BIODIVERSITAS
Volume 24, Number 4, April 2023
Pages: 2324-2333

ISSN: 1412-033X
E-ISSN: 2085-4722
DOI: 10.13057/biodiv/d240446

Floristic composition and diversity of indigenous wild food resources in northwestern Cagayan, Philippines

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Manuscript received: 2 February 2023. Revision accepted: 27 April 2023.

Abstract. *Cacatian SB, Tabian JLT. 2023. Floristic composition and diversity of indigenous wild food resources in Northwestern Cagayan, Philippines. Biodiversitas 24: 2324-2333.* The indigenous knowledge of the floristic composition and the species diversity of wild food resources are primary indicators for wildlife management and conservation. The present study surveyed the ethnobotany of the indigenous wild plants, the possible environmental threats, and the traditional conservation practices of the rural people in the remote barangays of Sta. Praxedes, Claveria, Sanchez Mira, Pamplona and Abulug in Northwestern Cagayan, Philippines. The study employed a field-based cross-sectional design. Forty-eight wild plant species belonging to 42 families, mainly Moraceae, Solanaceae, Amaranthaceae and Cucurbitaceae, were harvested for food by the rural communities in the study areas. Among the identified species, trees and perennials were reported to be the most dominant. The most significant proportion grows in the lowland. Fruits and leaves are the most harvested plant parts consumed raw and or cooked. The phenological calendar was developed in relation to the specific months when the edible plant parts are available for harvest within the study sites. Agricultural land expansion or development, overexploitation of wildlife, and excessive rainfall are the greatest threats to plant diversity. Considering the importance of these food resources, the locals primarily keep and protect them from potential threats through harvesting and use of selected plants or plant parts, collecting firewood from dead and fallen trees, and domesticating and cultivating indigenous wild plants.

Keywords: Floristic composition, indigenous wild food resources, northwestern Cagayan, Philippines, plant diversity

INTRODUCTION

Several indigenous societies in many parts of the globe rely on traditional and wild plants as their primary food source to mitigate food insecurity (Lugo-Morin 2020). Wild food plants are primary components of traditional and indigenous food systems that are neither cultivated nor domesticated, but they naturally thrive and reproduce in their natural habitats (Pawera et al. 2020; Ahmed et al. 2022). They are the primary sources of fruits, vegetables, root crops and nuts that are essential to ensure a sufficient food supply for the locals (Heywood 2011). They are commonly found in forests, field margins, grasslands, woodlands and barren lands.

In times of food shortage, indigenous wild flora may be eaten only occasionally and more often by children (Lemke and Delormier 2017) and marginalized groups of society (Kuhnlein and Chotiboriboon 2022). However, amid an extreme scarcity of food, indigenous wild plants may become widely consumed as a supplement to staple food and as emergency food (Duguma 2020). They also play a significant role in the subsistence of many human populations, particularly when family finances are insufficient to buy adequate food or when market access is challenging (Borelli et al. 2020). Thus, using indigenous wild plants is an essential local survival strategy (Berihun and Molla 2017).

Indigenous wild plants offer numerous benefits and are gaining relevance in our society today. They provide essential nutrients and bioactive compounds (Mbhenyane 2017; Punchay et al. 2020). Because of their health-promoting properties, they are frequently regarded as functional foods (Motti 2022). In some cases, they also address the cultural needs and maintain the cultural heritage of the local inhabitants (Durst and Bayasgalanbat 2014). Indigenous wild plants can develop independently using only the energy and materials in the surroundings. They are maintained every growing season and can survive within the year without expensive inputs or intervention from human beings. They can be collected and harvested with no monetary amount expended. Moreover, they are less damaging to the environment because they do not require fertilizers and pesticides.

A number of research studies on indigenous wild plant resources were conducted in some provinces of the Philippines, such as in Ilocos Norte (Antonio et al. 2011), Benguet (Chua-Barcelo 2014), Kalinga Mt. Province (Tombali 2016), Guimaras (Ong and Kim 2017), Southern Palawan (Bernadas and Peralta 2017) and Cebu Island (Rosales et al. 2018). Nonetheless, the purpose and value of indigenous wild plant resources have never been fully explored in Northwestern Cagayan, Philippines. The traditional knowledge, practice, and skill linked with these plants have been neglected, and these wild plants' role in rural livelihoods has yet to be commonly acknowledged (Ashagre et al. 2016).

The dependence of the rural farming communities on conventional plants has kept the practice of eating

indigenous wild plants in Northwestern Cagayan, Philippines. The consumption of these plants is still prevalent in many impoverished communities up to this time. These plants form a significant share in their traditional dishes, particularly during long periods of drought and famine as well as in times of disasters and crises.

Indigenous wild food plants can play an essential role in reducing poverty, ensuring food security, increasing agricultural diversification, generating income and alleviating malnutrition (Ashagre et al. 2016). However, due to the rapid population growth, scarcity of fertile land for cultivation, and high prices of available staple foods, poor people recurrently gather indigenous wild food plants (Abera 2022), disrupting their continuous supply. As natural habitats are also under increased pressure due to development and agricultural expansion, the supply and access to these food sources may also decline (Mbhenyane 2017). This situation could threaten the biodiversity of local plants as some indigenous wild food resources could be selectively conserved and managed by the local inhabitants.

Consequently, this present study aims to document available information about the indigenous wild plant resources in the remote barangays of Northwestern Cagayan, Philippines, that are safe for human consumption, develop a phenological calendar of the availability of all the identified indigenous wild food resources in the area, and determine the possible environmental threats of these edible plants and the conservation measures practiced by the local communities, The findings of the study have the potential to inform conservationists and policymakers to promote effective bio-conservation and management strategies to ensure the continuous availability of these indigenous wild food resources for impoverished families in Northwestern Cagayan, Philippines.

MATERIALS AND METHODS

Research design

The study utilized a field-based cross-sectional design, allowing the researchers to collect data at a specific time. Nonetheless, a reconnaissance survey of the study sites was first conducted to gather valuable information that would help the researchers plan their field data collection.

Site selection

The study was conducted in five study sites in Northwestern Cagayan, Philippines in the municipalities of Sta. Praxedes (18°34' N, 120°59' E), Claveria (18°37' N, 121°5' E), Sanchez Mira (18°34' N, 121°14' E), Pamplona (18°28' N, 121°20' E) and Abulug (18°27' N, 121°27' E) (Figure 1). The composition of municipalities is practically based on their geographic proximities and strategic location. A remote barangay from each municipality was purposely selected based on the availability of indigenous wild food resources as recommended by the key informants.

