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Use of Edible Forest Plants among Indigenous Ethnic Minorities in Cat Tien Biosphere Reserve, Vietnam

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Abstract - Based on the surveys combining the use of household interviews, key informants, rapid rural appraisal (RRA), and the "walk-in-the-wood" method; this article examines the uses of edible forest plants among the indigenous ethnic minorities (IEMs) in Cat Tien Biosphere Reserve (CTBR), southern Vietnam. The findings confirm that all of the respondents gathered and harvested the edible forest plants for both subsistence and income generation, primarily for favorite daily food. Overall, the survey identified 100 species of edible forest plants belonging to 45 families used by the IEM households, these were collected from natural forest, forest plantations and allocated forest land in CTBR, but primarily from the first type of land; 100% of households surveyed harvested some or many species of the plants. However, poor harvesting practices and overuse of the plant species are threatening their sustainability, the local uses and even the food source for wildlife. Additionally, most of the gathering was officially illegal since it occurred in state protected forests. It is recommended

that the participation of IEMs in planned uses as well as the forest resource management, improved harvesting practices, techniques of domestication, encouragement of priority forest edible cultivation should be preferred.

Keywords - Cat Tien Biosphere Reserve, domestication, edible forest plants, indigenous ethnic minorities, sustainable use

INTRODUCTION

Abundant resources in tropical forests have played a vital role in livelihoods of residents living in or around the forests. Poverty has been found to be a major driving force for households to extract forest products often beyond sustainable harvesting rates (Cavendish 2000). A lot of studies in different areas have illustrated that the livelihoods of poor households have relied upon non-timber forest products (NTFPs) more than the other groups (Sills, Erin and Lee 2003; Ticktin 2004; Belcher and Kusters 2004; Sang 2006). Most indigenous groups around the world have been poor, highly dependent on forest resources and accumulated an extensive knowledge on uses of local plants as foodstuffs and other purposes (Sundriyal, Sundriyal, Sharma and Purohit 1998). Edible forest plants are not only important in terms of supplementing food to these groups but also essential in terms of providing traditional medicinal products to them. Furthermore, many researches have found that edible forest plants are linked to local medicinal knowledge and traditional food culture (Etkin and Ross1982; Ogle, Tuyet, Duyet and Dung 2003; Rethy, Angami, Gajurel, Singh and Kalita 2006; Sang and Ogata 2011).

Many studies find that protected areas have been conventionally designed based on top-down approaches by government agencies without concerning locals (Well and Brandon 1992). Consequently, experience has shown that top-down approaches to protected area management are often ineffective in reaching conservation objectives (Brown 2002). Beyond conventional protected areas, biospheres reserves are found to take into account both biodiversity conservation and socioeconomic development of local population. Local people, especially indigenous ethnic minorities (IEMs) are considered as a

key element for sustainable management of the biosphere reserve (Sang 2006). To achieve conserving biodiversity as well as securing livelihoods of IEMs, sustainable use of resources in biosphere reserves is considered as more crucial than others. The sustainable use depends on ecological knowledge, flexible policy implementation and adaptive management in terms of local reality (Olsson and Folke 2001; Ostrom 1990 and 2005).

Located in the tropical monsoon region, Cat Tien Biosphere Reserve (CTBR) has a high diversity of species and the poor indigenous ethnic groups have highly relied on edible forest plant resources for generations. Of course, they have brought challenges to biodiversity conservation due to their overuse of the resources. Consequently, the forest resources in the reserve have continued to be degraded and so various species of plants and animals living there have been threatened.

OBJECTIVES OF THE STUDY

The aims of this paper are to identify the uses of edible forest plants among the indigenous ethnic households in CTBR of Vietnam and to clarify the opportunities and challenges for biodiversity conservation. Emphasis on domestication of conventional forest edibles may be important for balancing between biodiversity conservation and local livelihoods.

MATERIALS AND METHODS

The study was conducted in CTBR where the plateaus of Vietnam Central Highlands give way to Nam Bo Delta, at E107°09'05"-107°35'20", N11°20'50"-11°50'20". It covers an area of approximately 71,350 ha and consists of three following sectors: South Cat Tien (39,627 ha), West Cat Tien (4,193 ha) and Cat Loc (27,539 ha). Its topography comprises a mosaic of landforms of both Truong Son Mountain Range and of the lowland rivers, semi-plains, medium hills, relatively flat land, scattered lakes, ponds and wetland of eastern Nam Bo Delta (Cox, Cools and Ebregt, 1995). Most of the area of CTBR lies on a bedrock of basalt and four principal soil orders can be categorized into ferralitic soils developed on basalt stone, sandstone, old alluvium, shale and conglomerate.

