

# Underutilized Edible Plants of Nagaland: A Survey and Documentation from Kohima, Phek and Tuensang District of Nagaland, India

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## Abstract

With the rapid rise in the population, there is higher demand of the food supply to feed millions of people. As such dependence on the few major staple crops to meet the needs of the people has led to increases in starvation and poverty. Underutilized edible plants offer a cheaper and affordable option in providing more crop diversification to tackle these problems and provide food security to the poor to the world in general and to the developing countries in particular. In the present investigation, a total of 142 underutilized edible plants were collected, identified and documented from three districts (Kohima, Phek and Tuensang) of Nagaland, India. The collected plant consists of 126 species of plants and 16 wild edible mushrooms or macro fungus species. The collected plants were categorized according to types of plant and their parts used collected during the period 2012-2016 with their scientific name, family, common name, vernacular name and accession number. The study discusses the need to promote these plants for providing food security and income generation through sustainable collection, cultivation and marketing and to workout proper conservation strategies to prevent depletion and loss of the natural habitat caused by anthropogenic activities. The study also encourages more survey and researches in the rest of the districts of the state and to study the phytochemical constituents to harness the nutraceutical properties of these plants.

## Keywords

Bioresources, Conservation, Food Security, Nagaland, Underutilized Plants

## 1. Introduction

Human health depends on the quality of the environment in which they live.

The interrelationships between society and nature, and the importance of environmental health to human health depend on biodiversity which have direct impact on human-well being as well [1]. Human population is growing at an alarming rate in the developing countries and only ~30 plant species are used to meet 95% of the world's food requirements, which are considered as the "major crops" [2] [3]. Millions of people in the developing countries do not have enough food to meet their daily requirement, further the diet is deficient in one or more nutrient [4] and same is true to India, world second largest in human population in this earth [5]. Mankind depends on a very limited number of crop plants to meet the needs of staple diets [6]. Increasing reliance on these major food crops leads to shrinking of the food basket which mankind has been relying upon for generations [7] and the need to feed hundreds and thousands of mouth has led to starvation in many developing countries [8]. The gap between the human population and the quantity of the food supply has already become a global threat and an international issue [9] and therefore, to bridge the gap efforts are being made to identify and evaluate underutilized food sources [10]. Since time immemorial, man lived by hunting and gathering and has been using wild plants as food source [11].

Biodiversity is the very basis of human survival and economic well being that constitutes the resources upon which families, communities, nations and future generations depend [12]. The status and characteristics of biodiversity prevalent in a country/state/region is dependent on the land (soil, topography), climate and people (their habitats and population density) inhabiting the region [13]. Biodiversity and bioresources are key in securing different fundamental human needs [14] [15] [16]. India is one of the 17 mega-biodiversity rich regions and the North-Eastern part of the country harbours rich and unique biodiversity. India has rich concentration of 500 tribal communities, who have close association with the forest and its resources since time immemorial. The tribal communities also use locally available medicinal plants to meet their daily healthcare needs which have become a recognized tool in search for new sources of drugs and nutraceuticals, these medicinal plant offers an economically inevitable alternative to expensive medicines [17]. Forest plays a large indispensable role in improving the food security and livelihood of the tribal society [18]. Millions of people in many developing countries depend on forest resources including wild edible plants to meet their food needs especially in periods of food crisis [4] [19]. Therefore, forest resources reduce the vulnerability of local communities to food insecurity and provide a buffer in times of food shortage [19] [20] [21]. The wild edible plants provide staple food for indigenous people, serve as complementary food for non-indigenous people and offer an alternative source of cash income [22] [23] [24] and they have substantial potential for the development of new crops through domestication and provide a genetic resource pool for hybridization and selection [25] [26] [27].

The North-Eastern region being one of the hot-spots of biodiversity is known for its richness in ethnic diversity and traditional culture [28]. Nagaland state is

part of the Indo-Burma biodiversity hot-spot which have a diverse flora and fauna. The state is inhabited mostly by the tribal people called the Naga tribes. Naga are Mongolian race with racial and socio-cultural affinities with the inhabitants of Southeast Asian countries forming one of the largest tribal communities in North-Eastern India [29] [30]. Though the Naga society have been greatly influenced by modern cultures, yet traditional cultures are practice even today and they still depend widely on forest resources for food, shelter, and medicines. Forest resources especially wild edible plants plays a major role in supplementing the staple foods in many tribal areas [31] [32] [33], however many of the wild edible plants are unknown to people outside the state and remains insufficiently exploited, despite their nutritional values, thus becoming underutilized crops at the global level.

Jaenicke Höschle-Zeledon [34] defined Underutilized crops as “those species which are under exploited for contributing to food security (nutritional/medicinal), income generation and environmental services”. They are also referred as “Neglected and Underutilized species”/“Orphan crops”/“Minor crops” [35] [36]. These plants as locally abundant but globally rare, lack of scientific knowledge, has a limited current use relative to their economic potential. They are often presented as “New crops” for the fact that commercial companies/researchers are only recently working on them [37]. Replacing traditional foods by “modern feeding habits” has resulted in the loss of genetic diversity in traditional food species and a decline in cultural diversity [38]. The vast store of information on indigenous knowledge, practices and technologies is being eroded as a result of rapid urbanization, over-exploitation of resources, unscientific land use, change of lifestyles and behavior [39]. As reported by Blanco [40], regarding issues of traditional culture the process of oral transmission has broken down and most traditional knowledge can only be found in the memory of the elderly and is gradually fading as these repositories of ancestral knowledge received from parents and grandparents succumb to age. The loss of indigenous knowledge has also been recognized as one of the general factors affecting biological diversity [41]. There is an urgent need for exploration on traditional knowledge of underutilized plant uses, development of database, strategy for conservation through sustainable use and management of the resources and search for new potential plant sources as drugs and food [31] and to support biodiversity conservation programs [27]. Present study has been undertaken to survey and document the Underutilized Edible Plants (UEP’s) from three districts (Kohima, Phek and Tuensang), Nagaland, India.

