ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 17, Issue, 04, pp.32569-32575, April, 2025
DOI: https://doi.org/10.24941/ijcr.48704.04.2025

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

REVIEW ARTICLE

ASSESSMENT OF DIVERSITY AND ASSOCIATED INDIGENOUS KNOWLEDGE OF WILD EDIBLE BERRIES IN NEMBE LOCAL GOVERNMENT AREA, BAYELSA STATE

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ARTICLE INFO

Article History:
Received 20th January, 2025
Received in revised form
19th February, 2025
Accepted 26th March, 2025
Published online 30th April, 2025

Key words:

Wild edible plants, Berries, Indigenous knowledge, Food security, Conservation, Ethnobotany.

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ABSTRACT

Wild edible plants, particularly berries, offer a potential solution to nutritional problems, providing rich sources of nutrients, vitamins, and nutraceuticals while requiring minimal environmental impact. The study focused on the documentation of the diversity of wild edible berries and the indigenous knowledge of the species in Nembe Local Government Area (LGA), Bayelsa State, Nigeria a region rich in biodiversity but increasingly threatened by environmental degradation from oil exploration and urbanization. Fieldwork conducted across seven communities in study area identified fourteen (14) wild berry species distributed across 10 families. These species have historically played a vital role in local diets, cultural practices, and traditional medicine. However, findings revealed significant decline in both the consumption of these berries and the transmission of related indigenous knowledge, posing a risk to the conservation of these species. The impact of forest degradation and indiscriminate harvesting leading the loss of the plant genetic resources as well as indigenous knowledge is highlighted. Also, crucial is the urgent need for strategies to preserve and sustainably utilize these genetic resources and exploration of cultivation techniques to overcome the constraints on these valuable resources.

Citation: Eneni Roberts Inala and Nengimote Eremiemi Ipogi, 2025. *"Assessment of diversity and associated indigenous knowledge of wild edible berries in nembe local government area, bayelsa state". International Journal of Current Research, 17, (04), 32569-32575.*

INTRODUCTION

Food and nutritional security face significant challenges due to rapid population growth and the impacts of climate change. Globally, there is growing interest in wild plants due to their widespread cultural suitability and economic potential (Aziz *et al*, 2024). Wild edible plants are plants species that are not yet cultivated or domesticated but collected from the natural or semi-environment and used as food source (Ju *et al*, 2024). Historically, wild edible plants have been a tradition and an important part of human diet and nutrition (Walsh, 2009). They have also been used as important element in tourism (Korzh, 2022). They constitute a rich reservoir of nutrients that contribute to reducing undernourishment in households (Atungbou 2020; Duguma, 2020) and human survival in many countries (Pironi *et al*, 2007,; FAO, 2019) especially in lean years (Alebel and Mohammed, 2021). In many cultures around the world, edible wild plants hold significant cultural and symbolic value often featuring prominently in traditional cuisines, rituals, and ceremonies (Coe and Gaoue 2020, Ghanbari *et al*., 2022). For indigenous communities, wild fruits are not only a source of sustenance but also a connection to ancestral lands and traditions, carrying stories and memories passed down through generation (Migicovsky *et al*, 2022; Iannotti *et al*, 2024). They are often celebrated across diverse cultures and ethnicities for their unique flavors, textures, and aromas, inspiring culinary creativity and innovation. Their versatility and culinary appeal makes the useful in a variety of culinary applications, from jams and preserves to pies and desserts (Kallas, 2010). However, they are underreported and underrepresented in ex-situ and in-situ collections, conservation strategies and risk being threatened or extinct (Kumar *et al*., 2023, Tripathi, 2024)**.** Wild edible berries are safe, tasty and versatile foods traditionally consumed by local folks (Aguilera and Toledo 2024). They span across a wide array of ecosystem and have been utilized by many generations for medicinal and nutritional purpose. They are valuable as source of food for both human and primates providing vitamins, minerals, nutraceuticals, soluble sugars, dietary fiber; and are advocated to be a minor burden on the environment (Nilsson, 2018; Smith *et al.,* 2019, Wan *et al.,* 2023). Also, multiple health benefits have been associated with their components including the prevention of chronic disease, loss of weight, anti-diabetic properties etc. (Vincente *et al*, 2014; Tahir *et al.,* 2023, Aguilera and Toledo 2024). Recently, several studies have documented their importance as well as the status of the current knowledge of the utilization of wild edible berries in many parts of the world (Migicovsky *et al*, 2022; Wan *et al.,* 2023). As these resources have special roles and meaning for many indigenous communities, especially for those communities that their food systems and practices rely

