Documentation and Evaluation of Underutilized Edible Plants of Kohima, Phek and Tuensang Districts of Nagaland, India

By

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DECLARATION

I, Ms. Neilazonuo Khruomo bearing Ph. D. Registration No. 582/2014 dated May 20, 2014 hereby declare that the subject matter of my Ph. D. thesis entitled 'Documentation and Evaluation of Underutilized Edible Plants of Kohima, Phek and Tuensang Districts of Nagaland, India' is the record of original work done by me, and that the contents of this thesis did not form the basis for award of any degree to me or to anybody else to the best of my knowledge. This thesis has not been submitted by me for any Research Degree in any other University/Institute.

This is further certified that the Ph. D. thesis is submitted in compliance with the UGC Regulation 2016 dated May 05, 2016 (Minimum Standard and Procedure for Award of M. Phil./Ph. D. Degree). This thesis is being submitted to the Nagaland University for the degree of 'Doctor of Philosophy in Botany'.

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Ph. D. Course Work Mark Sheet and Certificate

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The following are the marks secured by Mr/Ms Neilazonuo

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Subject(s)/Paper(s)	Max. Marks	Minimum Qualifying Marks	Marks Scored
Course No... B.-Ph.D -I Research Methodology	100	35	65
Course No... B.-Ph.D -II Elective/Optional	100	35	70
Course No... B.-Ph.D -III Review of Literature Reports/Seminar	100	35	74
Total Aggregate marks			209
Average Pass Mark - 55%			

Result	Rank/Class/Division	Percentage
Passed		69.6 %

Marks Entered by
Dated

Marks Compared by
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Abbreviations

Abbreviation	Full Form
AOAC	Association of Official Agricultural Chemists
APAARI	Asia-Pacific Association of Agricultural Research Institutions
BAIF	Bharathiya Agro-Industries Foundation
BSA	Bovine Serum Albumin
BSI	Botanical Survey of India
CFF	Crops for the Future
DNA	Deoxyribo Nucleic Acid
DNS	3,5- Dinitrosalicylic acid
DPPH	2,2-Diphenyl-1-picryllydazyl
DPPHH	1,1-Diphenyl-2-picrylhydrazine
FAO	Food and Agriculture Organization
GAE	Gallic Acid Equivalent
HCL	Hydrochloric Acid
ICAR	Indian Counsel of Agricultural Research
ICRAF	International Council for Research in Agro Forestry
ICUC	International Centre for Underutilized Crops
IFIC	International Food Information Council Foundation
IIVR	Indian Institute of Vegetable Research
NARI	National Agricultural Research Institute
NARS	National Agricultural Research Systems
NBPGR	National Bureau of Plant Genetic Resources
NEH	North Eastern Hill
NRC	National Research Council
NGO	Non-Governmental Organization
NUCS	Neglected and Underutilized Crop Species
PAPGREN	Pacific Plant Genetic Resources Network
PEM	Protein-Energy Malnutrition
PCS	Production to Consumption System
PEM	Protein-Energy Malnutrition
SHG	Self-Help Group
SPC	Secretariat of the Pacific Community

Chapter - 1

Introduction

Human health depends on the quality of the environment in which people 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 (Panda, 2014). 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' (Jain, 2012) and plants for human consumption account for about 5% of the total plant species of the world (Asfaw and Tadesse, 2001). Mankind depends on a very limited number of crops to meet the needs of staple diets and on a very limited number of major non-food crops to meet associated needs (Williams and Haq, 2000). The increasing reliance on these major food crops leads to shrinking of the food basket which mankind has been relying upon for generations (Prescott and Prescott, 1990) and the need to feed hundreds and thousands of mouth has led to starvation in many developing countries, as such the need to fight against poverty has raised great concern for the developing countries (Deb *et al.*, 2016).

It has become an international issue to tackle and the need to take urgent action to promote easy and cheaper crop diversification to encounter such problem. Underutilized edible plants can play a very important and crucial role in providing more crop diversification to tackle the problem of poverty and be able to provide food security to the poor in the world in general and in the developing countries in particular.

Underutilized crops is defined as 'those species which are under exploited for contributing to food security (nutritional/medicinal), income generation and environmental services' (Jaenicke and Zeledon, 2006) and their ability to cope with adverse growing and climatic conditions offer great promise in the era of climate change (Bala Ravi *et al*., 2006). They are also referred as 'Neglected and Underutilized species'/'Orphan crops'/'Minor crops' (Padulosi *et al.*, 2002). Underutilized crops are often presented as `New crops' (Vielmeyer, 1990) for the fact that commercial companies/researchers are only recently working on them. Gruère e*t al*. (2006) categorized underutilized crops by the fact: a) they are locally abundant but globally rare, b) has lack of scientific knowledge concerning their physiology, agronomic and ecological properties as well on the properties of the plants products, and c) has a limited current use relative to their economic potential. Underutilized crops generally have common characters or features such as representing an enormous wealth of agro-biodiversity and great potential for contributing to improved incomes, food security and nutrition, combating the 'hidden hunger' caused by micronutrients deficiencies, strongly linked to the cultural heritage of their original place, mainly local and traditional crops (with their ecotypes and landraces) or wild species whose distribution, biology, cultivation and uses are poorly documented and are well adapted to specific agro-ecological niches and marginal lands, mostly gathered from the wild or produced in traditional systems with little or no external inputs. They are poorly received with little

attention from research, extension services, farmers, policy and decision makers, donors, technology providers and consumers although they may be highly nutritious and/or have many medicinal properties or other multiple uses. Some of the economic factors explaining underutilization of these crops are of the following:

1. Crop product output markets may be missing due to exogenous underutilized and/or endogenous constraints. For example, Capers (*Capperis spinosa* L.) is underutilized in Syria due to high transaction costs cause by a lack of information and trust among market chain actors (Giuliani *et al*., 2006). African garden egg (*Solanum aethiopicum* L.) is underutilized in Ghana due to its short shelf life (Horna and Gruire, 2006).

2. The market equilibrium may be suboptimal as a result of market imperfections, such as the need for processing infrastructure and organization, causing for instance a lack of caper supply in Syrian consumer markets (Giuliani *et al*., 2006).

3. Market failure may generate greater public than private value. For example, rice bean (*Vigna umbellata*) is undervalued as a nitrogen-containing bio-fertilizer in the mountainous areas of Vietnam (Gruire *et al*., 2006).

Underutilized crops can be categorized into different groups according to the plant parts used which are as followed in **Table 1.1.**

Table 1.1: Underutilized crops categorized into different groups of plant

Cereal and Pseudo-cereal Crops		
Sl. No.	**Botanical Name**	**Common Name(s)**
1	*Amaranthus caudatus*	Love-lies-bleeding, Pendent
2	*Chenopodium quinoa*	Kinua, Parka
3	*Chenopodium pallidicaule*	Canihua, Kanewa
4	*Digitaria exilis*	Hungry millet, Hungry rice
5	*Echinochloa frumentaceae*	Indian barnyard millet
6	*Echinochloa utilis*	Japan millet, Shirohie millet
7	*Eleusine coracana*	Finger millet
8	*Fagopyrum esculentum*	Buck millet
9	*Panicum miliaceum*	Broom corn millet, White millet
10	*Panicum milliare*	Panic grass, Crab grass
11	*Paspalum Scrobiculatum*	Kodo millet, Scrobic paspalum
12	*Setaria italic*	Foxtail bristle grass

Fruits and Nut Species		
1	*Adansonia digitata*	Dead-rat-tree, Monkey
2	*Annan cherimola*	Custard apple
3	*Bactris gasipaes*	Peach palm
4	*Ficus carica*	Common fig
5	*Juglans regia*	Walnut
6	*Passiflora edulis*	Passion fruit
7	*Ziziphus mauritiana*	Indian jujube, Ber
Vegetables and Pulse Crops		
1	*Amaranthus spp.*	Pig weed
2	*Brescia carinita*	Abyssinian mustard, Ethiopian mustard
3	*Chenopodium album*	Lamp's quarters, Goose foot
4	*Crambe cordifolia*	Heart-leavd-colewort
5	*Hibiscus sabdariffa*	Roselle, White/red sorrel
6	*Ipomoae aquatic*	Water spinach, Aquatic morning glory
7	*Lablab purpureus*	Hyacinth bean, poor man's bean
8	*Moringa oleifera*	Drum stick, Moringa
9	*Parkia biglobosa*	African locust bean, Soumbora
10	*Solanum nigrum*	Black nightshade marshcress
11	*Talinum triangulare*	Water leaf, Philippine spinach
12	*Vigna aconitifolia*	Mung bean
13	*Vigna angularis*	Cow bean
Root and Tuber Crops		
1	*Arracacia xanthorrhiza*	Arracacha, White carrot
2	*Calathea allouia*	Sweet corn root, Guinea arrow root
3	*Canna edulis*	African arrow root, Canna lily
4	*Colocasia esculenta*	Cocoyam, Green taro
5	*Harpogophytum procumbens*	Devil's claw, Grapple plant
6	*Oxalis tuberose*	Oxa, Oxalis, New Zealand yam
7	*Pachyrhizus erosus*	Jicama, Yam bean
8	*Plectranthus esculentus*	Living stone potato, Coleus potato
9	*Solenostemon rotundifolius*	Housapotato, Country potato
10	*Sphenostylis stenocarpa*	African yam bean
11	*Tylosema fassoglense*	Creeping Bauhinia
12	*Vigna vexillata*	Wild cow pea, Zombi pea
13	*Xanthosoma sagittifolium*	Tanna, New cocoyam Tania
Industrial Underutilized Oil Seed Crops		
1	*Acrocomia aculeate*	Totai, Macauba
2	*Bactris gasipaes*	Peach palm
3	*Balanites aegyptiaca*	Desert date, Soap berry tree
4	*Butyrospermum paradoxum*	Shea butter tree
5	*Carthamus tinnctorius*	Saf flower
6	*Catullus colocynthis*	Bitter apple
7	*Euphorbia lagascae*	Caper spurge, Wild spurge
8	*Jatropa curcas*	Physic nut, Purging nut
9	*Lesquerella fendleri*	Fendler's bladder pod
10	*Perilla frutenscens*	Beefsteak plant

11	*Ricinus communis*	Caster oil plant
12	*Sesame indicum*	Gingely oil plant, Sesame
Latex/Rubber/Gum		
1	*Couma utilis*	Milk tree
2	*Parthenium argentatum*	Mexican rubber, Guayule
Fibers		
1	*Hibiscus cannabinus*	Deccan hemp, Kenaf
Starch/Sugar		
1	*Ceratonia siliqua*	Carob, St. John tree
2	*Metroxylon sagu*	Sago palm
Dye		
1	*Bixa orellana*	Achiote, Annato
2	*Carthamus tinctorius*	Saf flower
3	*Hibiscus sabdariffa*	Roselle

(Source: Wikipedia, the free encyclopedia)

Underutilized crops/plants play a vital and crucial role in the daily life of many developing countries. Of many fold important benefits of underutilized crops/plants, some of which are cited below:

1. Ensuring the food security to millions of people worldwide.
2. Having the potentiality to contribute to poverty elimination through employment opportunities and income generation through profitable farm household labor use in both rural and urban environments.
3. Provide or contribute to sustainable livelihoods through household food security offering cheaper and variety of food thereby widening the food basket.
4. They add nutrient to daily diet that fights better against diseases caused by micronutrients deficiencies.
5. They are well adapted to different environmental conditions such as famine, drought etc.
6. They provide a broader diversity of crops/plants to improve productivity and global food security and to meet new market demands.