## 2. Materials and Method

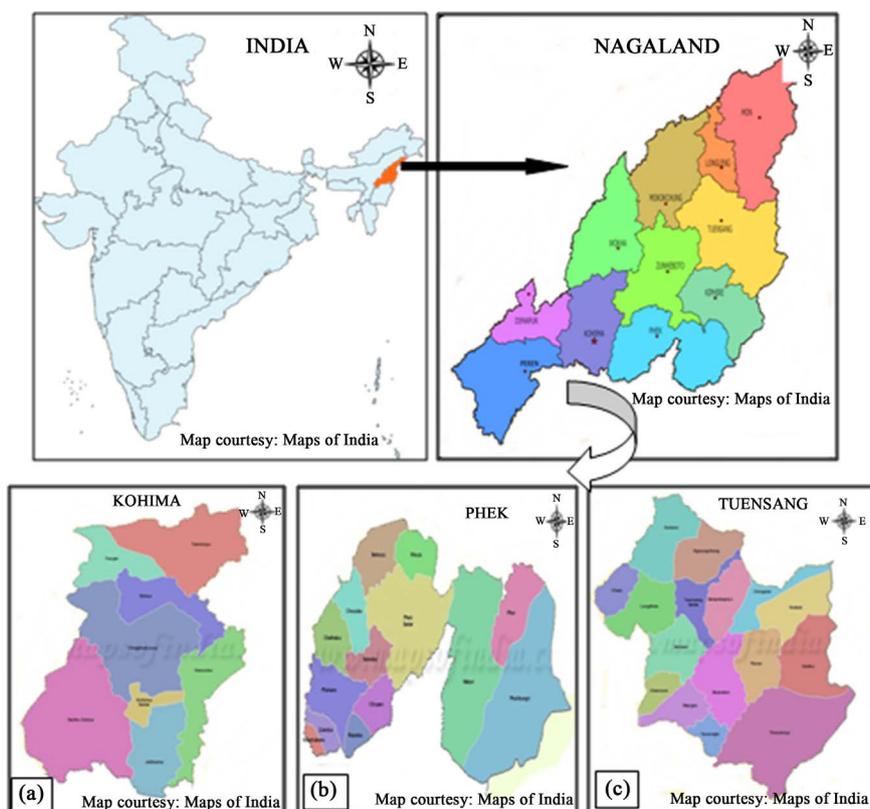
### 2.1. Study Area

Nagaland is a mountainous state located in the North-Eastern part of India that lies between the geographical coordinates of 25° 6' and 27° 4' north latitudes and 93° 20' and 95° 15' east longitude. Nagaland is bordered by the states of Assam to

the West, Arunachal Pradesh and part of Assam to the north, Myanmar to the east and Manipur to the south with Kohima as its capital. It has an area of 16,579 square kilometers with a population of 1,980,602 per the 2011 Census of India. The district of Kohima, Phek and Tuensang of Nagaland were considered for the present study. The brief information about these three districts is given below (Figure 1).

**Kohima District:** Kohima is the capital city of Nagaland state, India. Kohima is located between the geographical coordinates of 25.6701°N and 94.1077°E and is surrounded by the Dimapur district to the west, Phek and Zunheboto district to the east, Wokha district to the north and Manipur state to the south. It has a total geographical area of 1463 sq. km and an average elevation of 1444 m (4738 ft) above sea level. Kohima has a pleasant and moderate climate with temperature ranging an average of 27°C - 32°C (80°F - 90°F). The district have Dzükou valley situated at an altitude of 2438 m (7998.68 ft) above sea level and Japfü peak, the second highest peak in Nagaland at an altitude of 3048 m (9890 ft) above sea level. The average annual rainfall of the district is 1863 mm. Kohima is the home land of the Angami Naga tribe and agriculture is the main occupation.

**Phek District:** Phek district lies in the South-East of Nagaland with geographical coordinate of 25.40°N and 94.28°E, bounded by Kohima district in the west, Zunheboto and Kiphire districts in the North, Myanmar in the South East



**Figure 1.** Map of Nagaland showing the three study areas: (a) Kohima district; (b) Phek district and (c) Tuensang district.

and Manipur state in the South with an area of 2026 sq-km. The average temperature during the summer season is 28°C and 15°C during the winter season. Pfutsero is the highest altitude town [2133 m (6998 ft)] and coldest inhabited place in Nagaland with the temperature dropping down to below minus zero degree during the nights in winter. The average annual rainfall of the district is 1527 mm. The district is inhabited by the Chakhesang Naga tribe and Puchury tribes. Agriculture is the main occupation with 80.84% of the population engaged in agriculture and Terrace rice cultivation is predominant.

**Tuensang District:** Tuensang district is the largest district of Nagaland with geographical coordinate of 26.14°N and 94.49°E. The district shares an international border with Myanmar all along its eastern sector and is bounded by Mon district in the north east, Longleng in the north, Mokokchung in the south. The average annual rainfall of the district is 1329 mm. During summer season, the average temperature is 21.4°C and during the winter season the temperature drops down to 10°C. The highest peak, Mount Saramati [3840 m (12,598 ft)] is present in Tuensang district. Chang, Sangtam, Yimchunger and Khiamniungan are the main indigenous tribes of the district. Jhum-shifting cultivation is the main agricultural practice of the district. **Figure 1** showed the three study area A. Kohima, B. Phek and C. Tuensang.

## 2.2. Fieldwork and Data Collection

The present investigation was based on extensive field survey carried out in different seasons during the period 2012-2016. The primary aim of the present investigation is to collect, identify and document the UEP from the three districts of Nagaland, India. The study area was surveyed during the different seasons of the year and also at the peak seasons of the plants with the help of forest experts and field guides. The plant materials were collected randomly from the study sites and kept in zipper poly bags and brought to the laboratory for identification. Information was also collected on the traditional knowledge on the different types of plants (leafy vegetables plants, fruit trees, macrofungus etc.) and parts use (leaves, fruits, nuts, rhizome, flowers and inflorescence) of the collected plant materials through interacting with the local inhabitants of these three districts. The global positioning system (GPS) readings on the collected plant materials were also recorded from different regions of these districts.

