index; VU - Vulnerable.
Ethics approval and consent to participate: Before conducting the study, approval was obtained from the Dong Nai Culture and Nature Reserve. This included written consent from the Reserve, allowing for contact with the indigenous community and collection of tree samples within the area. We also obtained consent from the interviewees to record their traditional knowledge. We informed them about the purpose of the study and how we intended to use the data collected from the community.
Consent for publication: Not applicable
Availability of data and materials: The figures and tables supporting the results of this study are included in the article, and the original data sets are available from the first author upon request.
Competing interests: The authors declare that there are no conflicts of interest in this article.
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Author contributions: Conceptualization: XMAN and TMAN; Application for study permits: XMAN; Supervision and coordination of the study: XMAN; Conducting of the interviews: XMAN and TMAN; Data analysis: XMAN and TMAN. All authors read and approved the final manuscript.

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Appendix 1. Plants used for preparing traditional alcohol **rượu cần**

Role	Species (Plant part used)	
Yeast cake (32 taxa)	*Alpinia conchigera* Griff. (tuberous roots)	*Ixora dongnaiensis* Pierre ex Pit. (leaves)
	Amomum sp. (tuberous roots)	***Lasianthus chrysoneurus*** (Korth.) Miq. (leaves)
	Glenniea thorelii (Pierre) Leenh. (leaves)	*Uvaria* sp. (leaves)
	Benkara fasciculata (Roxb.) Ridsdale (roots)	*Lygodium subareolatum* Christ. (leaves)
	Stachyphrynium repens (Körn.) Suksathan & Borchs (stems, roots)	*Melastoma osbeckioides* Guillaumin (whole plant)
	Castanopsis sp1. (leaves, stem barks)	*Callicarpa* sp. (leaves)
	Castanopsis sp2. (leaves)	*Peliosanthes teta* Andrews (roots)
	Clausena anisata (Willd.) Hook.f. ex Benth. (leaves)	*Pothos scandens* L. (leaves, stems)
	Commelina sp. (leaves, stems)	***Psychotria adenophylla*** Wall. (leaves)
	Croton argyratus Bl. (leaves)	*Raphidophora* sp. (leaves, stems)
	Croton poilanei Gagnep. (leaves, stem barks)	*Rinorea anguifera* Kuntze (leaves)
	Croton sp. (leaves, stem barks)	*Sargentodoxa cuneata* (Oliv.) Rehder&E.H.Wilson (leaves, stem barks)
	Drynaria quercifolia (L.) J.Smith (leaves, stems)	Sp2. (leaves)
	Dracaena elliptica Thunb. & Dalm. (leaves, tuber)	*Syzygium jambos* (L.) Alston (leaves)
	Fagraea fragrans Roxb.(stem barks)	*Vatica odorata* (Griff.) Symington (stems)
	Gonocaryum lobbianum (Miers) Kurz (leaves, stem barks)	
	***Hedyotis* sp.** (whole plants)	
Wrapping items (2 taxa)	***Colona scabra*** (Sm.) Burret (leaves)	
	Solanum ferox L. (leaves)	
Auxiliary item (1 taxon)	Sp3. (leaves)	

Species in **bold** were the main ingredients.