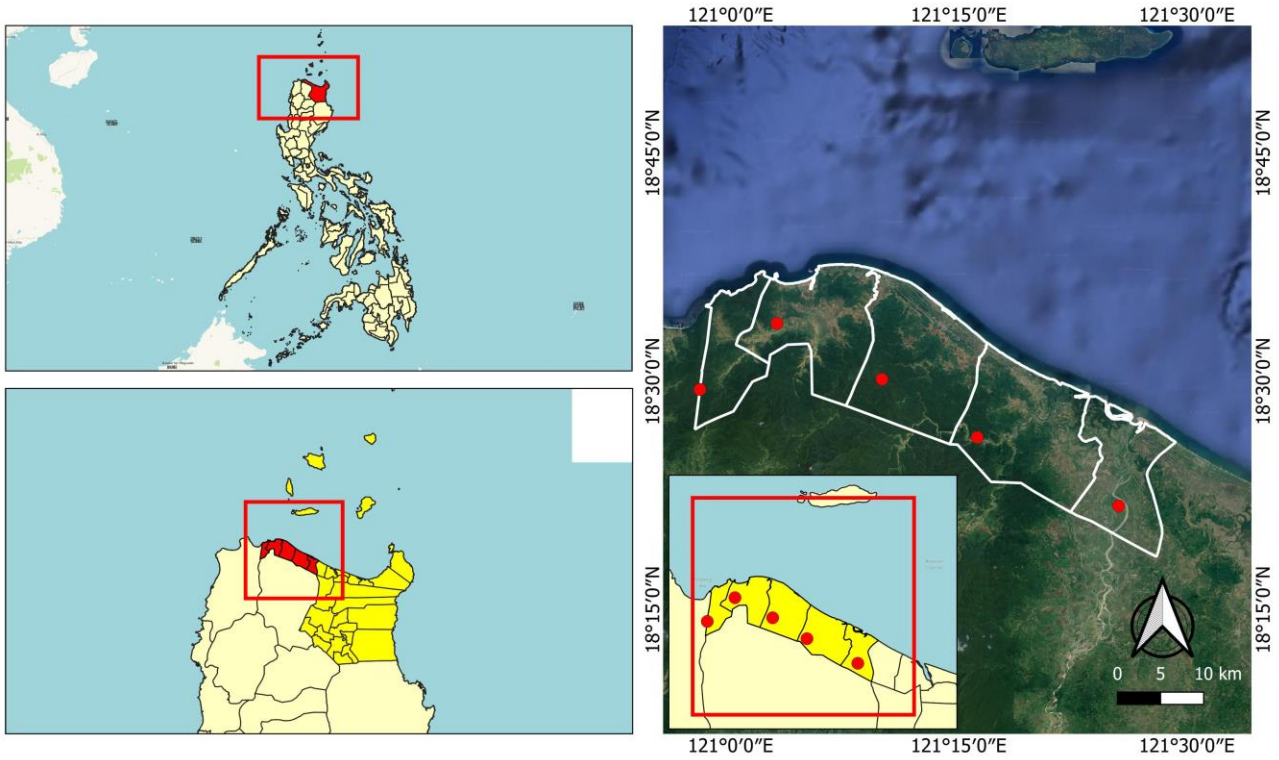

Figure 1. The study sites in Northwestern Cagayan, Philippines

Description of the study area

Geographically, the study sites exemplify a tropical climate. Consequently, it is commonly warm, humid and fairly consistent from year to year. The sites are basically plain except for the hilly and mountainous section at their southern periphery. Due to its topography, Type 1 climate prevails in the five municipalities with two pronounced seasons. It is relatively dry from the early month of March to the later part of August and wet the rest of the year. Rainfall starts in September and continues from February to March. The peak or heaviest amount of precipitation is during the period from the early part of October to the later part of January and moderate rain showers from February to the early part of March.

Northwestern Cagayan has abundant water resources. It is well traversed by many rivers, with Abulug River as the largest in terms of watershed size. Along the northern coast in Sta. Praxedes, Claveria and Sanchez Mira are patches of Miocene bedrock formation of lava flows of basalt-andesite series with pyroclastic. These bedrock foundations are quite expected of the study sites, being located on the Pacific Ocean side of the country.

As far as land cover is concerned, natural forests constitute 47,063.7 hectares. In comparison, per Local Government Unit, the municipality of Sanchez Mira has the biggest portion of the total natural forests, about 33% (15,679.2 hectares). Nevertheless, Abulug has the biggest area covered with inland water and built-up areas totaling 2,666 and 1,329 hectares, respectively.

Basically, Northwestern Cagayan is agricultural whose main agricultural products are rice, corn, coconut, vegetables, and fruits. Rice and corn are the leading commodities. Livestock products include cattle, hogs, carabaos, and poultry. Fishing various species of fish is also undertaken (AgAPIT-BAVA Convergence Area Development Plan, unpublished data of 2019).

Informant selection

Prior to the conduct of the study, permission from the Barangay Officials and community members was sought. Following a grant of permission, the objectives and other critical elements of the study, as well as the involvement of the informants, were properly and honestly communicated with the local communities. Fifty informants, 20 males as well as 30 females, were chosen for this present investigation. The informants were selected purposively based on the following criteria: 22-65 years old, have thorough knowledge about the indigenous wild plant resources found in the sample site and are original inhabitants of the area.

Data gathering procedure

Data were obtained through a semi-structured questionnaire. The closed-ended and open-ended questions were prepared and administered after translating them into the informants' local dialect. Guided field walks, field observation and market surveys were also employed in the study. Informal interviews with local foresters and agriculturists, who happened to explore the areas, as well as parents and barangay officials in the remote barangays, provided the baseline data concerning the presence of indigenous wild food plants in the selected communities. The participants were likewise requested to accompany the researchers as they looked for indigenous wild plants for food.

Taxonomic identification of indigenous wild food resources was made at each study site. The other data gathered were growth form, life span, agro-ecology, abundance, edible plant part and preparation and mode of consumption of the edible plant part. Soon after the pertinent data were gathered, they were compiled and a phenological calendar, representing the period when each plant part is available for harvest, was developed. The possible environmental threats to the plant resources in the area, and the traditional plant conservation practices were likewise determined. Data were thoroughly reviewed with respect to the parameters of the study.