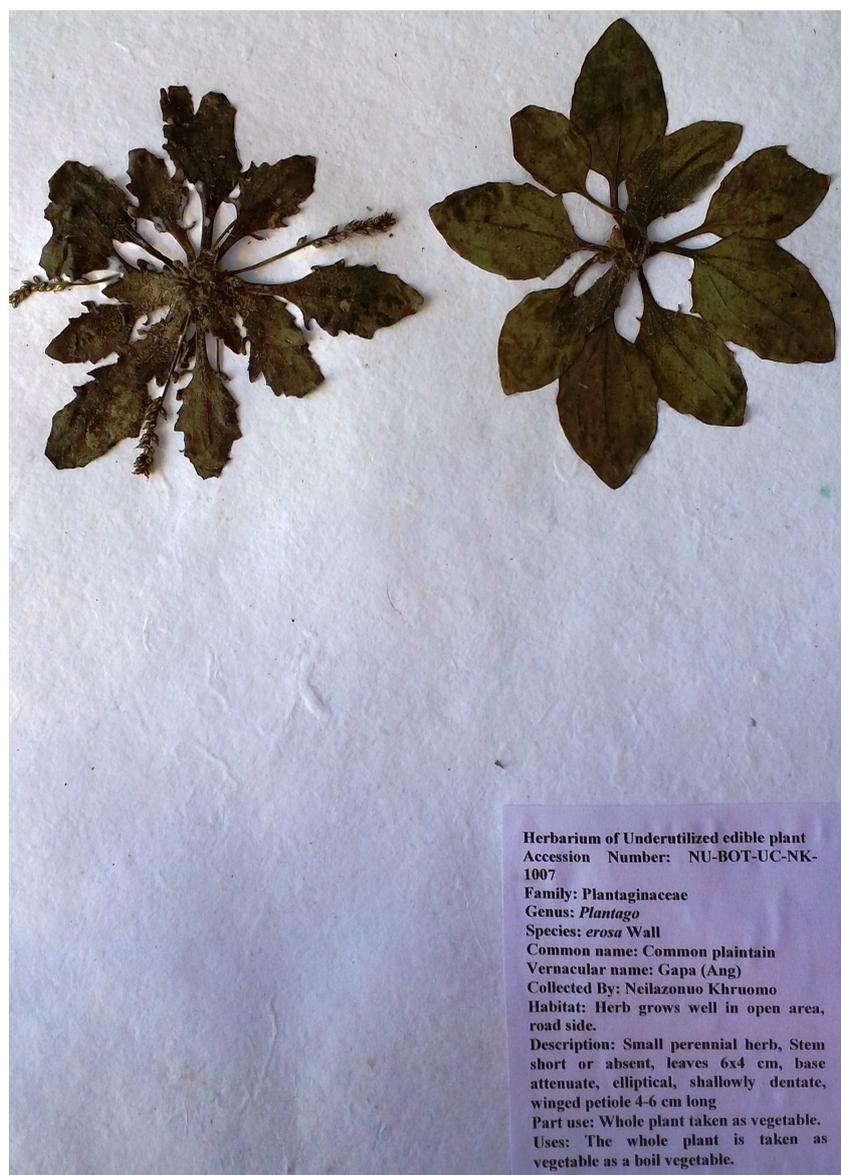
## 2.3. Identification

The collected plant materials were categorized according to the types of plants and their parts used (e.g., cereals, whole plants, leafy vegetables, fruits, nuts, stem, flowers and inflorescence, roots, rhizomes, tuber, bulb etc.) by the local inhabitants of the study areas. The authentic identification is done with the help of the available authentic literature, Departmental Herbarium, Botanical Survey of India (BSI), Shillong and also the experts on the concern field. Specimens such as leafy vegetable, flower and inflorescence, rhizome etc. are mounted with

50% formaldehyde solution (v/v) and preserved as herbarium. Specimens such as fruits, nut, rhizome, bulb etc. are preserved in 2% formaldehyde solution (v/v) and kept in jar bottle as herbarium. For the collected plant specimens, both conventional as well as digital Herbarium is maintained and deposited in the Department of Botany, Nagaland University, Lumami. Sample herbarium sheet is given in **Figure 2**.

### 3. Results and Discussion

From the present investigation, a total of 142 UEP's were collected during the survey which consists of 126 plants species and 16 wild edible mushrooms or macrofungus species. **Table 1** showed the different types UEP's categorized



**Figure 2.** A model conventional herbarium submitted to the Herbarium of the department of Botany, Nagaland University.