A brief review of past research on underutilized crops in different parts of the world is given below:

International Status

Leakey *et al*. (1982) reported on the domestication of *Triplochiton scleroxylon*, an important timber tree of the moist West Africans forest since *Triplochiton scleroxylon* K. Schum (Sterculiaceae) for its good peeling properties being favored by plywood manufacturers. They have reported that the extension of the seed viability by appropriate drying and cold storage and the successful development of vegetative propagation methods for seed supply. Rooted cuttings, branching physiology and flowering in glasshouse conditions has also allowed progress promising clones of good form, branching habit and control over reproduction respectively. Also, domestication of other timber and tropical trees for minor forest products (gum/fodder/tannin etc.) are discussed.

Autran *et al*. (1995) worked on the Durum wheat to improve the quality for making various types of bread by using genetic variation as its bread making quality is inferior to that of bread wheat *Triticum aestivum.* The genetic variation does showed as the durum wheat cultivars analyzed so far show high alveograph tenacity/extensibility (P/L) ratios typical of tenacious glutin character (Boggini and Pogna, 1989).

A study was conducted on *Vitex agnus-castus* (chaste tree) an underutilized plant for its ecological and economical attributes such as pharmaceutical drug, as a dye plant, as a source of honey, as a material in basket weaving (Passalacqua *et al.*, 2006, Dogan *et al*., 2008a, 2008b, 2011), Traditionally used by practitioners of phytotheraphy in the treatment of many female conditions (Christie and Walker, 1997; Lans *et al.*, 2006; Padmalatha *et al*., 2009; Tareen *et al*., 2010).

Looy *et al.* (2008) studied the Underutilized Agroforestry Food Products in Amazonas focusing on the Piaroa indigenous people who collect and cultivate several indigenous species with local, regional, national and even international potential. Seven agro forestry food products were identified as underutilized and after thorough investigation and trader surveys on the local markets and participatory exercises in selected Piaroa communities revealed that the main causes of underutilization are the general lack of transport, processing and market infrastructure in Amazonas; the lack of demand, due to a lack product information; the lack of market information and co-operation between the different market chain actors; and the low productivity of the traditional slash and burn plots. Solutions to overcome the infrastructure constraints are sought by looking at the example set by a local NGO.

A regional consultation on 'Crops of the Future: Towards Food, Nutritional, and Economic and Environmental Security' was organized by Secretariat of the Pacific Community (SPC), Asia-Pacific Association of Agricultural Research Institutions (APAARI), Biodiversity International on behalf of the Pacific Plant Genetic Resources Network (PAPGREN) , Crops for the Future (CFF) and National Agricultural Research Institute (NARI), Papua New Guinea on 21-22 September 2009, Nadi and Fiji Island (Taylor *et al*., 2009) where the issues concerning effective utilization of crop diversity to manage the vagaries climate change and to increase and diversify the local food production to ensure food and nutritional security were addressed. It also discussed on to develop appropriate strategy for effective use of neglected species for the regions for sustainable food production as well as food security. Through this consultation, the pacific region is well placed to take advantage of opportunities to develop these species and also to strengthen available expertise and skills by building new partnerships to augment existing capacity of National Agricultural Research Systems (NARS).

In the past many works were conducted on underutilized crops like *Lablab purpureus*- A lost crop of Africa, has been noted for decades as being one of the most agro-morphologically diverse and this was earlier supported by many previous workers (Rivals, 1953; Pengally and Maass, 2001; Mohan and Aghora, 2006; Islam, 2008; Maass *et al*., 2010) versatile tropical legume species through its role as pulse (also used as `dhal'), vegetable (green been, pod, leaf), forage/green manure, herbal medicine and even ornamental (Adebesi and Bosch, 2004; NRC, 2006). In the recent past, Morris (2009) reviewed its bio-functional properties for use as pharmaceutical or nutraceutical. Lablab has been found to occur naturally in several African countries (Verdcourt, 1970, 1979) and both the wild and domesticated African landraces have been shown to be genetically diverse (Liu, 1996; Maass *et al*., 2005; Tefera, 2006). There is almost no ongoing Lablab research in Africa but a small number of studies (Fischler and Wortnann, 1990; Mureithi *et al*., 2003; Odunze *et al.*, 2004; Nyende and Delve, 2004; Tefera, 2006) have attempted to address with farmers the issue of acceptability of lablab, its varieties and potential uses. Lablab has an outstanding adaptation to drought (Maundu *et al*., 1999) and has been reported to have better drought tolerance than common beans (*Phaseolus vulgaris*) or cowpea (*Vigna unguiculata*) (Keller *et al*., 2006; Piper and Morse, 1915). Since there is no report of ongoing research on improving lablab as a food for Africa, the traditional diversity of lablab in Africa is undoubtly under threat of genetic erosion.

Danaila *et al*. (2012) reported the *in vitro* behavior of various somatic explants from some cultivated *Amaranthus* genotypes for its nutritional and economic potential for the future agriculture. This work focused mainly on the three ancient *Amaranthus* sp., *Amaranthus caudatus* (L), *Amaranthus hypochondriacus* (L) and *Amaranthus cruentus* (L) cultivated worldwide because of their exceptional nutritional value of both seeds and

leaves, widespread ornamental uses, potential as forage crops and red food colorants, antioxidant compounds and valuable photochemical such as α-amylase, trypsin inhibitors and other active compounds with important uses in medicine. Besides, this rediscovered crop has some agricultural advantages and noted ability to grow successfully in adverse environmental conditions such as high irradiance, temperature and drought.

The 6th International Conference of the European Amaranth Association was held on 21-24 October 2012 at Nitra, Slovak Republic under the theme 'Neglected and Under-utilized Species Research in 21st Century' where Grain amaranth (*Amaranthus* sp.), a pseudocereal was the main focused plant. Different papers were presented on Amaranth, depending on cultivation conditions and properties of the species; this crop is used as food, medicinal and ornamental plant in many countries (Yudina *et al.*, 2005). Crude grain protein content ranges from 12.5 to 22.5 % on a dry matter basis and rich in the essential amino acid higher mineral content which are limited to cereal crops but since its genetics is poorly studied, Kečkešová *et al*. (2012) studied the different enzyme polymorphism analysis in irradiated amaranth (*Amaranthus* sp.) lines, Viljoen *et al*. (2012) studied the whole genome sequence of *A. tricolor* which resulted in reconstructing 97% of the chloroplast genome by mapping 2.4 million reads to sugarbeet (*Beta vulgaris* L.) showing sugarbeet and spinach *(Spinacia oleraceae)* to closely related to it, adding value to amaranth through the use of radiation mutagenesis (Hricová *et al*., 2012).

Melo *et al*. (2013) analyzed different nutrient value in the leaves, flowers, tender pods, edible of *Moringa oleifera* where pods has the highest water content (90.86%), seed has highest value as 96.89%, 32.19, 32.40 in dry matter, protein, lipid respectively and pods having highest value as 13.40, 22.57 in minerals and fiber with flowers having highest value as 58.08 in soluble carbohydrates.

Seifu (2014) reviewed the plant *Moringa stenopetala* in Ethopia where many tribes consume its leaves as a vegetable, especially during the dry season (Jahn, 1991; Demeulenaere, 2001; Abuye *et al*., 2003). The plant leaves contents high nutritional value such as essential amino acids and vitamins A and C (Steinmüller *et al*., 2002; Abuye *et al*., 2003; Mathur, 2005; Melesse *et al*., 2009) and a tree can produce up to 4,500-10,000 seeds (EIAR, 2003) with an average ash, crude fiber contents of 57 ± 2.8 g/kg DM, 96 ± 10.5 g/kg DM (Melesse *et al*., 2009; Seifu, 2012) respectively. It also exhibit medicinal properties such as lower blood glucose and cholesterol levels (Ghebreselassie *et al*., 2011), diabetes (Toma *et al*., 2012), malaria (Mekonnen, 2003), exhibit anti-leishmanial activity (Kinuthia *et al*., 2013), anti-microbial properties (Eilert *et al*., 1981; Jahn, 1991; Mekonnen, 2003; ICRAF, 2006; Walter *et al*., 2011), antibacterial properties (Tesemma *et al*.,2013), leprosy (Demeulenaere, 2001). Also, the plant is used as fodder for animals (ICRAF, 2006; Melesse *et al*., 2013), clarify muddy water (Mekonnen, 2003; ICRAF, 2006; Hellsing *et al*., 2013), reduced bacterial contamination (Sutherland *et al*., 1989), removed cadmium (II) ions, chromium and lead from contaminated water and tannery wastewater. (Mataka *et al*., 2006; Mataka *et al*., 2010; Degefu and Dawit, 2013; Gatew and Mersha, 2013).