The reserve situates in the tropical monsoon region with two main seasons: the rainy season from May to November, the dry season from December to April. February and March are the driest. The mean annual rainfall is 2,435 mm, the mean annual temperature is 25.5°C and the mean relative humidity is 80%. Rain falls on an average of 150-190 days per year, mainly from July to October. During the rainy season, rainfall is about 300 mm per month. In Bao Loc, it is up to 245 mm of rain, while in Phuoc Long 167 mm of rainfall has been recorded in one day (Cox, Cools and Ebregt, 1995).

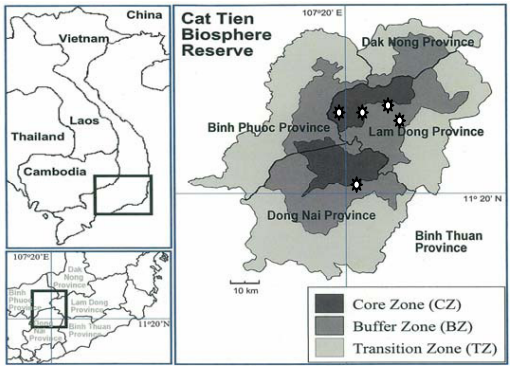
CTBR has been shown to have a high diversity of species of fauna, especially for a relatively small area with a limited altitudinal range. The high biodiversity of the reserve stems from its location in an area between the biogeographically distinct Da Lat Plateau and East Nam Bo Delta. According to CTBR (2010), there are 103 species of mammals, 348 species of birds, 79 species of reptiles, 159 species of fish, 49 species of amphibians, and 435 species of butterflies. Especially one of the two Javan Rhino populations left on the earth is living in Cat Loc Sector. So far 1,610 species of flora on five geographical landscapes have been classified which belong to 24 genera, 162 families and 75 orders; 34 species listed in Vietnam Red Data Book (CTBR, 2010).

According to decision 360 / TTg of the Prime Minister on July 7th, 1978, Cat Tien National Park, the first name of Cat Tien Biosphere Reserve, was protected initially as two sectors, South Cat Tien in Dong Nai Province and West Cat Tien in Binh Phuoc Province. Then based on decision 8 / CT of the Chairman of the Council of Ministers on January 13th, 1992, South Cat Tien was approved as a national park. Gazetted as a Rhino Reserve in 1992 upon the discovery of a Javan Rhino population, Cat Loc received the protected status from Lam Dong Province in the same year. Subsequently, decision 38-QD of February 16th, 1998 approved the integration of South Cat Tien, West Cat Tien and Cat Loc into Cat Tien National Park. On November 10th, 2001 the park was recognized by United Nations Educational, Scientific and Cultural Organization (UNESCO) as a biosphere reserve of the world.

CTBR is divided into three zones. Core zone (CZ) is strictly protected; some activities and sustainable resource uses can be acceptable if they are in accordance with its conservation goals. Buffer zone (BZ) may provide a variety of sustainable uses which ensure

the protection and conservation of the reserve, and improve the local socioeconomic conditions. Transition zone (TZ) is for sustainable socioeconomic development to reduce pressure on the reserve.

CTBR is the home of about 2,000 people in the core zones (CZs) and approximately 200,000 residents in the buffer zone (BZ). In the CZ 32% of the inhabitants are IEMs, migrant ethnic minorities make up 30%, while 38% are Kinh. About 60-80% of the population has the main source of living from forest resources. Most of the local people, especially ethnic minorities within and around CTBR have depended much on forest resources for generations and have caused the major loss of the reserve (Sang, Pretzsch and Ogata 2009).



Note: ✡ = survey hamlets

Fig. 1. Location and the map of CTBR
(Sang, Ogata and Yabe 2010)

CTBR was chosen as a case study because the forest resources in the reserve continue to be degraded owing to a lot of pressures and various species are threatened by the local people. To reflect the use of edible forest plants among IEMs, the research data were gathered in sites where there were natural forests and IEMs, they were dependent on forest resources and the sites were accessible.

The research reported here was carried out in 2005, 2006 and 2010. The random sampling method was used to choose 133 sample households in 5 hamlets. The data collected in this research are primary as well as secondary in nature. Primary data were gathered initially through household interviews based on questionnaires, Rapid Rural

Appraisal (RRA). Interviews were also carried out with community leaders, government officials, staff of CTBR and non-governmental organizations, and sellers in the local markets. The data covered qualitative and quantitative information including socioeconomic status, forest resource use, crops, land holding, and cultural practices. Secondary data used in the study were mostly drawn from the authors' previous studies as well as the reports of CTBR and the local government.

Moreover, to determine edible forest plants used by the IEMs, the "walk-in-the-wood" method was used (Prance, Balee, Boom and Carneiro 1987). Field observations were organized with indigenous elders who knew about the species, and local uses of these edible forest products were also assessed. Additionally, observing forest product collection in situ was made. The scientific names of the edible forest plants in this area were identified by cross-refereeing the respondents' knowledge and matching vernacular names with manuals such as An Illustrated Flora of Vietnam (Ho 2003), Vietnam Medical Plants (Loi, 1995).