**Table 1.** List of underutilized edible plants categorized according to types of plants and their parts used.

Sl. No	Scientific name	Family	Common Name	Vernacular Name	Accession No.
<b>Cereal Crops</b>					
1	<i>Coix-lacryma jobi</i> L.	Poaceae	Job's tear	Kesi (Ang)	NU-BOT-UC-NK-1016
2	<i>Setaria italica</i> (L.) P. Beauvois	Poaceae	Foxtail Millet	Chütienuo (Ang)	NU-BOT-UC-NK-1017
3	<i>Sorghum bicolor</i> (L.) Moench	Poaceae	Great millet	Menyi thesü (Ang)	NU-BOT-UC-NK-1094
<b>Leafy Vegetables</b>					
4	<i>Antidesma bunius</i> (L.) Spreng.	Phyllanthaceae	Salamander tree	Gaja sei (Ang)	NU-BOT-UC-NK-1002
5	<i>Centella asiatica</i> (L.) Urb.	Apiaceae	Indian Pennywort	Gara (Ang)	NU-BOT-UC-NK-1003
6	<i>Clerodendrum glandulosum</i> Lindl.	Lamiaceae	Glory Hill Bower	Gathere (Ang)	NU-BOT-UC-NK-1004
7	<i>Houttuynia cordata</i> Thunb	Saururaceae	Fishy mint, Stink plant, Chameleon plant	Gatha (Ang)	NU-BOT-UC-NK-1005
8	<i>Gynura bicolor</i> (Roxb. Ex Willd.) DC.	Asteraceae	Valvet plant	Liezienuo (Ang)	NU-BOT-UC-NK-1006
9	<i>Plantago erosa</i> Wall.	Plantaginaceae	Common plaintain	Gapa (Ang)	NU-BOT-UC-NK-1007
10	<i>Polygonum chinense</i> L.	Polygonaceae	Chinese Knotweed	Gare (Ang)	NU-BOT-UC-NK-1008
11	<i>Polygonum molle</i> D. Don	Polygonaceae	Soft knot grass	Gazie (Ang)	NU-BOT-UC-NK-1009
12	<i>Lasia spinosa</i> (L.) Thwaites	Araceae	Queen Flower	Telega (Ang)	NU-BOT-UC-NK-1010
13	<i>Elatostema lineolatum</i> Wight	Urticaceae	Elatostema	Jotho (Ang)	NU-BOT-UC-NK-1021
14	<i>Alpinia nigra</i> (Gaertn.) Burt	Zingiberaceae	Black Galangal, Wild ginger	Sokrünüo (Ang)	NU-BOT-UC-NK-1022
15	<i>Spilanthes acmella</i> (L.) L.	Asteraceae	Toothache plant	Kevenha (Ang)	NU-BOT-UC-NK-1025
16	<i>Fagopyrum esculentum</i> Moench	Polygonaceae	Buckwheat	Garei (Ang)	NU-BOT-UC-NK-1026
17	<i>Begonia palmata</i> D. Don	Begoniaceae	Begonia	Rhichü (Ang)	NU-BOT-UC-NK-1028
18	<i>Zanthoxylum oxyphyllum</i> Edgew.	Rutaceae	Cape Yellow, Indian Ivy-rue, Indian pepper	Ganyasei (Ang)	NU-BOT-UC-NK-1033
19	<i>Cardamine hirsuta</i> L.	Brassicaceae	Hairy bittercress	Seguoga (Ang)	NU-BOT-UC-NK-1034
20	<i>Pseudognaphalium affine</i> (D. Don) Anderb.	Asteraceae	Jersey cudweed	Chienega (Ang)	NU-BOT-UC-NK-1038
21	<i>Amorphophallus nepalensis</i> (Wall.) Bogner & Mayo	Araceae	Nepalese voodoo lily	Teinhyiemidu (Ang)	NU-BOT-UC-NK-1045
22	<i>Cheilocostus speciosus</i> (J. König) C. Specht	Costaceae	Crepe ginger, Malay ginger, Cane ginger, Wild ginger	Thevobuotonyü (Ang)	NU-BOT-UC-NK-1049
23	<i>Herpetospermum pedunculatum</i> (Ser.) C.B. Clarke	Cucurbitaceae	Himalayan Gourd	Galü (Ang)	NU-BOT-UC-NK-1050
24	<i>Colocasia antiquorum</i> Schott.	Araceae	Eddoe or Eddo	Thekrü (Ang)	NU-BOT-UC-NK-1051
25	<i>Elatostema platyphyllum</i> Wedd.	Urticaceae	Elatostema	Johunyü (Ang)	NU-BOT-UC-NK-1052
26	<i>Ficus geniculata</i> Kurz.	Moraceae	Wild fig	Chiedebo (Ang)	NU-BOT-UC-NK-1091
27	<i>Trichodesma khasianum</i> C. B. Cl.	Boraginaceae	Trichodesma	Sekisekuo (Ang)	NU-BOT-UC-NK-1092
28	<i>Diplazium esculentum</i> (Ritz.) Sw.	Athyriaceae	Vegetable fern	Gasülo (Ang)	NU-BOT-UC-NK-1093
29	<i>Gynura nepalensis</i> DC.	Asteraceae	Nepal gynura	Liezienuo (Ang)	NU-BOT-UC-NK-1095

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30	<i>Crassocephalum crepidioides</i> (Benth.) S. Moore	Asteraceae	Ragleaf, Fireweed, Thickhead	Nhasa (Ang)	NU-BOT-UC-NK-1096
31	<i>Asparagus officinalis</i> L.	Asparagaceae	Asparagus, sparrow grass	Shiehou (Ang)	NU-BOT-UC-NK-1098
32	<i>Trevesia sundaica</i> Miq.	Araliaceae	Trevesia, Snowflake Aralia	Teirhünyü (Ang)	NU-BOT-UC-NK-1101
33	<i>Gnaphalium uliginosum</i> L.	Asteraceae	Marsh cudweed	Cienega (Ang)	NU-BOT-UC-NK-1102
34	<i>Paederia foetida</i> L.	Rubeaceae	Skunk vine, Stink vine, Chinese fever vine	Menyi (Ang)	NU-BOT-UC-NK-1103
35	<i>Rumex patientia</i> L.	Polygonaceae	Patience dock, garden patience, herb patience	Meza gakrie (Ang)	NU-BOT-UC-NK-1104
36	<i>Chenopodium album</i> L.	Amarantheceae	Fat hen, lamb's quarter, white goosefoot, pigweed	Terhuotiepfü (Ang)	NU-BOT-UC-NK-1105
37	<i>Chenopodium giganteum</i> D. Don	Amarantheceae	Tree, spinach, Magenta spreen, Purple Goosefoot, Giant Lambsquarters	Terhuotiepfü (Ang)	NU-BOT-UC-NK-1106
38	<i>Amaranthus viridis</i> L.	Amarantheceae	Green Amaranth, slander amaranth	Niedza (Ang)	NU-BOT-UC-NK-1109
39	<i>Amaranthus tricolor</i> L.	Amarantheceae	Chinese spinach	Niedza (Ang)	NU-BOT-UC-NK-1110
40	<i>Pilea scripta</i> (Buch-Ham. ex D. Don) Webb.	Urticaceae	Himalayan Clearweed	Therhie (Ang)	NU-BOT-UC-NK-1111
41	<i>Lecanthus peduncularis</i> (Wall. Ex Royle)	Urticaceae	Stalked dishead	Gabo (Ang)	NU-BOT-UC-NK-1112
42	<i>Elatostema sessile</i> J.R Forst. & G Forst.	Urticaceae	Stalkless elatostema	Gajo (Ang)	NU-BOT-UC-NK-1113
43	<i>Ficus fistulosa</i> Reinw. Ex. Blime	Moraceae	Yellow stem fig	Khrübvü Kecüu (Ang)	NU-BOT-UC-NK-1114
44	<i>Impatiens latifolia</i> L.	Begoniaceae	Indian Angel Balsam, Baba budan balsam	Gasa (Ang)	NU-BOT-UC-NK-1115
45	<i>Amaranthus spinosus</i> L.	Amarantheceae	Spiny Amaranth, Prickly Amaranth	Niedza (Ang)	NU-BOT-UC-NK-1120
46	<i>Begonia roxburghii</i> A.DC.	Bogoniaceae	East Himalayan Begonia	Rhichü (Ang)	NU-BOT-UC-NK-1126
47	<i>Oenanthe javanica</i> (Blume) DC.	Apiaceae	Java water dropwort, water dropwort	Gakra (Ang)	NU-BOT-UC-NK-1128
48	<i>Justicia santapau</i> Bennet	Acantheceae	Santapau's Justicia	Gapfü (Ang)	NU-BOT-UC-NK-1129
49	<i>Urtica ardens</i> Link	Urticaceae	Himalayan Nettle	Zozie (Ang)	NU-BOT-UC-NK-1130
50	<i>Urtica fissa</i> E. Pritz.	Urticaceae	Stinging Nettle	Zozie (Ang)	NU-BOT-UC-NK-1131
51	<i>Persicaria nepalensis</i> (Meisn.) Miyabe	Polygonaceae	Nepal Knotweed	Pruzie (Ang)	NU-BOT-UC-NK-1135
52	<i>Solanum nigrum</i> L.	Solanaceae	Black Nightshade	Gatsi (Ang)	NU-BOT-UC-NK-1136
53	<i>Rumex crispus</i> L.	Polygonaceae	Curly dock, yellow dock	Meza gakrie (Ang)	NU-BOT-UC-NK-1137
<b>Fruits and Nuts</b>					
54	<i>Ficus auriculata</i> Lour.	Moraceae	Roxburg fig, Elephant ear fig	Khrübvü Kezhau (Ang)	NU-BOT-UC-NK-1011
55	<i>Ficus semicordata</i> Buch-Ham ex J. E. Smith	Moraceae	Wedgeleaf fig, Drooping fig	Chiede (Ang)	NU-BOT-UC-NK-1012