A book was published on diversity of underutilized plant species – an Asia-pacific perspective on the works done by R.K Arora in 2014. R.K Arora, an eminent plant scientist who dedicated his life to the field of underutilized crops and useful wild relatives of crop plants. The book emphasized on the enumeration of 778 underutilized and less minor food plant species of Asia-pacific region, their distribution, uses, priority species for research and development, nutritional aspects and the emerging concerns such as diversity distribution/assessment, biotechnology applications, documenting indigenous knowledge, diverse uses and conservation of these species and the need for

partnership/networking at regional, national and international level for realizing the full potential of these plants.

Nyadanu and Lowor (2015) studied five indigenous leaf (*Amaranthus cruentus, Corchorus olitorius, Solanum macrocarpon, Xanthosoma sagittifolium, Adasonia digitata*) and three fruit vegetables (*Solanum torvum, Solanum aethiopicum, Solanum macrocarpon*) of Ghana for promoting consumption of indigenous vegetables and conservation of their genetic resources. *Solanum macrocarpon* has the highest protein and carbohydrate content (58.44Kcal and 15.21 Kcal). Cocoyam has the highest protein content (11.61Kcal). Among the indigenous fruit vegetables, *Solanum aethiopicum* has the highest protein and carbohydrate content (4.82Kcal and 10.11Kcal) respectively then the other two fruit vegetables. The mineral nutrients of the indigenous vegetables varied significantly then the exotic vegetables (Cucumber, Tomato, Green pepper, Cabbage, cauliflower, lettuce).

Baldermann *et al*. (2016) in their article 'Are Neglected Plants the Food for the Future?' discussed the different issues and problems relating to health. One major issue was malnutrition which is still the world's greatest challenges as around 800 million suffers from it particularly in underprivileged population groups (FAO, 2010). Potential of neglected plants in different continents *viz*., Asia, Africa, North and South America were reviewed. Asia has broad biodiversity due its diverse climatic conditions; in China alone have over 400 families, 3100 genera, and about 30000 species known (Chen and Zhang, 2001). Arora (2014) lists 778 underutilized species in the Asian- Pacific region, including 261 fruits, 213 vegetables, 55 root/tuber types, 34 nuts, 28 pseudo cereals and millets, 14 grain legumes/pulses, 25 industrial crops, and 148 others and bitter gourd, moringa, and ivy gourd were listed as neglected plants by the biodiversity international organization in 2013 (Padulosi *et al*., 2013). Seaweed has a huge biodiversity, complex

composition, and broad range of nutritional and health beneficial compounds (Cardozo *et al*., 2007; El Gamal, 2010). *Gnetum africanum* and *Telfairia occidentalis* used for its many medical purposes in parts of Africa (Esuoso *et al*., 1998; Oboh *et al*., 2006; Ali *et al*., 2011; Ingram *et al*., 2012; Otitoju *et al*., 2014). Maca roots (*Lepidium meyenii*) have been used by native Indians in Peru for nutritional and putative medicinal purposes (Gonzales, 2012). Arracachà (*Arracacia xanthorrhiza*) is an important food in North and South America for its different food purposes (Arbizu *et al*., 1997; Lim, 2015). Cashew apple (*Anacardium occidentale*) a by-product of cashew nut production is an important plant because of its many uses like beverages, jam, syrup, chutney, and juice (de Abreu *et al*., 2013) and medicinal properties like potent diuretic and sudorific properties (Talasila *et al*., 2015), applied as an ointment to relieve the pain of rheumatism and neuralgia (Morton, 1987), antibacterial (Kubo *et al*., 1999), antioxidant (Melo Cavalcante *et al*., 2003: da Silva *et al*., 2013), anti-inflammatory, and wound-healing effects (da Silveira Vasconcelos *et al*., 2015). Maca (*Lepidium meyenii*) used as a root vegetable as well as a medicinal herb (Valentova *et al*., 2003; Taylor, 2005; Ernst *et al*., 2011; Lee *et al*., 2011), Nance (*Byrsonima crassifolia*) plant is use as food and beverages (Orwa *et al*., 2009) and medicinal purposes (Caceres *et al*., 1991; Caceres *et al*., 1993; Bejar *et al*., 1993; Martinez-Vazquez *et al*., 1999; Morales *et al*., 2001). The paper also discusses benefits and barriers of establishing neglected plants along the food supply chain (Fanzo *et al*., 2013) and different Strategies to bring neglected plants out of their niche role (Chweya *et al*., 1999; Thies, 2000; Eissing & Amend, 2008; Fanzo *et al*., 2013; Meaza *et al*., 2015; Latynskiy *et al*., 2016).

Salvi and Katewa (2016) did a review on underutilized wild edible plants as a potential source of alternative nutrition where ethnobotanical observations on underutilized wild edible plants and nutritional value of underutilized wild edible plants

at international and national level was reviewed. 6 underutilized plant species in Pakistan are prominently used as medicinal and food species viz. *Adhatoda vasica, Artemisia scoparia, Amaranthus viridis, Hedera nepalensis* and *Urtica dioica* (Ahmad and Javed, 2007). Dansi *et al*. (2012) reported 41 neglected and underutilized crop species (NUCS) among which 19 species were identified as of priority base on 10 criteria among which included their extent and degree of consumption in of Benin (West Africa). Abubakar *et al*. (2012) sixty underutilized flowering plant species as vegetable, Abuja and Nigeria and Osewa *et al*. (2013) investigated the uses of neglected and underutilized plan species in akinyele, Nigeria. Nayagum *et al*. (1993) recorded 27 species of less known wild edible fruits, Singh and Gupta and Jain and Sinha (1987) studied life support species used by rural people under extreme environment condition, Sundriyal and Sundriyal (2003) reported six plant species of underutilized wild edible plants as a food. Bhatt et al. reported that flowers and buds of *Crotalaria tetragona* are cooked as vegetable in non-vegetarian recipes in the north-eastern hill region of India while Terangpi et al reported *Gnetum gnemon* and *Rhynchotechum ellipticum* as less known plants used by Karbi ethnic group in Assam, Northeast India. Onweluzo *et al*. (1995) studied on isolation and characterization of protein of some lesser known tropical legumes, nutritional potential of an underutilized legume *Mucuna pruriens* var. *utilis* (Pugalenthi *et al*., 2005), Murthy and Emmanuel (2011) studied nutritional and antinutritional properties of the underexploited wild legume *Rhynchosia bracteata* Benth while Barminas *et al*. (1998) studied mineral composition of six nonconventional leafy vegetables. Dolezal *et al*. (2001) investigated chemical composition of less- Known wild fruits while Bhatt and Karim (2009) studied Nutritional Potential of Wild and Underutilized Legumes. Aberoumand (2011) investigated nutritional and bioactive components of an under exploited food plant *Alocasia indica*. Ng *et al*. (2012) studied

five underutilized wild vegetables for nutritional value, phenolic components and antioxidant activities. Maikhuri (1991) studied nutritional value of some lesser known wild food plants and their role in tribal nutrition in North India. Duhan *et al*. (1992) studied nutritional value of thirteen non-conventional plant foods fruits, leaves and grains consumed in various parts of the Indian sub-continent. Rao (1994) has worked on nutrient composition of some less familiar oil seeds of Andhra Pradesh while Sankhala *et al*. (2005) studied less familiar leaves consumed by the tribals of Udaipur region. Bhargava *et al*. (1996) analyzed different edible parts of seven bamboo species for their nutrient contents viz., total carbohydrates, proteins, vitamins C and minerals. Siddhuraju *et al*. (1996) studied chemical composition and nutritional characteristics of seeds of *Mucuna pruriens* while Kala and Mohan (2010) studied nutritional and anti-nutritional potential of genus *Mucuna pruriens var. pruriens*. Mohan and Kalidass (2010) described the nutrition and anti-nutritional value of 23 unconventional wild edible plants Nazarudeen (2010) studied nutritional composition of some lesser - known fruits used by the ethnic communities and local folks. They reported 218 species of wild edible fruit plants from forest of Kerala. Kunwar *et al.* (2012) studied relative importance of 49 underutilized plant species by using relative importance (RI) technique. Khomdram *et al*. (2014) studied Nutritional composition of two underutilized wild edible fruits of *Elaeagnus pyriformis* and *Spondias pinnata*. Their work is an attempt to disseminate knowledge to help maintain cultural traditions and facilitate research into food history and new food sources and the need to implement the application of modern biotechnological methods for the commercial exploitation of these plants for developing new foods (or for bio-fortification) as well as for use in the pharmaceutical industry.

National Status

Mishra *et al*. (2005) did a review on micropropagation on certain underutilized fruit crops. This review outlined the works done on micropropagation of many important yet underutilized fruit crops in India such as Indian gooseberry (*Emblica officinalis* Gaertn), bael (*Aegle marmelos* Corr.), jackfruit (*Artocarpus hetrophyllus* L.), tamarind (*Tamarindus indica* L.) and jamun or black plum (*Syzygium cuminii* L. Skeels.). Aonla or Indian gooseberry is one of the important fruit crops of India and thrives well in saline and sodic soils and is also well suited for other wasteland situations (Ram, 1982) having many medicinal properties (Anon, 1960). The success rate of vegetative propagation Indian gooseberry (*Emblica officinalis* Gaertn) in different genotypes ranges from 25-80% (Ram, 1982). A procedure for control of the in vitro oxidative browning was reported by Mishra *et al*. (1999) and high frequency plantlet regeneration was achieved from callus cultures (Verma and Kant, 1999). Bael (*Aegle marmelos* Corr.) is taken as a beverage (Arora and Pandey, 1996). Regeneration from seed explant tissue such as hypocotyl, nucellus, cotyledons, leaf and zygotic embryo (Arya *et al*., 1981; Hossain *et al*., 1993) has been worked out. Biochemical changes relation to differentiation in callus cultures have been reported (Bhardwaj *et al*., 1995) and micropropagation using nodal shoot explant from mature, bearing tree is has been recently reported by Mishra *et al*. (2003). Regeneration of plants via adventitious bud formation from, mature zygotic embryo axis of tamarind (*Tamarindus indica* L.) was successfully achieved by Mehta *et al*. (2000). Direct differentiation of shoot buds from hypocotyl segments of 12-day-old tamarind seedlings was obtained on MS medium with or without growth regulators (Jaiswal *et al*., 1998) and *In vitro* rhizogenesis of *Tamarindus indica* L. micro shoots was reported by Ganga *et al*. (2000). Jackfruit (*Artocarpus hetrophyllus* L.) was micropropagated using shoot tip explants techniques , large-scale plant production from

nodal segments or shoot tips (Monette, 1986), shoot tip culture for rapid multiplication has been described by Jaiswal and Amin (1991) and 75% of the seedlings survived after transplanting into the open field through this method (Roy and Roy, 1996). Also Micropropagation was achieved from terminal and axillary buds of 40-year-old trees on supplemented MS medium and 75% of these plants survived (Roy *et al*., 1991). Jamun or black plum is an important indigenous underutilized fruit of commercial value. Micropropagation of jamun (*Syzygium cuminii* L. Skeels.) has been worked out utilizing juvenile tissue (Roy *et al*., 1996). Micropropagation using seedling explant has been described by Yadav *et al*. (1990) and Jain and Babber (2000) described a detailed micropropagation protocol using nodal explants excised from young shoots from mature trees. Successful micropropagation protocol of *Syzygium cuminii* L. Skeels. has been developed at CISH, Lucknow using nodal explants from mature tree (Mishra, 2003). This review discussed about the commercial production of these crops which is restricted due to the shortage of desirable planting material and how micropropagation can play an important role in rapidly increasing new cultivars of these fruit crops.

