



# Ethnobotanical study of edible plants sold in Nong Muen Than Forest Product Market at Roi Et Province, Thailand

Piyaporn Saensouk, Surapon Saensouk, Phiphat Sonthongphithak, Auemporn Junsongduang, Kamonwan Koompoot, Wei Shen, Bin Huang, Tammanoon Jitpromma

## Correspondence

Piyaporn Saensouk<sup>1,2</sup>, Surapon Saensouk<sup>1,3\*</sup>, Phiphat Sonthongphithak<sup>1</sup>, Auemporn Junsongduang<sup>4</sup>, Kamonwan Koompoot<sup>1</sup>, Wei Shen<sup>1,3,5</sup>, Bin Huang<sup>1,3,5</sup>, Tammanoon Jitpromma<sup>1,3</sup>

<sup>1</sup>Diversity of Family Zingiberaceae and Vascular Plant for Its Applications Research Unit, Mahasarakham University, Maha Sarakham, Thailand.

<sup>2</sup>Department of Biology, Faculty of Science, Mahasarakham University, Maha Sarakham, Thailand.

<sup>3</sup>Walai Rukhvej Botanical Research Institute, Mahasarakham University, Maha Sarakham, Thailand.

<sup>4</sup>Program of Biology, Department of Science and Technology, Faculty of Liberal of Art and Science, Roi Et Rajabhat University, Roi Et, Thailand.

<sup>5</sup>Agriculture and Food Engineering College, Baise University, Baise City 533000, Guangxi, China.

\*Corresponding Author: surapon.s@msu.ac.th

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## Research

### Abstract

**Background:** Forest-product markets in northeastern Thailand play a crucial role in maintaining traditional food systems and transmitting local ecological knowledge. However, their ethnobotanical composition and cultural significance remain insufficiently documented. This study examines the diversity, utilization patterns, and cultural importance of edible plants sold in the Nong Muen Than Forest Product Market in Roi Et Province.

**Methods:** Ethnobotanical data were collected through market surveys, interviews with market customers, and direct botanical identification. Quantitative analysis was conducted using the Relative Frequency of Citation (RFC) to evaluate cultural salience among recorded edible plant species.

**Results:** A total of 88 edible plant species belonging to 42 families and 79 genera were documented. The most species-rich families were Fabaceae (10 species) and Cucurbitaceae (7 species). Over half of the species were native to Thailand (54.54%), with the remainder introduced or cultivated. Key culturally important taxa included *Oryza sativa* L., *Curcuma singularis* Gagnep., *Citrus × aurantiifolia* (Christm.) Swingle, *Carica papaya* L., and *Solanum virginianum* L. Wild and forest-associated vegetables, aquatic plants, and aromatic herbs were well represented, reflecting diverse landscape-based food procurement practices. RFC values ranged from 0.100 to 1.000, with seasoning plants and multipurpose vegetables receiving the highest citations from vendors.

**Conclusions:** The Nong Muen Than Forest Product Market serves as an important repository of biocultural heritage, supporting the resilience of traditional food knowledge and the continued integration of wild, semi-wild, and cultivated

edible plants into local diets. The diversity and cultural significance of these species underscore the essential role of rural markets in sustaining regional food security and culinary identity in northeastern Thailand.

*Keywords:* edible plants; Ethnobotany; local market; Nong Muen Than Forest Product Market; Roi Et Province

## Background

Traditional knowledge of plant use plays a crucial role in sustaining livelihoods, healthcare practices, and cultural identity in many rural communities across Southeast Asia (Persoon & Minter 2020.). In Thailand, plants continue to be widely harvested, traded, and consumed for food, medicine, rituals, and household needs, reflecting a deep connection between people and their natural environments (Ormsby *et al.* 2021). Forest product markets are important nodes where this biocultural knowledge becomes visible (Sohail *et al.* 2024). These markets serve not only as economic sources of income for local harvesters but also as reservoirs of traditional ecological knowledge, as they reveal the diversity of plant resources that local people rely upon in their daily lives (Heindorf *et al.* 2021).

Northeastern Thailand (Isan) is particularly rich in traditional plant use due to its diverse ecosystems, strong cultural heritage, and long history of subsistence practices. Local markets in this region supply a wide range of wild and cultivated species, many of which remain understudied despite their importance for food security and community health (Saensouk *et al.* 2025a). Roi Et Province, located at the center of the Khorat Plateau, is home to numerous forest product markets where local people sell seasonal vegetables, medicinal plants, edible mushrooms, spices, and other non-timber forest products collected from surrounding landscapes (Ampha & Wongbumru 2025).

Nong Muen Than Forest Product Market, situated in Phanom Phrai District, is one such market with a long-standing role in supporting both local livelihoods and the transmission of ethnobotanical knowledge. The market is known for its rich assortment of plant resources sourced from homegardens, community forests, fallow fields, and wetlands. However, scientific documentation of the plant diversity, their uses, and cultural significance in this market remains limited. As forest resources continue to face pressures from land-use change, overharvesting, and socioeconomic transitions, documenting these plant-based traditions has become increasingly urgent (Makwinja & Kimengsi 2025).

Comparative studies from neighboring countries demonstrate similar roles of local markets as hubs of plant knowledge and exchange. Ethnobotanical market surveys in Lao PDR and Cambodia, for example, have documented extensive use of wild-harvested vegetables and medicinal herbs that support rural diets and primary healthcare, while highlighting threats from habitat loss and commercialization (Cui *et al.* 2020; Łuczaj *et al.* 2021). Research in Myanmar and Vietnam similarly emphasizes markets as places where identity, seasonality, and livelihood strategies intersect, with marked differences in species composition reflecting biogeography and cultural preferences (Nguyen *et al.* 2019; Zhang *et al.* 2020). Beyond the Mekong region, market-based ethnobotanical studies from South Asia, China, and parts of Africa and Latin America reinforce the global importance of markets for maintaining plant-based knowledge, documenting rare or endemic species, and identifying species with potential for wider pharmacological or nutritional use (Boakye *et al.* 2022; Cao *et al.* 2020; Manzanero-Medina *et al.* 2020; Panda *et al.* 2023). Together, these comparative findings show recurring themes—markets act as biodiversity indicators, they reflect local ecological knowledge and dietary choices, and they can signal conservation concerns where high-demand taxa become overexploited (Santana *et al.* 2024).

However, despite the growing body of ethnobotanical market research in Asia and elsewhere, there is still a clear research gap in northeastern Thailand—particularly in Roi Et Province—where forest product markets remain understudied in terms of plant diversity, cultural importance, and traditional knowledge associated with traded species. No comprehensive study has yet documented the full range of plant resources sold at Nong Muen Than Market, nor analyzed their ethnobotanical significance across multiple use categories. Filling this gap is essential for understanding local plant-based traditions, supporting sustainable management of non-timber forest products, and preserving cultural knowledge amid rapid socioeconomic and environmental change (Chamberlain *et al.* 2019).

This study seeks to offer a comprehensive ethnobotanical investigation of the plant resources sold in the Nong Muen Than Forest Product Market. Its specific objectives are to: (i) record the range and diversity of plant species present in the market; (ii) categorize and describe their traditional uses, including major utilization groups and the plant parts employed; and (iii) evaluate the cultural importance of each taxon by examining usage trends, citation frequencies, and their contributions to local food practices and market dynamics.

## Materials and Methods

### Study area

The study was carried out at the Nong Muen Than Forest Product Market in Phanom Phrai District, Roi Et Province, northeastern Thailand (Fig. 1). Roi Et lies within the Khorat Plateau and experiences a tropical savanna climate marked by pronounced wet and dry seasons. The study site is positioned at 15.761289°N, 103.995013°E. Average annual temperatures typically range between 25–28 °C, and annual rainfall averages 1,300–1,500 mm, with the majority falling from May to October. The market functions as a key local center for trading edible plants and forest-derived products, encompassing both cultivated crops and wild-gathered species. It operates as a fixed daily market, with vendors selling products throughout the day; however, trading activity is particularly intensive during the morning hours, when most fresh vegetables, spices, and forest products are exchanged. Plant materials sold at the market are sourced from surrounding villages, agricultural areas, and nearby natural ecosystems, reflecting the depth of ethnobotanical knowledge within the community. Local residents maintain distinct cultural traditions and plant-use practices, contributing to a rich repository of indigenous knowledge. These characteristics make the market an ideal location for documenting the diversity of edible plants used in the region. This study represents the first comprehensive effort to catalogue the edible plant species available in the Nong Muen Than Forest Product Market and to describe their uses within Roi Et Province.