Data analysis

The study used Plants of the World Online (POWO) database, expert determination, dichotomous key, pictorial flora, and taxonomic references (Pelser et al. 2011) to identify plant taxa properly. Using descriptive statistics, the data were efficiently arranged, organized and sorted with reference to the ethnobotany of the indigenous wild plants by means of a spreadsheet. Priority ranking was employed to identify the environmental threats to indigenous wild plant resources, while the Likert scale was used to assess traditional conservation practices.

RESULTS AND DISCUSSION

Floristic composition, growth form, life span and agro-ecology

The study areas have rich floristic composition and have a large number of useful indigenous wild edible plants. The present investigation documented a total of 48 indigenous wild edible plants inhabiting Northwestern Cagayan. A complete list of species with their common, local, scientific and family names is presented in Table 1. These plant resources belong to 42 families and 46 genera. The relatively high number of indigenous wild plant species is attributed to the favorable agro-climatic conditions in the study sites (Cacatian et al. 2013), which permitted plant growth and diversification (Cacatian 2016). Among the recorded taxa, Moraceae and Solanaceae, each with four species and Amaranthaceae and Cucurbitaceae, each with two species, dominate the study sites. The rest of the plant families are represented by a single species. The same result was reported in other local studies about plant resources in the Philippines by and Antonio et al. (2011) and Rosales et al. (2018). According to Rosales et al. (2018), Moraceae exhibited the most significant number of edible wild plants in Cebu Island. On the other hand, Antonio et al. (2011) identified Solanaceae as the leading family represented by five species, followed by Cucurbitaceae, Moraceae, Fabaceae, Dioscoreaceae, and Araceae, each with three species. The Philippines, unlike many other countries, is dominated by one biome, the tropical rainforest. This could be the reason for the similarity of observation.

Table 1. List of reported indigenous wild plant resources with their growth form, lifespan, and agro-ecology

Common name	Local name	Scientific name	Family name	Growth form	Life span	Agro-ecology
Anahaw	Labig	*Saribus merrillii* (Becc.)	Arecaceae	T	P	Hi
Arrowroot	Sagu	*Maranta arundinacea* L.	Marantaceae	H	P	L
Ayo	Ariwat	*Tetrastigma harmandii* Planch.	Vitaceae	C	P	L
Betelnut	Buwa	*Areca catechu* L.	Arecaceae	T	P	L
Birch flower	Alukun	*Brussonetia luzonica* L.	Moraceae	T	P	L
Bitter gourd	Parya bakir	*Momordica charantia* L.	Cucurbitaceae	C	A	L
Breadfruit	Rimas	*Artocarpus altilis* (Parkinson)	Moraceae	T	P	L
Bush passion fruit	Maria-Maria	*Passiflora foetida* L.	Passifloraceae	C	A	L
Canistel	Chesa	*Pouteria campechiana* (Kunth) Baehni	Sapotaceae	T	P	L
Carabao's teats	Allagat	*Uvaria rufa* (Dunal) Blume	Annonaceae	S	P	L
Cavendish banana	Balayang	*Musa balbisiana* Colla	Musaceae	H	P	L
Cayenne pepper	Sili sairu	*Capsicum annuum* L.	Solanaceae	H	A	L
Chammaliang	Dirig	*Lepisanthes fruticose* L.	Sapindaceae	T	P	L
Chinese water spinach	Balangeg	*Ipomea aquatica* Forssk.	Convolvulaceae	Cr	A	L
Climbing fern	Barangbang	*Stenochlaena palustris* (Burm.f.) Bedd.	Blechnaceae	C	P	M
Creeping cucumber	Wild pipino	*Melothria pendula* L.	Curcubitaceae	Cr	A	L
Fiddlehead fern	Pakpaku	*Diplazium esculentum* (Retz.) Sw.	Athyriaceae	H	P	M
Green amaranth	Kulitis	*Amanranthus viridis* L.	Amaranthaceae	H	A	L
Guava	Bayabas	*Psidium guajava* L.	Myrtaceae	T	P	L
Indian almond	Lugu	*Terminalia catappa* L.	Combretaceae	T	P	L
Indian spurge tree	Karimbuaya	*Euphorbia neriifolia* L.	Euphorbiaceae	H	P	L
Katmon	Palali	*Dillenia philippinensis* Rolfe	Dilleniaceae	T	P	L
Los baños	Wild watermelon	*Passiflora foetida* L.	Passifloraceae	C	A	L
Madre de cacao	Kaw - Kawati	*Gliricidia sepium* (Jacq.) Kunth	Fabaceae	T	P	L
Malayan cherry	Mansanita	*Muntingia calabura* L.	Muntingiaceae	S	P	L
Mango pine	Barakbak	*Barringtonia asiatica* L.	Lecythidaceae	T	P	L
Mangrove apple	Kullabban	*Sonneratia alba* Sm.	Lythraceae	T	P	L
Mulberry	Amuras	*Morus alba* L.	Moraceae	T	P	L
Nalta jute	Saluyot	*Corchorus olitirius* L.	Malvaceae	H	A	L
Nipa palm	Tata	*Nypa fruticans* var. neameana F.M.Bailey	Arecaceae	T	P	L
Pandan	Pandan	*Pandanus luzonensis* Merr.	Pandanaceae	T	P	L
Pantug-pantugan	Tultullaki	*Nicandra indica* Roem. & Schult.	Solanaceae	H	A	L
Passion fruit	Miraflor	*Passiflora diaden* Vell.	Passifloraceae	C	P	L
Philippine wild tea	Tsaang Gubat	*Ehretia microphylla* Lam.	Boraginaceae	S	P	L
Scouring leaf	Uplas	*Ficus ulmifolia* Lam.	Moraceae	T	P	L
Silverberry	Bayuyu	*Elaeagnus commutate* L.	Elaeagnaceae	S	P	L
Slender carpetweed	Papait	*Glinus spergula* (L.) Steud.	Aizoaceae	H	A	L
Snake fruit	Arimuran	*Calamus ornatus* Blume	Palmae	C	P	Hi
Spiny amaranth	Kalunay	*Amaranthus spinosus* L.	Amaranthaceae	H	A	L
Taro	Aba	*Colocasia esculenta* L.	Araceae	H	P	L
Thorny bamboo	Bayug	*Bambusa spinosa* Roxb.	Poaceae	G	P	M
Tipolo	Pakak	*Artocarpus blancoi* (Elmer) Merr.	Moraceae	T	P	L
Velvet apple	Mabolo	*Diospyros discolor* Willd.	Ebenaceae	T	P	L
Water chestnut	Buslig	*Eleocharis dulcis* L.	Cyperaceae	H	P	L
Waterleaf	Taltalinu	*Talinum triangulare* L.	Portulacea	H	A	L
White gourd melon	Tangkuy	*Benincasa hispida* (Thunb.) Cogn.	Cucurbitaceae	C	A	L
Wild cherry	Bugnay	*Antidesma bunius* L.	Phyllanthaceae	T	P	L
Wild eggplant	Balballusa	*Solanum undatum* Lam.	Solanaceae	H	A	L