Appendix 2. The list of priority species identified by free-listing technique

Male group						No. mentioned (M)	Rank (M)	Species	Rank (F)	No. mentioned (F)	Female group				
M1	**M2**	**M3**	**M4**	**M5**	**M6**						**F1**	**F2**	**F3**	**F4**	**F5**
Cu Me	Cu Eu	Cu	Cu Me	Cu Eu	Cu Eu Ac	*6*	**1**	*Gnetum gnemon* L.	**1**	*5*	Cu Me Ec Mu Eu	Cu Me	Cu Me Eu	Cu	Cu
Me Ec	-	Cu Me	Eu Me	Cu Me Ec	Me Ec Eu	*5*	**2**	*Lasia spinosa* (L.) Thwaites	**1**	*5*	Cu Me Ec	Me Ec Mu	Me Ec	Cu Me Ec	Me Mu Eu
Cu	Cu	Cu	Cu	-	-	*4*	**3**	*Daemonorops jenkinsiana* (Griff.) Mart.	**1**	*5*	Cu Mu	Cu	Cu Mu Eu	Cu	Cu Me
Cu Me	Cu Eu	-	-	Cu	Cu	*4*	**3**	*Dioscorea hamiltonii* Hook.f.	**1**	*5*	Cu	Cu	Cu Me	Cu Eu	Cu Eu
Cu	Cu Ac	-	-	Cu	-	*3*	**6**	*Solanum ferox* L.	**1**	*5*	Cu	Cu	Cu	Cu	Cu Ac
Ma	Ma	-	-	-	Cu Ma Ec	*3*	**6**	*Bambusa procera* A.Chev. & A.Camus	**6**	*4*	-	Cu Ma Mu	Cu Ma Mu	Ma Ec Mu	Cu Ma Ac
Cu Ma	-	Cu	-	Cu Ma Ec	-	*3*	**6**	*Calamus poilanei* Conrard	**8**	*3*	Cu Ma	-	Cu Ma	-	Ma
Ma A	-	Ma	-	-	Ma Eu Ac	*3*	**6**	*Arenga caudata* (Lour.) H.E.Moore	**8**	*3*	Ec	Ma	Ma	-	-
Cu	Cu	-	-	-	Cu	*3*	**6**	*Grewia* sp.	**8**	*3*	Cu	Cu	-	-	Cu
Fd Me E	-	-	-	Fd Me E	Fd Me E	*3*	**6**	*Scaphium macropodum* (Miq.) Beumee ex K.Heyne	**14**	*2*	Fd Me E	-	-	-	Fd Me E
Me Eu Ac	-	-	-	-	Cu Me	*2*	**12**	*Passiflora foetida* L.	**6**	*4*	-	Cu Me	Cu Me	Cu Me	Cu Me Eu Ac
Me Eu Ac	-	-	-	-	Me Ec Ac	*2*	**12**	*Eurycoma longifolia* Jack	**8**	*3*	Me Ec	Cu Me	-	Cu Me	-
Fd	Fd E	Fd	Fd	-	-	*4*	**3**	*Diplazium esculentum* (Retz.) Sw.	-	*0*	-	-	-	-	-
-	-	-	-	-	-	*0*	-	*Alpinia conchigera* Griff.	**8**	*3*	Cu	-	Cu Ec	Cu Me Ac	-
-	-	-	-	-	-	*0*	-	*Momordica charantia* L.	**8**	*3*	Cu	Cu Me	-	Cu Me Mu	-

(-) = not selected; Ac = Accessible; F = Female; M = Male

Appendix 3. The list of priority species identified by the direct ranking technique

Male group							SCV (M)	Species	SCV (F)	Female group							Total SCV
Cu	Me	Ec	Mu	Eu	Ma	Ac				Cu	Me	Ec	Mu	Eu	Ma	Ac	
3	1	1.5	2.5	2.5	3	2.5	16	*Gnetum formosum* Markgr.	19	4	0	4	3	2	3	3	35
3.7	2.3	0	1.3	2.3	3	2.3	15	*Schumannianthus dichotomus* (Roxb.) Gagnep.	20	4	3	3	2	2	4	2	35
4	4	1	3	2	4	2	20	*Pandanus urophyllus* Hance	14	1.5	3.5	2	1	3.5	1	1.5	34
4	0	0	0	3	2	2	11	*Ancistrocladus tectorius* (Lour.) Merr.	23	4	2	2	3	4	4	4	34
2.7	0	2	2	3	3.3	3.3	16.3	*Bambusa procera* A.Chev. & A.Camus	17	2.8	0	2.5	3.5	2.3	2.8	3.3	33.3
2.7	0	2.7	2	2.7	3.3	3.3	16.7	*Calamus poilanei* Conrard	15	3.7	0	3	0.7	2	3.7	2	31.7
3.5	2.5	0	1.8	3.5	0	3.2	14.5	*Gnetum gnemon* L.	15.8	3.6	2.4	1.8	2.4	3.2	0	2.4	30.3
3	0	1	3	2	3	3	15	*Lasia spinosa* (L.) Thwaites	14	2	0	2	3	2	2	3	29
0	4	2.5	2	3	0	2	13.5	*Licuala spinosa* Wurmb	16.2	1.4	4	2.2	3	3	0	2.6	29.7
1	3	1	2.3	3.3	0	3.7	14.3	*Passiflora foetida* L.	14.5	0	3.8	1.3	2.8	3.5	0	3.3	28.8
3.5	0	0	1.5	3	3	3	14	*Gigantochloa* sp.	14	0	0	2.5	3	3	3.5	2	28
2.5	1.5	1	1	3	0	3	12	*Gonocaryum lobbianum* (Miers) Kurz	16	0	4	2	4	3	0	3	28
2	2	0	3	3	0	3	13	*Lithocarpus* sp.	14.5	1	4	2.5	2	2	0	3	27.5
1.5	1.5	0	1	3	1	3.5	11.5	*Caryota urens* L.	15.7	1.7	2.7	2.3	2.3	2.7	0.7	3.3	27.2
1	3.7	1.7	0	3.3	0	3.7	13.3	*Eurycoma longifolia* Jack	13.3	0.8	3.5	1.8	1.5	2.8	0	3	26.6
3.5	3.5	0	2	2.5	0.5	2.5	14.5	*Limacia triandra* Miers	12	1	3	0	1.5	3	0	3.5	26.5