Bala *et al*. (2010) did a study on mobilizing neglected and underutilized crops to strengthen food security and alleviate poverty in India where the M.S. Swaminathan Research Foundation, Chennai in collaboration with Biodiversity International, Rome has been implementing a project on neglected and underutilized crops with the support of the International Fund for Agricultural Development, Rome in which 3 neglected and underutilized crops was chosen for the study - finger millet (*Eleusine coracana*), Italian or foxtail millet (*Setaria italica*) and little millet (*Panicum sumatrense*) focusing on eleven villages in Kolli Hills (Namakkal District, Tamil Nadu) and Kundura (Koraput District, Orissa), as these areas have been traditionally under cultivation and intrinsically linked with food security, livelihood and cultural identity of local tribal communities.

This work demonstrated the different advantages offered by the underutilized and neglected crops which enjoy high adaptive advantages under marginal agro-ecological and edaphic situations, in enhancing the food and nutritional security of local communities and enhancing their income and potential in the era of climate change in view of their unique adaptive strength and importance in the future agriculture of India and elsewhere in the world.

Gajanana *et al*. (2010) has done many case studies on small scale processing and marketing of underutilized fruits, one of which is 'Exploring Market Potential and Developing Linkages – A Case of Underutilized Fruit Products in India'. In this study, Indian Institute of Horticultural Research, Bangalore, India, under the International Centre for Underutilized Crops (ICUC), trained the officials of Bharathiya Agro-Industries Foundation (BAIF, NGO), on small scale processing and marketing of underutilized fruits like aonla, tamarind and jackfruit into different products in August, 2004 as a result of which small scale processing units were established at the community village level in the state of Karnataka, Maharashtra and Gujarat in India. Market surveys was undertaken to ascertain the processing and market potential of underutilized fruit products like citron pickles, tamarind paste and jackfruit chips (Hassan district, Karanataka), aonla pickle, aonla squash, aonla supari and tamarind products like concentrate, pani puri masala (Pune, Maharashtra), pachan aonla (digestive aonla), ber powder, salted ber and tamarind under different brand names like Oswal, Khelkar, Frootlet (Dharmapur and Valsad markets, Gujarat) sold by the retailers in small quantities. These products are small but have made their presence felt in the market and consumers have accepted the quality and price of the products of the small scale community processing unit yet label needs improvement and is to be made more attractive. Thus, market research has helped in identifying the potential markets for the

underutilized fruit products of the community level processing units. The institutional arrangements in the form of IIHR-BAIF have benefited the community at large and the women, self-help group (SHGs) in particular.

Pandey *et al*. (2011) worked on *Moringa oleifera* Lam, a medium sized tree species that has gained importance due to its multipurpose potential uses like edible fruits and medicinal purpose (Wealth of India 1962; Singh *et al*. 2000) and well adaptability to dry and hot climates of north-western plains, central India and dry regions of peninsular India with distribution of diversity and genetic resources value in different parts of the country (Ramachandran *et al*., 1980; Gaur 1999; Singh *et al*., 2000; Grubben and Denton 2004; Murthy and Venu 2005; Bhattarai and Baral 2006). Also information on diversification in use *viz.*, regional importance has been included in the publication to broaden the scope for value addition, identification of potential value and use in plant genetic resource programs.

Sasi *et al*. (2011) documented a total of 50 wild edible plants belonging to 31 families under 43 genera given in a tabulated form along with the botanical name, family, habit, parts used, mode of preparation and dietary form from Kotagiri Hills which is a part of Nilgiri Biosphere Reserve, Southern India. The study showed that the tribal communities of this area fulfill their food deficiency by supplementing wild food plants in their daily diet.

Indian Institute of Vegetable Research (IIVR), Varanasi, India documented 'Vision 2030' in July 2011 highlighting the issues strategies relevant for the next twenty years. The IIVR, Varanasi has a major challenge in the years ahead to develop technologies that enhance quality and productivity of vegetables in an environment with several biotic and abiotic stresses. It was expected that the analytical approach and forward looking concepts present in the vision 2030 document will prove useful for the

researchers, policy makers and stakeholders to address the future challenges for growth and development of the agricultural sector and ensure food and income security with a human touch.

Dod *et al*. (2013) worked on different underutilized *Momordica* species *viz*. *Momordica dioica* Roxb (spine gourd), *Momordica subangulata* sp. *renigera* (teasel gourd) and *Momordica cochinchinensis* (sweet gourd) and their nutritive value particularly for protein (spine gourd) and carotene and lycopene (sweet gourd). The study was undertaken to evaluate *Momordica* species for growth and yield. They concluded that the established genotype with the most superior yield could be utilized for further crop improvement of spine gourd and promising selected genotypes will be tested for its performance at several locations.

Thakur (2014) reviewed the works on underutilized food crops and discussed what underutilized crops are and how it is importance towards Indian economy and their benefits to the environment by replacing the depleting resources with the new ones. The paper also emphasized the Indian government policies and strategies for food security to set-up appropriate steps for uplifting the status of underutilized crops as many of these species have the potential to contribute to food security, nutrition, dietary and culinary diversification, health and income generation and environmental services.

Mulay and Sharma (2014) documented 85 weed species belonging to 65 genera and 37 families from Ahmednagar district, Maharastra, India which was given in a tabulated form along with the botanical name, family, local name, parts used and their preparation. The study showed five dominant families in respect of maximum number of species used for food *viz*., Amaranthaceae (8 species), which is followed by Fabaceae (7 species), Asteraceae, (6 species), Caesalpiniaceae and Malvaceae (5 species). Other family includes Solanaceae and Lamiaceae (4 each), Convolvulaceae, Cleomaceae,

Menispermaceae and Cucurbitaceae (3 each), Apiaceae, Commelinaceae, Verbenaceae, Arecaceae, Cappraceae, Chenopodiaceae and Poaceae (2 each), while remaining families have single species used as food.

Dandsena and Banik (2016) worked on processing and value addition of the underutilized agriculture crops and indigenous fruits of Bastar region of Chhattisgarh that attempted to study the potential of underutilized crops and indigenous fruit and their value-addition as well as popularization in particular found in Bastar region of Chhattisgarh through production to consumption system (PCS value-chain). They also studied the close adaptive relationship between the tribal and the environment that enabled them to grow, manage and collect many lesser known agricultural or non-timber forest species which are available only in the local markets and practically unknown in other parts of the world. This work also discussed the different nutritious value added food items prepared from different underutilized crops and fruits of Bastar region. The different food items prepared from these plants are biscuits, muffins, health drinks, multi-grain noodles, sauces, soup, curry, herbal tea, soft drinks, jam, jelly, chips, pickles etc. The paper also discusses the different approaches like publicity, awareness campaigns and training so as to popularize the local product in the market and capturing the market share.

Gowthami *et al*. (2016) documented 45 species of underutilized green leafy vegetables mostly belonging to the species of *Amaranthus* sp., *cleome* sp., *Solamun* sp. etc along with their botanical name, family, common name, local name and also their mode of consumption from South Karnataka of India.

Banka *et al*. (2017) studied varieties of underutilized green leafy vegetables rich in iron and other essential micronutrients and made an effor to develop standardize iron rich value added products like Chakali, Namakpara, Bhujia and Tarts by using varieties

of dried powder of underutilized green leafy vegetables rich in iron such as cauliflower leaves, carrot leaves, beet green leaves, turnip leaves and curry leaves etc., which are mostly not utilized by general mass for human consumption.

Regional Status

Hore and Rathi (2002) executed a study on collection, cultivation and characterization of buck wheat in North-East region of India as survey and collection of buckwheat was carried out in the North Eastern Hill (NEH) Region of India in the states of Sikkim, Arunachal Pradesh, Assam, Manipur, Nagaland and Meghalaya beginning in 1987. In this study a total of 40 accessions belonging to two species, *Fagopyrum esculentum* and *F. tataricum* were collected during the period of 1987-2001. Buckwheat grain is consumed by humans in a similar manner to cereals, as animal feed and fodder, as a leafy vegetable and also as a cover crop. There are a lot of advantages and scope to grow this crop in the northeastern region. Northeastern region is normally an agricultural region and with high rainfall, low temperature and abandoned areas due to shifting cultivation (locally known as jhoom) can be utilized effectively to grow the crop as it requires little inputs. The prevailing agro-ecological condition of the region is very suitable to producing such an under-utilized crop as buckwheat in a large scale. The study also shows assured marketing channel encouraging the farmer to grow this crop in a larger scale in this region.