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56	<i>Juglans regia</i> Linn.	Juglandaceae	Persian walnut, Butter nut	Pfhüsei (Ang)	NU-BOT-UC-NK-1013
57	<i>Rhus chinensis</i> Mill.	Anacardiaceae	Nutgall tree	Zomhusei (Ang)	NU-BOT-UC-NK-1014
58	<i>Terminalia chebula</i> Retz.	Combretaceae	Myrobalan	Mhiechüsei (Ang)	NU-BOT-UC-NK-1015
59	<i>Choerospondias axillaris</i> (Roxb.) B.L Burt & A.W. Hill	Anacardiaceae	Nepali Hog Plum	Khola (Ang)	NU-BOT-UC-NK-1018
60	<i>Stixis suaveolens</i> (Roxburgh) Pierre	Capparaceae	Stixis	Rokasei (Ang)	NU-BOT-UC-NK-1019
61	<i>Spondias pinnata</i> (L. f.) Kurz	Anacardiaceae	Wild Mango	Mezisei (Ang)	NU-BOT-UC-NK-1020
62	<i>Elaeagnus latifolia</i> L.	Elaeagnaceae	Bastard Oleaster	Pesü (Ang)	NU-BOT-UC-NK-1024
63	<i>Diospyros kaki</i> L.F	Ebenaceae	Japanese Persimmon	Ziedi (Ang)	NU-BOT-UC-NK-1027
64	<i>Abelmoschus moschasta</i> Medik.	Malvaceae	Musk Mellow	Gakhokoka (Ang)	NU-BOT-UC-NK-1029
65	<i>Cucumis hystrix</i> Chakrav.	Cucurbitaceae	Wild cucumber	Ketsa tsütuo (Ang)	NU-BOT-UC-NK-1030
66	<i>Docynia indica</i> (Wall.) Decne.	Rosaceae	Wild Apple, Assam Apple	Ciepho (Ang)	NU-BOT-UC-NK-1032
67	<i>Mahonia nepalensis</i> DC.	Berberidaceae	Mahonia	Athuo (Ang)	NU-BOT-UC-NK-1035
68	<i>Myrica esculenta</i> Buch-Ham ex. D. Don	Myricaceae	Box-myrtle, bayberry	Thugei (Ang)	NU-BOT-UC-NK-1036
69	<i>Physalis peruviana</i> L.	Solanaceae	Cape goose berry, Goldenberry	Chahamiacasei (Ang)	NU-BOT-UC-NK-1037
70	<i>Rubus niveus</i> Thunb.	Rosaceae	Ceylon Raspberry	Temeirom (Ang)	NU-BOT-UC-NK-1039
71	<i>Rubus ellipticus</i> Sm.	Rosaceae	Golden Himalayan Raspberry, Yellow Himalayan Raspberry	Rom (Ang)	NU-BOT-UC-NK-1040
72	<i>Castanopsis indica</i> (Roxb. ex Lindl.) A.DC.	Fagaceae	Indian chestnut	Thezüsei (Ang)	NU-BOT-UC-NK-1041
73	<i>Syzygium cumini</i> (L.) Skeels	Myrtaceae	Black plum, Java plum, Jambolan	Keloguo (Ang)	NU-BOT-UC-NK-1042
74	<i>Prunus nepalensis</i> (Ser.) Steud.	Rosaceae	Wild black berry.	Rünyüsei (Ang)	NU-BOT-UC-NK-1043
75	<i>Garcinia xanthochymus</i> Hook.f. ex T. Anderson	Clusiaceae	Mysore Gamboge, Sour mangosteen, False mangosteen	Chierie (Ang)	NU-BOT-UC-NK-1044
76	<i>Prunus carmesina</i> H. Hara	Rosaceae	Wild cherry	Kezie (Ang)	NU-BOT-UC-NK-1053
77	<i>Zanthoxylum armatum</i> DC.	Rutaceae	Winged prickly ash	Ganyasei (Ang)	NU-BOT-UC-NK-1054
78	<i>Duchesnia indica</i> (Andrews) Th. Wolf	Rosaceae	Mock strawberry, Indian strawberry or false strawberry	Kijirümvü (Ang)	NU-BOT-UC-NK-1055
79	<i>Aphananthe cuspidata</i> (Blume) Planch.	Ulmaceae	Aphananthe	Npyonpyosei (Ang)	NU-BOT-UC-NK-1056
80	<i>Evodia fraxinifolia</i> (Hook.) Benth.	Rutaceae	Evodia	Vocusei (Ang)	NU-BOT-UC-NK-1057
81	<i>Saurauia punduana</i> Wall.	Actinidiaceae	Saurauia, Gogan	Ketsa tsakhosei (Ang)	NU-BOT-UC-NK-1058
82	<i>Saurauia macrotricha</i> Kurt ex Dyer	Actinidiaceae	Saurauia	Ketsa tsakhosei (Ang)	NU-BOT-UC-NK-1059
83	<i>Toddalia asiatica</i> (L.) Lam.	Rutaceae	Orange climber, Forest pepper, wild orange tree	Ketsa sehüo (Ang)	NU-BOT-UC-NK-1060
84	<i>Actinidia callosa</i> Lindl.	Actinidiaceae	Wild kiwi	Ketsa kiwi (Ang)	NU-BOT-UC-NK-1061
85	<i>Debregeasia longifolia</i> (Burm. f.) Wedd	Urticaceae	Orange Wild Rhea	Zhüdu (Ang)	NU-BOT-UC-NK-1062