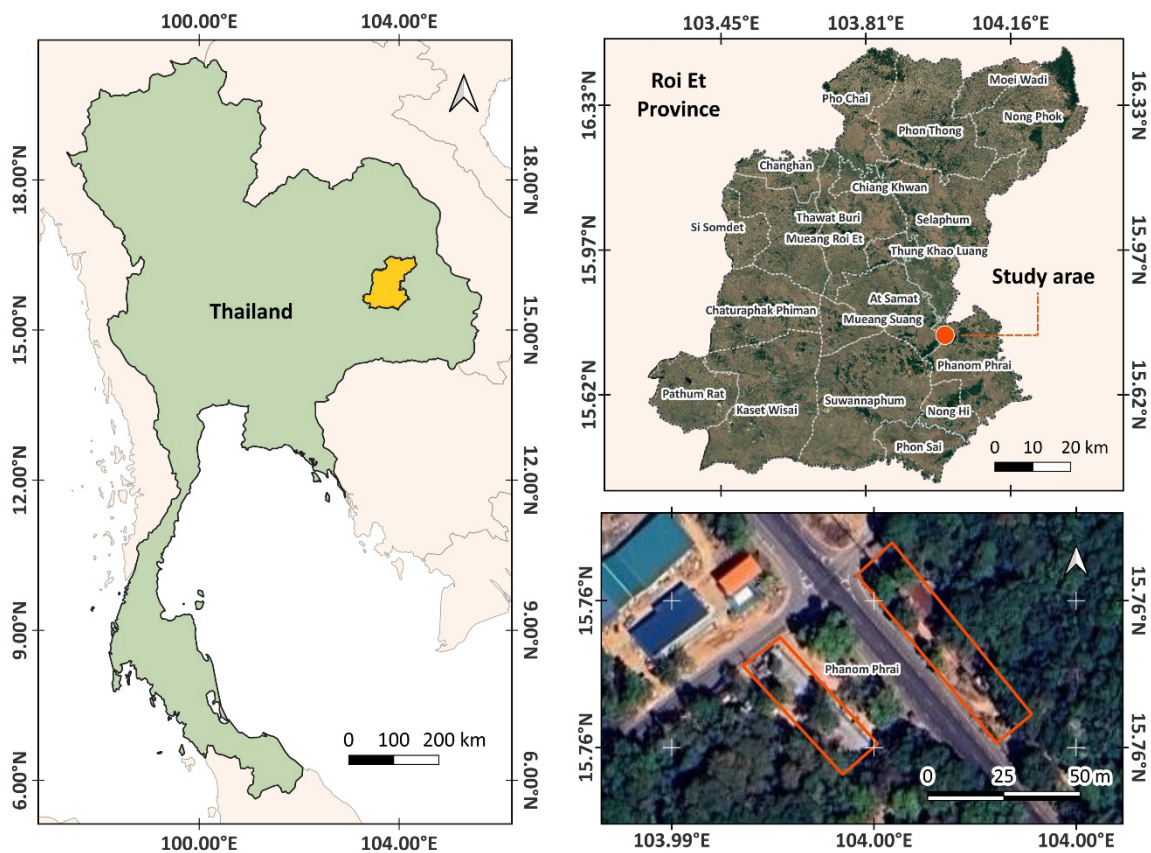


Figure 1. Map of Nong Muen Than Forest Product Market, located in At Samat District, Roi Et Province, northeastern Thailand, showing the study area (map created with “QGIS” program ver. 3.34, geographic system ID: WGS 84, EPSG 4326).

### Plant Collection and Identification

All edible plant species recorded from the Nong Muen Than Forest Product Market were collected during market surveys. Specimens were photographed in the field, prepared as herbarium vouchers, and deposited in the Vascular Plant Herbarium, Mahasarakham University (VMSU), Kantharawichai District, Maha Sarakham Province, Thailand, for long-term storage. Taxonomic identification of the collected plant species was carried out using standard floras, including *Flora of Thailand*, as well as other relevant scientific publications. Scientific names and family classifications were further verified through the online database Plants of the World Online (2025) (POWO; <https://powo.science.kew.org/>).

### Ethnobotanical Data Collection

Ethnobotanical fieldwork was carried out from May 2024 to April 2025 at the Nong Muen Than Forest Product Market in At Samat District, Roi Et Province, Thailand. The study employed qualitative ethnobotanical approaches, combining semi-structured interviews, participant observation, and guided market surveys with experienced local informants.

A total of 30 market customers (15 males and 15 females), aged 22–56 years, were selected using purposive sampling techniques (Tajik *et al.* 2025). The informants were regular customers of the Nong Muen Than Forest Product Market and were primarily household food preparers with practical experience in selecting, purchasing, and using edible plants. Interviews, conducted in Thai or the regional dialect, explored local plant names, utilized plant parts, preparation and consumption practices, collection sites, seasonal occurrence, and the cultural importance attributed to each species.

Before data collection, the objectives and procedures of the study were clearly explained to all participants, and prior informed consent was obtained in accordance with the International Society of Ethnobiology (ISE) (2006), Code of Ethics, World Medical Association (2024), the Declaration of Helsinki, and the Nagoya Protocol on Access and Benefit-Sharing (2011). Participants were made aware of their rights, including that participation was voluntary and that they could discontinue involvement at any time without penalty.

### Data Analysis

The data were analyzed using Plant Part Value (PPV) and Relative Frequency of Citation (RFC) to assess the local importance and recognition of each edible plant species. Although the study focused on a single local market, these indices were applied to support standardized interpretation of plant-use patterns and to identify relative differences in frequency of use and cultural salience among recorded species. Ethnobotanical data were organized and managed using Microsoft Excel 365.

#### Plant Part Value (PPV)

The Plant Part Value (PPV) index was used to quantify the relative importance of different plant parts utilized by the local community. This index highlights which parts—such as leaves, stems, roots, bark, flowers, fruits, or seeds—are most commonly employed in traditional practices. Following the approach of Gomez-Beloz (2002), PPV was calculated using the formula:

$$PPV = \frac{\sum RU_{(\text{plant part})}}{\sum RU} \times 100$$

where  $RU_{(\text{plant part})}$  represents the number of use reports attributed to a specific plant part, and  $\sum RU$  is the total number of use reports for all plant parts recorded in the study. PPV is expressed as a percentage, with higher values indicating more frequent citation and greater relative importance of the given plant part in local ethnobotanical applications.

#### Frequency of Citation (RFC)

The Frequency of Citation (RFC) index was applied to assess the relative importance and recognition of each species within the community. Following Tardío and Pardo-de-Santayana (2008), RFC was calculated as:

$$RFC = FC/N \quad (0 < RFC < 1)$$

where FC is the number of informants who mentioned a species, and N is the total number of informants interviewed. RFC values range from 0 (no citation) to 1 (cited by all informants), with higher values indicating species that are widely recognized and culturally important within the community. This index provides a quantitative measure for comparing the relative popularity and significance of edible plant species documented in the market.

## Results

### Diversity of edible plants

A total of 88 edible plant taxa belonging to 42 families and 79 genera were recorded from the Nong Muen Than Forest Product Market in Roi Et Province, Thailand. The most species-rich families were Fabaceae (10 species), Cucurbitaceae (7 species), Sapindaceae (6 species), Poaceae (5 species), and Zingiberaceae (5 species), followed by Solanaceae (4 species), Anacardiaceae (3 species), and Araceae (3 species). Several families were represented by two species, including Amaryllidaceae, Annonaceae, Apiaceae, Arecaceae, Bignoniaceae, Brassicaceae, Convolvulaceae, Dioscoreaceae, Myrtaceae, Phyllanthaceae, and Rutaceae, while the remaining 27 families were represented by a single species each (Table 1 & Fig. 2). Photographs of selected edible plant species recorded in this study are presented in Fig. 3.

Table 1. List of edible plants sold in Nong Muen Than Forest Product Market at Roi Et Province, Thailand.

Family	Scientific name	Thai name	Vernacular name	Distribution status in Thailand	Growth habit	Source	Used parts	Utilization	RFC	Voucher specimen
Alismataceae	<i>Limnocharis flava</i> (L.) Buchenau	ผักก้านจอง	Phak Kan Chong	Introduced	Herb	Wild	Leaf	VG	0.367	TJR0047
Amaryllidaceae	<i>Allium cepa</i> L.	หอมแดง	Hom Daeng	Introduced	Herb	Cultivated	Bulb, leaf	CF, VG	0.700	TJR0042
Amaryllidaceae	<i>Allium sativum</i> L.	กระเทียม	Krathiam	Introduced	Herb	Cultivated	Bulb	CF	0.733	TJR0063
Anacardiaceae	<i>Bouea macrophylla</i> Griff.	บักปราง	Bak Prang	Native	Tree	Cultivated	Fruit	FT	0.200	TJR0017
Anacardiaceae	<i>Mangifera indica</i> L.	บักม่วง	Bak Muang	Native	Tree	Cultivated	Fruit	FP, FT	0.333	TJR0018
Anacardiaceae	<i>Spondias pinnata</i> (L.f.) Kurz	บักกอก	Bak Kok	Native	Tree	Cultivated	Fruit	CF	0.367	TJR0008
Annonaceae	<i>Annona squamosa</i> L.	บักเขียบ	Bak Kheab	Introduced	Tree	Cultivated	Fruit	FT	0.267	TJR0082
Annonaceae	<i>Uvaria rufa</i> Blume	ผีผวน	Phi Phuan	Native	Climber	Wild	Fruit	FT	0.167	TJR0007
Apiaceae	<i>Anethum graveolens</i> L.	ผักชีลาว	Phak Chilao	Introduced	Herb	Cultivated	Leaf	VG	0.433	TJR0032
Apiaceae	<i>Coriandrum sativum</i> L.	ผักชี	Phakchi	Introduced	Herb	Cultivated	Leaf, root	CF, VG	0.500	TJR0084
Apocynaceae	<i>Willughbeia edulis</i> Roxb.	บักยาง	Bak Yang	Native	Climber	Wild	Fruit	FT	0.133	TJR0006
Araceae	<i>Amorphophallus brevispathus</i> Gagnep.	อีรอก	I Rok	Native	Herb	Wild	Leaf	VG	0.267	TJR0031
Araceae	<i>Colocasia esculenta</i> (L.) Schott	เผือก	Phueak	Native	Herb	Cultivated	Tuber	SF, SW	0.233	TJR0085
Araceae	<i>Wolffia globosa</i> (Roxb.) Hartog & Plas	ผำ	Phum	Native	Herb	Wild	Whole plant	VG	0.200	TJR0020
Arecaceae	<i>Calamus caesius</i> Blume	หวาย	Wai	Native	Climber	Wild	Shoot	VG	0.100	TJR0030
Arecaceae	<i>Cocos nucifera</i> L.	บักพร้าว	Bak Phrao	Introduced	Tree	Cultivated	Fruit	FT, SW	0.400	TJR0045
Asteraceae	<i>Lactuca sativa</i> L.	ผักกาดหอม	Phak Kat Hom	Introduced	Herb	Cultivated	Leaf	VG	0.600	TJR0014
Bignoniaceae	<i>Dolichandrone serrulata</i> (Wall. ex DC.) Seem.	แตนา	Khae Na	Native	Tree	Wild	Inflorescence	VG	0.233	TJR0026
Bignoniaceae	<i>Oroxylum indicum</i> (L.) Kurz	ลิ้นฟ้า	Lin Fa	Native	Tree	Wild	Inflorescence	VG	0.200	TJR0034
Brassicaceae	<i>Brassica oleracea</i> L. cv. Alboglabra Group	ผักคะน้า	Phak Khana	Introduced	Herb	Cultivated	Leaf	VG	0.500	TJR0035
Brassicaceae	<i>Brassica oleracea</i> L. cv. Capitata Group	กะหล่ำปลี	Kalam Pli	Introduced	Herb	Cultivated	Leaf	VG	0.633	TJR0048
Caricaceae	<i>Carica papaya</i> L.	บักหุ้ง	Bak Hung	Introduced	Tree	Cultivated	Fruit	VG	0.833	TJR0053

