



*Full Length Research Paper*

# **Biodiversity indices and utilization of edible wild plants: a case study of the Cham Island in Quang Nam Province, Vietnam**

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## **ABSTRACT**

**This study clarified the biodiversity, ecology and utilization of wild edible plants in the biosphere reserve Cham Island, Hoi An, Quang Nam Province. Using the research methods of quantitative analysis (identification of index), biological diversity (biodiversity measurement): Shannon Index - H (Shannon index), Simpson index - Cd (Concentration of Dominance), Abundance - A and frequency - F of each species. These methods have been applied to assess the biodiversity of plants used as vegetable. This study implemented 20 plots survey and recorded 43 plant species, belonging to 30 families, in different habitats such as: evergreen forests, woodlands scattered sparse, shrub - grassland, bare land, fields and along streams. H index ranged from 0.46 to 1.94 with average value about 1.28 is the lowest in evergreen forest habitats (0.69 -1.46), scattered sparse woodlands (1.15 to 1.53), grass, shrubs (1.35) and vacant land, rice fields, along streams (0.46 to 1.94). This study was aimed to create a database solution for the conservation, development and planning sustainable use of biodiversity resources.**

**Keywords:** Biodiversity; edible plants; island; quantitative analysis.

## **INTRODUCTION**

Edible wild plants are usually called "rau rừng" in Vietnam. "Rau rừng" literally means wild vegetable grown in forest. It has been important food resources in the mountains of Vietnam. Resource edible wild plants is one of the most important plant resources, the demand for edible wild vegetables growing, so the research and development of this product will bring economic benefits, creating identities in regional food culture. On the other hand through the analysis, quantitative assessment of biodiversity indicators and the value of biodiversity of the resource selection will help to identify quantitative indicators, policies and development resources where sustainable and lasting.

The Biosphere Reserve Cham Islands is a cluster of eight islands, the largest island is Hon Lao with 1.317 ha, 19 km far from the center of Hoi An town as the crow flies, Tan Hiep commune, Hoi An City, Quang Nam (UNESCO Vietnam, 2008). For a long time, people on this island have exploited wild vegetable as food to eat

every day. Wild vegetables become a "special" food for tourists, who visit the island and bring more income to the population of island. Especially in winter, the species of edible wild plants are an important source vegetable for local people.

This study solved the following five problems:

- (1) Make a taxonomic survey of wild edible plants species distributed in the study areas with their relevant names and habitat distribution.
- (2) Identify the edible form, part used, percentage of use report and other uses.
- (3) Record the traditional knowledge associated with harvest to ensure no harm to natural regeneration. Reviewed the current situation of edible wild plant utilization in Cham Island.
- (4) Clarified the biodiversity and ecology of wild edible plants.
- (5) Discuss about the challenges to harvest and consumption of edible wild plant.