heavily on resources from the wild (Krozh, 2023). However, unfortunately today due to the development of modern agriculture, urbanization and globalization the population are becoming more and more distant from their environment (Turner and Turner, 2008; Corlett 2016) resulting to gradually changing diets of rural people, as well as erosion wild edible plants and their knowledge (Ojelel *et al*, 2019). Moreover, the transmission of knowledge between older and younger is not always assured (Ages *et al.,* 2011; Hopkins *et al,* 2015). In order to conserve plant genetic resources and prevent genetic erosion of agro-biodiversity the first priority is understand and document wild relatives as well as to assess threats to their natural habitats and determine gaps in their conservation (Khoury et al., 2019). Additionally, in the face of global challenges such as climate change, habitat loss, and food insecurity; the conservation and utilization of edible wild berries offer promising opportunities for building more sustainable food systems. These genetic resources could play an important role in achieving the sustainable development goal of combating hidden hunger as well as improve livelihoods (Bellows *et al.,* 2023). Additionally, by integrating wild fruits into agricultural practices traditional communities can diversify their diets reduce reliance on monoculture crops and enhance food security (Aguilera and Toledo, 2022).

Like many parts of the oil rich Niger Delta, Nembe LGA is comprises coastal barrier islands and is endowed with luxuriant and unique floral assemblage that remains one of the mostly poorly surveyed. Hitherto, the area was lightly populated and has been relatively protected due to inaccessibility. However, with the discovery of crude oil in commercial quantities and urbanization, most of the areas the forest have been encroached upon resulting in severe degradation and depletion of genetic resources. Despite this, studies on the ethnobotany and associated indigenous knowledge on the wild edible plants species remains meagre in the area. Therefore, the study focused on the documentation of the taxonomic diversity of wild berry species and the indigenous knowledge of the species in Nembe L.G.A.

MATERIALS AND METHODS

The Study Area and Its People: The study area is Nembe L.G.A, Bayelsa state, Nigeria (4º 32 ' 12.85 " N 6º 24 ' 22.36 " E). It is in eastern part of the central Niger Delta and forms part of the Edumanom National Forest Reserve which is home to a variety of wild edible plants and resources that have contributed to the development process. The area is renowned for its rich cultural heritage, natural beauty, and strategic importance within the Niger Delta region. Nembe is situated on lowland flood plains, with elevations between 3m and 7m above sea level. There are two well marked seasons, the rainy season (April to October) and dry season (November to March). The temperature is 25°C - 31°C annually. Relative humidity is high throughout the year, with a slight decrease during the dry season. The area's geography has shaped the traditional lifestyle and cultural practices of the Nembe people. The people have a notable oral tradition and unique diet in food choice and lifestyle; which preserves stories, myths, and folklore that are passed down through generations.

Data Collection: Semi-structured interviews and participants' observation were conducted with 50 respondents to obtain plant data from eight communities: Otatubu, Igopiri, Biantubu, Okparantaba, Etiema, Okipiri, Oromabiri and Bassambiri town. Field visits were conducted from November 2023 – July 2024 to collect wild berries throughout their distribution ranges in the study area with the aid of local guides and indigenous knowledge holders. Data on plants abundance was determined based on on-site assessment, market surveys within the environment and information provided by participants during visits.

The plants were identified according to vernacular names and subsequently identified by Latin names with the help of taxonomic literatures, plant identification apps and plants online database. The taxonomic identities of the plants were verified by a taxonomist in the Department of Biology, Federal University Otuoke. Voucher specimens were deposited at the Federal University Otuoke Herbarium.