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Cleomaceae	<i>Cleome gynandra</i> L.	ผักเสี้ยน	Phak Sian	Native	Herb	Wild	Inflorescence, leaf, shoot	FD	0.433	TJR0024
Clusiaceae	<i>Garcinia mangostana</i> L.	มังคุด	Mangkhut	Introduced	Tree	Cultivated	Fruit	FT	0.333	TJR0029
Combretaceae	<i>Terminalia chebula</i> Retz.	ส้มมอ	Som Mo	Native	Tree	Wild	Fruit	FP, FT	0.133	TJR0043
Convolvulaceae	<i>Ipomoea aquatica</i> Forssk.	ผักบุ้ง	Phakbung	Native	Herb	Wild	Leaf	VG	0.767	TJR0080
Convolvulaceae	<i>Ipomoea batatas</i> (L.) Lam.	มันเทศ	Manthet	Introduced	Herb	Cultivated	Tuber	SF, SW	0.300	TJR0044
Cucurbitaceae	<i>Benincasa hispida</i> (Thunb.) Cogn.	ฟัก	Fak	Introduced	Climber	Cultivated	Fruit	VG	0.500	TJR0050
Cucurbitaceae	<i>Citrullus lanatus</i> (Thunb.) Matsum. & Nakai	แตงโม	Taeng Mo	Introduced	Climber	Cultivated	Fruit	FT	0.533	TJR0003
Cucurbitaceae	<i>Cucumis sativus</i> L.	แตงกวา	Taeng Kwa	Native	Climber	Cultivated	Fruit	FP, VG	0.600	TJR0004
Cucurbitaceae	<i>Cucurbita maxima</i> Duchesne	ฟักทอง	Fakthong	Introduced	Climber	Cultivated	Fruit	SW, VG	0.633	TJR0016
Cucurbitaceae	<i>Lagenaria siceraria</i> (Molina) Standl.	น้ำเต้า	Nam Tao	Introduced	Climber	Cultivated	Fruit	VG	0.333	TJR0054
Cucurbitaceae	<i>Luffa aegyptiaca</i> Mill.	บวบหอม	Buap Hom	Introduced	Climber	Cultivated	Fruit	VG	0.367	TJR0077
Cucurbitaceae	<i>Momordica charantia</i> L.	มะระขี้นก	Mara Khi Nok	Native	Climber	Cultivated	Fruit	VG	0.400	TJR0056
Dioscoreaceae	<i>Dioscorea hispida</i> Dennst.	กลอย	Kloi	Native	Climber	Wild	Tuber	SF, SW	0.300	TJR0040
Dioscoreaceae	<i>Dioscorea pseudotomentosa</i> Prain & Burkill	มันหนก	Man Nok	Native	Climber	Wild	Tuber	SF	0.267	TJR0041
Fabaceae	<i>Adenanthera pavonina</i> L.	ผักอีหล้า	Phak I Lam	Native	Tree	Wild	Seed	SW	0.133	TJR0002
Fabaceae	<i>Arachis hypogaea</i> L.	ถั่วดิน	Thua Din	Introduced	Herb	Cultivated	Seed	SW	0.533	TJR0010
Fabaceae	<i>Cajanus cajan</i> (L.) Huth	ถั่วแระ	Thua Hae	Introduced	Shrub	Cultivated	Seed	VG	0.300	TJR0019
Fabaceae	<i>Parkia speciosa</i> Hassk.	สะตอ	Sato	Native	Tree	Cultivated	Seed	VG	0.467	TJR0066
Fabaceae	<i>Pithecellobium dulce</i> (Roxb.) Benth.	บักขามแป	Bak Kham Pae	Introduced	Tree	Wild	Fruit	FT	0.400	TJR0069
Fabaceae	<i>Senegalia pennata</i> (L.) Maslin	ผักขา	Phak Kha	Native	Climber	Cultivated	Leaf	VG	0.667	TJR0072
Fabaceae	<i>Senna siamea</i> (Lam.) H.S.Irwin & Barneby	ขี้เหล็ก	Khilek	Native	Tree	Wild	Leaf	VG	0.567	TJR0073
Fabaceae	<i>Sesbania grandiflora</i> (L.) Poir.	แค	Khæ	Introduced	Tree	Cultivated	Inflorescence	VG	0.633	TJR0074

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Fabaceae	<i>Tamarindus indica</i> L.	บักขาม	Bak Kham	Introduced	Tree	Wild	Fruit	CF, FT	0.533	TJR0079
Fabaceae	<i>Vigna unguiculata</i> subsp. <i>sesquipedalis</i> (L.) Verdc.	ถั่วฝักยาว	Thuafakyao	Introduced	Climber	Cultivated	Fruit	VG	0.567	TJR0083
Hypericaceae	<i>Cratoxylum formosum</i> (Jack) Benth. & Hook.f. ex Dyer	ผักต้ว	Phak Tio	Native	Tree	Wild	Leaf	CF	0.400	TJR0033
Irvingiaceae	<i>Irvingia malayana</i> Oliv. ex A.W.Benn.	บักบก	Bak Bok	Native	Tree	Wild	Seed	SW	0.367	TJR0046
Lamiaceae	<i>Ocimum</i> × <i>africanum</i> Lour.	ผักอีตู	Phak I Tu	Native	Herb	Cultivated	Leaf	CF	0.600	TJR0062
Lecythidaceae	<i>Careya arborea</i> Roxb.	ผักกระโดน	Phak Kra Don	Native	Tree	Wild	Leaf	VG	0.367	TJR0023
Menispermaceae	<i>Tiliacora triandra</i> (Colebr.) Diels e	ย่านาง	Yanang	Native	Climber	Wild	Leaf	CF	0.500	TJR0081
Moraceae	<i>Artocarpus heterophyllus</i> Lam.	บักมี่	Bak Mi	Introduced	Tree	Cultivated	Fruit	FT, VG	0.433	TJR0011
Moringaceae	<i>Moringa oleifera</i> Lam.	ผักอีซุม	Phak I Hum	Introduced	Tree	Cultivated	Leaf	FP, VG	0.367	TJR0057
Musaceae	<i>Musa acuminata</i> Colla	กล้วยหอม	Kluai Hom	Native	Herb	Cultivated	Fruit	FT	0.700	TJR0058
Myrtaceae	<i>Psidium guajava</i> L.	บักสีดา	Bak Sida	Introduced	Tree	Cultivated	Fruit	FT	0.633	TJR0070
Myrtaceae	<i>Syzygium jambos</i> (L.) Alston	ชมพู่	Chomphu	Native	Tree	Cultivated	Fruit	FT	0.467	TJR0078
Nelumbonaceae	<i>Nelumbo nucifera</i> Gaertn.	บัวหลวง	Bua Luang	Native	Herb	Cultivated	Seed	SW	0.300	TJR0059
Opiliaceae	<i>Melientha suavis</i> Pierre	ผักหวาน	Phak Wan	Native	Tree	Wild	Leaf	VG	0.600	TJR0055
Pandanaceae	<i>Pandanus amaryllifolius</i> Roxb. ex Lindl.	เตยหอม	Toei Hom	Introduced	Shrub	Cultivated	leaf	CF	0.500	TJR0065
Passifloraceae	<i>Passiflora edulis</i> Sims	กะทกรก	Katokrok	Introduced	Climber	Cultivated	Fruit	FT	0.367	TJR0067
Phyllanthaceae	<i>Antidesma puncticulatum</i> Miq.	บักเฒ่า	Bak Mao	Native	Tree	Wild	Fruit	FT	0.300	TJR0009
Phyllanthaceae	<i>Baccaurea ramiflora</i> Lour.	บักไฟ	Bak Fai	Native	Tree	Cultivated	Fruit	FT	0.267	TJR0012
Piperaceae	<i>Piper sarmentosum</i> Roxb.	ผักอีเล็ด	Phak I Loet	Native	Herb	Cultivated	Leaf	CF, VG	0.733	TJR0015
Plantaginaceae	<i>Limnophila aromatica</i> (Lam.) Merr.	ผักขวยขง	Phak Khayaeng	Native	Herb	Wild	Leaf, shoot	CF, VG	0.767	TJR0036
Poaceae	× <i>Thyrsocalamus liang</i> Sungkaew & W.L.Goh	หน่อไม้ไผ่เลี้ยง	Nomai Phai Liang	Native	Bambo o	Wild	Shoot	VG	0.667	TJR0037
Poaceae	<i>Bambusa spinosa</i> Roxb.	หน่อไม้ไผ่สีสุก	Nomai Phai SiSuk	Native	Bambo o	Wild	Shoot	VG	0.700	TJR0087