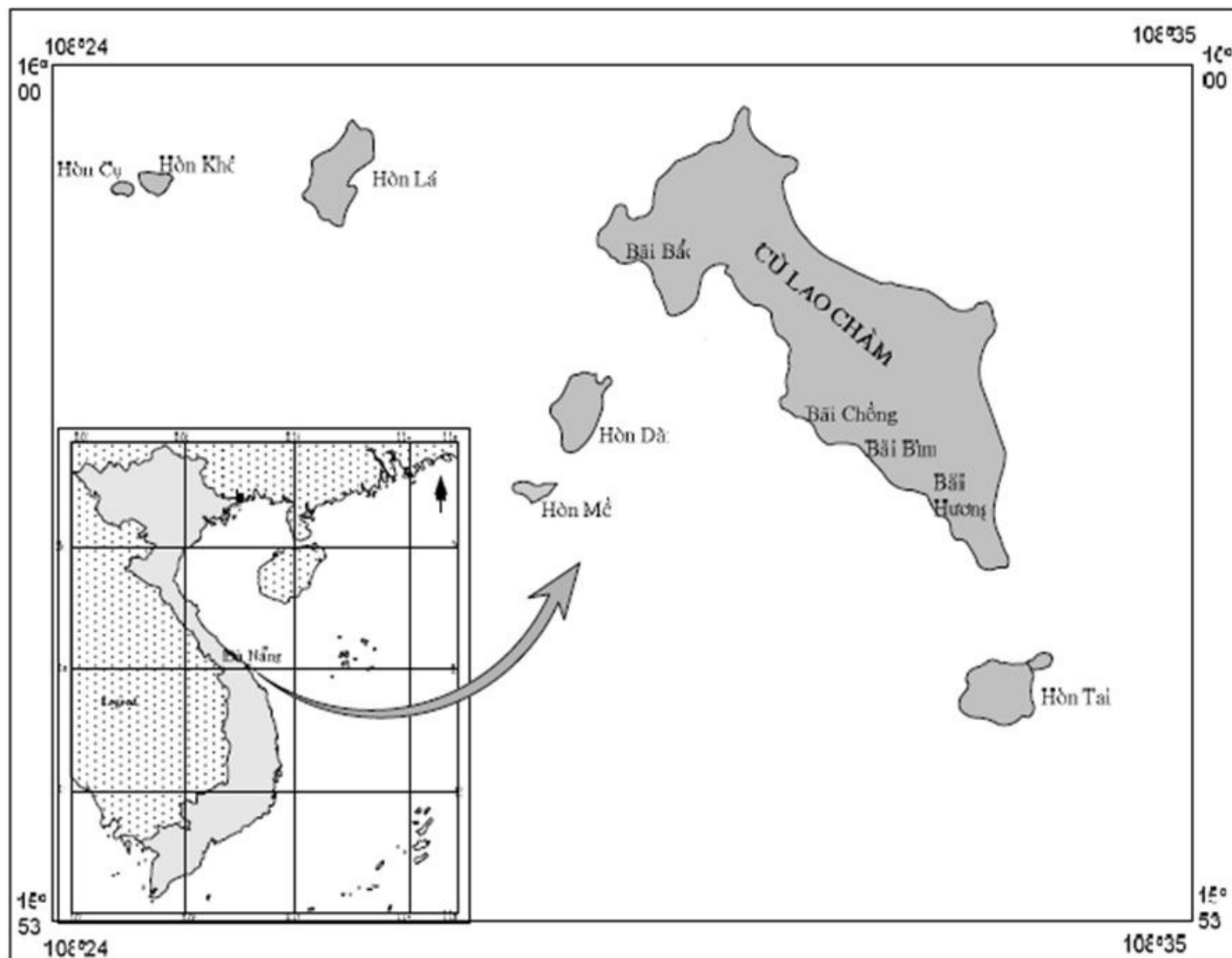


Figure 1: Location of Cham Island (source: Management board of Cham Islands MPA, 2012)

## Survey sites and Method

### Survey sites

Cu Lao Cham is an archipelago, which includes eight small islands named in the order of Hon Lao, Hon La, Hon Dai, Hon Tai, Hon Mo, Hon Kho Me, Hon Kho Con, and Hon Ong. Total natural area is 15.2 km<sup>2</sup>, but the entire region was located in the 235 km<sup>2</sup> sea water surface, under the Cham Islands Marine Protected Area (CIMPA). Cu Lao Cham island group is mainly low hills, most of the frustum-shaped island. High altitude compared to sea level varies from 70m to 200m. Forests cover large, about 60-70%. There are about 3000 people living in the Cu Lao Cham, mainly on the Hon Lao, also

known as Hon Cu Lao Cham. More than 80% of the population live on fishing and depend on the sea (UNESCO Vietnam, 2008). **Fig. 1 above.**

### METHOD

In order to identify plant species, habitat and obtain relevant ecological information, we have visited the forest to pick up edible wild plants with local communities. In depth interviews were implemented, relevant to the utilization of wild edible plants: collectors, consumers, and specialists of wild edible plants.

We also have spent several weeks to collect basic ecological information by learning cooking and