(-) = not selected; Ac = Accessible; Cu = Culture; Ec = Economy; Eu = Easy to use; F = Female; M = Male; Ma = Material; Me = Medicine; Mu: Multi-use.

Appendix 4. List of threatened plants in the study site

No.	Species	Status (Ordered by degree of threatened)			
		IUCN		Vietnam's Red book (2007)	Decree 06/2019
		Status	Evaluation date		
1.	*Camellia flava* (Pit.) Sealy	CR	08/08/2019		
2.	*Calamus poilanei* Conrard			EN	IIA
3.	*Peliosanthes teta* Andrews			VU	
4.	*Cycas* sp.				IIA
5.	*Cymbidium aloifolium* (L.) Sw.				IIA
6.	*Aglaia grandis* Korth. ex Miq.	NT	01/01/1998		
7.	*Calamus godefroyi* Becc.	NT	25/07/2011		
8.	*Dioscorea hamiltonii* Hook.f.	NT	07/05/2019		
9.	*Aglaonema simplex* (Blume) Blume	LC	25/07/2011		
10.	*Alpinia conchigera* Griff.	LC	22/07/2019		
11.	*Baccaurea ramiflora* Lour.	LC	12/06/2018		
12.	*Caryota urens* L.	LC	05/06/2009		
13.	*Cheilocostus speciosus* (J.Koenig) C.D.Specht	LC	27/03/2020		
14.	*Clausena anisata* (Willd.) Hook.f. ex Benth.	LC	12/06/2018		
15.	*Croton argyratus* Bl.	LC	15/05/2019		
16.	*Diospyros maritima* Blume	LC	12/06/2018		
17.	*Diplazium esculentum* (Retz.) Sw.	LC	26/01/2011		
18.	*Dracaena elliptica* Thunb. & Dalm.	LC	29/04/2019		
19.	*Fagraea fragrans* Roxb.	LC	12/06/2018		
20.	*Gnetum formosum* Markgr.	LC	25/06/2009		
21.	*Gnetum gnemon* L.	LC	19/05/2009		
22.	*Irvingia malayana* Oliv. ex A.W.Benn.	LC	27/01/2019		
23.	*Lasia spinosa* (L.) Thwaites	LC	11/04/2010		
24.	*Leea indica* (Burm. f.) Merr.	LC	12/06/2018		
25.	*Melicope pteleifolia* (Champ. ex Benth.) T.G. Hartley	LC	12/06/2018		
26.	*Mimosa pudica* L.	LC	19/08/2010		
27.	*Parinari anamensis* Hance	LC	12/06/2018		
28.	*Pterospermum acerifolium* (L.) Willd.	LC	01/01/2020		
29.	*Sandoricum koetjape* (Burm.f.) Merr.	LC	08/11/2017		
30.	*Scaphium macropodum* (Miq.) Beumee ex K.Heyne	LC	01/01/1998		
31.	*Castanopsis* sp1.	LC	03/07/2020		
32.	*Syzygium jambos* (L.) Alston	LC	12/07/2018		
33.	*Zanthoxylum nitidum* (Roxb.) DC.	LC	12/06/2018		

IIA = The group is at risk of being endangered if not managed according to the Government's Decree; CR = Critically endangered; EN = Endangered; VU = Vulnerable; NT= Near threatened; LC= Least concern