Poaceae	<i>Cymbopogon citratus</i> (DC.) Stapf	ตะไคร้	Takhrai	Introduced	Herb	Cultivated	Pseudostem	CF	0.800	TJR0027
Poaceae	<i>Oryza sativa</i> L.	ข้าว	Khao	Introduced	Herb	Cultivated	Seed	SF	1.000	TJR0028
Poaceae	<i>Zea mays</i> L.	ข้าวโพด	Khaophot	Introduced	Herb	Cultivated	Seed	SF, SW	0.733	TJR0039
Rhamnaceae	<i>Ziziphus mauritiana</i> Lam.	บักหั่น	Bak Than	Native	Tree	Wild	Fruit	FT	0.267	TJR0049
Rutaceae	<i>Citrus × aurantiifolia</i> (Christm.) Swingle	บักนาว	Bak Nao	Introduced	Tree	Cultivated	Fruit	CF	0.867	TJR0052
Rutaceae	<i>Citrus × aurantium</i> L.	บักส้ม	Bak Som	Introduced	Tree	Cultivated	Fruit	FT	0.467	TJR0060
Sapindaceae	<i>Dimocarpus longan</i> Lour.	ลำไย	Lamyai	Native	Tree	Cultivated	Fruit	FT	0.433	TJR0022
Sapindaceae	<i>Lepisanthes rubiginosa</i> (Roxb.) Leenh.	บักหวดข่า	Bak Huat Kha	Native	Tree	Wild	Fruit	FT	0.233	TJR0075
Sapindaceae	<i>Litchi chinensis</i> Sonn.	ลิ้นจี่	Lin Chi	Native	Tree	Cultivated	Fruit	FT	0.300	TJR0076
Sapindaceae	<i>Nephelium hypoleucum</i> Kurz	บักแงว	Bak Ngaew	Native	Tree	Wild	Fruit	FT	0.367	TJR0005
Sapindaceae	<i>Nephelium lappaceum</i> L.	เงาะ	Ngo	Native	Tree	Cultivated	Fruit	FT	0.400	TJR0061
Sapindaceae	<i>Schleichera oleosa</i> (Lour.) Oken	บักค้อ	Bak Kho	Native	Tree	Wild	Fruit	FT	0.200	TJR0071
Sapotaceae	<i>Chrysophyllum cainito</i> L.	บักน่านม	Bak Namnom	Introduced	Tree	Cultivated	Fruit	FT	0.167	TJR0025
Solanaceae	<i>Capsicum annuum</i> L.	พริก	Phrik	Introduced	Herb	Cultivated	Fruit	CF	0.767	TJR0021
Solanaceae	<i>Capsicum frutescens</i> L.	พริกขี้หนู	Phrik Khinu	Introduced	Shrub	Cultivated	Fruit	CF	0.800	TJR0068
Solanaceae	<i>Solanum lycopersicum</i> L.	บักเขือเทศ	Bak Khuea Thet	Introduced	Herb	Cultivated	Fruit	VG	0.733	TJR0051
Solanaceae	<i>Solanum virginianum</i> L.	บักเขือขื่น	Bak Khuea Khuen	Introduced	Shrub	Cultivated	Fruit	VG	0.833	TJR0001
Zingiberaceae	<i>Alpinia siamensis</i> K.Schum.	ข่า	Kha	Native	Herb	Cultivated	Rhizome	CF	0.733	TJR0013
Zingiberaceae	<i>Boesenbergia rotunda</i> (L.) Mansf.	กระชาย	Kra Chai	Native	Herb	Cultivated	Rhizome	CF	0.800	TJR0038
Zingiberaceae	<i>Curcuma angustifolia</i> Roxb.	กระเจียวแดง	Kra Chiao Daeng	Native	Herb	Wild	Inflorescence	VG	0.667	TJR0064
Zingiberaceae	<i>Curcuma singularis</i> Gagnep.	กระเจียวขาว	Kra Chiao Khao	Native	Herb	Wild	Inflorescence	VG	0.900	TJR0086
Zingiberaceae	<i>Zingiber officinale</i> Roscoe	ขิง	Khing	Introduced	Herb	Cultivated	Rhizome	CF, VG	0.700	TJR0088

**Note: Utilization:** CF=condiments or flavoring, FP=fermented or preserved products, FT=fruits, SF=staple food, SW=sweets, desserts, or snacks, VG=vegetables.

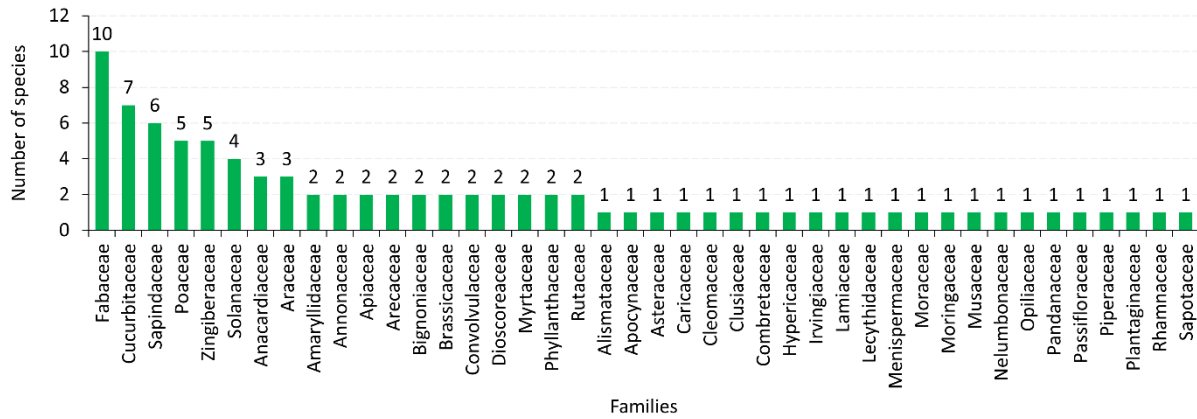


Figure 2. Diversity of edible plant species across different families.



Figure 3. Representative edible plant species recorded during the ethnobotanical survey. A. *Annona squamosa* L., B. *Antidesma punctulatum* Miq., C. *Brassica oleracea* L. cv. Alboglabra Group, D. *Ipomoea batatas* (L.) Lam., E. *Luffa aegyptiaca* Mill., F. *Melientha suavis* Pierre, G. *Momordica charantia* L., H. *Ocimum x africanum* Lour., I. *Senna siamea* (Lam.) H.S.Irwin & Barneby, J. *Sesbania grandiflora* (L.) Poir., K. *Spondias pinnata* (L.f.) Kurz, L. *Wolffia globosa* (Roxb.) Hartog & Plas (Photos by Tammanoon Jitpromma).

**Distribution status in Thailand**

Of the 88 edible plant taxa recorded from the Nong Muen Than Forest Product Market, 48 species (54.54%) were native to Thailand, while 40 species (45.46%) were introduced. This indicates that the market hosts a relatively balanced mix of indigenous and non-indigenous species, reflecting both the local flora and the influence of cultivated or imported plants in the diet of the local communities.

**Growth habit**

The growth-form analysis revealed that trees constituted the largest proportion of the recorded edible plants, accounting for 40.91% of the taxa, followed by herbs (34.09%) and climbers (18.18%). Shrubs represented 4.55% of the species, while bamboos were the least common, comprising only 2.27% (Fig. 4).

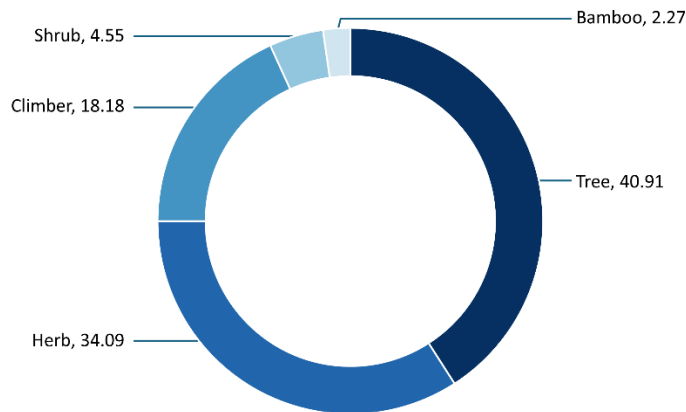


Figure 4. Percentage of growth habit from edible plants recorded in the Nong Muen Than Forest Product Market, Roi Et Province, Thailand.

**Source of edible plants**

The edible plants were analyzed according to their source and distribution status in Thailand (Fig. 5). Of the 88 recorded species, 37 species (42.05%) were cultivated and introduced, 29 species (32.95%) were wild and native, 19 species (21.59%) were cultivated and native, and only 3 species (3.41%) were wild and introduced.

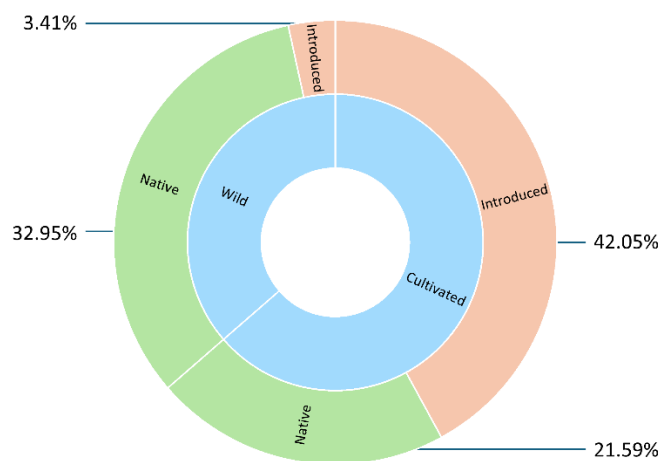


Figure 5. Source and distribution status of edible plants recorded in Nong Muen Than Forest Product Market, Roi Et Province, Thailand.

**Plant parts used**

The plant parts used were analyzed (Fig. 6), showing that fruits were the most utilized part (44.08%), followed by leaves (22.57%) and seeds (8.60%). Other parts included inflorescences (6.45%), shoots (5.38%), tubers (4.30%), rhizomes (3.23%), bulbs (2.15%), and single species of pseudostems, roots, and whole plants (1.08% each).