To calculate a use index (UI) for each important EFP based on the ethnobotanical inventory, the following equation is used: UI = Us / N, where Us is the number of households using the species s, N is the total households interviewed in the surveyed area (Phillips and Gentry 1993; De Lucena, Lima Araujo, and Albuquerque 2007).

Additionally, the abundance of the species was classified as high - rich and easy to find, medium - neither rich nor rare, low - rare and endangered if continuing to be collected; the abundant information was collected from the direct field observations and the secondary data of CTBR. The collection intensity was categorized as high - large amounts of the edible forest plants collected on account of high demand of self consumption and/or market, medium - moderate amounts of those collected because of moderate abundance or difficulty in harvest. Market demand was classified as high - easy to sell large amounts, low - self consumption and sometimes sold on local markets (see table 2).

RESULTS AND DISCUSSION

Overall, the survey identified 100 species of edible forest plants belonging to 46 families used by the IEM households (see table 1). The results of the study revealed 10 species of Araceae, 9 species of Zingiberaceae, and 6 ones of Poaceae. The other families have a few species or even 1. Out of 100 species, the majority of them are hers (35%), followed by trees (22%), shrubs (19%), climbers (18%), and finally mushrooms (6%) (see table 1). There were 23 new recorded species in the flora list of CTBR, but not in that of Vietnam (see table 1). These species were collected from natural forests, forest plantations and allocated forest land in CTBR, but primarily from natural forests. 100% of households surveyed harvested some or many species of edible forest plants in CTBR.

Plants used as vegetables are the most important food for all of them and accounted for 42.5 % of the total uses (see fig. 3). Particularly, leaves of 2 *Gnetum gnemon* species and shoots of 4 rattan ones have been used extensively as their conventional food (see table 1and 2); and 100% of respondents agreed with this statement. Those rattan species for the favorable daily food are as follows: *Plectocomiopsis geminiflorus, Calamus poilanei, Calamus tetradactylus* and *Korthalsia laciniosa.* The people extract rattan shoots every month in a year. They have used shoots of these species, one of the most important NTFPs for their traditional meals, to cook a daily favorite food and even wedding one. This food is as a soup comprising shoots of the rattans and meat or fish. The local name "may đot đang" of *Plectocomiopsis geminiflorus* shows the bitter taste which the indigenous ones like most. This reality confirms that the utilization of these forest edibles has become an important part of their traditional culture. Moreover, these species are also among 15 favorite main foods for Javan Rhinos in CTBR (Sang and Ogata 2011); so overusing the species will raise a challenge for these animals. A near total of households identified that most rattan species were overharvested nearby and they had to go further in order to harvest young shoots or stems. According to their experience, after harvesting, rattan stumps need more than five years to provide the stem products.

''If one day there are no more rattan shoots or leaves of *Gnetum gnemon*, we will miss them because of our favorite traditional food; we love eating them every day'', said a Chau Ma man in Da Nhar Hamlet of Lam Dong Province.

Also, all of the sample households harvested bamboo shoots for their self consumption. The harvest period is often from May to October every year. They use the fresh shoots for that moment and store pickle or dry sliced products for subsistence in other seasons. Both of these bamboo products can be sold in the local markets or bought by outside traders who can come to each household. Of the total number of bamboo shoot harvesting households, 70.68 % who sold harvested shoots were poor or very poor, or had idle labors.

Edible forest fruits are commonly used in the area (see fig. 2 and 3), about 63.2% of the surveyed families collected those from 34 species in the natural forest of CTBR for subsistence, half of them are wood species (see table 1). 46 households reported that their children were the primary collectors. Especially, one important species for high cash income is *Scaphium macropodium* whose nuts are collected on trees by males or on the forest floor (see table 1 and 2); the harvest season stretches from March to May and it only flowers at an interval of 3 or 4 years. However, because the trees are high the people often cut down them to harvest nuts for convenience. And 12 respondents cut down trees for collecting the products. The conservation impact of this way of exploitation is likely to be high, so it should be strictly prohibited and changed to more sustainable ways (Sang, Hyakumura and Ogata, 2011).

''Last season (March and April) I harvested nuts of *Scaphium macropodium* and earned about 17 million VND, this income is really high for us'', said a Chau Ma man in Brun Hamlet of Lam Dong Province.

Additionally, the edible forest plants are also important in terms of providing traditional medicinal products to the IEMs. As shown in Fig. 3, the utilization pattern of medicinal forest edibles was around 15.1%. Some of the high medicinal demand species such as *Alpinia conchigera, Amomum aurantiacum, Amomum longiligulare, Amomum villosum, and Amomum xanthioides* were bought by outside traders. As can be seen from table 1, the Use Index spectrum for favorite food

plants is quite different from that of medicinal edibles. For favorite edible species, the vast majority has high ($0.62 \leq UI \leq 1.00$) but almost all of the edible medicinal ones are low ($0.29 \leq UI \leq 0.34$). This indicates that the use of traditional forest plants for food is more common than the medicinal use. From generations to generations, they have not only depended on forest resources but also accumulated their ethnic medicinal knowledge. However, nowadays with the fast development of the modern life related to modern medicine, this outstanding part of their ethnic knowledge has been gradually sinking into oblivion.