RESULTS

Demographic profile of informants: A total of fifty (50) respondents were interviewed. The socioeconomic status of the respondents is presented in Table 1. The predominant age range of the respondents is between 30 and 65 years. A significant number of respondents are involved in agricultural businesses, and Christianity is the main religion practiced by the local inhabitants.

Table 1. Demographic Characteristics of Respondents in the Study Area

S/N	Variables	Criteria	Frequency
1	**Location**	Onshore	40
		Offshore	10
2	**Gender**	Male	28
		Female	22
3	**Age**	20 – 30	8
		31 – 60	26
		60 and above	16
4	**Literacy Status**	Literate	20
		Illiterate	30
5	**Economic status**	Small	22
		Medium	20
		Large	8
6	**Occupation**	Farming	10
		Fishing	18
		Civil servant	8
		Others	14
7	**Religion**	Christianity	40
		Islam	-
		Others	10

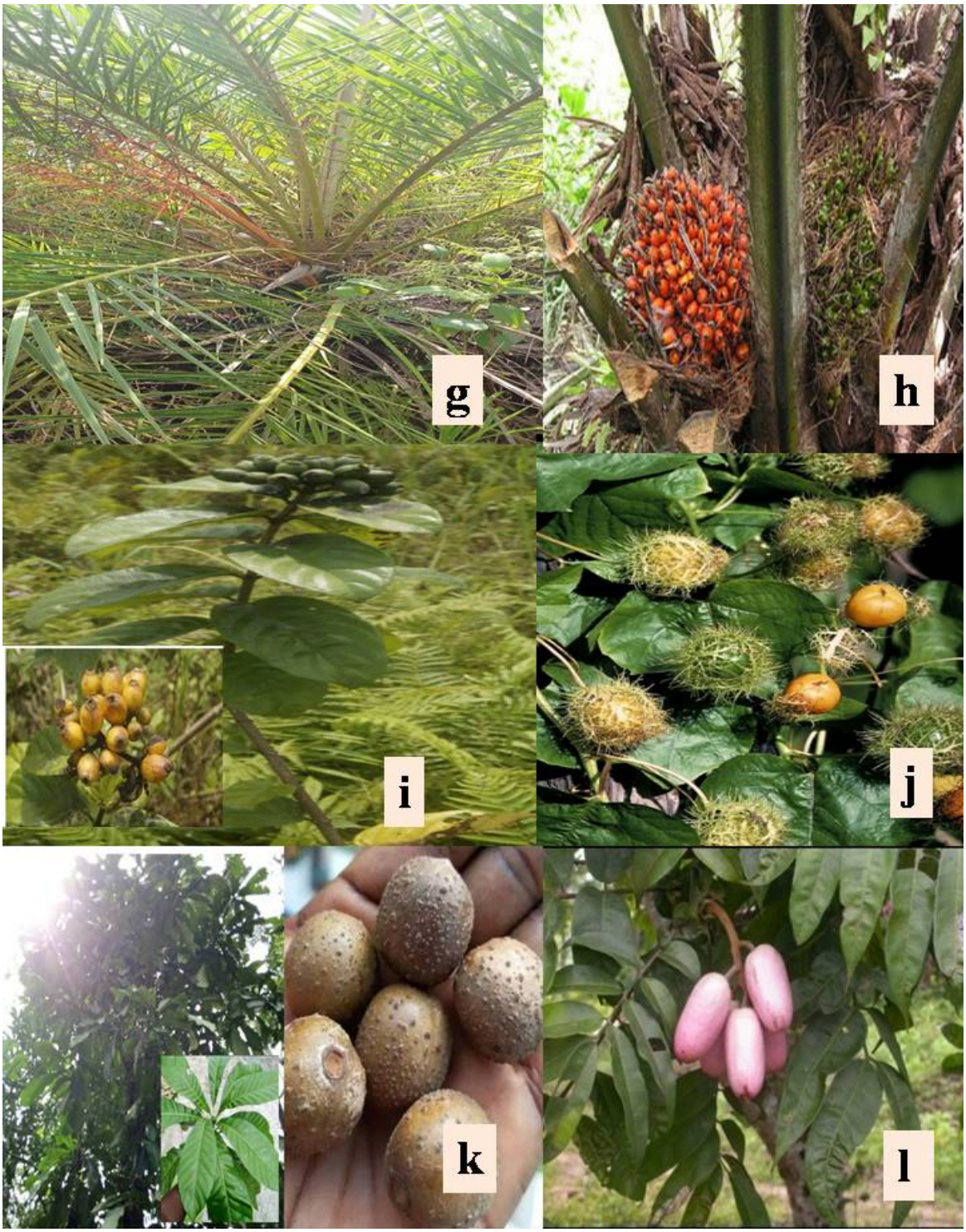
A total of fourteen (14) wild berry species were documented from eight (8) communities in the study area; they are distributed in ten (10) families (Table 2). The species comprises trees, shrubs and herbs with the majority being trees. The berries are often consumed fresh or processed and are popular for their unique sweet-sour taste. Some of the species are common, while others have become scarce (Table 3)