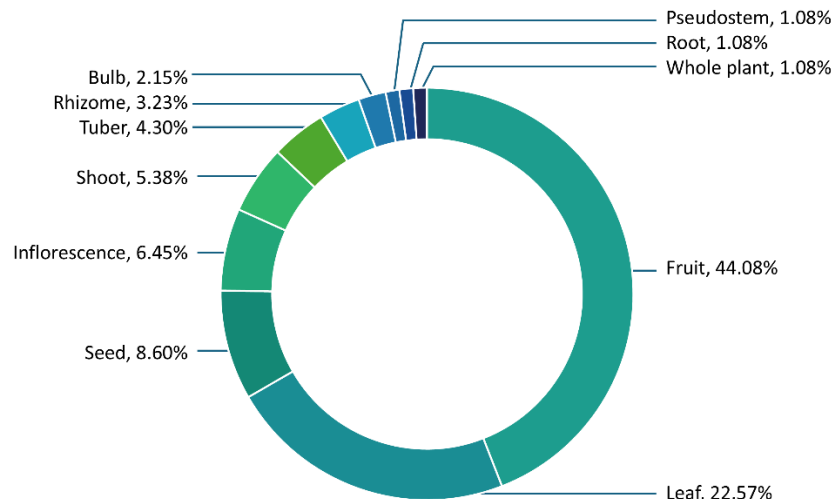


Figure 6. Percentage of plant parts used from edible plants recorded in the Nong Muen Than Forest Product Market, Roi Et Province, Thailand.

#### Relative Frequency of Citation (RFC) of edible plants

The RFC values of edible plants documented at the Nong Muen Than Forest Product Market ranged from 0.100 to 1.000, reflecting differences in local familiarity and frequency of use (Table 1). *Oryza sativa* showed the highest RFC (1.000), underscoring its fundamental importance as a dietary staple. In this study, rice was recorded at the species level, and local landraces (e.g., glutinous and non-glutinous types, paddy and upland rice) were not distinguished, as they are commonly traded and referred to collectively as rice in the market context. Other frequently cited species included *Citrus × aurantiifolia* (0.867), *Curcuma singularis* (0.900), *Cymbopogon citratus* (0.800), *Capsicum frutescens* (0.800), and *Boesenbergia rotunda* (0.800), all of which are widely valued for their culinary, flavoring, or aromatic properties.

Vegetables such as *Ipomoea aquatica* (0.767), *Limnophila aromatica* (0.767), *Allium sativum* (0.733), and *Piper sarmentosum* (0.733) also showed high RFC, reflecting their frequent use in daily dishes. Staple tubers including *Colocasia esculenta*, *Dioscorea hispida*, and *Ipomoea batatas* had moderate RFC values (0.233–0.300), indicating their regular but less widespread consumption compared with rice.

Fruit species varied in RFC, with commonly consumed fruits such as *Carica papaya* (0.833), *Solanum virginianum* (0.833), and *Musa acuminata* (0.700) being widely cited. Other fruits, including *Bouea macrophylla* (0.200), *Schleichera oleosa* (0.200), and *Chrysophyllum cainito* (0.167), had lower RFC, suggesting more occasional or seasonal use.

Condiments and flavoring plants such as *Allium cepa* (0.700), *Cymbopogon citratus* (0.800), and *Boesenbergia rotunda* (0.800) were highly cited, reflecting their importance in enhancing taste and aroma in local cuisine. Overall, RFC analysis highlights the culturally significant edible plants in the market, illustrating patterns of frequent consumption, culinary preference, and the ethnobotanical knowledge maintained by the local community.

#### Utilization of edible plants

The edible plant species recorded in the study area were grouped into six major categories based on their primary culinary functions (Table 2; Fig. 7). Vegetables represented the largest group, with 39 species, highlighting their central role in daily meals. Fruits formed the second-largest category with 27 species, reflecting their importance as fresh foods and ingredients in various dishes. A total of 18 species were used as condiments or flavoring agents, emphasizing the community's reliance on diverse aromatic plants. Additionally, 10 species were prepared as sweets, desserts, or snacks, showing the richness of traditional food culture. Six species were identified as staple foods providing essential carbohydrates, while five species were used in fermented or preserved forms. This classification illustrates the wide-ranging uses of plant resources and their significance in local dietary practices.

Table 2. Mode of consumption of edible plants recorded in the Nong Muen Than Forest Product Market, Roi Et Province, Thailand.

Scientific name	Used parts	Mode of consumption
× <i>Thyrsocalamus liang</i> Sungkaew & W.L.Goh	Shoot	Shoot: Boiled and eaten as a vegetable; used in curry dishes or for pickled bamboo shoots.
<i>Adenanthera pavonina</i> L.	Seed	Seed: Roasted and eaten as a snack.
<i>Allium cepa</i> L.	Bulb, leaf	Bulb: Used as a spice to enhance sweetness and aroma; leaf: eaten fresh or used in boiled, stir-fried, or fried dishes.
<i>Allium sativum</i> L.	Bulb	Bulb: Used as a spice to enhance aroma.
<i>Alpinia siamensis</i> K.Schum.	Rhizome	Rhizome: Used as a spice to enhance aroma.
<i>Amorphophallus brevispathus</i> Gagnep.	Leaf	Leaf petiole: Peeled and boiled to reduce itchiness, then used in curry dishes.
<i>Anethum graveolens</i> L.	Leaf	Leaf: Eaten fresh as a vegetable or used in boiled dishes or Isan-style aom soup.
<i>Annona squamosa</i> L.	Fruit	Fruit: The ripe fruit is eaten fresh.
<i>Antidesma puncticulatum</i> Miq.	Fruit	Fruit: Ripe fruit is eaten fresh.
<i>Arachis hypogaea</i> L.	Seed	Seed: Roasted or boiled and eaten as a snack.
<i>Artocarpus heterophyllus</i> Lam.	Fruit	Fruit: Ripe fruit eaten fresh; unripe fruit used in Isan-style soups.
<i>Baccaurea ramiflora</i> Lour.	Fruit	Fruit: Ripe fruit is eaten fresh.
<i>Bambusa spinosa</i> Roxb.	Shoot	Shoot: Boiled and eaten as a vegetable; used in curry dishes or for pickled bamboo shoots.
<i>Benincasa hispida</i> (Thunb.) Cogn.	Fruit	Fruit: Used in boiled or curry dishes.
<i>Boesenbergia rotunda</i> (L.) Mansf.	Rhizome	Rhizome: Used as a spice to enhance aroma.
<i>Bouea macrophylla</i> Griff.	Fruit	Fruit: The ripe fruit is eaten fresh.
<i>Brassica oleracea</i> L. cv. Alboglabra Group	Leaf	Leaf: Used in stir-fried dishes.
<i>Brassica oleracea</i> L. cv. Capitata Group	Leaf	Leaf: Eaten fresh or used in stir-fried, boiled, or curry dishes.
<i>Cajanus cajan</i> (L.) Huth	Seed	Seed: Boiled and eaten as a vegetable.
<i>Calamus caesius</i> Blume	Shoot	Shoot: Used in curry dishes.
<i>Capsicum annuum</i> L.	Fruit	Fruit: Used in cooking to add spiciness.
<i>Capsicum frutescens</i> L.	Fruit	Fruit: Used in cooking to add spiciness.
<i>Careya arborea</i> Roxb.	Leaf	Leaf: Eaten fresh.
<i>Carica papaya</i> L.	Fruit	Fruit: Used in salad dishes ( <i>som tam</i> ).
<i>Chrysophyllum cainito</i> L.	Fruit	Fruit: Ripe fruit is eaten fresh.
<i>Citrullus lanatus</i> (Thunb.) Matsum. & Nakai	Fruit	Fruit: Ripe fruit is eaten fresh.
<i>Citrus × aurantiifolia</i> (Christm.) Swingle	Fruit	Fruit: Used to add sour flavor to dishes.
<i>Citrus × aurantium</i> L.	Fruit	Fruit: Ripe fruit is eaten fresh.
<i>Cleome gynandra</i> L.	Inflorescence, leaf, shoot	Leaf, shoot, inflorescence: Used for pickling.
<i>Cocos nucifera</i> L.	Fruit	Fruit: Ripe fruit is eaten fresh; flesh used to make coconut milk for both savory and sweet dishes.