Noticeably, bark of *Cinnamomum iners* or leaf of *zingiber sp*. is the key material for yeast to make an indigenous traditional alcohol called 'Ruou Can' (Sang, Hyakumura and Ogata 2011). These species have been retained in their traditional drink which appeared in their traditional festivals, parties of the lunar new years, weddings, or other events (Sang, Hyakumura and Ogata 2011).

Six mushroom species are used as favorite foodstuffs by the IEMs: *Auricularia polytricha, Auricularia polytricha, Lepista sordida, Termitomyces albuminosa,* nam goc lo o and nam ray (see table 1). Most of them can differentiate between edible and poisonous mushrooms. For instance, they never eat mushrooms which are motley, rough or black spotty.

With regard to forest plants used to make pickle, 6.2% of the uses were for this purpose (see fig. 3). As can be seen from table 1, 5 out of 9 species are bamboos whose shoots were used for that product. The material for pickle also came from fruits of 2 wood species and petioles of 2 species belonging to Araceae. That product is very good for long term use, especially during the dry season.

Additionally, the IEMs in the area used the forest edibles as spice or for their water-content (see fig. 3). The majority of species used for spice were herbs (5 species); but each of the following life forms had only one species: tree, climber and shrub. They also drank water from 2 climber species in case of lacking in boiled water during the time in jungles (see table 1).

Remarkably, *Canarium tramdenum* is a wood species found in the Red Data Book of Vietnam (2007). This is vulnerable, possibly threatened to be extinct. *Mangifera dongnaiensis* that also provides fruits is an endemic flora species in CTBR (CTBR 2010).

Table 1. Edible forest plants used by the IEMs in CTBR

Note: UI = use index;

Parts used: Bark = Ba, Ea = ear, Fb = flower bud, Fl = flower, Fo = Fruiting body, Fr = fruit, Le = leaf, Nu = nut, Pe = petiole, Ro = root, Rh = rhizome, Se = seed, Sh = shoot, St = stem, Tu = tuber, Wp = whole plant;

Uses : Ag = Agar, Fo = Fodder, Me = medicinal, Pi = pickle, Sp = Spice, Tb = Taken boiled, Tr = Taken raw, Ve = Vegetable, Wa = water, Ye = yeast;

Places harvested: Natural forest = NF, Plantation forest: PF, Allocated forest land: AL

Purposes: Cash income = CI, Self consumption = SC;

Price: USD 1 = 20600 VND (Approximate exchange rate in May of 2011), Bp = bundle of poles, Db = dried bark, Dm = dried bamboo shoots, Fc = fresh rattan cane, Ff = fresh fruit, Fl = fresh leaf, Fm = fresh rattan shoots, Fp = fresh products, Fs = fresh seeds, Ft = fresh bamboo shoots (Price at the households);

New record in CTBR, but not in Vietnam: *

Scientific name	Family	Vernaculaname	Parts Used	Uses	Use index	Places harvested	Purposes	Price (USD)
Actinidia sp. *	Actinidiaceae	La bot ngot	Le	Sp	0.48	NF	CI, SC	0.73/ kg
Aganonerion polymorphum Pierre ex Spire *	Apocynaceae	La giang	Le	Ve	0.16	NF	SC	-
Aglaia perviridis Hiern.	Meliaceae	Goi xanh	Fr	Tr	0.19	NF	SC	-
Alocasia odora (Roxb.) C.Kock.	Araceae	Mon bac ha	Pe, Le	Ve, Pi	-	NF	SC	-
Alocasia sp.	Araceae	Mon chua rung	Pe	Ve, Pi	0.37	NF	SC	-
Alpinia conchigera Griff.	Zingiberaceae	Rieng rung	Rh	Sp, Me	0.74	NF	SC	0.15/ kg
Alpinia globosa (Lour.) Horan	Zingiberaceae	Rieng se lon	Rh	Sp, Me	-	NF	SC	-
Alpinia sp.	Zingiberaceae	Rieng dang	Rh	Sp, Me	0.23	NF	SC	-
Alternanthera sessilis (L.) A. DC.	Amarantaceae	Rau diep dai	Le	Ve	0.24	NF, PF, AL	SC	-
Amaranthus lividus L.	Amarantaceae	Rau den com	Le, Sh, or Wp	Ve	0.72	PF, AL	CI, SC	0.39 / kg
Amaranthus spinosus L.	Amarantaceae	Rau den gai	Le, Sh, or Wp	Ve	0.70	PF, AL	CI, SC	0.34 / kg
Amaranthus tricolor L.	Amarantaceae	Rau den tia do	Le, Sh, or Wp	Ve	0.54	PF, AL	CI, SC	0.34 / kg