Note: Growth Form: T: tree, S: shrub, H: herb, C: climber, Cr: creeper, G: grass; Life Span: A: annual, B: biennial, P: perennial; Agro-Ecology: Hi: highland, M: midland, L: lowland

The genus *Passiflora* was recorded to have two species. The rest of the genera were represented by a single species. The most commonly harvested plants for their products were trees (40%, n = 19); followed by herbs (29%, n = 14), climbers (17%, n = 8), shrubs (8%, n = 4), creeper (4%, n = 2) and grass (2%, n = 1). Trees, being the dominant growth form, concurs with what was found by Rosales et al. (2018). The resemblances could be attributed to the comparability in climatic and other environmental conditions as well as ecological factors such as climate, topography, and soil type.

In terms of life span analysis of the documented plant resources, findings revealed that perennial plants formed the most significant proportion with 34 or 71%, while annual plants constituted 14 species or 29%. The majority (43 or 90%) of the wild edible plants grew in the lowland,

followed by those that thrived in the midland (3 or 6%) and the highland (2 or 4%). Consideration could be due to the geographical location of the study areas. Northwestern Cagayan province is a vast expanse of plains and valleys (Department of Tourism 2011) which is a low stretch of land mainly occupying the lower basin of the Cagayan River (Cagayan Valley and Northern Philippine Islands 2018).

Phenological calendar of indigenous wild edible plant parts

With the description of the local people and the field observation as a guide, the researchers developed a phenological calendar consisting of the abundance of indigenous wild plants at each of the study sites, the availability of the plant parts, including the preparation and mode of consumption of the edible parts. In all the study areas, a total of 10 wild plants were recorded to be commonly seen. Only (8, 6, 5, and 2) were recorded to be abundantly, frequently, occasionally, and rarely in sight, respectively (Table 2).

Twenty-seven of the plant species are a source of food all year round. These are: anahaw (*Saribus merrillii*), ayo (*Tetrastigma harmandii*), birch flower (*Brussonetia luzonica*), breadfruit (*Artocarpus altilis*), cavendish banana (*Musa balbisiana*), cayenne pepper (*Capsicum annuum*), Chinese water spinach (*Ipomea aquatica*), climbing fern (*Stenochlaena palustris*), creeping cucumber (*Melothria pendula*), fiddlehead fern (*Diplazium esculentum*), green amaranth (*Amanranthus viridis*), guava (*Psidium guajava*), Indian spurge tree (*Euphorbia neriifolia*), katmon (*Dillenia philippinensis*), Los Baños (*Passiflora foetida*), mango pine (*Barringtonia asiatica*), mangrove apple (*Sonneratia alba*), nalta jute (*Corchorus olitirius*), nipa palm (*Nypa fruticans*), pandan (*Pandanus luzonensis*), Philippine wild tea (*Ehretia microphylla*), scouring leaf (*Ficus ulmifolia*), snake fruit (*Calamus ornatus*), taro (*Colocasia esculenta*), thorny bamboo (*Bambusa spinosa*), water leaf (*Talinum triangulare*), and white gourd melon (*Benincasa hispida*). These indigenous wild plants, therefore, play a very significant role in supplying the nutritional requirements of the local community.

The peak period when wild fruits are collected is from April to June, while wild leafy vegetables are from March to May. The months of April to June fall under the summer months in the Philippines, which are characterized by hot and humid weather and low precipitation. This weather condition is ideal for the growth and ripening of various wild fruits, resulting in an abundance of fruits during this period. Further, this denotes that wild fruits that have matured during the dry season are ready for picking, while new fruits are also beginning to emerge. For the case of wild leafy vegetables, March is generally considered a transitional period between the wet and dry seasons in the Philippines. During this period, the weather is usually warm and humid, which is ideal for the growth of green leafy vegetables. This change in weather conditions creates an ideal environment for wild plants to thrive, resulting in an abundance of leafy vegetables.

The dearth period for collecting wild food resources is November to December. During this period, the study sites are already experiencing the peak or heaviest amount of precipitation. This change in weather conditions can impact the growth and availability of many wild plants, resulting in a decrease in the availability of wild food resources. Too much rain can flood fields and hinder plant performance. During the rainy season, the soil can become waterlogged, which can restrict the growth of plant roots and limit their access to nutrients. This can lead to stunted growth or even death of the plants, reducing the yield of wild plant resources. The high humidity and moisture levels during the rainy season can create ideal conditions for the growth of plant diseases and pests, which can damage or kill plants (Velásquez et al. 2018). This can further reduce the yield of wild plant resources. The period of food scarcity, therefore, is most common from November to December.

Twelve edible plant parts were documented. In particular, the frequently eaten parts are fruits (56%, n= 27) and leaves (33%, n= 16) because they are delicious, accessible and can be used for immediate consumption. They are consumed after cooking, or in the case of fruits, they can be eaten raw. Fruits and leaves, being the most commonly eaten plant part, is similar to what was found by Alemayehu (2017), Berihun and Molla (2017) and Abera (2022), which according to them is due to the taste of the fruits. The preference of the informants for fruits and leaves over underground plant parts may also be attributed to the ease of harvesting the parts above ground (Alemayehu 2017). Fruits and leaves are, therefore, an essential part of the diet of the community people in Northwestern Cagayan, Philippines, in times of food plenty and food shortage. Fruits and leaves contain essential vitamins, minerals and dietary fiber that help prolong sensations of fullness and stop overeating.