<i>Colocasia esculenta</i> (L.) Schott	Tuber	Tuber: Boiled and eaten as a staple food or used to make desserts.
<i>Coriandrum sativum</i> L.	Leaf, root	Leaf: Eaten fresh as a vegetable or used in boiled dishes; Root: used as a spice to enhance aroma, included in curry pastes.
<i>Cratogeomys formosum</i> (Jack) Benth. & Hook.f. ex Dyer	Leaf	Leaf: Used to enhance sour flavor in dishes.
<i>Cucumis sativus</i> L.	Fruit	Fruit: Eaten fresh as a vegetable; used in salads ( <i>som tam</i> ), stir-fried dishes, or for pickling.
<i>Cucurbita maxima</i> Duchesne	Fruit	Fruit: Used in boiled, curry, stir-fried dishes, or in desserts.
<i>Curcuma angustifolia</i> Roxb.	Inflorescence	Inflorescence: Boiled or eaten fresh as a vegetable.
<i>Curcuma singularis</i> Gagnep.	Inflorescence	Inflorescence: Boiled or eaten fresh as a vegetable.
<i>Cymbopogon citratus</i> (DC.) Stapf	Pseudostem	Pseudostem: Used to enhance aroma in cooking.
<i>Dimocarpus longan</i> Lour.	Fruit	Fruit: Ripe fruit is eaten fresh.
<i>Dioscorea hispida</i> Dennst.	Tuber	Tuber: Steamed and eaten as a staple food or used in desserts.
<i>Dioscorea pseudotomentosa</i> Prain & Burkill	Tuber	Tuber: Boiled and eaten as a staple food.
<i>Dolichandrone serrulata</i> (Wall. ex DC.) Seem.	Inflorescence	Inflorescence: Boiled or eaten fresh as a vegetable.
<i>Garcinia mangostana</i> L.	Fruit	Fruit: Ripe fruit is eaten fresh.
<i>Ipomoea aquatica</i> Forssk.	Leaf	Leaf, shoot: Boiled or eaten fresh as a vegetable; used in stir-fried dishes.
<i>Ipomoea batatas</i> (L.) Lam.	Tuber	Tuber: Boiled and eaten as a staple food or used in desserts.
<i>Irvingia malayana</i> Oliv. ex A.W.Benn.	Seed	Seed: Eaten fresh or roasted as a snack to add richness.
<i>Lactuca sativa</i> L.	Leaf	Leaf: Eaten fresh as a vegetable.
<i>Lagenaria siceraria</i> (Molina) Standl.	Fruit	Fruit: Used in boiled or curry dishes.
<i>Lepisanthes rubiginosa</i> (Roxb.) Leenh.	Fruit	Fruit: Ripe fruit is eaten fresh.
<i>Limnocharis flava</i> (L.) Buchenau	Leaf	Leaf: Eaten fresh as a vegetable or used in cooked dishes after blanching, often mixed in som tam.
<i>Limnophila aromatica</i> (Lam.) Merr.	Leaf, shoot	Leaf, Shoot: Eaten fresh as a vegetable or used to enhance aroma in cooking.
<i>Litchi chinensis</i> Sonn.	Fruit	Fruit: Ripe fruit is eaten fresh.
<i>Luffa aegyptiaca</i> Mill.	Fruit	Fruit: Used in boiled, curry, or stir-fried dishes.
<i>Mangifera indica</i> L.	Fruit	Fruit: Both ripe and unripe fruits are consumed; unripe fruits are used for pickling.
<i>Melientha suavis</i> Pierre	Leaf	Leaf: Used in curry dishes.
<i>Momordica charantia</i> L.	Fruit	Fruit: Eaten fresh as a vegetable.
<i>Moringa oleifera</i> Lam.	Leaf	Leaf: Boiled and eaten as a vegetable; Inflorescence: used for pickling.
<i>Musa acuminata</i> Colla	Fruit	Fruit: Ripe fruit is eaten fresh.
<i>Nelumbo nucifera</i> Gaertn.	Seed	Seed: Eaten as a snack.
<i>Nephelium hypoleucum</i> Kurz	Fruit	Fruit: Ripe fruit is eaten fresh.
<i>Nephelium lappaceum</i> L.	Fruit	Fruit: Ripe fruit is eaten fresh.
<i>Ocimum</i> × <i>africanum</i> Lour.	Leaf	Leaf: Eaten fresh or used to add aroma to dishes.

<i>Oroxylum indicum</i> (L.) Kurz	Inflorescence	Inflorescence: Boiled or eaten fresh as a vegetable.
<i>Oryza sativa</i> L.	Seed	Seed: Cooked and eaten as a staple food.
<i>Pandanus amaryllifolius</i> Roxb. ex Lindl.	leaf	Leaf: Used to enhance aroma in desserts.
<i>Parkia speciosa</i> Hassk.	Seed	Seed: Eaten fresh as a vegetable or used in stir-fried dishes.
<i>Passiflora edulis</i> Sims	Fruit	Fruit: Ripe fruit is eaten fresh.
<i>Piper sarmentosum</i> Roxb.	Leaf	Leaf: Eaten fresh as a vegetable or used to enhance aroma in cooking.
<i>Pithecellobium dulce</i> (Roxb.) Benth.	Fruit	Fruit: Ripe fruit is eaten fresh.
<i>Psidium guajava</i> L.	Fruit	Fruit: Unripe fruit is eaten fresh.
<i>Schleichera oleosa</i> (Lour.) Oken	Fruit	Fruit: Ripe fruit is eaten fresh.
<i>Senegalia pennata</i> (L.) Maslin	Leaf	Leaf: Eaten fresh or used in boiled or fried dishes.
<i>Senna siamea</i> (Lam.) H.S.Irwin & Barneby	Leaf	Leaf: Boiled to reduce bitterness before using in curry dishes.
<i>Sesbania grandiflora</i> (L.) Poir.	Inflorescence	Inflorescence: Boiled, steamed, or eaten fresh as a vegetable; used in curry or <i>aom</i> soup dishes.
<i>Solanum lycopersicum</i> L.	Fruit	Fruit: Used in both raw and cooked dishes.
<i>Solanum virginianum</i> L.	Fruit	Fruit: Eaten fresh as a vegetable.
<i>Spondias pinnata</i> (L.f.) Kurz	Fruit	Fruit: Both ripe and unripe fruits are used to add sourness and distinctive flavor without heat processing.
<i>Syzygium jambos</i> (L.) Alston	Fruit	Fruit: Ripe fruit is eaten fresh.
<i>Tamarindus indica</i> L.	Fruit	Fruit: Eaten both ripe and unripe; unripe fruit used to add sour flavor.
<i>Terminalia chebula</i> Retz.	Fruit	Fruit: Unripe fruit is eaten fresh or used for pickling.
<i>Tiliacora triandra</i> (Colebr.) Diels	Leaf	Leaf: Juiced and filtered; liquid used in Isan-style curry ( <i>kaeng Isan</i> ).
<i>Uvaria rufa</i> Blume	Fruit	Fruit: The ripe fruit is eaten fresh.
<i>Vigna unguiculata</i> subsp. <i>sesquipedalis</i> (L.) Verdc.	Fruit	Fruit: Boiled or eaten fresh as a vegetable; used in stir-fried dishes.
<i>Willughbeia edulis</i> Roxb.	Fruit	Fruit: The ripe fruit is eaten fresh.
<i>Wolffia globosa</i> (Roxb.) Hartog & Plas	Whole plant	Whole plant: Used in curry dishes.
<i>Zea mays</i> L.	Seed	Seed: Boiled, steamed, or roasted and eaten as a staple food, or used in desserts.
<i>Zingiber officinale</i> Roscoe	Rhizome	Rhizome: Used as a spice to add spiciness and aroma; used in pickled vegetables commonly eaten with Isan-style sausages.
<i>Ziziphus mauritiana</i> Lam.	Fruit	Fruit: Ripe fruit is eaten fresh.

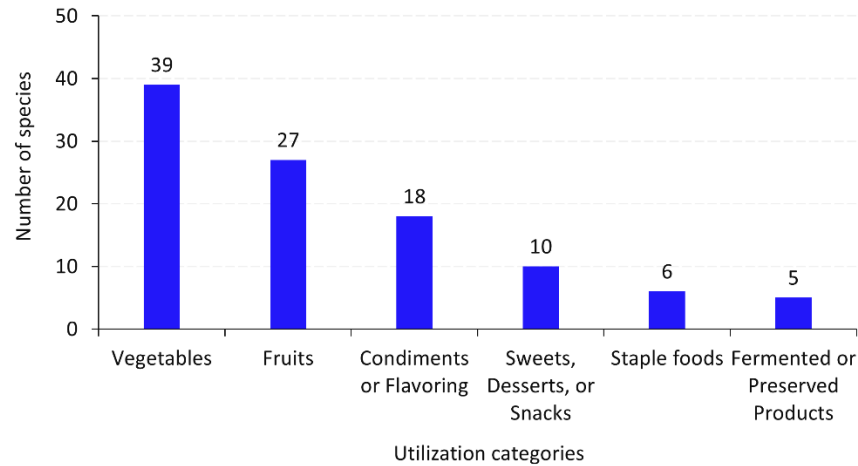


Figure 7. Number of edible plant species recorded in each utilization category, including vegetables, fruits, condiments or flavoring, sweets, desserts or snacks, staple foods, and fermented or preserved products.

### Edible Plants Used as Vegetables

A total of 39 edible plant species were documented as being used primarily as vegetables, reflecting the wide botanical diversity incorporated into local diets. These species represent a variety of plant parts—leaves, shoots, inflorescences, fruits, seeds, bulbs, rhizomes, and whole plants—each contributing distinct textures, flavors, and nutritional values to traditional dishes.

Leafy vegetables formed a major component of the recorded taxa. Commonly consumed species such as *Limncharis flava*, *Anethum graveolens*, *Coriandrum sativum*, *Ipomoea aquatica*, *Senegalia pennata*, *Senna siamea*, and *Moringa oleifera* were frequently eaten fresh, blanched, or incorporated into soups, stir-fried dishes, or curry preparations. Aromatic leafy species including *Piper sarmentosum* and *Limnophila aromatica* were valued not only as vegetables but also for enhancing flavor in local cuisine.

Fruit vegetables were also widely used, including *Carica papaya*, *Cucumis sativus*, *Benincasa hispida*, *Cucurbita maxima*, *Lagenaria siceraria*, *Luffa aegyptiaca*, *Momordica charantia*, *Solanum lycopersicum*, and *Solanum virginianum*. These fruits were eaten fresh or cooked in boiled, stir-fried, curry, and salad dishes. Unripe *Artocarpus heterophyllus* fruits were incorporated into Isan-style soups, demonstrating the creative use of plant parts across maturity stages.

Several species contributed edible shoots, notably *Thyrsocalamus liang*, *Calamus caesius*, and *Bambusa spinosa*, which were boiled or pickled and commonly used in curries. Inflorescences of *Dolichandrone serrulata*, *Oroxylum indicum*, *Sesbania grandiflora*, and two *Curcuma* species were eaten fresh or boiled as mild-flavored vegetables. Seeds of *Cajanus cajan* and *Parkia speciosa* provided additional vegetable resources and were incorporated into fresh, boiled, or stir-fried dishes. Rhizomes of *Zingiber officinale* served as an aromatic spice and were also used in pickled vegetable preparations.

Overall, the wide variety of plant taxa and plant parts utilized as vegetables reflects the community's extensive ethnobotanical knowledge and its dependence on diverse plant resources in daily food preparation. Such diversity is essential for sustaining household nutrition, preserving culinary traditions, and supporting the continuity of local food heritage.

### Edible Plants Used as Fruits

A total of 27 species recorded at the Nong Muen Than Forest Product Market are consumed primarily as fruits (Table 4). Most species are eaten ripe, while some are consumed unripe for sourness or pickling purposes. *Annona squamosa*, *Antidesma punctulatum*, *Baccaurea ramiflora*, *Bouea macrophylla*, *Chrysophyllum cainito*, *Citrullus lanatus*, *Citrus × aurantium*, *Dimocarpus longan*, *Garcinia mangostana*, *Lepisanthes rubiginosa*, *Litchi chinensis*, *Musa acuminata*, *Nephelium hypoleucum*, *Nephelium lappaceum*, *Passiflora edulis*, *Pithecellobium dulce*, *Syzygium jambos*, *Uvaria rufa*, *Willughbeia edulis*, and *Ziziphus mauritiana* are consumed ripe, primarily for direct fresh consumption.