**Table 1.** A full list of wild plants used as food

scientific name	Family	Plant parts used for food	Habitat
<i>Amaranthus viridis</i> L.	Amaranthaceae	Young leaf, leaf	Field, road side, grassland, garden, bank of field
<i>Hydrocotyle sibthorpioides</i> Lam.	Apiaceae	Young leaf, leaf	Wet road side, garden, abandoned land
<i>Centella asiatica</i> (L.) Urb.	Apiaceae	Young leaf, leaf	Abandoned land, bush, roadside, forest, ditch.
<i>Diplazium esculentum</i> (Retz.) Sw.	Aspleniaceae	Young leaf	Wetland in the mountain, river bank, roadside, wetland
<i>Blumea riparia</i> (Blume) DC.	Asteraceae	Young leaf	River bank forest
<i>Emilia sonchifolia</i> (L.) DC. ex DC.	Asteraceae	Young leaf	Roadside, sunny wetland, abandoned field, at the foot of a mountain
<i>Ageratum conyzoides</i> (L.) L.	Asteraceae	Young leaf	roadside, fallow land, rice paddy
<i>Bidens pilosa</i> L.	Asteraceae	Young leaf	
<i>Stenochlaena palustris</i> (Burm. f.) Bedd.	Blechnaceae	Young leaf	Riverside, wetland in the mountain, forest
<i>Cassia occidentalis</i> L.	Caesalpiniaceae	Young leaf	Open space, road side, foothills .
<i>Cleome chelidonii</i> L.f.	Capparaceae	Young leaf	Open field, roadside, at the foot of a mountain .
<i>Murdannia nudiflora</i> (L.) Brenan	Commelidaceae	Young leaf	Roadside, forest fringe, riverside, wet road side
<i>Commelina diffusa</i> Burm.f.	Commelidaceae	Young leaf	Foothills, roadside, wet road side.
<i>Nephrolepis falcata</i> (Cav.) C. Chr.	Davalliaceae	Young leaf	Riverside, wetland in the forest
<i>Strophoblachia fimbriicalyx</i> Boerl.	Euphorbiaceae	Young leaf	Forest, riverside, hill and mountain, rock, forest fringe,
<i>Glochidion zeylanicum</i> (Gaertn.) A.Juss.	Euphorbiaceae	Young leaf	Forest fringe, mountain
<i>Cratoxylum maingayi</i> Dyer	Hypericaceae	Young leaf	Forest, at the foot of a mountain
<i>Leucas zeylanica</i> (L.) W.T.Aiton	Laminaceae	Young leaf	Open field, road side field , foothills
<i>Barringtonia macrostachya</i> (Jack) Kurz	Lecythydaceae	Young leaf	Forest
<i>Barringtonia acutangula</i> (L.) Gaernt.	Lecythydaceae	Young leaf	Mountain, forest
<i>Hibiscus surattensis</i> L.	Malvaceae	Young leaf	Riverside, forest fring, wet road side.
<i>Ficus superba</i> var. <i>henniana</i> (Miq.) Corner	Moraceae	Young leaf	Mountain, forest
<i>Morus alba</i> L.	Moraceae	Young leaf	Road side, fence, forest
<i>Morus macroura</i> Miq.	Moraceae	Young leaf	Mountain, forest
<i>Ardisia poilanei</i> Pit.	Myrsinaceae	Young leaf	Mountain, forest
<i>Peperomia pellucida</i> (L.) Kunth	Piperaceae	Young leaf, leaf, Top of the Stem	Wet road side, road side, garden
<i>Plantago major</i> L.	Plantaginaceae	Young leaf	Abandoned land, roadside, garden, forest fringe
<i>Ixora cocinea</i> L.	Rubiaceae	Flower	Forest fringe, foothills

Table 1 continues

<i>Mussaenda cambodiana</i> Pierre ex Pit.	Rubiaceae	Young leaf	Forest fringe, mountain, edge of the forest
<i>Paederia foetida</i> L.	Rubiaceae	Young leaf	Forest fringe, mountain forest
<i>Zanthoxylum nitidum</i> (Roxb.) DC	Rutaceae	Young leaf	Forest, mountain roadside, mountain, forest fringe
<i>Limnophila aromatica</i> (Lam.) Merr.	Scrophulariaceae	Young leaf, Top of the Stem	Rice paddy, wetland
<i>Smilax zeylanica</i> L.	Smilacaceae	Young leaf, top of the vine	Hill and mountain, forest fringe,
<i>Smilax bauhinioides</i>	Smilacaceae	Young leaf, top of the vine	Forest fringe, foothills
<i>Solanum americanum</i> Mill.	Solanaceae	Young leaf	Roadside, abandoned land, edge of the mountain
<i>Vitis balansana</i> Planch.	Vitaceae	Young leaf, top of the vine	Hill and mountain, forest fringe,
<i>Tetrastigma rupestre</i> Planch.	Vitaceae	Young leaf	Forest
<i>Passiflora foetida</i> L.	Passifloraceae	Young leaf	Forest fringe, mountain roadside, mountain forest
<i>Premna serratifolia</i> L.	Verbenaceae	Young leaf	Forest fringe, forest
<i>Peristrophe paniculata</i> (Forsk.) Brumitt	Acanthaceae	Young leaf	Road side, wet road side, open space
<i>Connarus semidecandrus</i> Jack	Connaraceae	Young leaf	Hill at the foot of a mountain
<i>Garcinia benthamiana</i> (Planch. & Triana) ined.	Clusiaceae	Young leaf, fruit	Mountain forest
<i>Spondias dulcis</i> L.	Anacardiaceae	Young leaf, fruit	Garden, forest.

preservation skills of edible wild plants. The interviewees were asked how frequently they purchase, eat, and collect edible wild plants during the harvest season of edible wild plants of the locals. Ecological knowledge of plant habitats and different ways of use were documented in detail. A list of edible wild plants was compiled after consulting with local experts of vegetation and specialists of wild edible plants.