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86	<i>Hodgsonia macrocarpa</i> (Blume) Cogn.	Cucurbitaceae	Lard seed	Ketsamo (Ang)	NU-BOT-UC-NK-1063
87	<i>Litsea cubeba</i> (Lour.) Pers	Lauraceae	Aromatic Litsea, May chang	Cie (Ang)	NU-BOT-UC-NK-1064
88	<i>Carallia brachiata</i> (Lour.) Merr.	Rhizophoraceae	Carallia	Meho (Ang)	NU-BOT-UC-NK-1065
89	<i>Trichosanthes dunniana</i> H. Lévl.	Cucurbitaceae	Trichosanthes	Dzorume (Ang)	NU-BOT-UC-NK-1066
90	<i>Terminalia bellirica</i> (Gaertn.) Roxb.	Combretaceae	Myrobalan	Mhiechüsei (Ang)	NU-BOT-UC-NK-1067
91	<i>Rubus sumatranus</i> Miq	Rosaceae	Rubus	Rom (Ang)	NU-BOT-UC-NK-1068
92	<i>Ficus hispida</i> L.f.	Moraceae	Hairy fig	Ketsa chiede (Ang)	NU-BOT-UC-NK-1069
93	<i>Phyllanthus emblica</i> L.	Phyllanthaceae	Indian gooseberry, Emblic myrobalan	Ciehusei (Ang)	NU-BOT-UC-NK-1070
94	<i>Olox imbricata</i> Roxb.	Olaceae	Olox	Puyano (Ang)	NU-BOT-UC-NK-1071
95	<i>Elaeocarpus floribundus</i> Blume	Elaeocarpeaceae	Indian olive	Chüyechüku (Ang)	NU-BOT-UC-NK-1083
96	<i>Oxalis corniculata</i> Linn.	Oxalidaceae	Creeping wood sorrel, Yellow sorrel, sleeping beauty	Thevotsütuo (Ang)	NU-BOT-UC-NK-1084
97	<i>Pyrus pashia</i> Buch-Ham. Ex D. Don	Rosaceae	Indian Wild pear, Himalayan Wild pear	Ketsa naspati (Ang)	NU-BOT-UC-NK-1085
98	<i>Cornus capitata</i> Wall	Cornaceae	Bentham's cornel, Evergreen dogwood, Himalayan flowering dogwood	NA	NU-BOT-UC-NK-1086
99	<i>Hovenia dulcis</i> Thunb.	Rhamnaceae	Japanese raisin tree, Oriental raisin tree	Chelisei (Ang)	NU-BOT-UC-NK-1087
100	<i>Livistona jenkinsiana</i> Griff	Araceae	Fan palm	Niezorobo (Ang)	NU-BOT-UC-NK-1089
101	<i>Passiflora subpeltata</i> Ortege	Passifloraceae	White passionflower	Ketsa bell (Ang)	NU-BOT-UC-NK-1090
102	<i>Elaeagnus umbellata</i> Thunb.	Elaeagnaceae	Japanese Silverberry, Umbellata oleaster, autumn olive	Pesü ketsüyo (Ang)	NU-BOT-UC-NK-1097
103	<i>Canavalia gladiata</i> (Jacq.) DC.	Fabaceae	Sword bean	Zaprie sei (Ang)	NU-BOT-UC-NK-1099
104	<i>Melastoma malabathricum</i> L.	Melastomataceae	Indian rhododendron, Singapore rhododendron	Tehelakhu (Ang)	NU-BOT-UC-NK-1100
105	<i>Morus alba</i> L.	Moraceae	White mulberry	Khravü (Ang)	NU-BOT-UC-NK-1116
106	<i>Morus nigra</i> L.	Moraceae	Black mulberry	Khravü (Ang)	NU-BOT-UC-NK-1117
107	<i>Caryota urens</i> L.	Arecaceae	Fisgtail palm	Tepfisupari (Ang)	NU-BOT-UC-NK-1118
108	<i>Tetrastigma lanceolarium</i> (Roxb.) Planch.	Vitaceae	Indian chestnut vine	Thevomhachübo (Ang)	NU-BOT-UC-NK-1127
109	<i>Physalis minima</i> L.	Solanaceae	Sunberry, Ground berry	Chahamiaca (Ang)	NU-BOT-UC-NK-1132
110	<i>Zanthoxylum acanthopodium</i> DC.	Rutaceae	Andaliman	Ganyasei (Ang)	NU-BOT-UC-NK-1133
111	<i>Nephelium lappacium</i> L.	Sapindaceae	Rambutan	Ketsa lichu (Ang)	NU-BOT-UC-NK-1134
112	<i>Viburnum mullaha</i> Buch-Ham. ex D. Don	Adoxaceae	Starry viburnum	Tsakhasei (Ang)	NU-BOT-UC-NK-1139
113	<i>Baccaurea ramiflora</i> Lour.	Phyllanthaceae	Burmese grape	Ziedisei (Ang)	NU-BOT-UC-NK-1140
114	<i>Ardisia Crispa</i> (Thunb.)	Primulaceae	Coralberry	Tevümhachübo (Ang)	NU-BOT-UC-NK-1141
115	<i>Calamus tenuis</i> Roxb.	Arecaceae	Slander Ratten Cane	Tekhrasei (Ang)	NU-BOT-UC-NK-1142
116	<i>Amomum dealbatum</i> Roxb.	Zingiberaceae	Javda Cardamon	Sokrünüo (Ang)	NU-BOT-UC-NK-1001
117	<i>Bauhinia variegata</i> L.	Fabaceae	Orchid tree, Mountain Ebony	Teguo (Ang)	NU-BOT-UC-NK-1023