*Artocarpus heterophyllus* is consumed both ripe, eaten fresh, and unripe, used in Isan-style soups. *Cocos nucifera* provides ripe fruit for fresh consumption, with its flesh also used to make coconut milk for both savory and sweet dishes. *Mangifera*

*indica* and *Tamarindus indica* are consumed ripe and unripe, with unripe fruits used for pickling or to add sour flavor. *Psidium guajava* and *Terminalia chebula* are consumed unripe, either eaten fresh or used for pickling. These fruit-bearing plants reflect the ethnobotanical knowledge of local communities, demonstrating their ability to utilize different stages of fruit maturity for diverse culinary applications, including fresh consumption, sour flavoring, and preservation.

#### **Edible Plants Used as Condiments or Flavoring**

A total of 18 edible plant species were documented as being used as condiments or flavoring agents in dishes prepared by the local communities at the Nong Muen Than Forest Product Market (Table 2). These species belong to diverse plant families and include bulbs, leaves, shoots, pseudostems, rhizomes, and fruits.

Bulbs of *Allium cepa* and *Allium sativum* are commonly used as spices to enhance sweetness and aroma, while roots of *Coriandrum sativum* are incorporated into curry pastes to add fragrance. Fruits of *Spondias pinnata* and *Tamarindus indica* are used to impart sourness and distinctive flavor, with *S. pinnata* being utilized both ripe and unripe, and *T. indica* primarily in its unripe form. Fruits of *Capsicum annuum*, *C. frutescens*, and *Citrus × aurantiifolia*, are also employed to add spiciness or sourness to dishes.

Leaves of *Cratoxylum formosum*, *Ocimum × africanum*, *Tiliacora triandra*, *Pandanus amaryllifolius*, *Piper sarmentosum*, and *Limnophila aromatica* (also shoots) are used to enhance aroma, with *T. triandra* juice being filtered and added to Isan-style curries. The pseudostem of *Cymbopogon citratus* is utilized to improve fragrance in cooking.

Rhizomes of *Alpinia siamensis*, *Boesenbergia rotunda*, and *Zingiber officinale* are commonly used as aromatic and spicy condiments, reflecting their dual role in enhancing both flavor and aroma. These findings highlight the extensive ethnobotanical knowledge of local communities in utilizing plant parts not only for nutrition but also for their culinary properties, contributing to the characteristic flavors and sensory qualities of traditional dishes in Roi Et Province.

#### **Edible Plants Used as Sweets, Desserts, or Snacks**

A total of ten edible plant species are used as ingredients in sweets, desserts, or snacks, reflecting the diversity of traditional food practices in the local community. These plants provide important sources of carbohydrates, fats, and natural flavor enhancers that contribute to both daily diets and festive cuisines.

*Colocasia esculenta*, *Ipomoea batatas*, and *Dioscorea hispida* provide starchy tubers that, in addition to their role as staple foods, are commonly processed into a variety of traditional desserts. *Cocos nucifera* is highly valued for its flesh, which is used to produce coconut milk—a key component in many sweet dishes. *Cucurbita maxima* is also used in both desserts and cooked dishes.

Several species contribute directly as snacks, particularly through their edible seeds. *Adenanthera pavonina*, *Arachis hypogaea*, *Irvingia malayana*, and *Nelumbo nucifera* yield seeds that are roasted, boiled, or eaten fresh. *Zea mays* offers versatile uses, with kernels consumed as snacks or incorporated into sweet preparations. These plant resources emphasize the role of local biodiversity in shaping traditional snack and dessert culture, offering both nutritional value and cultural continuity within the community.

#### **Edible Plants Used as Staple Foods**

A total of six species utilized as staple foods, primarily for their carbohydrate-rich tubers or seeds (Table 5). The tuberous species *Colocasia esculenta*, *Ipomoea batatas*, *Dioscorea hispida*, and *D. pseudotomentosa* are traditionally prepared by boiling or steaming and consumed as staple foods. Among them, *D. hispida* is steamed before consumption to reduce potential toxicity. The cereal crops *Oryza sativa* and *Zea mays* are important staple foods, with seeds cooked by boiling, steaming, or roasting. These species illustrate the reliance of local communities on both wild and cultivated plants as essential sources of dietary carbohydrates and their integration into traditional food systems.

#### **Edible Plants Used as Fermented or Preserved Products**

A total of five species were documented in this category (Table 3). Fruits of *Mangifera indica* and *Terminalia chebula* are used in pickling, with unripe fruits of *Mangifera indica* being especially preferred for their sourness. *Cucumis sativus* fruits are also commonly preserved through pickling. In addition to fruits, leafy and reproductive parts of plants are utilized for preservation. Leaves, shoots, and inflorescences of *Cleome gynandra* are prepared as pickled vegetables, while the

inflorescences of *Moringa oleifera* are also used for the same purpose. These practices illustrate the ethnobotanical knowledge of the local communities in employing various plant parts for fermentation and preservation, contributing to food diversity, flavor enhancement, and dietary availability beyond the harvest season.

#### Traditional Dishes Prepared from Edible Plants Sold in the Market

**Bamboo shoot curry with pork:** Bamboo shoots (*× Thyrsochloa liang*) serve as the primary vegetable in this traditional Isan dish. Sliced shoots are boiled to reduce bitterness and combined with minced pork. Additional plant ingredients include onion leaves (*Allium cepa*) for texture, chili (*Capsicum annuum*) to enhance spiciness, and aromatic leaves (*Ocimum × africanum*) to impart fragrance. The mixture is wrapped in banana leaves and steamed. This preparation illustrates the multifaceted use of local edible plants, showcasing their roles as staple vegetables, spices, and aromatic enhancers in traditional culinary practices (Fig. 8).

**Mixed spicy salad:** This popular Isan dish incorporates a variety of fresh vegetables, fruits, and herbs. Key plant ingredients include *Carica papaya*, leaf and shoot of water spinach (*Ipomoea aquatica*), and fruit of yardlong bean (*Vigna unguiculata* subsp. *sesquipedalis*) for freshness. Spiciness is added using chili (*Capsicum annuum*), while the main souring components are unripe fruits of *Spondias pinnata* or *Citrus × aurantiifolia*. *Solanum lycopersicum* fruit is included to enhance color, and additional aromatic elements, such as bulbs of *Allium cepa*, contribute fragrance. All ingredients are pounded together in a mortar, reflecting the local community's traditional knowledge of combining multiple edible plants to achieve a balanced flavor, color, and aroma profile (Fig. 8).

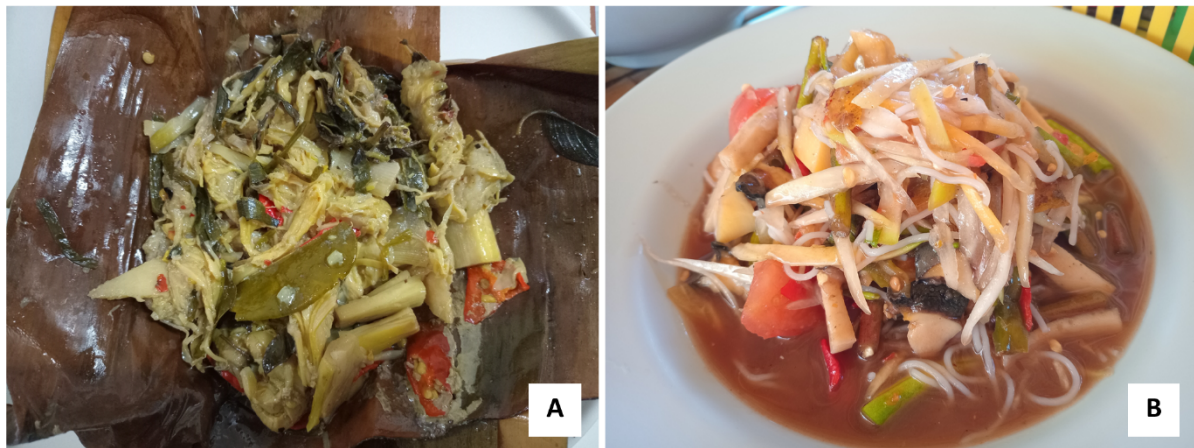


Figure 8. Examples of traditional Isan dishes prepared using local edible plants. A. Bamboo shoot curry with pork, B. Mixed spicy salad (Photos by Tammanoon Jitpromma).

## Discussion

### Edible Plant Diversity in the Nong Muen Than Forest Product Market

The diversity of edible plant taxa recorded in this study reflects patterns commonly reported across local markets and rural communities in mainland Southeast Asia. Surveys from Indonesia, Laos, and Vietnam consistently highlight families such as Fabaceae, Cucurbitaceae, Poaceae, Zingiberaceae, and Solanaceae as central components of regional diets (Łuczaj et al. 2021; Marpaung et al. 2025; Nguyen et al. 2019). The composition observed in the Nong Muen Than market follows similar trends, indicating that local food systems draw on both cultivated homegarden species and seasonally gathered wild resources. Evidence from comparable studies supports this interpretation. For instance, a market survey in Luang Prabang, Laos, documented more than 110 edible wild plants—nearly half originating from woody species such as trees and shrubs, whose young shoots and leaves are commonly sold as vegetables—highlighting the importance of perennial species in market diversity (Łuczaj et al. 2021). Similarly, research among rice-farming communities in Northeast Thailand reported a rich wild-food flora composed of trees, herbs, and climbers sourced from rice fields, secondary forests, and homegardens, underscoring how both anthropogenic and semi-natural landscapes continue to supplement cultivated crops in everyday diets (Cruz-Garcia et al. 2011).