Amomum aurantiacum H. T. Tsai et S.W.Zhao*	Zingiberaceae	Sa nhan do	Sh, Fb, Se	Ve, Me	0.34	NF	CI, SC	1.46 / kg - Fs
Amomum longiligulare T. L. Wu. *	Zingiberaceae	Sa nhan tim	Sh, Fb, Se	Ve, Me	0.32	NF	CI, SC	1.46 / kg - Fs
Amomum villosum (Wall.) Hu.	Zingiberaceae	Sa nhan	Sh, Fb, Se	Ve, Me	0.29	NF	CI, SC	1.46 / kg - Fs
Amomum xanthioides Wall. et. Bak. *	Zingiberaceae	Sa nhan xanh	Sh, Fb, Se	Ve, Me	0.31	NF, AL	CI, SC	1.46 / kg - Fs
Artocarpus chaplasha Roxb.	Moraceae	Mit rung	Fr	Tr	0.06	NF	SC	-
Auricularia auricula (Hook.) Underew.	Auriculariaceae	Nam meo tron	Ea	Ve	0.74	NF, PF	CI, SC	0.24 / kg - Fp
Auricularia polytricha (Mount.) Sacc.	Auriculariaceae	Nam meo long	Ea	Ve	0.74	NF, PF	CI, SC	0.24 / kg - Fp
Baccaurea oxycarpa Gagn.	Euphorbiaceae	Dau trai nhon	Fr, Le, Fl	Tr, Me	0.12	NF	SC	-
Baccaurea ramiflora Lour.	Euphorbiaceae	Dau da	Fr, Le, Fl	Tr, Ve	0.17	NF	SC	-
Bambusa balcoa Roxb.	Poaceae	Lo o	Sh	Ve, Pi	0.41	NF, PF	CI, SC	0.12 / kg - Ft, 1.7/ kg - Dm
Bambusa blumeana Schult. f.	Poaceae	Tre la nga	Sh	Ve, Pi	0.92	NF, PF	CI, SC	0.15 / kg - Ft, 1.7/ kg - Dm

Bambusa procera A. Chev. & A Cam.	Poaceae	Lo o Binh Long	Sh	Ve, Pi	0.95	NF, PF	CI, SC	0.15 / kg - Ft,1.7/ kg - Dm
Biophytum sensitivum (Lour.) DC. *	Oxalidaceae	Chua me dat	Le, Sh	Ve	-	NF, PF, AL	SC	-
Calamus poilanei Conr.	Arecaceae	Song bot	Sh	Ve	0.68	NF	CI, SC	0.15 / 10 Fms, 0.10 / kg - Fc
Calamus scipionum Lour.	Arecaceae	May nuoc	Fr	Tr	0.23	NF, PF	CI, SC	0.10 / kg - Fc
Calamus viminalis Willd *	Arecaceae	May cat	Sh	Ve	-	NF, PF	CI, SC	-
Calamus tetradactylus Hance	Arecaceae	May ruot ga	Sh	Ve	0.97	NF	CI, SC	0.15 / 10 Fms, 0.10 / kg - Fc
Canarium album (Lour.) Raeusch.	Burseraceae	Tram trang	Fr	Tb, Me	0.42	NF	SC	-
Canarium subulatum Guill.	Burseraceae	Tram do	Fr	Tr, Pi	0.45	NF	CI, SC	0.10 / kg - Ff
Canarium tramdenum Dai. & Yakol.	Burseraceae	Tram den	Fr	Tb	0.42	NF	SC	-
Caryota mitis Lour.	Arecaceae	Dung dinh	Sh	Ve	0.39	NF	SC	-

Centella asiatica (L.) Urb.	Apiaceae	Rau ma	Wp	Ve	0.74	NF, PF	SC	-
Champereia manillana (Blume) Merr.	Opiliaceae	Ngot rung	Le	Ve, Me	0.06	NF	SC	-
Cinnamomum iners Reinw. ex Blume	Lauraceae	Que rung	Ba, Le, Ro	Sp, Ye, Me	0.64	NF	CI, SC	3.4 / kg - Db
Cleome viscosa L.	Capparaceae	Son tien	Fr, Le	Tr, Ve, Me	0.03	NF	SC	-
Colocasia gigantea Hook.F.	Araceae	Bac ha	Pe	Ve	-	NF	SC	-
Colocasia esculenta (L.) Schott.	Araceae	Mon nuoc	Pe, Tu	Ve, Tb	0.52	NF, AL	SC	-
Colocasia sp. *	Araceae	Khoai mon tim	Tu	Tb	0.04	AL	SC	-
Corchorus capsularis L.	Tiliaceae	Day dai	Le	Ve	0.23	NF	SC	-
Corchorus olitolius L.	Tiliaceae	Day la dai	Le	Ve	-	NF	SC	-
Curcuma thorelii Gagn.	Zingiberaceae	Nghe rung	Rh	Sp, Me	0.17	NF, PF, AL	SC	-
Cyclea barbata Miers.	Menisperma-ceae	Sam nam	Le, Ro	Ag, Me	0.05	NF	CI, SC	0.39 / kg - Fl