## Continued

118	<i>Curcuma angustifolia</i> Roxb.	Zingiberaceae	East Indian Rrrowroot, Narrow-leaved Turmeric	Hupfü (Ang)	NU-BOT-UC-NK-1031
119	<i>Chimonobambusa callosa</i> (Munro) Nakai	Poaceae	Small bamboo	Kerie ketsüyo (Ang)	NU-BOT-UC-NK-1046
120	<i>Musa sikkimensis</i> Kurz.	Musaceae	Darjeeling banana	Tepfhe (Ang)	NU-BOT-UC-NK-1047
121	<i>Musa thomsonii</i> (King ex Baker) A.M. Cowan & Cowan	Musaceae	Musa	Ruochünüo (Ang)	NU-BOT-UC-NK-1048
122	<i>Bauhinia purpurea</i> L.	Fabeceae	Purple orchid tree, Purple bauhinia	Teguo (Ang)	NU-BOT-UC-NK-1108
123	<i>Dendrocalamus giganteus</i> Munro	Poaceae	Giant bamboo	Vümi (Ang)	NU-BOT-UC-NK-1138
<b>Root, Tuber, Rhizome and Bulb</b>					
124	<i>Allium tuberosum</i> Rottler ex Spreng.	Amaryllisaceae	Garlic chives, Asian chives	Chümerie (Ang)	NU-BOT-UC-NK-1088
125	<i>Dioscorea bulbifera</i> L.	Dioscoreaceae	Air yam, Aerial yam	Rüphie (Ang)	NU-BOT-UC-NK-1107
126	<i>Cinnamomum verum</i> J.Presl	Lauraceae	Cinnamon	Seichü (Ang)	NU-BOT-UC-NK-1119
<b>Mushrooms</b>					
127	<i>Auricularia auricula-judae</i> (Bull.) Quél.	Auriculariaceae	Jew's Ear, Tree Ear, Wood Ear	Thezunyieto (Ang)	NU-BOT-UC-NK-1072
128	<i>Auricularia polytricha</i> (Mont.) Sacc.	Auriculariaceae	Cloud ear fungus	Thezunyieto (Ang)	NU-BOT-UC-NK-1073
129	<i>Laetiporus sulphureus</i> (Bull.) Murr.	Polyporaceae	Crab of the wood, chicken of the wood, Sulphur Polypore	NA	NU-BOT-UC-NK-1074
130	<i>Lactarius volemus</i> (Fr.) Kuntze	Russulaceae	Weeping milk cap	Cietou (Ang)	NU-BOT-UC-NK-1075
131	<i>Laccaria tortilis</i> (Bolton) Cooke	Hydnangiaceae	Twisted Deceiver	Ciene (Ang)	NU-BOT-UC-NK-1076
132	<i>Lentinula edodes</i> (Berk.) Pegler	Marasmiaceae	Shiitake	Cietou (Ang)	NU-BOT-UC-NK-1077
133	<i>Lactarius piperatus</i> (L.) Pers	Russulaceae	Peppery Milk-cap	Cietou (Ang)	NU-BOT-UC-NK-1078
134	<i>Pleurotus pulmonarius</i> (Fr.) Quél.	Pleurotaceae	Indian Oyster, Italian Oyster, Phoenix Mushroom, Lung Oyster	NA	NU-BOT-UC-NK-1079
135	<i>Schizophyllum commune</i> Fr.	Schizophyllaceae	Split gill fungus	Cieso (Ang)	NU-BOT-UC-NK-1080
136	<i>Macrolepiota albuminosa</i> (Berk.) Pegler	Agaricaceae	Termitomyces	Rüpucie (Ang)	NU-BOT-UC-NK-1081
137	<i>Termitomyces heimii</i> Natarajan	Lyophyllaceae	Termitomyces	Rüpucie (Ang)	NU-BOT-UC-NK-1082
138	<i>Melanoleuca grammopodia</i> (Bull.) Fayod	Tricholomataceae	Melanoleuca	Ciekro (Ang)	NU-BOT-UC-NK-1121
139	<i>Cantharellus cibarius</i> (Fr.)	Cantharellaceae	Chanterelle	NA	NU-BOT-UC-NK-1122
140	<i>Lentinus squarrosulus</i> Mont. Singer	Polyporaceae	Lentinus	NA	NU-BOT-UC-NK-1123
141	<i>Tricholoma imbricatum</i> (Fr.) P. Kumm.	Tricholomataceae	Matt knight	Mene cie (Ang)	NU-BOT-UC-NK-1124
142	<i>Termitomyces microcarpus</i> (Berk. & Broome) R. Heim	Lyophyllaceae	Termitomyces	Zogacie (Ang).	NU-BOT-UC-NK-1125

Note: Ang: Angami tribe. NA: Not available.

according to types of plants and their parts used collected during the period 2012-2016 with their scientific name, family, common Name, vernacular Name, accession number. The collected 126 UEP's belonging to 58 family and 95 genera, of which 49 family and 84 genera belongs to dicotyledones (Acantheaceae, Actinidaceae, Adoxaceae, Amarantheaceae, Anacardiaceae, Apiaceae, Araliaceae, Asteraceae, Athyriaceae, Begoniaceae, Berberidaceae, Boraginaceae, Brassicaceae, Capparaceae, Clusaceae, Combretaceae, Cornaceae, Cucurbitaceae, Ebenaceae, Elaeagnaceae, Elaeocarpeceae, Fabaceae, Fagaceae, Juglandaceae, Lamiaceae, Lauraceae, Malvaceae, Melastomataceae, Moraceae, Myricaceae, Myrtaaceae, Olaceae, Oxalidaceae, Passifloraceae, Phyllanthaceae, Plantaginaceae, Polygonaceae, Primulaceae, Rhamnaceae, Rhizophoraceae, Rosaceae, Rubeaceae, Rutaceae, Sapindaceae, Saururaeaceae, Solanaceae, Ulmaceae, Urticaceae, Vitaceae) and 9 family with 19 genera belonging to monocotyledones (Amaryllidaceae, Asparagaceae, Araceae, Arecaceae, Costaceae, Dioscoreaceae, Musaceae, Poaceae, Zingiberaceae). Among all the 58 families, Rosaceae and Urticaceae were found to be the dominant family amongst dicotyledones with 8 genera each which was followed by Moraceae with 7 genera and Asteraceae and Polygonaceae with 6 genera each. Poaceae was found to be dominant family amongst monocotyledones with 5 genera followed by Araceae with 4 genera, Zingiberaceae with 3 genera and Musaceae and Arecaceae with 2 genera.

From the collected 126 underutilized edible plant species, 3 were cereal crops (*Coix-lacryma jobi*, *Setaria italica* and *Sorghum bicolor*), 50 leafy vegetables where the young shoots and leaves or the whole plant part is taken as vegetable, 62 fruits and nuts where fruits are eaten young or mature, ripe or unripe and nuts are eaten raw or roasted, 8 plants (*Amomum dealbatum*, *Bauhinia variegata*, *B. purpurea*, *Curcuma angustifolia*, *Chimonobambusa callosa*, *Musa sikkiensis*, *M. thomsonii*, *Dendrocalamus giganteus*) where either stem, flower or inflorescence are taken as vegetable and 3 plants (*Allium tuberosum*, *Dioscorea bulbifera*, *Cinnamomum verum*) where either root, tuber, rhizome or bulb are eaten.