Distribution of the knowledge: The distribution of the knowledge about wild edible plants in the study area revealed that the predominant age range of the respondents with knowledge of the wild berries was between 30 and 65. Plants could easily be identified by their vernacular names by folks between the ages 30 - 65. However, most of the younger folks lacked knowledge of some of the species and seem uninterested in the plants.

Table 2. Wild Edible Berries of Nembe Local Government Area of Bayelsa State

SN	Species name	Common name	Family name	Nembe name	Habit
1	*Caryota mitis*	Fishtail palm	Arecaceae	*Ipiri*	Tree
2	*Phoenix dactylifera*	Date palm	Arecaceae	*Asangasi*	Tree
3	*Raphia vinifera*	Wine palm or bamboo palm.	Arecaceae	*Ingbesụ*	Tree
4	*Elaeis guineensis*	African oil palm	Arecaceae	*Lụgụ tin*	Tree
5	*Dacryodes edulis*	African pear	Burseraceae	*Ọ̃be*	Tree
6	*Uapaca kirkiana*	African wild loquat	Phyllanthaceae	*Ịle*	Tree
7	*Chrysophyllum albidum*	African star apple	Rosaceae	*Ọdara*	Tree
8	*Syzygium austral*	Brush cherry	Myrtaceae	*Ọ̃ka*	Shrub
9	*Tristemma mauritianum*	Mauritian tristemma	Melastomataceae	*Opuranga*	Herb
10	*Spondias mombin*	Hog plum	Meliaceae	*Ilelemu*	Tree
11	*Mussaenda isertiana*	Velvet peanut butter plant	Rubiaceae	*Obori indo*	Shrub
12	*Theobroma cacao*	Cocoa	Malvaceae	*Mhew*	Small tree
13	*Microcos oligoneura*	Africa Red Bole	Malvacae	*Igbufu*	Tree
14	*Passiflora foetida*	Passion fruit	Cucurbitaceae		Herb

Plates of selected wild berries in Nembe Local Government Area: a: *Caryota mitis*, b: *Spondias mombin*, c: *Microcos oligoneura*, d: *Tristemma mauritianum*, e: *Syzygium australe* f: *Raphia vinifera*



Plates of selected wild berries in Nembe Local Government Area: g: *Phoenix dactylifera*, h: *Elaeis guineensis*, i: *Mussaendai sertiana*, j: *Passilora foetida*, k: *Uapaca kirkiana*; l: *Dacryodes edulis*

Table 3. Abundance of species within the study area

SN	Species name	Abundant (0- 8 hours)	Frequent (8 – 24 hours)	Occasional (24 - 48 hours)	Rare (Over 48 hours)
1	*Caryota mitis*				+
2	*Phoenix dactylifera*		+		
3	*Raphia vinifera*	+			
4	*Elaeis guineensis*	+			
5	*Dacryodes edulis*	+			
6	*Uapaca kirkiana*				+
7	*Chrysophyllum albidum*		+		
8	*Syzygium austral*		+		
9	*Tristemma mauritianum*			+	
10	*Spondias mombin*		+		
11	*Mussaenda isertiana*				+
12	*Theobroma cacao*		+		
13	*Microcos oligoneura*				+
14	*Passiflora foetida*			+	