Rai *et al*. (2004) studied the conservation and genetic enhancement of underutilized vegetable crops species in North-East region in India on the different diversity of underutilized crops in the North-East region and the problem related in the conservation and improvement of these crops. They concluded that problems relating to conservation and enhancement of underutilized crops in north eastern region are land tenure issues, gender and equity issues, interdepartmental coordination, shifting

cultivation, inter-state border dispute, insurgency etc. Adequate attention was given for systematic management and enhancement of underutilized crop species available in this region with the establishment of institutions like National Bureau of Plant Genetic Resources (NBPGR), Indian Counsel of Agricultural Research (ICAR), and Botanical Survey of India (BSI) etc. that made tremendous efforts and keeping in view, the regional demand for vegetable crops, underutilized species needs to be identified for collection, particularly, for high yield, quality, resistance to diseases and pests, tolerance to frost and acidity.

Again, Rai *et al*. (2005) worked on underutilized horticultural crops in North Eastern region *viz.* Assam, Meghalaya, Manipur, Mizoram, Nagaland, Tripura and Sikkim emphasizing on the scope of underutilized horticultural crops, the diversification of underutilized horticultural crops of these region, the constraints for the development of underutilized horticultural crops and the strategies for the development of underutilized horticultural crops of North-East region as these crops can provide many fold employment opportunities in agro-based industries, packaging, storage, preservation, canning and transportation.

Sankaran *et al*. (2006) reported 40 wild edible fruits from Tripura state were 5 species were found only in west Tripura, 1 species restricted to north and 2 species to west and south Tripura and only few of the fruits are commercially cultivated and stress upon the step needed for the improvement and agro-techniques for these crops.

Hore and Rathi (2007) studied the characterization of Jobis tears germplasm in North-East India. Jobi`s tear (*Coix lacryma-jobi* Linn.), an underutilized crop widely distributed in the South-East Asia and the seeds are used as pseudo-cereal, poultry feed and beer brewing; while leaf are used as fodder. North-Eastern India is considered as one of the major centre of diversity for these crops. The study shows four well-marked forms

of Jobi`s tear within India, which differs in their size, shape, colour and degree of hardiness of the involucres. Till 2004 NBPGR Regional, Shillong, Meghalaya, collected a total of 54 accessions of Jobi`s tears germplasm. The germplasm characterization and protein and phosphorus contents of 21 accessions have been described in this work. Potentiality for systematic large scale cultivation of genotypes has been emphasized.

Yadav *et al*. (2009) worked on the genetic resources of vegetable crops of North-Eastern Himalayan Region where they studied the geographical structure and the favorable climatic condition, their rich biodiversity and ethnicity and social set up of the Northeastern region of India. They described the status of vegetables in the North-East region which shows the productivity level of horticultural and vegetable crops in the NE region is quite below as compared to the national productivity (Anon, 2002). The paper throws light on different biodiversity of vegetable crops in North Eastern region which are solanum group, tomato and chilli, crucifers, cucurbitaceous vegetables, leguminous vegetables, leafy vegetables, tubers and rhizomatous Crops, lesser-known vegetables and their germplasm evaluation. The paper also discusses the problem relating to diversity, conservation and development of horticulture in these region which are mainly land tenure issues, gender and equity issues in natural resources and diversity management, inter-departmental coordination, smuggling of timber across the international border, shifting cultivation, inter-state border dispute etc. The study concluded that different organizations like NBPGR, ICAR, BSI and various Universities in North East region have made tremendous efforts in collection, evaluation, conservation and utilization of regional germplasm for development of horticultural varieties in this region.

Jeeva (2009) reported 151 species belonging to 49 families and 86 genera wild edible fruits used by the Khasi tribes of Meghalaya of which 100 were trees, 34 shrubs, 12 climbers and 5 herbs. He stresses upon the requirement for greater evaluation of

nutritional, pharmacological, and toxicological properties of these plants and introduction of some of the wild edibles into the home gardens of local people.

Kar *et al*. (2012) documented 47 species of wild edible plants sold in the local market of Garo hills. The study showed out of the 30 families, 7 families belongs to monocotyledon, 21 families to dicotyledons and 2 families to pteridophyte, Euphorbiaceae family was found to be the dominant family. The authors further suggested investigation of nutritional aspects, pharmacological prospects and conservational issues from the present findings.

Singh *et al*. (2012) reviewed the diversity of underutilized vegetable crops in North-East India with special reference to Manipur as wide range of vegetable crops are grown in this region and exploitation of their of potential is important towards the crop improvement (Chadha, 2009). Wide ranges of diversity in vegetable are found in this region viz., cucurbitaceous vegetables (*Cucumis hystrix, cucumis trigonus, Luffa graveolens, Momordica macrophylla, M. subangulata, Trichosanthes cucumerina, T. khasiana, T. ovata, and T. truncasa*) which are grown and consumed by tribals of the region and wild relatives of several cucurbits (*Cucumis hardwickii, Momordica cochinchinensis, M. dioica* etc) have also been reported with significant genetic variability (Sirohi *et al*., 2005: Ram *et al*., 2002), several varieties of Solanaceous vegetables both wild (*Solanum torvum, S. indicum, S. khasianum, Solanum macrocarpon L., S. xanthocarpum* Scradt. & Wendl and cultivated (*S. melongena*) having excellent quality and resistance to many plant diseases are found in this region (Seshadri and Srivastava, 2002: Kalloo *et al*., 2005). 6 species different indeginous of chilli cultivar are found in Manipur viz. *Capsicum annuum* L. (cvs 'Meiteimorok' and 'Haomorok'), Capsicum lutescens L. (cvs 'Uchithi' and 'Mashingkha') and Capsicum chinense Jacq. (cvs 'Umorok' and 'Chiengpi') (Sanatombi *et al*., 2008). In grain legumes, the region is

known for several wild forms and high variability in rice bean (*Vigna umbellate*), Jack bean [*Canavalia ensiformis* (L.) DC.], winged bean (*Psophocarpus tetragonolobus*), Tree bean (*Parkia roxburghii* G. Don.) (CSIR, 1950: Kumar *et al*., 2002). The region is also rich in spices and condiments some of which are *Piper nigrum*, Megha turmeric-1 and Singhat (turmeric varieties), ginger variety Nadia, Bayleaf/ *tejpat* (*Cinnamomum tamala* T.Nees & Eberm.), Bengal cardamom (*Amomum aromaticum* Roxb.), camphor tree [*Cinnamomum glanduliferum* (Wall.) Meisn., *C. pauciflorum* Nees], snap ginger [*Alpinia calcarata* (Roscoe) Merrill, *A. malaccensis* (Burm. f.) Roscoe], kaempferia (*Kaempferia galangal* L.), black pepper (*Piper nigrum* L.), long pepper (*Piper longum* L.), *Piper peepuloides* Roxb. At present Dalchini, Long pepper and Smilex are collected from the forest of Manipur to the extent of 83,598, 43,940 and 69,600 kg per year respectively (Talukdar, 2009). *Colocasia esculenta*, *Eleocharis dulcis* (kakthum), *Sagittoria sagithefolia* (kaukha), *Flemingia vestita* (soh phlang), *Trapa bispinosa* (heikak), *Nelumbo nucifera* Gaertn. (Lotus) are the potential tuber and rhizomatous crops of Manipur (Jain *et al*., 2004). 42 species of zingiberaceae from Manipur have been maintained in IBSD, at Imphal out of 19 genera and 88 species available in NE India. *Zinziber cassumar* and *Zingiber zerumbet* are used in indigenous folk medicines (Talukdar, 2009), *Curcuma caesia, Curcuma angustifolia, Heychium coronarium, Hedychium spicatum* are some species of zinger of Manipur, *Hedychium luteum, H. aureum, H. radiatum, H. robustum, H. dekianum* are rare and threatened ornamental species. Out of 136 species of bamboos found in India, 63 species in 22 genera are found in Northeast India, spread over an area of 30,500 sq.km and 55 species reported from Manipur (Talukdar, 2009). *Arundinaria callosa* Munro. “soidon” an evergreen thorny bamboo grows abundantly in dense foggy areas of the hill peaks in Manipur (at 2,800-9,000 ft altitude) (Devi and Sharma, 2009). Manipur has the highest diversity with

species of *Calamus*, *Daemonorops*, and *Plectocomia* (Thomas, 2002). Out of the 43 aquatic/semi-aquatic medicinal plants recorded, 20 plants are regularly used as vegetables in Manipur and among them 13 are sold in the market (Jain *et al*., 2007). *Zizania caduciflora* Hand Mazz. (wild rice) a rare wild edible aquatic plants belongs to the family Poaceae naturally growing only in Manipur State of the Indian sub-continent. The paper discusses the scope and importance of underutilized species as N-E region of India is rich in species diversity known for many alternative plant sources. Many Indigenous plant species provide a variety of products like food, medicines, raw materials, and are good source of renewable energy, rich in vitamins, antioxidants, medicinal properties famous for the retentive value in Ayurvedic medicine. The paper also discusses the various problems relating to conservation and enhancement of underutilized crops in north eastern region and concludes that the diversity present in the northeast Manipur will be very useful to state's economy, if managed scientifically and screening newer sources of vegetables for present and future needs.

Buragohain *et al*. (2013) worked on collection and evaluation of some underutilized leafy vegetables of Meghalaya where twenty five underutilized leafy vegetables were collected from different parts of Meghalaya and were evaluated for physical and chemical parameters considering the importance of these crops in the nutrition and livelihood of the local population. They concluded that these underutilized leafy vegetables are rich sources of dry matter, crude protein and total chlorophyll contents showing that these inexpensive plants could provides various nutrients in the daily diet of the local people which are missing from the commonly consumed staple foods.

Terangpi *et al*. (2013) worked on the utilization of less known plants, *Gnetum gnemon* L. and *Rhynchotechum ellipticum* (Dietr.) A. DC. among the Karbis, Northeast

India where dietary utilization, cultural significance and conservation of these plants were discussed. These plants are dietary components of the Karbi ethnic group and the study was conducted at five sites- one representing urban population and four in remote rural areas with interview of priests and women elders particularly to document the origin of the plants and cultural significance. Ethnobotanical studies of the plants among other ethnic groups could reveal important information of their migration and association with other tribes. Agroforestry practice with *G. gnemon* promises to deliver multiple benefits- food supply, health, cultural identity and biodiversity conservation.