Regarding mode of consumption, 25 or 52% of the recorded plant resources were eaten uncooked or unprocessed; 23 or 48% were recorded to be cooked, boiled, and/ pickled before consumption. Fruits are the essential produce of the plant which the people in Northwestern Cagayan directly consume as food. The significant proportion of raw edibles is attributed to the nature of the fruits, that they are more beneficial when eaten raw, especially when freshly picked. According to Brookie et al. (2018), the intake of raw fruits provides higher micronutrient levels than processed ones, as the presence of essential micronutrients may easily be lost in the water during processing or cooking. The identified wild fruits consumed raw when ripe are as follows: anahaw (*Saribus merrillii*), bush passion fruit (*Passiflora foetida*), canistel (*Pouteria campechiana*), carabao teats (*Uvaria rufa*), chammaliang (*Lepisanthes fruticose*), guava (*Psidium guajava*), Los Baños (*Passiflora foetida*), Malayan cherry (*Muntingia calabura*), mulberry (*Morus alba*), Philippine wild tea (*Ehretia microphylla*), scouring leaf (*Ficus ulmifolia*), snake fruit (*Calamus ornatus*), velvet apple (*Diospyros discolor*) and wild cherry (*Antidesma bunius*). Others preferred to dip the fruits in vinegar to add a refreshing dash of tartness that balances out the fruit's sweetness or blandness, like the case of creeping cucumber (*Melothria pendula*), katmon (*Dillenia philippinensis*), silverberry (*Elaeagnus commutate*) and wild cherry (*Antidesma bunius*).

Table 2. Phenological calendar of indigenous wild edible plant parts in the study sites

Common name	Local name	Scientific name	Plant abundance					Availability of plant part												Edible part (s)	Preparation and mode of consumption
			Sta. Praxedes.	Claveria	Sanchez Mira	Pamplona	Abulug	J	F	M	A	M	J	J	A	S	O	N	D		
Anahaw	Labig	*Saribus merrillii* (Becc)	Ab	Ab	Ab	Ab	Ab													Fruit	Ripe fruit is eaten raw.
																				Ubod	Ubod is eaten when cooked or raw, dressed with fish sauce and lime juice.
Arrowroot	Sagu	*Maranta arundinacea* L.	F	Oc	F	F	Oc													Rhizome	Rhizome is eaten when boiled.
Ayo	Ariwat	*Tetrastigma harmandii* Planch.	F	F	F	F	F													Leaves, stem	Young leaves and stems are eaten when cooked.
Betelnut	Buwa	*Areca catechu* L.	Ab	Ab	Ab	Ab	Ab													Fruit	Ripe fruit is eaten raw.
Birch flower	Alukun	*Brussonetia luzonica* L.	O	O	Co	Co	O													Leaves	Young leaves are eaten when cooked.
																				Flower spikes	Flower spikes are eaten when cooked.
Bitter gourd	Parya bakir	*Momordica charantia* L.	Co	Co	Co	Co	Co													Leaves	Leaves are eaten when cooked.
																				Fruit	Fruit is eaten when cooked.
Breadfruit	Rimas	*Artocarpus altilis* (Parkinson)	F	F	Co	F	O													Fruit	Fruit is eaten when cooked.
Bush passion fruit	Maria - Maria	*Passiflora foetida* L.	O	O	O	O	O													Fruit	Ripe fruit is eaten raw.
Canistel	Chesa	*Pouteria campechiana* (Kunth) Baehni	F	O	F	O	O													Fruit	Ripe fruit is eaten raw.
Carabao's teats	Allagat	*Uvaria rufa* (Dunal) Blume	Co	Co	Co	Co	Co													Fruit	Ripe fruit is eaten raw.
Cavendish banana	Balayang	*Musa balbisiana* Colla	F	Co	Co	F	Co													Fruit	Sliced unripe fruit is pickled before eating.
Cayenne pepper	Sili sairu	*Capsicum annuum* L.	Co	Co	Co	Co	Co													Fruit	Fruit is eaten when cooked. It can also be eaten raw as an appetizer.
Chammaliang	Dirig	*Lepisanthes fruticose* L.	R	R	R	R	R													Fruit	Ripe fruit is eaten raw.
Chinese water spinach	Balangeg	*Ipomea aquatica* Forssk.	Ab	Ab	Ab	Ab	Ab													Leaves, stem	Young leaves and stems are eaten when cooked. It can also be pickled when the stem and leaves are cut into small portions.
Climbing fern	Barangbang	*Stenochlaena palustris* (Burm.f.) Bedd.	Co	Co	Co	Co	O													Leaves	Young leaves are eaten when cooked. It can also be prepared as a salad.
Creeping cucumber	Wild pipino	*Melothria pendula* L.	Ab	Ab	Ab	Ab	Ab													Fruit	Fruit is eaten raw.
Fiddlehead fern	Pakpaku	*Diplazium esculentum* (Retz.) Sw.	Ab	Ab	Ab	Ab	Ab													Fiddle Heads	Fiddleheads are eaten raw or cooked.
Green amaranth	Kulitis	*Amanranthus viridis* L.	Ab	Ab	Ab	Ab	Ab													Leaves, stem	Young leaves and stems are eaten when cooked.
Guava	Bayabas	*Psidium guajava* L.	Ab	Co	Co	Co	Ab													Fruit	Ripe fruit is eaten raw. It can also be processed as jelly or jam.
Indian almond	Lugu	*Terminalia catappa* L.	Co	F	F	F	Co													Seed	Seed from the dried fruit is eaten raw.
Indian spurge tree	Karimbuaya	*Euphorbia neriifolia* L.	O	O	O	O	O													Leaves	Leaves are stuff for lechon and stuffed fish