Cymbopogon citratus DC. ex Nees *	Poaceae	Sa chanh	St	Sp	-	NF, PF, AL	SC	-
Daemonorops pierreanus Becc.	Arecaceae	May cat	Fr	Tr	0.23	NF	CI, SC	0.10 / kg - Fc
Dialium cochinchinensis Pierre.	Fabaceae	Xoay	Fr	Tr, Me	-	NF	SC	-
Dioscorea hamiltonii Hook *	Dioscoreaceae	Cu chup	Tu	Tb	0.31	NF	SC	-
Dioscorea esculenta (Lour.) Burk. *	Dioscoreaceae	Cu tu gai	Tu	Tb	-	NF, AL	CI, SC	-
Dioscorea persimilis Prain & Burk.	Dioscoreaceae	Cu mai	Tu	Tb	0.35	NF	SC	-
Diplazium esculentum (Retz.) Sw. *	Woodsiaceae	Rau don	Le	Ve	0.36	NF	SC	-
Dracuntomelon duperreanum Pierre.	Anacardiaceae	Sau	Fr	Tr	0.24	NF	SC	-
Ficus racemosa L.	Moraceae	Sung	Fr, Le	Tr, Pi, Ve	-	NF	SC	-
Ficus fulva Reinw. ex Bl.	Moraceae	Va	Fr	Ve	-	NF	SC	-
Garcinia oblongifolia Champ.*	Clusiaceae	Bua rung	Le, Fr	Ve, Tr	0.34	NF	SC	-

Gigantochloa sp.	Poaceae	Mum	Sh	Ve, Pi	0.38	NF	CI, SC	0.97 / Bp
Gnetum gnemon L. var. domesticum (Rumph.) Margf.	Gnetaceae	La bep	Le, Fl, Fr	Ve, Tr	0.98	NF	CI, SC	0.73 / kg - Fl
Gnetum gnemon L. var. griffithii Margf.	Gnetaceae	La nhip	Le, Fl, Fr	Ve, Tr	1.00	NF	CI, SC	0.73 / kg - Fl
Gnetum latifolium Blume.	Gnetaceae	Day gam la rong	Se, St	Tr, Wa, Me	0.17	NF	SC	-
Gonocaryum lobbianum (Miers.) Kurz.	Icacinaceae	Cuong vang	Le	Ve, Me	0.35	NF	SC	-
Grewia tomentosa Roxb. ex DC.	Tiliaceae	Co ke long	Fr	Tr	-	NF, AL	SC	-
Gynura crepidioides Benth.	Asteraceae	Rau tau bay	Le, Sh	Ve	0.58	NF	SC	-
Hibiscus sabdariffa L. *	Malvaceae	Cay bup giam	Le	Ve	0.69	NF, PF, AL	SC	-
Hibiscus surattensis L. *	Malvaceae	Bup xuoc	Le	Ve	0.09	NF	SC	-
Helminthostachys zeylanica (L.) Hook	Ophioglossaceae	Sam dat	Le	Ve	-	NF	SC	-
Houttuynia cordata Thunb.	Saururaceae	Rau diep ca	Le	Ve, Me	0.62	NF, AL	SC	-

Korthalsia laciniosa Mart.	Arecaceae	May ra	Sh	Ve	0.62	NF, PF	CI, SC	0.15 / 10 Fms, 0.10 / kg - Fc
Lepista sordida (Fr.) Singer	Tricholomataceae	Nam ca	Fo	Ve	0.11	NF, PF, AL	CI, SC	0.17 / kg - Fp
Lithocarpus dealbatus (Hook. f. et Thoms.) Rehd. *	Fagaceae	Soi da trang	Le	Ve	-	NF	SC	-
Maesa indica Wall. Ex DG.	Myrsinaceae	Rau chua chat	Le	Ve, Me	0.15	NF	SC	-
Mangifera dongnaiensis Pierre.	Anacardiaceae	Xoai Dong Nai	Fr	Tr	0.17	NF	SC	-
Mangifera minutifolia Evrard.	Anacardiaceae	Xoai rung	Fr	Tr	0.23	NF	SC	-
Musa acuminata Colla.	Musaceae	Chuoi rung	Fr, Fb, St	Tr, Ve	0.26	NF	SC	-
Musa rosaceae Jacq.	Musaceae	Chuoi rung do	Fr, Fb, St	Tr, Ve	0.24	NF	SC	-
Nephelium melliferum Gagn.	Sapindaceae	Chom chom rung	Fr	Tr	0.14	NF	SC	-
Oenanthe javanica (Blume) DC. *	Apiaceae	Rau can nuoc	Le	Ve	0.09	NF, AL	SC	-
Pandanus sp. *	Pandanaceae	Thom rung	Fr	Tr	0.14	NF, AL	SC	-