Saha *et al*. (2015) worked on chemical composition of some underutilized green leafy vegetables of Sonitpur district of Assam, India. Eight locally available underutilized green leafy vegetables (*Amaranthus viridis, Basella alba, Basella rubra, Brassica nigra, Brassica juncea, Diplazium esculentum, Chenopodium album* and *Moringa oleifera*) were considered for the study. *Moringa oleifera* (98.20g/100 g), *Brassica juncea* (26.01g/100 g), *Basella rubra* (8.61g/100g), *Chenopodium album* (18.56g/100g), *Basella alba* (11.16g/100g) showed the highest moisture content, ash content, crude fibre value, protein content and carbohydrate content respectively. *Brassica juncea* (95.55%) showed the highest free radical scavenging activity, *Diplazium esculentum* (23.59mg/100g), *Moringa oleifera* (18.90mg/100g), *Basella alba* (2.64mg/g) showed the highest ascorbic acid, β-carotenoid and phenolic content respectively.

Nayak *et al*. (2016) studied the physical parameters of elephant apple fruit (*Dillenia Indica*), an underutilized fruit of North - Eastern India. Elephant apple have extensive medicinal value (Rai, 1994) to prevent certain forms of cancer, diabetes, and cardiovascular diseases etc. but it has been considered as an underutilized fruit due to the drudgery in post-harvest processing. The physical properties of the whole fruit possessed the average length, width, thickness, geometric diameter, surface area and spehericity of

93.10 mm, 83.20 mm, 80.60 mm, 86.87 mm, 23702.77 mm2 and 0.85, respectively, whereas the average values of length, width, thickness, overlapping, geometric mean diameter, surface area, sphericity, aspect ratio and weight of central core were calculated as follows : 67.1± 3.51 mm, 57.6±3.25 mm, 57.6 ± 3.21 mm, 34.9±2.90 mm, 59.75±2.82 mm, 11214.29±973.5 mm2, 0.94 ± 0.02 %, 0.91±0.04 and 155±5.25gm, respectively.

Nagaland Status

Jamir (1996) reported 61 species of wild edible fruits from Nagaland state. He stress upon the need to conserve these plants species as anthropogenic activities has been leading these plants to vanish with the course of time.

Deb *et al*. (2013) worked on the survey and documentation of underutilized crops of three districts of Nagaland, India that emphasized on the various importances of underutilized crops which can be exploited at the commercial level. The survey showed a total of 41 species of under exploited crops that have been identified and collected along with the botanical name, family, parts used, mode of use, cultivated/wild. The study also showed that availability of most of these wild crops are now depleting rapidly owing to various factors such as 'Jhum/shifting cultivation', forest fire, felling of trees for timber and other socio-economic anthropogenic activities in the area and encourages the people to conserve these forest wealth and workout the ways for commercial scale propagation of these plant species.

Dohtdong *et al*. (2014) twelve lesser known wild leafy edible plants widely consumed by Lotha Nagas of Wokha district. Nutritional analysis shows maximum moisture content in Chumrum (*Gynura nepalensis*) (93.5%), protein (6.20%) in Rhnozo wo (*Legumenoced*) maximum ascorbic acid (vitamin C) 13.06 mg/100g in Nrukphen (*Fagopyrum esculentum*), calcium (7.35mg/100g) in Mpunghan and potassium content

(153.33 mg/100g) in Hanyon (*Antidesma deandrum*) and energy (38.4 Kcal/100g) in Thukrohan (*Impatient* sp).

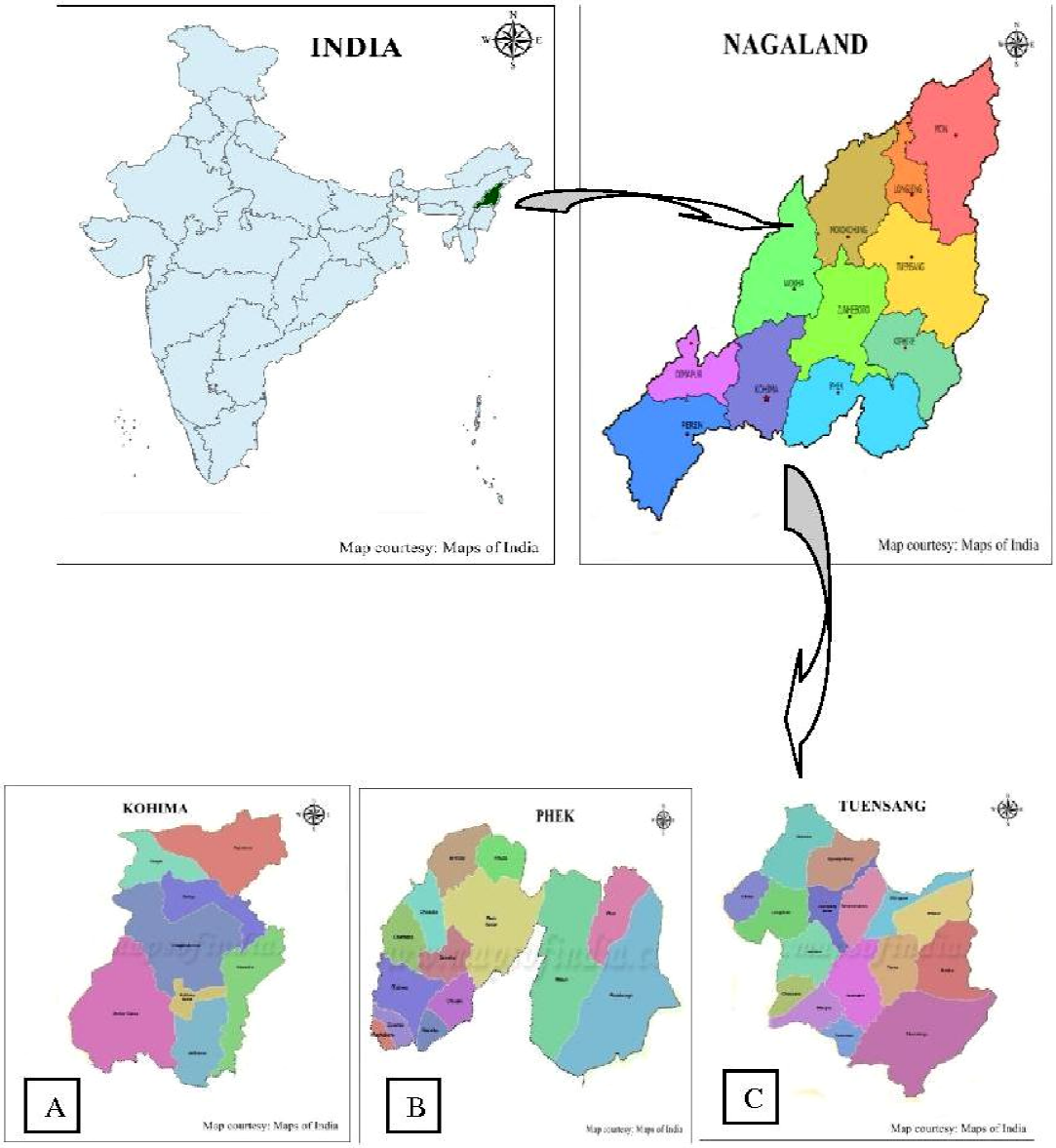
Deb *et al*. (2016) did a study on the documentation and market acceptability of underutilized wild edible crops of Kohima district, Nagaland, India where a total of 53 plant species belonging to 32 families was collected and identified. The collected plants were categorized according to the types of plant and their parts used *i.e.* cereal, fruits, nuts and leafy vegetables. Market survey was also carried out in the local market of the district showing different price rate per unit. The paper discussed the important role of underutilized plants in the daily life of the local people of Kohima and also problem relating to the underutilization of the plants and how to conserve and popularize the underutilized plants.

Pradheep *et al*. (2016) reported 41 species of wild edible plants used by konyak tribe in Mon district of Nagaland categorizing them by the parts of plants used viz. fruits, seeds and nuts, leafy vegetable, roots and tuber, buds and flower. Out of 41 species, 15 species were prioritized for germplasm collection and conservation.

Pongener *et al*. (2017) worked on wild, semi-domesticated and underutilized legumes of Nagaland, India which threw light to the different legumes of Nagaland, both edible as well as non-edible legumes. The study showed 19 species of edible pulses with some of their varieties and 31 non-edible but medicinal legumes collected and recorded from six districts (Kohima, Dimapur, Mokokchung, Zunheboto, Wokha, Tuensang) of Nagaland. The paper also discusses the importance of pulses which are considered as the sustainable seed-grains for the future to be helpful in overcoming the nutritional deficiencies in rural area and boost the socio-economic conditions of local people and add to their food security.

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. The state Nagaland is blessed with rich floristic diversity and is one of the 25 hot spots of the world with respect to its biodiversity. The state largely has undulating terrain and hilly landscape and low lying areas giving rise to a very conductive climate with presence of perennial water and moisture for truly rich variety of flora and fauna. Forest is an important source of sustenance and livelihood for the people of Nagaland. The state Nagaland is mostly inhabited by the tribal who depend mostly on the forest product for their livelihood and economy. 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 these tribal and indigenous inhabitants (Zingkhai, 2015). The traditional knowledge on the uses of different forest product has been passed down from generation to generation. Though these minor forest products provides the basic necessities to the tribal, there is no proper documentation, scientific base or exact idea of their nutritional values and no attempt to either popularize the acceptability, commercial scale production or proper strategy for these crops (Deb *et al*., 2016). Moreover, the natural biodiversity of the state is depleting tremendously due to many anthropogenic activities like forest fire, deforestation (for timber and fire wood), Jhum-shifting cultivation, over grazing, unplanned urbanization etc. Therefore, the present investigation was undertaken with the following four objectives:

1. Survey and collection of the underutilized crops/plants from three different districts of Nagaland (Kohima, Phek and Tuensang) (Figure 1.1).
2. Identification and documentation of the species.
3. Evaluation of market acceptability.
4. Nutritional analysis of some selected 'Underutilized Crops' to check their nutrient content such as proteins, carbohydrates, reducing sugar etc.