Katmon	Palali	*Dillenia philippinensis* Rolfe	Co	Co	Co	Co	Co	Fruit	Fruit is used as a souring agent in sinigang (stew). It can also be eaten raw.
								Flower	The flower is eaten raw or cooked.
Los baños	Wild watermelon	*Passiflora foetida* L.	Co	Co	Co	Co	Co	Fruit	Ripe fruit is eaten raw.
Madre de cacao	Kaw- Kawati	*Gliricidia sepium* (Jacq.) Kunth	Co	Co	Co	Co	Co	Flower	Young flower is eaten when cooked.
Malayan cherry	Mansanita	*Muntingia calabura* L.	O	O	O	O	O	Fruit	Fruit is eaten raw.
Mango pine	Barakbak	*Barringtonia asiatica* L.	F	O	O	F	F	Leaves, stem	Young leaves and stems are eaten when cooked
Mangrove apple	Kullabban	*Sonneratia alba* Sm.	F	F	F	F	F	Fruit	Ripe fruit juice is used as a souring agent for fish delicacies.
								Leaves	Leaves are eaten raw or cooked.
Mulberry	Amuras	*Morus alba* L.	O	Co	O	O	O	Fruit	Ripe fruit is eaten raw.
Nalta jute	Saluyot	*Corchorus olitirius* L.	Co	Ab	Ab	Co	Co	Leaves, stem	Young leaves and stems are eaten when cooked
Nipa palm	Tata	*Nypa fruticans* var. neameana F.M.Bailey	O	Co	Co	Co	Co	Flower stalk	Young flower stalk is crushed to obtain water
								Fruit (meat)	The nipa palm meat is eaten raw.
Pandan	Pandan	*Pandanus luzonensis* Merr.	Co	Co	Co	Co	Co	Leaves	Leaves are boiled, juiced, or used to wrap and flavor meats and rice.
Pantug-pantugan	Tultullaki	*Nicandra indica* Roem. & Schult.	F	F	F	F	F	Fruit	Fruit is eaten when cooked.
Passion fruit	Miraflor	*Passiflora diaden* Vell.	F	F	F	F	F	Pulp, seed	Pulp and seeds are eaten raw.
Philippine wild tea	Tsaang Gubat	*Ehretia microphylla* Lam.	Co	Co	Co	Co	Co	Leaves	Leaves are made into tea.
								Fruit	Ripe fruit is eaten raw.
Scouring leaf	Uplas	*Ficus ulmifolia* Lam.	R	R	R	R	R	Fruit	Ripe fruit is eaten raw.
Silverberry	Bayuyu	*Elaeagnus commutate* L.	O	Co	O	O	O	Fruit	Ripe fruit is eaten raw. It can also be eaten with vinegar and salt as a condiment.
Slender carpetweed	Papait	*Glinus spergula* (L.) Steud.	Co	Co	Co	Co	Co	Leaves, stem	Leaves and stems are eaten raw or cooked
Snake fruit	Arimuran	*Calamus ornatus* Blume	O	O	O	O	R	Fruit	Ripe fruit is eaten raw.
								Ubod (heart of palm)	Ubod is eaten when cooked or raw, dressed with fish sauce and lime juice.
Spiny amaranth	Kalunay	*Amaranthus spinosus* L.	Co	Co	Co	Co	Co	Leaves, stem	Young leaves and stems are eaten when cooked
Taro	Aba	*Colocasia esculenta* L.	Co	Ab	Ab	Ab	Co	Leaves, stem, corm	Identified plant parts are eaten when cooked
Thorny bamboo	Bayug	*Bambusa spinosa* Roxb.	Ab	Ab	Ab	Ab	Ab	Shoot	Shoot can be eaten when cooked. It is commonly used as an ingredient in a fresh spring roll.
Tipolo	Pakak	*Artocarpus blancoi* (Elmer) Merr.	F	F	F	F	F	Fruit	Fruit is eaten when cooked.
Velvet apple	Mabolo	*Diospyros discolor* Willd.	F	F	F	F	F	Fruit	Fleshy part of the ripe fruit is eaten raw.
Water chestnut	Buslig	*Eleocharis dulcis* L.	O	O	O	O	O	Corm	Corm can be eaten after being boiled or roasted
Waterleaf	Taltalinu	*Talinum triangulare* L.	Ab	Ab	Ab	Ab	Ab	Leaves, stem	Young leaves and stems are eaten when cooked
White gourd melon	Tangkuy	*Benincasa hispida* (Thunb.) Cogn.	O	O	O	O	O	Fruit	Fruit is eaten when cooked.
Wild cherry	Bugnay	*Antidesma bunius* L.	Ab	Ab	Ab	Ab	Ab	Fruit	Ripe fruit is eaten raw. It can also be eaten with vinegar and salt as a condiment.
Wild eggplant	Balballusa	*Solanum undatum* Lam.	F	O	O	O	F	Fruit	Fruit is eaten when cooked.

Note: Abundance: Ab: abundant, Co: common, F: frequent, O: occasional, R: rare

Leaves | Leaves, Stem | Leaves, Stem, Corm | Fruit | Rhizome | Flower | Flower Spikes | Fiddlehead | Seed | Flower Stalk | Pulp, Seed | Ubod | Corm | Shoot

Some locals resort to the rhizome of arrowroot (*Maranta arundinacea*), the fruit breadfruit (*Artocarpus altilis*) and the corm of taro (*Colocasia esculenta*) when there is a shortage in the supply of rice. The informants reported that the consumption of these starchy foods is a healthy and tasty alternative to rice because these foods help them feel more satisfied and fuller.

Leaves, stems, bulbs, tubers and flowers of the other reported wild plants are eaten as vegetables. The vegetables are usually consumed as stews or boiled. This is expected because most of the traditional dishes in Northwestern Cagayan are *inabraw* (soup-based dish), *pinakbet* (a medley of vegetables and shrimp paste), and *kinilnat* (vegetable salad). Conventional *food dishes from wild* vegetables are prepared without using cooking oil (Deb et al. 2013). The key informants likewise disclosed that most of these recipes are made extra delicious using *bagoong* (fish sauce) or *shrimp paste.*

Environmental threat

To identify the knowledge of the local communities on the factors affecting the abundance of indigenous plant resources, the key informants assessed the current and potential threats through ranking (Table 3). Agricultural land expansion or development was found to be the most threatening factor. The result of the survey of Berihun and Molla (2017) concerning the diversity and use of wild edible plants in Aygal Mozanbus and Azemna Bansh villages in Bullen District, Northwestern Ethiopia, displayed a similar pattern to the perceptions of the local communities on the drivers of the decreased abundance of food resources in the wild. The result is a direct consequence of the increasing demand for food and energy requirements due to continuing growth of the human population. People clear land for farming to produce food, grazing to feed livestock, and urbanization to make room for infrastructural development.

Ranked second was the overexploitation of wildlife. Locals unsustainably gather wild populations threatening their continued survival. They heavily gather some plants even if they are out of season and sell them at a high price. During harvesting season, everyone is in a *rush* to collect those items that command high prices even before maturing. They seem to practice the idiom, "First come, first served." They can hardly wait for the plant to mature because if they do not gather them yet, others will gather them and eventually run out.

Moreover, excessive rainfall was noted to be the third threat. Northwestern Cagayan frequently experiences tropical cyclones as a consequence of its geographical location, which generally produces torrential rains. During the rainy season, heavy downpour triggers flooding to low-lying areas in Claveria as well as Abulug and Ballesteros, thereby causing extensive damage to plants. Also, strong winds result in the destruction of crops.