Passiflora foetida L.	Passifloraceae	Chum bao	Fr, Sh	Tr, Ve	0.12	NF, AL	SC	-
Pentaphragma honbaense Gagnep. *	Pentaphragmaceae	Mong toi nui	Le	Ve	-	NF	SC	-
Peperomia pellucida Kunth.	Piperaceae	Cang cua	Le, St	Ve	0.70	NF, PF, AL	SC	0.19 / kg - Fp
Phyllanthus emblica L.	Euphorbiaceae	Me rung	Fr	Tr	0.20	NF	SC	-
Piper lolot C. DC.	Piperaceae	La lot	Le	Sp, Ve, Me	0.68	NF, PF, AL	SC	-
Plantago major L.	Plantaginaceae	Ma de	Le	Ve, Me	0.42	NF, PF, AL	SC	-
Plectocomiopsis geminiflorus Becc. *	Arecaceae	May đot đang	Sh	Ve	0.99	NF	CI, SC	0.15 / 10 Fms, 0.10 / kg - Fc
Portulaca oleracea L.	Portulacaceae	Rau sam	Le, St	Ve	0.67	NF, PF, AL	CI, SC	
Pouteria sapota (Jacq.) H.E. Moore & Stearn. *	Sapotaceae	Trung ga	Fr	Tr	0.03	NF	SC	-
Psidium guajava L.	Myrtaceae	Oi rung	Fr	Tr	0.29	NF	SC	-
Rhodomyrtus tomentosa (Ait.) Hassk.	Myrtaceae	Sim	Fr	Tr, Me	-	NF, AL	SC	-

Sauropus brevipes Muell.-Arg. *	Euphorbiaceae	Bo ngot chan ngan	Le	Ve	-	AL	SC	-
Scaphium macropodium (Miq.) Beumec	Sterculiaceae	Luoi uoi	Nu /Se	Tr	0.74	NF	CI, SC	5.83 / kg
Schizostachyum sp.	Poaceae	Nua	Sh	Ve, Pi	0.38	NF	CI, SC	0.15 / kg - Ft
Spondias pinnata (L.f.) Kurz.	Anacardiaceae	Coc rung	Fr, Le	Tr, Ve	0.31	NF	SC	-
Tamarindus indica L.	Caesalpiniaceae	Me	Fr	Tr	0.28	NF	SC	-
Termitomyces albuminosa Berk. et Br.	Tricholomataceae	Nam moi	Fo	Ve	0.66	NF, PF, AL	CI, SC	0.17 / kg - Fp
Tetrastigma sp. *	Vitaceae	Tu thu	St, Fr	Wa, Tr	0.14	NF	SC	-
Walsura cochinchinensis Harms.	Meliaceae	Nhan moi	Fr	Tr	-	NF	SC	-
Willughbeia cochinchinensis Pierre.	Apocynaceae	Cay guoi	Fr	Tr	0.36	NF	CI, SC	0.24 / kg - Ff
Zingiber sp.	Zingiberaceae	Gung que	Le	Ye	-	NF	SC	-
-	-	Nam goc lo o	Fo	Ve	0.60	NF, PF	CI, SC	0.15 / kg - Fp
-	-	Nam ray	Fo	Ve	0.54	PF, AL	CI, SC	0.19 / kg - Fp

Table 2. Most important edible forest plants used by the IEMs in CTBR

Scientific Name	Family	Abundance	Intensity of collection	Market demand	Note
Bambusa blumeana Schult. f.	Poaceae	Medium	High	High	High demand on shoots for cash income and self consumption
Bambusa procera A. Chev. & A Cam.	Poaceae	High	High	High	High demand on shoots for cash income and self consumption
Calamus poilanei Conr.	Arecaceae	-	High	High	High demand on shoots for self consumption; canes for furniture frames, handicrafts
Calamus tetradactylus Hance	Arecaceae	-	High	High	High demand on shoots for self consumption,
Cinnamomum iners Reinw. ex Blume	Lauraceae	Medium	Medium	High	Medium demand on bark, leaf for self consumption, making a traditional alcohol; used as spice and traditional medicine
Gigantochloa sp.	Poaceae	High	High	High	High demand on stems for cash income, but low on shoots
Gnetum gnemon L. var. domesticum (Rumph.) Margf.	Gnetaceae	High	High	Low	High demand on leaf for self consumption, making a traditional food
Gnetum gnemon L. var. griffithii Margf.	Gnetaceae	High	High	Low	High demand on leaf for self consumption, making a traditional food
Korthalsia laciniosa Mart.	Arecaceae	-	High	High	High demand on shoots for self consumption, making a traditional food; canes for handicrafts
Plectocomiopsis geminiflorus Becc.	Arecaceae	-	High	High	High demand on shoots for self consumption, making a traditional food; canes for handicrafts
Scaphium macropodium (Miq.) Beumec	Sterculiaceae	High	High	High	High demand on seed for high cash income, making a favorite food
Schizostachyum sp.	Poaceae	High	High	High	High demand on shoots for cash income and self consumption