#### *Method of quantitative assessment of biodiversity resources*

We use diversity index: Shannon Index; Simpson Index (in information theory). We implemented measurement method: standard plot (Sharma, P. D, 2003). Overall the study has investigated 20 plots, each plot with area of 25m<sup>2</sup> randomly distributed across the landscape: evergreen closed forest, scattered sparse woodlands, shrub - grassland, vacant land, paddy land - along streams, Each edge of the plot size 5 x 5 m (25m<sup>2</sup>):

In each plot, the necessary data was collected: (i) the number of species and species sampled for the species

name if necessary; (ii) the number of individuals, the quality of individual growth for each species in each plot; (iii) the field data is used to calculate the relative values appear as relative frequency, relative density.

Details of the survey methodology and calculation of plant biodiversity indicators can refer to (Huy, L. Q, 2005). According to the quantitative measurement of biodiversity indicators, diversity is a statistical allows the combination of the two factors: the number of species composition and distribution uniformity or potentially appearance of individuals of each species. This means that the H component not only depends on the number of species but also on the number of individuals and the probability of appearance of individuals in each species.

There are many proposed methods for quantitative studies of biodiversity indices. This study successfully applied the most commonly method Shannon Index (Shannon, C. E. and W. Wiener, 1963; Simpson, E. H, 1949), which is calculated as following equation:

$$H = -\sum [(N_i / N) \times (\ln N_i / N)]$$



**Figure 2.** Local distributed edible wild vegetables (source: Management board of Cham Islands MPA, 2012)

H: Shannon Diversity Index

N<sub>i</sub>: Number of individuals belonging to i species

N: Total number of individuals

**Shannon Index** is an index applied to biological systems by derived from a mathematical formula used in communication area by Shannon (Shannon, C. E. and W. Wiener, 1963; Simpson, E. H, 1949). It's the most preferred index among the other diversity indices.

In addition, H index also depends on many other factors such as climatic conditions, latitude, levels of environmental pollution.

**Simpson Diversity Index** - The dominant level (Concentration of Dominance ( $\Delta$ ) - Cd):

This index is calculated by Simpson (Simpson, E. H, 1949) as following equation:

$$1 - \Delta = \left[ \frac{\sum N_i (N_i - 1)}{N(N-1)} \right]$$

$\Delta$ : Simpson Diversity Index

N<sub>i</sub>: Number of individuals belonging to i species

N: Total number of individuals

It's a diversity indices derived by Simpson. Simpson index values ( $\Delta$ ) are between 0 – 1. But while calculating, final result is subtracted from 1 to correct the inverse proportion.

**Abundance (A); frequency (F)**

+ Abundance is calculated by dividing individual/m<sup>2</sup>, is the ratio of the total number of individuals appearing on all study plots and plot number of species studied appear.

+ Frequency appears that the number of cells in which the sample is studied species appear, based on the percentage value (Pandey, P.K. et al., 2002; Rastogi, 1999; Sharma, 2003).

## RESULTS AND DISCUSSION

### **Characteristics of distribution and the exploitation edible wild vegetables at Cham Island**

List of all the recorded plant species are presented (Table 1) including 43 edible plant species belonging to 30 families.

Edible wild plants in Cham Island were widely distributed, and diverse. However, number of species is highest in the foothills, forest fringe, forest, consistent with the growth of vegetables shrubs (with 24 out of 43 species accounted about 55.81%), located in the habitat as wasteland, roadside, wet road side,... mostly herbaceous species, high lighting (with 13 species accounted about 27.91%). In riverine habitats, ditch, field, wetland area (with 5 species accounted about 11.63%).

Edible wild vegetables were harvested mainly in rural Bai Ong, Bai Bac, Bai Lang and Bai Xep, Bai Bim, Bai Chong. Because these areas have many edible wild vegetables with less cattle grazing, convenient terrain for the harvest, bringing income, as well as providing daily food source for the local people.