Traditional plant conservation practices

Currently, most rural people in Northwestern Cagayan depend largely on plant resources to meet their livelihood needs. The findings indicate that rural people practice, to a large extent, the conventional way of protecting and conserving plants (Table 4). Of the eight indigenous conservation practices, five are practised to a very high extent. However, harvesting and use of selected plants or certain plant parts ($\bar{x}$=3.87), collecting firewood from dead and fallen trees ($\bar{x}$=3.39), and domesticating and cultivating indigenous wild plants ($\bar{x}$=3.63) obtained the three highest mean scores. The findings indicate that they were observed more evidently in the study areas than in the other practices.

Table 3. Environmental threats identified by the key informants

Environmental Threat	Raw Score	Rank
Deforestation (clearing or thinning of forest and converting it to non-forest use)	231	5
Pollution (contaminating the land, air and water beyond its regenerative capacity)	262	6
Excessive rainfall (flooding resulting in the damage of grasslands, seedlings and other crops)	205	3
Invasion of non-native species (introducing unnatural species that can imminently cause serious injury, harm or even death to the species indigenous to the community)	304	7
Agricultural land expansion or development (clearing of land for farming, grazing, mining, drilling, and urbanization)	138	1
Habitat loss (thinning, fragmenting, destroying or altering the conditions necessary for wild plants to survive)	397	10
Overexploitation (overharvesting living resources at rates faster than they can repopulate themselves in the wild)	159	2
Fuelwood collection (continuous collecting of wood for fuel resulting in the gradual degradation and eventual deforestation of accessible areas)	373	9
Road construction and expansion (converting natural habitats to the pavement, dirt tracks, and cleared roadsides or rights-of-way resulting in loss of wildlife habitat)	226	4
Climate change (the global phenomenon of climate transformation characterized by the changes in temperature, precipitation, wind patterns and other measures of climate causing the planet's ecosystem to be under threat)	448	11
Forest conversion (clearing of natural forests for residential and other infrastructure development)	319	8

Table 4. Traditional plant conservation practices of the key informants

Traditional Plant Conservation Practices	Mean	Descriptive value	Transposed value
Using local energy-saving stoves	2.61	Agree	High extent of practice
Conserving sacred groves/forests	2.52	Agree	High extent of practice
Controlling invasive plant species	3.02	Agree	High extent of practice
Selective harvesting of plant parts	3.87	Strongly agree	Very high extent of practice
Protecting plants at the burial sites	2.68	Agree	High Extent of Practice
Collecting only dead and fallen wood for fuel	3.39	Strongly agree	Very high extent of practice
Domesticating and cultivating indigenous plants	3.63	Strongly agree	Very high extent of practice
Harvesting plant resources only during peak season	3.26	Strongly agree	Very high extent of practice
Keeping the name, location, and use of plants a secret	2.95	Agree	High Extent of Practice
Restricting/providing a particular season for harvesting the plant species	3.13	Agree	High Extent of Practice
Organic farming or avoiding the use of synthetic fertilizers, pesticides, and herbicides	3.09	Agree	High Extent of Practice
Harvesting only the leaves, fruits, flowers, or buds but not the root and whole plant	3.28	Strongly agree	Very high extent of practice
Overall mean	**3.12**	**Agree**	**High extent of practice**

In the study by Patel (2021), selective harvesting of plant parts has played a vital role in conserving native plant resources in the community. Trees are felled to produce firewood for use in homes. People in the community prefer to collect woody debris straight from the wild as a means of resource conservation. Besides, by selectively harvesting fruits and leaves, the plant can continue to produce food and potentially reproduce, which can contribute to the maintenance of biodiversity.

Domesticating and cultivating indigenous plants are viewed as necessary for the practice of conservation. Plants that have undergone genetic alteration as a result of domestication are not well adapted to their natural habitat, but they are best fit for human management (Clement et al. 2021). Only the indigenous food resources, which are needed most by the locals, are usually brought home.

The overall mean of 3.12 reveals that there is a great extent of practice in employing traditional plant conservation practices. This implies that the community is aware that these wild plant resources may only vanish if given thorough protection.

In conclusion, northwestern Cagayan, Philippines, is endowed with rich and diverse indigenous wild food plants that support the needs of the local populations. Despite limited written records, the locals have extensive awareness of the folkloric uses of the plants. The identified wild plants are consumed as food by the local inhabitants. A phenological calendar, consisting of the period when the edible parts of the indigenous wild plants are available for harvest, provides an idea of what is ready for consumption throughout the year. Agricultural land expansion or development, overexploitation of wildlife and excessive rainfall are the major factors threatening wild plant species with extinction. Considering these plants as a supplement to staple food and serve as emergency food, the locals mainly conserve them through selective harvesting, collecting dead wood for firewood and domesticating plants.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the Cagayan State University, Philippines, for providing financial support for this study.

REFERENCES

Abera M. 2022. Ethnobotanical study of wild edible plants and their indigenous knowledge in Sedie Muja District, South Gondar Zone, Northwestern Ethiopia. Am J Plant Sci 13 (2): 24-264. DOI: 10.4236/ajps.2022.132015.

AgAPIT-BAVA Convergence Area Development Plan. 2019. (Documentary survey). (Unpublished raw data). Region II Convergence initiative for Sustainable Rural Development.

Ahmed S, Warne T, Stewart A, Shanks CB, Dupuis V. 2022. Role of wild food environments for cultural identity, food security, and dietary quality in a Rural American State. Front Sustain Food Syst 6: 1-21. DOI: 10.3389/fsufs.2022.774701.

Alemayehu G. 2017. Plant Diversity and Ethnobotany of Medicinal and Wild Edible Plants of Amaro District of Southern Nations, Nationalities and Peoples Region and Gelana District of Oromia Region, Southern Ethiopia. [PhD Dissertation]. Addis Ababa University, Addis Ababa. [Ethiopia]

Antonio MA, Utrera RT, Agustin EO, Jamias DL, Badar AJ, Pascua ME. 2011. Survey and characterization of indigenous food plants in Ilocos Norte, Philippines. SEARCA Agriculture and Development Discussion Paper Series Vol. 2011 (2): 1-61.