(Sources: Maps of India)

Figure 1.1: Map of Nagaland showing the three study areas: A. Kohima district, B. Phek district and C. Tuensang district

Chapter - 2

Documentation of Underutilized Edible Plants/Crops

Underutilized crops is defined as 'the species which are under exploited of its potential for contributing to food security (nutritional/medicinal), income generation and environmental services' (Jaenicke and Zeledon, 2006). The neglected/under-utilized or minor crops are traditionally grown in centers of their origin or diversity by farmers with lesser importance in terms of global production and consumption systems. They are locally well adapted to marginal lands making them an important part of the daily local diet providing valuable nutritional elements such as proteins, vitamins, and minerals (Jain, 2012). They are also referred as 'Neglected and Underutilized species'/'Orphan crops'/'Minor crops' (Padulosi *et al.*, 2002) for the fact that commercial companies/researchers have recognized their importance and are only recently working on them.

Study Area

Nagaland is a mountainous North-Eastern state of India, 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 district as its capital (**Figure – 1.1**). 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 (**Figure – 1.1**). A brief information about these three districts are given below:

Kohima District: Kohima is the capital city of Nagaland state, India (**Figure 1.1-A**). Kohima is located between the geographical coordinates of 25.6701˚N and 94.1077˚E and is surrounded by the Assam state to the west, Zunheboto district to the east, Wokha district to the north and Manipur state to the south. It has a total geographical area of 1463sq. km and an average elevation of 1444m (4,738ft). Kohima has a pleasant and moderate climate- not too cold in winters and pleasant summers. During the height of summer, from June-August, the temperature ranges an average of 27-32˚C (80-90˚F). December and January are the coldest months of this region; the temperature drops down to 8˚C, even frost occurs in the higher altitudes, snowfall occurs occasionally. The average rainfall is 2000 mm which is received during the months of July to August with occasional rain diring the month of September to October. Kohima has a population of 267,988 with 138,966 male and 129,022 female and the sex ratio is 928 per 1000 male according to 2011 census. The district have Dzükou velley 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. 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 and Manipur state in the South with an area of 2026 sq. km. and a population of 163,418 with 83,743 male and 79,675 female and the sex ratio is 951 per 1000 male according to 2011 Census. The district has an average elevation of 1524m (5000 ft) above sea level and an average rainfall of 1527mm. The average temperature during the summer season is 28˚C and 15˚C during the winter season. Pfutsero is the highest altitude town [2133m (6998ft)] and coldest inhabited place in Nagaland with the temperature dropping down to below minus zero degree during the nights in winter. The district is inhibited by the Chakhesang Naga tribe and Puchury tribes of Mongoloid race. Phek district has moderate warm summer and cold winter. Agriculture is the main occupation with 80.84% of the population engaged in agriculture and Terrace rice cultivation is predominant (**Figure 1.1-B**).

Tuensang District: Tuensang district is the largest district of Nagaland with geographical coordinate of 26.14˚N and 94.49˚E (**Figure 1.1-C**). 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. Tuensang district has a population of 196,596 with 101,933 male and 94,663 female and the sex ratio is 929 per 1000 male according to 2011 Census. The total area of the district is 2526 sq. km with an average elevation of 1371 m (4498 ft) above sea level and an average rainfall of 2000 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 (12598 ft] is present in Tuesang 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.

Materials and Methods

The present work on documentation and evaluation of underutilized edible plants of Kohima, Phek and Tuensang Districts of Nagaland, India is based on extensive field survey in different seasons during 2013-2015. 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 in zipper poly bags and brought to the laboratory for identification. Information was also collected on the traditional knowledge on the different uses of the collected plant materials through interacting with the local inhabitants of these three districts. The GPS readings on the collected plant materials were also recorded from different regions of these districts.

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, 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 and 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.

Systematic Enumeration of Underutilized Edible Plants of Kohima, Phek and Tuensang District, Nagaland, India

The plants collected are categorized according to the types of plant and parts used of the plants (**Table 2.1)**. The detail enumerations of the plants are given below after **Table 2.1.**

Table 2.1: List of underutilized edible plants categorized according to types of plants and their parts used

Cereal crops					
Sl. No.	**Scientific name**	**Family**	**Common Name**	**Vernacular Name**	**Accession no.**
1	***Coix-lacryma jobi* L.**	Poaceae	Job's tear	Kesi (Ang)	NU-BOT-UC-NK-1016
2	***Setaria italica* (L.) P. Beauvois**	Poaceae	Foxtail Millet	Chütienuo (Ang)	NU-BOT-UC-NK-1017
3	***Sorghum bicolor* (L.) Moench**	Poaceae	Great millet	Menyi thesü (Ang)	NU-BOT-UC-NK-1094
Leafy Vegetables					
1	***Antidesma bunius* (L.) Spreng.**	Phyllanthaceae	Salamander tree	Gaja sei (Ang)	NU-BOT-UC-NK-1002
2	***Centella asiatica* (L.) Urb.**	Apiaceae	Indian Pennywort	Gara(Ang)	NU-BOT-UC-NK-1003
3	***Clerodendrum glandulosum* Lindl.**	Lamiaceae	Glory Hill Bower	Gathere (Ang)	NU-BOT-UC-NK-1004
4	***Houttuynia cordata* Thunb**	Saururaceae	Fishy mint, Stink plant, Chameleon plant	Gatha (Ang)	NU-BOT-UC-NK-1005
5	***Gynura bicolor* (Roxb. Ex Willd.) DC.**	Asteraceae	Valvet plant	Liezienuo (Ang)	NU-BOT-UC-NK-1006
6	***Plantago erosa* Wall.**	Plantaginaceae	Common plaintain	Gapa (Ang)	NU-BOT-UC-NK-1007
7	***Polygonum chinense* L.**	Polygonaceae	Chinese Knotweed	Gare (Ang)	NU-BOT-UC-NK-1008
8	***Polygonum molle* D. Don**	Polygonaceae	Soft knot grass	Gazie (Ang)	NU-BOT-UC-NK-1009
9	***Lasia spinosa* (L.) Thwaites**	Araceae	Queen Flower	Telega (Ang)	NU-BOT-UC-NK-1010
10	***Elatostema lineolatum* Wight**	Urticaceae	Elatostema	Jotho (Ang)	NU-BOT-UC-NK-1021
11	***Alpinia nigra***	Zingiberaceae	Black	Sokrünuo	NU-BOT-UC-

	(Gaertn.) Burtt		Galangal, Wild ginger	(Ang)	NK-1022
12	***Spilanthes acmella* (L.) L.**	Asteraceae	Toothache plant	Kevenha (Ang)	NU-BOT-UC-NK-1025
13	***Fagopyrum esculentum* Moench**	Polygonaceae	Buckwheat	Garei (Ang)	NU-BOT-UC-NK-1026
14	***Begonia palmata* D.Don**	Begoniaceae	Begonia	Rhichü (Ang)	NU-BOT-UC-NK-1028
15	***Zanthoxylum oxyphyllum* Edgew.**	Rutaceae	Cape Yellow, Indian Ivy-rue, Indian pepper	Ganyasei (Ang)	NU-BOT-UC-NK-1033
16	***Cardamine hirsuta* L.**	Brassicaceae	Hairy bittercress	Seguoga (Ang)	NU-BOT-UC-NK-1034
17	***Pseudognaphalium affine* (D. Don) Anderb.**	Asteraceae	Jersey cudweed	Chienega (Ang)	NU-BOT-UC-NK-1038
18	***Amorphophallus nepalensis* (Wall.) Bogner & Mayo**	Araceae	Nepalese voodoo lily	Teinhyiemidu (Ang)	NU-BOT-UC-NK-1045
19	***Cheilocostus speciosus* (J. König) C. Specht**	Costaceae	Crepe ginger, Malay ginger, Cane ginger, Wild ginger	Thevobuotonyü (Ang)	NU-BOT-UC-NK-1049
20	***Herpetospermum pedunculosum* (Ser.) C.B. Clearke**	Cucurbitaceae	Himalayan Gourd	Galü(Ang)	NU-BOT-UC-NK-1050
21	***Colocasia antiquorum* Schott.**	Araceae	Eddoe or Eddo	Thekrü (Ang)	NU-BOT-UC-NK-1051
22	***Elatostema platyphyllum* Wedd.**	Urticaceae	Elatostema	Johunyü (Ang)	NU-BOT-UC-NK-1052
23	***Ficus geniculata* Kurz.**	Moraceae	Wild fig	Chiedebo (Ang)	NU-BOT-UC-NK-1091
24	***Trichodesma khasianum* C. B. Cl.**	Boraginaceae	Trichodesma	Sekisekuo (Ang)	NU-BOT-UC-NK-1092
25	***Diplazium esculentum* (Ritz.) Sw.**	Athyriaceae	Vegetable fern	Gasülo (Ang)	NU-BOT-UC-NK-1093
26	***Gynura nepalensis* DC.**	Asteraceae	Nepal gynura	Liezienuo (Ang)	NU-BOT-UC-NK-1095
27	***Crassocephalum crepidioides* (Benth.) S. Moore**	Asteraceae	Ragleaf, Fireweed, Thickhead	Nhasa (Ang)	NU-BOT-UC-NK-1096
28	***Asparagus officinalis* L.**	Asparagaceae	Asparagus, sparrow grass	Shiehou (Ang)	NU-BOT-UC-NK-1098
29	***Trevesia sundaica* Miq.**	Araliaceae	Trevesia, Snowflake Aralia	Teirhünyü (Ang)	NU-BOT-UC-NK-1101