The balance between native and introduced species observed here corresponds with dietary transitions documented in other parts of northeastern Thailand. For example, a recent ethnobotanical survey in Yasothon Province recorded 170 edible plant species used by local communities, among which both wild and farmed plants — native and introduced alike — played important roles in food security, nutrition, and cultural traditions, reflecting a diversified and mixed plant repertoire

(Saensouk *et al.* 2025b). Similarly, a study of home-garden diversity in northeast Thailand documented that households maintain wild edible plants throughout the seasons, indicating that wild food plants (WFPs) remain major components of home gardens and contribute significantly to dietary diversity and resilience (Cruz-Garcia & Struik 2015). Thus, the near-equal proportion of native and introduced edible plants recorded in the Nong Muen Than market likely reflects a broader regional strategy: blending long-established cultivated species with seasonally managed wild resources across various landscape types (home gardens, agroecosystems, semi-natural habitats).

Growth-habit patterns also show parallels with earlier ethnobotanical studies. While many surveys identify herbs as the dominant life form (Ali *et al.* 2025), the higher number of trees recorded here resembles findings from communities located near forest edges and fruit-based agroecosystems. This may indicate that the Nong Muen Than market sources a substantial portion of its products from perennial or semi-wild environments rather than solely from annual cropping systems (Yaipharembi *et al.* 2023).

The proportion of wild native species found also aligns with previous studies emphasizing the continued reliance of northeastern Thai communities on wild-gathered foods, especially during transitional seasons (Purwayantie & Suryadi 2020.). Compared with markets in more urbanized settings, such as Khon Kaen Province this market exhibits a similar number of wild taxa, indicating that rural forest-product markets continue to serve as important venues for the circulation of wild and semi-wild foods and for sustaining associated ecological knowledge (Shirai & Rambo 2014).

Patterns of plant part utilization are broadly consistent with earlier research from Northeast Thailand and neighboring regions, where fruits and leaves commonly dominate consumption (Saisor *et al.* 2021). These preferences are strongly tied to regional cooking methods, including soups, curries, and fresh herb-based dishes. The wide range of plant parts recorded—from shoots and leaves to inflorescences and tubers—signals a flexible and ecologically adaptive food system that employs multiple morphological components for nutritional and sensory purposes (Saensouk *et al.* 2025a).

Taken together, the edible plant assemblage of the Nong Muen Than Forest Product Market aligns with broader regional ethnobotanical patterns while also showing characteristics typical of rural northeastern Thailand. The comparatively high proportion of perennial tree species, continued reliance on wild native resources, and integrated use of introduced crops underscore the market's role in sustaining diverse food practices. These features highlight the contribution of local markets to biocultural resilience, even as agricultural systems and socioeconomic contexts continue to change (Heindorf *et al.* 2021).

#### **Patterns and Interpretation of Relative Frequency of Citation (RFC)**

Patterns of RFC values in this study highlight relative differences in familiarity and frequency of use among edible plant species sold within the Nong Muen Than Forest Product Market. *Oryza sativa* shows the highest RFC, reflecting its fundamental role as a staple food and its consistent presence in everyday diets (Wannakham *et al.* 2024). Aromatic and seasoning species such as *Cymbopogon citratus*, *Boesenbergia rotunda*, and *Capsicum frutescens* also exhibit high RFC values, indicating their central importance in routine cooking practices and flavor construction (Engtipi & Raju 2022; Rambey *et al.* 2024). In contrast, species with lower RFC values tend to be seasonal, wild-harvested, or opportunistically collected, suggesting that availability and seasonality strongly influence citation frequency and cultural salience within the market context. In this study, RFC is therefore not intended for large-scale comparison, but rather serves as a quantitative tool to distinguish core food plants from those with more specialized, supplementary, or seasonal roles in local food practices (Luo *et al.* 2024).

#### **Utilization Categories of Edible Plants**

The utilization patterns recorded in this market correspond with ethno-culinary practices documented across mainland Asia. Vegetables, fruits, herbs, and condiments dominate the edible plant repertoire, a trend also observed in studies from Yasothon Province, Thailand (Saensouk *et al.* 2025b), Southern Shan State, Myanmar (Shin *et al.* 2018), and District Swat, Pakistan (Ali *et al.* 2025). Aromatic and flavoring taxa, as documented in recent studies (Inta *et al.* 2025), remain central to local cuisines, underscoring the continuing importance of plant-based seasonings in everyday cooking.

Fermented and preserved foods illustrate the persistence of traditional food-processing knowledge. Similar practices have been documented in areas with marked seasonality in wild food availability (Aworh 2023). The presence of items such as fermented leafy vegetables echoes patterns in northeastern Thailand and Laos (Pruksa *et al.* 2022; Sisouvanh *et al.* 2019)), while the use of *Moringa oleifera* inflorescences in fermentation represents a localized adaptation unique to communities in Roi Et.

The market also reflects the broader Mekong-region pattern of dual-purpose fruits—fresh when ripe and souring or pickled when unripe. The availability of wild fruits such as *Uvaria rufa* and *Willughbeia edulis* further emphasizes the continued role of forest-derived foods in rural diets (Praimee *et al.* 2024). Staple plants and tubers, ranging from *Oryza sativa* and *Zea mays* to semi-domesticated or processed wild species like *Dioscorea hispida*, reflect adaptive food strategies and the retention of intergenerational knowledge on detoxification techniques (Saensou *et al.* 2025a; Sangkanu *et al.* 2025).

Vegetable diversity remains particularly notable, consistent with earlier findings that Isan cuisine has one of the richest vegetable repertoires in Southeast Asia (Saensou *et al.* 2025c). The frequent use of bamboo shoots, palm shoots, and edible inflorescences such as *Dolichandrone serrulata* and *Sesbania grandiflora* highlights distinctive features of northeastern Thai food culture (Jantanukul & Kenaphoom 2020).

Traditional dishes observed in this study, including multi-species soups and mixed salads, mirror ethno-culinary patterns documented in Isan and Lao gastronomy. These dishes illustrate how multiple plant taxa are combined to create layered flavors and textures, reinforcing the cultural significance of plant diversity in everyday meals (Nugroho *et al.* 2023).

### Future Research Directions

Future ethnobotanical research on the Nong Muen Than Forest Product Market and comparable rural markets could expand in several complementary directions. First, longitudinal studies across multiple seasons and years would help clarify how ecological fluctuations, climatic variation, and market dynamics influence the availability, diversity, and cultural importance of edible plants over time. Such temporal data would provide a more nuanced understanding of how seasonal foraging, agricultural cycles, and household subsistence strategies shape market composition.

Second, integrating participatory approaches with local harvesters, sellers, and consumers would offer deeper insights into knowledge transmission, decision-making processes, and the cultural logic underlying plant selection for food, trade, and processing. This would be especially valuable for understanding under-documented taxa, specialized preparation techniques, and locally unique fermented or wild-gathered products.

Third, comparative studies across multiple markets within Roi Et Province and adjacent provinces could help assess how geography, ethnicity, and differing land-use histories influence edible plant diversity and utilization patterns. Such comparative frameworks would allow for wider regional generalizations while highlighting localized innovations.

Finally, future work could benefit from interdisciplinary integration—such as linking ethnobotanical data with nutritional analysis, ecological surveys, or socioeconomic assessments—to evaluate the contributions of wild and cultivated plant resources to dietary diversity, food security, and rural livelihoods. This would help illuminate the broader biocultural significance of forest-product markets in contemporary northeastern Thailand.

### Conclusion

This ethnobotanical study of the Nong Muen Than Forest Product Market in Roi Et Province demonstrates the continued vitality of wild and semi-wild edible plants in local food systems. Despite the growing availability of commercial vegetables and the influence of modernized dietary preferences, the market remains an essential space for sustaining traditional ecological knowledge and for maintaining strong cultural connections with surrounding forest, wetland, and agricultural landscapes. The diversity of edible plants recorded at the market—including key culturally important species such as *Oryza sativa*, *Curcuma singularis*, *Citrus × aurantiifolia*, *Carica papaya*, and *Solanum virginianum*—reflects long-standing practices of seasonal gathering and landscape-based food procurement. Many of these species, particularly leafy greens, aquatic vegetables, and aromatic herbs, serve as culinary staples that reinforce regional taste profiles and provide essential micronutrients. Patterns of Relative Frequency of Citation (RFC) highlight the prominence of widely used seasoning plants and multipurpose vegetables, while species with lower RFC values—often strictly seasonal or opportunistically harvested—illustrate the dynamic, availability-driven nature of rural plant use. The strong representation of wild and forest-associated taxa further indicates that the ecological mosaics surrounding Nong Muen Than continue to play a central role in household food security and culinary identity. Overall, the study affirms that traditional ethnobotanical knowledge in Roi Et Province remains resilient and deeply integrated into everyday life. The Nong Muen Than Forest Product Market functions not only as an economic space but also as a reservoir of biocultural heritage. Continued support for sustainable harvesting, market-based livelihood systems, and systematic documentation of edible plant knowledge will be crucial for safeguarding both cultural continuity and the biodiversity that underpins it.

## Declarations

**List of abbreviations:** RFC - Relative Frequency of Citation

**Ethics approval and consent to participate:** All participants provided their informed consent beforehand.

**Consent for publication:** All participants provided informed consent for the publication of anonymized data included in this study.

**Availability of data and materials:** Plant specimens are housed in VMSU.

**Competing interests:** The authors declare that they have no competing interests.

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**Author contributions:** P.S. (Piyaporn Saensouk), S.S., P.S. (Phiphat Sonthongphithak), A.J., K.K., W.S., B.H., and T.J. contributed to the conceptualization, methodology, validation, and writing—review and editing. P.S. (Phiphat Sonthongphithak) and T.J. were responsible for software development and data analysis. T.J. handled data curation, writing of the original draft, visualization, and project administration. P.S. (Piyaporn Saensouk) and S.S. provided supervision. All authors have reviewed, read and endorsed the final article.

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