The commonly species in the island are: *Strophoblachia fimbricalyx* Boerl., *Zanthoxylum nitidum* (Roxb.) DC, *Glochidion zeylanicum* (Gaertn.) A.Juss., *Pierre cambodiana* Mussaenda Pit ex., *Cratoxylum maingayi* Dyer, *Barringtonia macrostachya* (Jack) Kurz, *Diplazium esculentum* (Retz.) Sw., *Nephrolepis falcata* (Cav.) C. Chr, *Pasiflora foetida* L. Recently, more vegetables became scarce and more difficult to harvest, such as *Zanthoxylum nitidum* (Roxb.) DC, a fragrant herbs specially helps enhance the flavor for the dish, was used very popular in the island.

**Table 2.** Frequency of purchase, eating, and harvest wild edible plants of the local people.

Frequency	Number	Percentage
<b>Frequency of purchase</b>		
>3 times/week	11	20
1-3 times/week	14	25,45
Several times in a year	27	49,09
Never	3	5,45
<b>Total</b>	<b>55</b>	<b>100</b>
<b>Frequency of eating</b>		
>3 times/week	15	27,27
1-3 times/week	21	38,18
Several times in a year	19	34,55
Never	0	
<b>Total</b>	<b>55</b>	<b>100</b>
<b>Frequency of harvest</b>		
>3 times/week	11	20
1-3 times/week	13	23,64
Several times in a year	19	34,55
Never	12	21,81
<b>Total</b>	<b>55</b>	<b>100</b>

## \* Consumers

In the summer: principal customers are the restaurant, the “homestay” and tourists. Edible wild vegetables are favorite gifts when visitors leave the island. In the winter: abundance of edible wild vegetables, vegetables supply for locals on the island, tourists.

## \* How to harvest and store

To achieve best performance, it is usually harvested vegetables when the customers order, this form ensures fresh vegetables, sufficient quantities. After picking, vegetables can be sold or used immediately, without preservatives. Store the vegetables in a cool place, water spray.

## \*The processing, using

The form is processed mainly boiled, fried, soup, salad making, and raw food. With nearly 40 different species of vegetables are mixed and used to boil soup with shrimp, crab, and fresh fish.

***The utilization of edible wild vegetables resources in Cu Lao Cham Island***

Through two surveys between 28<sup>th</sup> Jan 2013 and 30<sup>th</sup> June 2013, the results were listed in Table 2. From Table 2, we can see: average frequency of the respondents use edible wild vegetables more than three times/week accounted about 27.3%, 1-3 times/week accounted about 38.1%. Thus, the edible wild vegetables have significance in daily nutrition of local people. They use wild vegetables the most (from September to December). Average harvest frequency > 3 times/week about 20%, from 1-3 times/week accounted about 23.64%, this is the cause of considerable pressure on edible wild vegetable sources and their ability to regenerate.

***Identify H (Shannon Index), Cd (Concentration of Dominance) of edible wild vegetables at Cham Island***

The results of identify H (Shannon Index) and Cd Index (Concentration of Dominance) are summarized in Table 3 below.

In species composition (S): the number of species in the plots changes from 3 to 8 species, average is 5 species. Plots with fewer species (3 species) as plot 6, 7, 20 are concentrated in the evergreen forest habitats. The number of plots has high species number (8 species) as plot 1, 4, 5 and 6 species at plot: 2, 12, 14 are concentrated in habitats such as: shrub - grassland, Abandoned land -fields, along streams in forests, sparse woodlands.

The number of individuals (N) ranged from 4 to 60 individuals, with an average of 17.6 individuals. The largest fluctuations in plot 4 and plot 15. H index ranged from 0.46 to 1.94, the average is 1.28. The number of plots has H index higher than average is 12 plots and accounted about 60% of the total plot. This detail shows quite uniform in the number and distribution of species. Cd index (Concentration of Dominance) ranged from 0.100 to 0,810, average is 0.267. The number of plots has index higher than average is 7 plots accounted about 35% of the total plot. Cd index in the plot 15 is the highest. Almost none of the most dominant species are widespread throughout the Cham Island.