DISCUSSION

Wild fruits are cheaper and more nutritious sources of nutrients that improve people's diet and contribute to food security (Borelli *et al* 2020; Duguma, 2020; Gada and Ismaila, 2021). Wild berries are reservoirs of antioxidants, vitamins and minerals in the diet and are important for human wellbeing and livelihood (Harris and Mohammed, 2003, Bere *et al.*, 2006; Essa *et al.,* 2014; Ermolaev *et al.,* 2021). They possess desirable traits that that can be incorporated or transferred to crops that can achieve nutritional security, and are also important at times of food shortage (Harris and Mohammed, 2003). The study shows that Nembe Local Government Area has a rich diversity of wild edible berry plants. The number can be increased if future studies cover all the region and communities. The practice of consuming these plant species has been widely spread throughout the communities in the study area. However, the abundance and consumption of indigenous edible wild berries has considerably reduced compared to the past. Also, on the verge of disappearance is the knowledge of the species. As the availability and consumption of the wild plant species declines so too does knowledge of their utilization. Many rural inhabitants are unfamiliar with the names of these valuable plant species, the existent knowledge is confined to the older folks. There is intense disappearance of wild useful plants, their consumption and the associated indigenous knowledge in especially in developing countries (Azhar, 2014; Yangdon *et al.* 2022; Nwala *et al.*, 2023); the study area is not exempted from this phenomenon.

Worthy of note is that most of the species have a patchy distribution, not forming recognizable stands, and are isolated from each other; this could be a contributory factor in their disappearance. Though they grow within the Edumanom National Forest Reserve, their populations are affected by human and environmental stressors like changes in land use, land grabbing, pollution, uncontrolled harvest and lack of interest. Furthermore, most of the plant species remain undomesticated, growing exclusively in the wild. The area faces severe human intrusion, deforestation and forest depletion, including the loss of parts of sacred forests, posing a significant threat to their habitat. Deforestation and human intrusion due to expansion of agricultural and residential areas are the primary factors causing diminishing diversity and density of wild edible plants (Delang, 2006; Azhar, 2014). Human activities such as deforestation, bush burning for farming and construction are major threats to plant species in the Niger Delta (UNEP, 2011). Without conservation and cultivation measures, several plant species will become more endangered and risk extinction. Some of the species are vulnerable in the study area as informants bemoan the disappearance, unusual flowering and fruiting time of certain species e.g. *Tristemma mauritianum*, *Uapaca kirkiana*, *Mussaenda isertiana*. It is crucial to promote these neglected plant species to prevent their loss as well as the loss of the tradition of consuming them. Also, stewardship practices can be utilized to insulate the species and prevent their vulnerability and extinction. The availability of the berries species is dependent on seasons, most of the species exhibit unique characteristics and requirements that influence their seasonality and they are mostly available during the warm wet season (August - October); this is the period when most mature and produce fruits. Seasonal availability of wild foods has been reported by Heywood (1999) and Yao et al (2015). *Microcosm oligoneura* and *Tristemma mauritianum* depend on consistent warmth for their seasonal cycles. *Caryota mitis* has been reported to needing consistent warm temperatures and high humidity year-round for optimal growth and fruiting (Maduelosi and Angaye, 2015). *Elaeis guineensis* requires a humid climate, with temperatures ranging between 24-28°C, crucial for successful fruit development (Rao *et al.,* 2023). *Chrysophyllum albidum* is reported to prefer subtropical to mild temperate climates, with its growth and fruiting cycles impeded by extreme cold (Xu *et al.,* 2023). The species are severely impacted by global climate change that induced increasing and erratic seasonal changes that deter flowering and fruiting.