Nagaland is blessed with rich floristic diversity and is one of the 25 hot spots of the world with respect to its biodiversity. The forest provides all the essential necessities such as food, fuel, wood, fodder, medicine, timber, raw material, shelter and protection and also forest related activities such as gathering forest resources for trading is an important source of livelihood income for the tribal and indigenous inhabitants [42]. The collected underutilized edible plants from the three districts of Nagaland consist of 3 cereal crops which are mostly cultivated by the farmers of Kohima, Phek and Tuensang district. These crops were either taken in place of rice or along with rice by the locals. Cereal crops are economically important to many local people as they provide means of food security as well as source of income generation through the cultivation and marketing of these crops. In the local market of these districts a cup or a packet which is approximately 500 grams could fetch around Rs. 50-100 INR. But during the study investigation it was found that with the course of time, the cultiva-

tion of these crops was reduced though the demand of the crops were high, one of the reason was damages caused by the infestation of birds in the case of *Setaria italica* (Foxtail millet) and *Sorghum bicolor* (Great millet) as their seeds are small making it easy target for the birds to eat them and *Coix-lacryma jobi* (Job's tears) by squirrels. It becomes difficult for the farmers to keep away these pests from damaging the crops and thus maintenance becomes difficult ultimately resulting in lesser or reduction in the production of these Fifty UEP species are consumed in the form of young shoots and leaves or the whole plant when tender. Some of the wild leafy vegetables including *Antidesma bunius*, *Clerodendrum glandulosum*, *Houttuynia cordata*, *Gynura bicolor*, *Polygonum chinense*, *Polygonum molle*, *Trichodesma khasianum*, *Gynura nepalensis* were also cultivated in home gardens. Many of these leafy vegetables were also found selling in the local market costing around Rs. 20 - 30 INR per bunch (200 - 250 grams).

Sixty two fruits and nuts were documented in the present study, They are mostly consumed when ripe and mature while some of them are eaten when young including *Trichosanthes dunniana*, *Canavalia gladiata* *Oxalis corniculata*. Plant of *Ficus auriculata*, *Elaeagnus latifolia*, *Docynia indica*, *Mahonia nepalensis*, *Myrica esculenta*, *Prunus nepalensis*, *Litsea cubeba*, *Phyllanthus emblica*, *Livistona jenkinsiana*, *Melastoma malabathricum*, *Caryota urens*, *Baccaurea ramiflora*, *Ardisia Crispa* are collected from the wild and cultivated in the home gardens. Seeds of *Castanopsis indica*, *Juglans regia* and *Hodgsonia macrocarpa* are taken in the form of nuts). The fruits and nuts were sold in local market in fresh form, dried form or roasted or made into a local product which cost around Rs. 20 - 50 per 400 - 500 gm packet. Eight UEPs has edible stem, flower and inflorescence and 3 have edible root, tuber and bulb. Common UEPs found selling in the local markets are *Amomum dealbatum*, *Curcuma angustifolis*, *Chimonobambusa callosa*, *Cinnamomum verum*, *Dioscorea bulbifera*, *Dendrocalamus giganteus*, *Musa sikkimensis*, and *Musa thomsonii*). Wild edible mushrooms have been consumed by mankind since time immemorial [43]. Besides having high nutrient content such as proteins, vitamins, minerals, fibers, trace elements and low/no calories and cholesterol [44], mushrooms are also known to be rich sources of various bioactive substances [45] [46]. In the present study, 16 wild edible mushrooms were collected from the three districts of Nagaland belonging to 11 families, with 5 families having 2 species each namely, 1) Lycophyllaceae [*Termitomyces heimii* Natarajan and *Termitomyces microcarpus* (Berk. & Broome) R. Heim], 2) Auriculariaceae [*Auricularia auricula-judae* (Bull.) Quél. and *Auricularia polytricha* (Mont.) Sacc.], 3) Polyporaceae [*Laetiporus sulphureus* (Bull.) Murr. and *Lentinus squarrosulus* Mont. Singer], 4) Russulaceae [*Lactarius volemus* (Fr.) Kuntze and *Lactarius piperatus* (L.) Pers], 5) Tricholomataceae [*Melanoleuca grammopodia* (Bull.) Fayod and *Tricholoma imbricatum* (Fr.) P. Kumm.], and remaining 6 families with 1 species each namely, 1) Hydnangiaceae [*Laccaria tortilis* (Bolton) Cooke], 2) Marasmiaceae [*Lentinula edodes* (Berk.) Pegler], 3) Pleurotaceae [*Pleurotus pulmonarius* (Fr.) Quél.], 4) Schizophyllaceae (*Schizophyllum commune* Fr.) and 5) Cantherella-

ceae [*Cantharellus cibarius* (Fr.)], 6) Agaricaceae [*Termitomyces eurhizus* (Berk.) R. Heim]. It was observed that most of the local people love collecting the wild mushroom during mushroom seasons. There was no gender oriented when it comes to mushroom collection, both young and old, men and women equally participate. The collected mushroom are locally consumed, while some are marketed both in fresh and dried form, which cost around Rs. 50 - 100 INR (fresh) to even Rs. 200 INR (dried) per plates (200 - 300 gm) according to the season.

#### 4. Conclusion

With each passing time, there is increase of population leading to more demand of food to feed hundreds and thousands of mouth and which has led to narrowing the world food basket, necessitate to promote crop/food diversification to meet the need of the hungers. The present study aims to collect and document UEPs of three district of Nagaland, in an effort to widen our knowledge on different types and uses of these plants. UEPs have the potential to provide food security that can sustain the future generation. The study will also help create awareness about the potential nutritional values of the UEPs among the consumers. Survey and documentation of UEPs from the remaining districts of Nagaland are urgently required. Most of the products (UEPs) sold in the local markets are collected from forest UEPs are in high demand because of its taste, medicinal properties etc. Sustainable collection and proper conservation strategies need to be workout to prevent depletion of natural population and lost of the natural habitat caused mainly by anthropogenic activities. Knowledge of the phytochemical and nutraceutical properties of these UEPs will help improve its marketability.

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#### Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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