\* ***The impacts on the local biodiversity***

Harvesting vegetables is increasing both in volume and frequency of harvest vegetables, puts tremendous

**Table 3.** Identify H (Shannon Index), Cd (Concentration of Dominance) of edible wild vegetables at Cham Island

Plot	Number of species	Number of individuals	Cd Index	H Index
1	8	19	0,123	1,91
2	6	19	0,339	1,34
3	5	12	0,333	1,23
4	8	54	0,317	1,37
5	8	20	0,116	1,94
6	3	4	0,133	0,69
7	3	4	0,167	1,04
8	5	12	0,212	1,42
9	4	17	0,581	0,79
10	5	20	0,195	1,53
11	5	12	0,258	1,36
12	6	20	0,368	1,27
13	4	23	0,328	1,15
14	6	23	0,229	1,51
15	5	60	0,810	0,46
16	5	9	0,167	1,46
17	4	10	0,178	1,37
18	4	5	0,100	1,33
19	3	4	0,167	1,04
20	4	5	0,100	1,33
Average	5,05	17,6	0,267	1,277

pressure on wild plant populations. Mostly wild vegetables to give the restaurant. In 2013, with more than 15 restaurants serving culinary tourists, on the menu of special dishes of Island appeared forests vegetables. Results of the survey interviews with 13 restaurants in Bai Lang, vegetable consumption average 1 - 1.5 kg of vegetables /day/ restaurant. Thus, with the increasing demand, the pressure to collecting wild vegetables also increased.

### Conservation

\* Management: The species of edible wild vegetables contributed diverse the forest vegetation and limit runoff, soil erosion. Therefore, in the management of NTFPs, the edible wild vegetables need to be managed.

Situ conservation of some species (*Strophoblachia fimbricalyx* Boerl, *Zanthoxylum nitidum* (Roxb.) DC) in the region was declining because of over-harvesting, diverse supply of vegetables to increase choice for the community. The rotation harvesting vegetables in the region will ensure natural regeneration capacity of vegetables, expanding the area harvested vegetables such as Bai Bac, Bai Chong và Bai Bim to reduce harvest pressure on area Bai Lang.

### CONCLUSION

Our survey in Cham Island found that exist abundant species of edible wild plants. This study documented 43 edible plant species belonging to 30 families. Local people have highly positive attitude towards edible wild

plants. Developing the sustainable use of natural resources in Cham Island by promoting the harvest and consumption of edible wild plants could be considered as an important means of rural vitalization.

In order to effectively expend the use and knowledge of native plants products classified as wild, the main strategy is to invest in basic and applied research of native flora and stimulate the production of seeds and seedlings for distribution to traditional farmers, as it is done today with conventional vegetables. These plants are categorized as wild exactly because we dont consume them enough in our daily diet.

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### REFERENCES

- Bixia C, Zhenmian Q(2011). "Consumers' Attitudes towards Edible Wild Plants: A Case Study of Noto Peninsula, Ishikawa Prefecture, Japan". Int. J. Forestry Res. Volume 2012, Article ID 872413. Pp.16.
- FAO, 2002. Non-Wood Forest Products in 15 Countries of Tropical Asia.
- Le QH(2005). Methods of quantitative analysis of indicators of biodiversity vegetation, J. Sci. Technol. Agric. Rural Dev. Ministry of Agriculture and Rural Development, 3 +4, Res. Center for Forest Ecol. Environ. Forestry Sci. Institute of Vietnam. Pp.117-121.
- Luong VD(2012). Selection and construction of model planted some edible wild vegetables in Lam Dong. Sci. Projects Technol. Dev. Lam Dong, Viet Nam.
- National Committee of UNESCO Vietnam, national committee man and biosphere Vietnam, Hoi An, Quang Nam (2008). The Biosphere Reserve Cham Island.
- Nguyễn TB, Bùi MĐ(1994). Some edible wild vegetables in Vietnam.

The Army Pub. (In Vietnamese).

Pandey PK, Sharma SC, Banerjee SK(2002). "Biodiversity studies in a moist temperate Western *Himalayan* forest". *Indian J. Tropical Biodiversity*. 10: 19-27.

Pham HH(1999). *Vietnam Plants*, young Publisher, Ho Chi Minh City, viet nam (in Vietnamese). Pp. 305-347.

Rastogi A(1999). *Methods in applied Ethnobotany: Lesson from the field*. Kathmandu, Nepal: International Center for Integrated Mountain Development (ICIMOD).

Shannon CE, Wiener W(1963). "The mathematical theory of communities". Illinois: Urbana University, Illinois Press, Urbana, USA. Pp. 117.

Sharma PD(2003). "Ecology and environment". New Delhi, Rastogi Publication. Pp. 415-489.

Simpson EH(1949). "Measurement of diversity". London: Nature. Pp.163-688.

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