Medicinal / Nutritional Value of the Wild Berry Species: Several studies have shown that wild fruits have higher nutritional and medicinal values compared to cultivated crops (Golovinskaia and Wang, 2021; Vahapoglu *et al.,* 2021). Wild berries have been reported to be especially useful in areas where access to farmed fruits and vegetables is limited, giving alternate and healthful dietary options (Duguma, 2020). All the plant species are recorded for use in medicinal or nutritional purposes. For instance, *Spondias mombin* contains flavonoids, saponins, alkaloids with anticancer, antioxidant, anti-inflammatory, and antiviral activities (Rashed, 2014). *Passiflora foetida*, contains quercetin, a flavonoid with anti-allergic, anti-inflammatory, and cardiovascular properties (Ożarowski and Karpiński, 2020). *Phoenix dactylifera* and *Theobroma cacao* are reported to have vitamin A which is essential for vision, skin health, and immunological function (Al-shahib and Marshall, 2003; Golovinskaia and Wang, 2021); high levels of vitamin C, an antioxidant that promotes immune function and collagen synthesis (Vendrame *et al.,* 2024) etc. *Chrysophyllum albidum* contains minerals like potassium, which helps regulate blood pressure, fluid balance, and muscular performance. (Vendrame *et al.,* 2022), manganese that controls fat and carbohydrate metabolism, calcium absorption, and blood sugar levels and contributes to the formation of connective tissues, blood clotting factors, and sex hormones (Studer *et al.,* 2022).

Additionally, some of the wild edible berries have various alternative uses beyond their edibility; they generate income (both in cash and barter) resulting to economic gains for small-scale farmers, and indigenous people (Adeagbo *et al*., 2020). They are processed into various value-added and specialist products increasing their value and shelf life, enabling commercialization and distribution beyond local markets (Jean-Marie *et al.,* 2022). The leaves of *Raphia vinifera* are used in thatching roofs and constructing traditional dwellings. The fibers extracted from its leaves are utilized in weaving ropes, baskets, mats, and other woven products. Also, their parts are used to treat various health issues among the indigenous people. For instance, the juice from species like *Elaeis guineensis* and *Chrysophullum albidum* is consumed to promote digestive health, alleviate stomach discomfort, stimulate wound healing, and aid skin regeneration. The leaves of *Tristemma mauritianurn* are used to treat inflammatory disorders such as arthritis and joint discomfort. The wild edible berries species also play an important part in cultural activities and rituals, frequently representing symbolic meanings and cultural linkages to the indigenous folks. For instance, *Elaeis guineensis* represents perseverance and vigor, whereas *Raphia vinifera* may represent wealth and appreciation. Though not

yet explored, the species have potential for export to domestic and international markets boosting revenues and promoting rural development. Sustainable harvesting, value-added processing facilities as well as enhanced conservation measures is needed to help to drive inclusive economic growth, and for protection and sustainability of the species.

CONCLUSION

Wild berries are reservoirs of vitamins, minerals and nutraceuticals, and are important for human well being and improved livelihoods. They have desirable traits that can be transferred to crops to achieve nutritional security. The study revealed that the study area is rich in diversity of wild berry species (WEBs) consumed in different forms. A total of fourteen (14) wild berry species (WEBs) were identified *viz Caryota mitis, Cedrela odorata, Mussaendai sertiana, Dacryodes edulis, Raphia vinifera, Elaeis guineensis, Tristemma mauritianum, Uapaca kirkiana, Chrysophyllum albidum, Theobroma cacao, Spondias mombin, Microcos oligoneura, Phoenix dactylifera,* and *Syzygium australe* distributed in ten (10) families. However, the rate of their consumption has dwindled at an alarming rate and is influenced by natural and social factors; most of the plants are becoming scarce and remain neglected. Conservation efforts of the resources are mostly through traditional practices and laws. Predominantly, lack of interest, loss of knowledge, human intrusion and practices which include deforestation and bush burning constitute a threat to these invaluable plants in the study area. The declining situation of these plants and their indigenous knowledge calls for adoption of strategies and policies that will ensure sustainable utilization and enhanced conservation to address the food insecurity and hunger, particularly in developing countries.

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