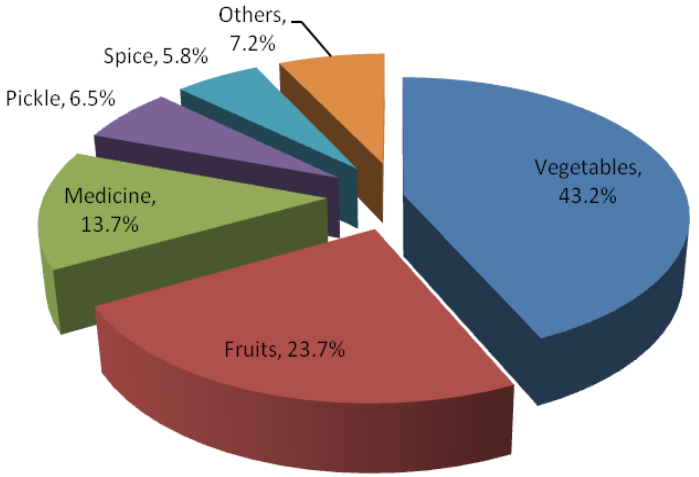


Fig. 2. Plant parts of forest edibles used

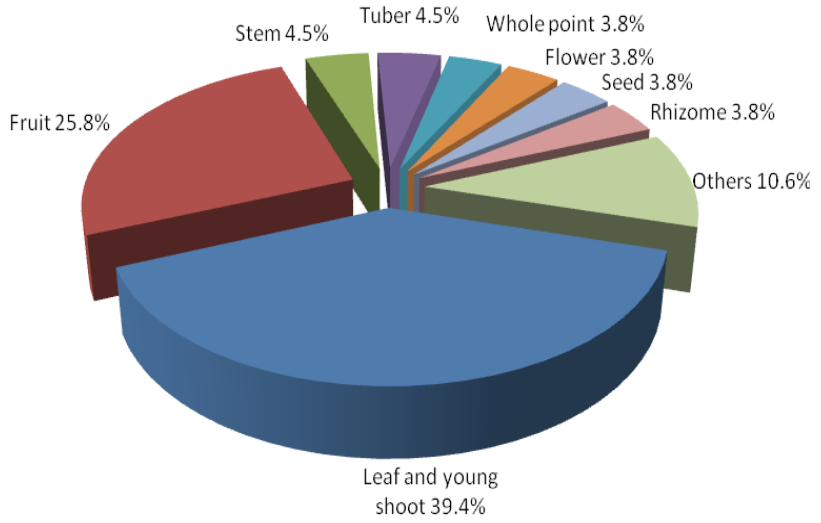


Fig. 3. Utilization pattern of forest edibles

CONCLUSIONS

CTBR is naturally endowed with great variety of the edible forest plant species on which the indigenous ethnic minorities commonly gather and harvest. The resources have been contributing very much to their livelihood, primarily for their domestic consumption. However, they often overuse the resources for their basic need income generation. Their dependence on the resources causes a lot of negative impacts on CTBR through overexploitation of the resources (Sang 2006). This is caused by lack of alternatives for their livelihood, particularly those in the CZs and the BZ, limitation of access to outside, and difficulty to understand the reserve regulations due to low education levels (Sang 2006).

The participation of the IEMs in forest management may be one of the effective strategies for sustainable management of the edible forest plants in CTBR. The approach of their participation aims at involving them not only in planned use of the plant species or ecotourism but also in the process of sustainable conservation management of CTBR. Moreover, conventional edible species should be encouraged in order to cultivate on farm, agro-forestry models and even "green fences" around gardens or plantations; the local extensions of agro-forestry should identify techniques of domestication and markets to promote and develop practices of the edible forest plants. Especially educating them about the importance of Javan Rhinos' conservation and their uses of forest plant food should be carried out.

RECOMMENDATIONS

Long term employment for local workforce should be created, especially for the residents in the core zone and the buffer area. For instance, the local government and the reserve should develop the potential of ethnic minorities' indigenous knowledge in craft products and promote home industry through craft activities.

As mentioned above, the ethnic knowledge on the use of edible forest plants contains both positive and negative aspects for biodiversity conservation in CTBR. To contribute to both biodiversity conservation and development, the positive points of the knowledge

should be applied widely and integrated with scientific knowledge. Further research to discover and understand more this knowledge on the use of edible forest plants for enhancing the adaptive capacity of sustainable use is needed.

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Fig. 1. Leaves of *Gnetum gnemon* harvested by IEMs
(Photo by Dinh Thanh Sang, Field survey 2010)

Fig. 2. A woman carrying a Gui of *Gnetum gnemon* leaves harvested from forest (Photo by Dinh Thanh Sang, Field survey 2010)