Ashagre M, Asfaw Z, Kelbessa E. 2016. Ethnobotanical study of wild edible plants in Burji District, Segan Area Zone of Southern Nations, Nationalities and Peoples Region (SNNPR), Ethiopia. J Ethnobiol Ethnomed 12: 32. DOI: 10.1186/s13002-016-0103-1.

Berihun T, Molla E. 2017. Study on the diversity and use of wild edible plants in Bullen District Northwest Ethiopia. J Bot 2017 (2): 1-10. DOI: 10.1155/2017/8383468.

Bernadas Jr CN, Peralta MD. 2017. Indigenous crops and wild plants used as food by the Pala'wan Tribe in Southern Palawan, Philippines. J Nat Stud 16 (1): 11-17.

Borelli T, Hunter D, Powell B, Ulian T, Mattana E, Termote C, Pawera L, Beltrame D, Penafiel D, Tan A, Taylor M, Engels J. 2020. Born to eat wild: An integrated conservation approach to secure wild food plants for food security and nutrition. Plants 9 (10): 1299. DOI: 10.3390/plants9101299.

Brookie KL, Best GI, Conner TS. 2018. Intake of raw fruits and vegetables is associated with better mental health than intake of processed fruits and vegetables. Front Psychol 487. DOI: 10.3389/fpsyg.2018.00487.

Cacatian SB, Pacris Jr. FA, Garan LM. 2013. Floral phenology of bee pasture plants in Northwestern Cagayan (Phase 1). IAMURE Intl J Ecol Conserv 7 (1): 125-45. DOI: 10.7718/ijec.v7i1.731.

Cacatian SB. 2016. Melliferous resources for bee forage. Recoletos Multidiscip Res J 4 (1): 15-33. DOI: 10.32871/rmrj1604.01.02.

Cagayan Valley and Northern Philippine Islands. 2018. About Cagayan Province. www.region2fun.ph/cagayan-province/

Chua-Barcelo RT. 2014. Ethnobotanical survey of edible wild fruits in Benguet, Cordillera administrative region, the Philippines. Asian Pacific J Trop Biomed 4 (Suppl 1): S525-38. DOI: 10.12980/APJTB.4.201414B36.

Clement CR, Casas A, Parra-Rondinel FA, Levis C, Peroni N, Hanazaki N, Cortés-Zárraga L, Rangel-Landa S, Alves RP, Ferreira MJ, Cassino MF, Coelho SD, Cruz-Soriano A, Pancorbo-Olivera M, Blancas J, Martínez-Ballesté A, Lemes G, Lotero-Velásquez E, Bertin VM, Mazzochini GG. 2021. Disentangling domestication from food production systems in the Neotropics. Quaternary 4 (1): 4. DOI: 10.3390/quat4010004.

Deb D, Sarkar A, Barma BD, Datta BK, Majumdar K. 2013. Wild edible plants and their utilization in traditional recipes of Tripura, Northeast India. Adv Biol Res 7 (5): 203-211. DOI: 10.5829/idosi.abr.2013.7.5.11895.

Department of Tourism. 2011. Cagayan. www.visitmyphilippines.com/index_title_Cagayan_func_all_pid_420_tbl_0.html

Duguma HT. 2020. Wild edible plant nutritional contribution and consumer perception in Ethiopia. Intl J Food Sci. DOI: 10.1155/2020/2958623.

Durst PB, Bayasgalanbat N. 2014. Promotion of Underutilized Indigenous Food Resources for Food Security and Nutrition in Asia and the Pacific. FAO, 2014.

Heywood VH. 2011. Ethnopharmacology, food production, nutrition and biodiversity conservation: towards a sustainable future for indigenous peoples. J Ethnopharmacol 137 (1): 1-15. DOI: 10.1016/j.jep.2011.05.027.

Kuhnlein HV, Chotiboriboon S. 2022. Why and how to strengthen indigenous peoples' food systems with examples from two unique indigenous communities. Front Sustain Food Syst 6. DOI: 10.3389/fsufs.2022.808670.

Lemke S, Delormier T. 2017. Indigenous Peoples' food systems, nutrition, and gender: Conceptual and methodological considerations. Mater Child Nutr 13 (S3): e12499. DOI: 10.1111/mcn.12499.

Lugo-Morin D. 2020. Indigenous communities and their food systems: A contribution to the current debate. J Ethn Foods 7 (6): 1-10. DOI: 10.1186/s42779-019-0043-1.

Mbhenyane XG. 2017. Indigenous foods and their contribution to nutrient requirements. South African J Clin Nutr 30 (4): 5-7.

Motti R. 2022. Wild edible plants: A challenge for future diet and health. Plants 11 (3): 344. DOI: 10.3390/plants11030344.

Ong HG, Kim YD. 2017. The role of wild edible plants in household food security among transitioning hunter-gatherers: Evidence from the Philippines. Food Secur 9 (1): 11-24. DOI: 10.1007/s12571-016-0630-6.

Patel BDP. 2021. Conservation, cultivation and sustainable utilization of lesser-known plants in Nepal. In: Tomar A, Singh S (eds.). Lesser Known Plants: Conservation, Management and Utilization. walnutpublication.com

Pawera L, Khomsan A, Zuhud EAM, Hunter D, Ickowitz A, Polesny Z. 2020. Wild food plants and trends in their use: From knowledge and perceptions to drivers of change in West Sumatra, Indonesia. Foods 9 (9): 1240. DOI: 10.3390/foods9091240.

Pelser PB, Barcelona JF, Nickrent DL (eds). 2011. Co's digital flora of the Philippines. www.philippineplants.org

Punchay K, Inta A, Tiansawat P, Balslev H, Wangpakapattanawong P. 2020. Nutrient and mineral compositions of wild leafy vegetables of the Karen and Lawa communities in Thailand. Foods 9 (12): 1748. DOI: 10.3390/foods9121748.

Rosales ER, Casio CR, Amistad VR, Polo CML, Dugaduga KDB, Picardal JP. 2018. Floristic inventory and ethnobotany of wild edible plants in Cebu Island, Philippines. Asian J Biodivers 9 (1): 90-114. DOI: 10.7828/ajob.v9i1.1236.

Tombali MS. 2016. The Documentation of wild fruit in Kalinga. Intl J Adv Res Manag Soc Sci 5 (3): 114-128.

Velásquez AC, Castroverde CD, He SY. 2018. Plant–pathogen warfare under changing climate conditions. Curr Biol 28 (10). DOI: 10.1016/j.cub.2018.03.054.