30	***Gnaphalium uliginosum* L.**	Asteraceae	Marsh cudweed	Cienega (Ang)	NU-BOT-UC-NK-1102
31	***Paederia foetida* L.**	Rubeaceae	Skunk vine, Stink vine, Chinese fever vine	Menyi (Ang)	NU-BOT-UC-NK-1103
32	***Rumex patientia* L.**	Polygonaceae	Patience dock, garden patience, herb patience	Meza gakrie (Ang)	NU-BOT-UC-NK-1104
33	***Chenopodium album* L.**	Amarantheceae	Fat hen, lamb's quarter, white goosefoot, pigweed	Terhuotiepfü (Ang)	NU-BOT-UC-NK-1105
34	***Chenopodium gigangeum* D. Don**	Amarantheceae	Tree, spinach, Magenta spreen, Purple Goosefoot, Giant Lambsquarters	Terhuotiepfü (Ang)	NU-BOT-UC-NK-1106
35	***Amaranthus viridis* L.**	Amarantheceae	Green Amaranth, slander amaranth	Niedza (Ang)	NU-BOT-UC-NK-1109
36	***Amaranthus tricolor* L.**	Amarantheceae	Chinese spinach	Niedza (Ang)	NU-BOT-UC-NK-1110
37	***Pilea scripta* (Buch-Ham. ex D. Don) Webb.**	Urticaceae	Himalayan Clearweed	Therhie (Ang)	NU-BOT-UC-NK-1111
38	***Lecanthus peduncularis* (Wall. Ex Royle)**	Urticaceae	Stalked dischead	Gabo (Ang)	NU-BOT-UC-NK-1112
39	***Elatostema sessile* J.R Forst. & G Forst.**	Urticaceae	Stalkless elatostema	Gajo (Ang)	NU-BOT-UC-NK-1113
40	***Ficus fistulosa* Reinw. Ex. Blime**	Moraceae	Yellow stem fig	Khrübvü Kecüu (Ang)	NU-BOT-UC-NK-1114
41	***Impatiens latifolia* L.**	Begoniaceae	Indian Angel Balsam, Baba budan balsam	Gasa (Ang)	NU-BOT-UC-NK-1115
42	***Amaranthus spinosus* L.**	Amarantheceae	Spiny Amaranth, Prickly Amaranth	Niedza (Ang)	NU-BOT-UC-NK-1120
43	***Begonia roxburghii* A.DC.**	Bogoniaceae	East Himalayan Begonia	Rhichü (Ang)	NU-BOT-UC-NK-1126
44	***Oenanthe javanica***	Apiaceae	Java water	Gakra (Ang)	NU-BOT-UC-

	(Blume) DC.		dropwort, water dropwort		NK-1128
45	***Justicia santapaui* Bennet**	Acantheceae	Santapau's Justicia	Gapfü (Ang)	NU-BOT-UC-NK-1129
46	***Urtica ardens* Link**	Urticaceae	Himalayan Nettle	Zozie (Ang)	NU-BOT-UC-NK-1130
47	***Urtica fissa* E. Pritz.**	Urticaceae	Stinging Nettle	Zozie (Ang)	NU-BOT-UC-NK-1131
48	***Persicaria nepalensis* (Meisn.) Miyabe**	Polygonaceae	Nepal Knotweed	Pruzie (Ang)	NU-BOT-UC-NK-1135
49	***Solanum nigrum* L.**	Solanaceae	Black Nightshade	Gatsi (Ang)	NU-BOT-UC-NK-1136
50	***Rumex crispus* L.**	Polygonaceae	Curly dock, yellow dock	Meza gakrie (Ang)	NU-BOT-UC-NK-1137
Fruits and Nuts					
1	***Ficus auriculata* Lour.**	Moraceae	Roxburg fig, Elephant ear fig	Khrübvü Kezhau (Ang)	NU-BOT-UC-NK-1011
2	***Ficus semicordata* Buch-Ham ex J.E. Smith**	Moraceae	Wedgeleaf fig, Drooping fig	Chiede (Ang)	NU-BOT-UC-NK-1012
3	***Juglans regia* Linn.**	Juglandaceae	Persian walnut, Butter nut	Pfhüsei (Ang)	NU-BOT-UC-NK-1013
4	***Rhus chinensis* Mill.**	Anacardiaceae	Nutgall tree	Zomhusei (Ang)	NU-BOT-UC-NK-1014
5	***Terminalia chebula* Retz.**	Combretaceae	Myrobalan	Mhiechüsei (Ang)	NU-BOT-UC-NK-1015
6	***Choerospondias axillaris* (Roxb.) B.L Burtt & A.W. Hill**	Anarcardiaceae	Nepali Hog Plum	Khola (Ang)	NU-BOT-UC-NK-1018
7	***Stixis suaveolens* (Roxburgh) Pierre**	Capparaceae	Stixis	Rokasei (Ang)	NU-BOT-UC-NK-1019
8	***Spondias pinnata* (L. f.) Kurz**	Anacardiaceae	Wild Mango	Mezisei (Ang)	NU-BOT-UC-NK-1020
9	***Elaeagnus latifolia* L.**	Elaeagnaceae	Bastard Oleaster	Pesü (Ang)	NU-BOT-UC-NK-1024
10	***Diospyros kaki* L.F**	Ebenaceae	Japanese Persimmon	Ziedi (Ang)	NU-BOT-UC-NK-1027
11	***Abelmoschus moschasta* Medik.**	Malvaceae	Musk Mellow	Gakhokoka (Ang)	NU-BOT-UC-NK-1029
12	***Cucumis hystrix* Chakrav.**	Cucurbitaceae	Wild cucumber	Ketsa tsütuo (Ang)	NU-BOT-UC-NK-1030

13	***Docynia indica* (Wall.) Decne.**	Rosaceae	Wild Apple, Assam Apple	Ciepho (Ang)	NU-BOT-UC-NK-1032
14	***Mahonia nepalensis* DC.**	Berberidaceae	Mahonia	Athuo (Ang)	NU-BOT-UC-NK-1035
15	***Myrica esculenta* Buch-Ham ex. D. Don**	Myricaceae	Box-myrtle, bayberry	Thugei (Ang)	NU-BOT-UC-NK-1036
16	***Physalis peruviana* L.**	Solanacae	Cape goose berry, Goldenberry	Chahamiacasei (Ang)	NU-BOT-UC-NK-1037
17	***Rubus niveus* Thunb.**	Rosaceae	Ceylon Raspberry	Temeirom (Ang)	NU-BOT-UC-NK-1039
18	***Rubus ellipticus* Sm.**	Rosaceae	Golden Himalayan Raspberry, Yellow Himalayan Raspberry	Rom (Ang)	NU-BOT-UC-NK-1040
19	***Castanopsis indica* (Roxb. ex Lindl.) A.DC.**	Fagaceae	Indian chestnut	Thezüsei (Ang)	NU-BOT-UC-NK-1041
20	***Syzygium cumini* (L.) Skeels**	Myrtaceae	Black plum, Java plum, Jambolan	Keloguo (Ang)	NU-BOT-UC-NK-1042
21	***Prunus nepalensis* (Ser.) Steud.**	Rosaceae	Wild black berry.	Rünyüsei (Ang)	NU-BOT-UC-NK-1043
22	***Garcinia xanthochymus* Hook.f. ex T.Anderson**	Clusiaceae	Mysore Gamboge, Sour mangosteen, False mangosteen	Chierie (Ang)	NU-BOT-UC-NK-1044
23	***Prunus carmesina* H. Hara**	Rosaceae	Wild cherry	Kezie (Ang)	NU-BOT-UC-NK-1053
24	***Zanthoxylum armatum* DC.**	Rutaceae	Winged prickly ash	Ganyasei (Ang)	NU-BOT-UC-NK-1054
25	***Duchesnia indica* (Andrews) Th. Wolf**	Rosaceae	Mock strawberry, Indian strawberry or false strawberry	Kijirümvü (Ang)	NU-BOT-UC-NK-1055
26	***Aphananthe cuspidata* (Blume) Planch.**	Ulmaceae	Aphananthe	Npyonpyosei (Ang)	NU-BOT-UC-NK-1056
27	***Evodia fraxinifolia* (Hook.) Benth**.	Rutaceae	Evodia	Vocusei (Ang)	NU-BOT-UC-NK-1057

28	***Saurauia punduana* Wall.**	Actinidaceae	Saurauia, Gogan	Ketsa tsakhosei (Ang)	NU-BOT-UC-NK-1058
29	***Saurauia macrotricha* Kurt ex Dyer**	Actinidiaceae	Saurauia	Ketsa tsakhosei (Ang)	NU-BOT-UC-NK-1059
30	***Toddalia asiatica* (L.) Lam.**	Rutaceae	Orange climber, Forest pepper, wild orange tree	Ketsa sehuo (Ang)	NU-BOT-UC-NK-1060
31	***Actinidia callosa* Lindl.**	Actinidiaceae	Wild kiwi	Ketsa kiwi (Ang)	NU-BOT-UC-NK-1061
32	***Debregeasia longifolia* (Burm.f.) Wedd**	Urticaceae	Orange Wild Rhea	Zhüdu (Ang)	NU-BOT-UC-NK-1062
33	***Hodgsonia macrocarpa* (Blume) Cogn.**	Cucurbitaceae	Lard seed	Ketsamo (Ang)	NU-BOT-UC-NK-1063
34	***Litsea cubeba* (Lour.) Pers**	Lauraceae	Aromatic Litsea, May chang	Cie (Ang)	NU-BOT-UC-NK-1064
35	***Carallia brachiata* (Lour.) Merr.**	Rhizophoraceae	Carallia	Meho (Ang)	NU-BOT-UC-NK-1065
36	***Trichosanthes dunniana* H. Lév.**	Cucurbitaceae	Trichosanthes	Dzorume (Ang)	NU-BOT-UC-NK-1066
37	***Terminalia bellirica* (Gaertn.) Roxb.**	Combretaceae	Myrobalan	Mhiechüsei (Ang)	NU-BOT-UC-NK-1067
38	***Rubus sumatranus* Miq**	Rosaceae	Rubus	Rom (Ang)	NU-BOT-UC-NK-1068
39	***Ficus hispida* L.f.**	Moraceae	Hairy fig	Ketsa chiede (Ang)	NU-BOT-UC-NK-1069
40	***Phyllanthus emblica* L.**	Phyllantheceae	Indian gooseberry, Emblic myrobalan	Ciehusei (Ang)	NU-BOT-UC-NK-1070
41	***Olax imbricata* Roxb.**	Olaceae	Olax	Puyano (Ang)	NU-BOT-UC-NK-1071
42	***Elaeocarpus floribundus* Blume**	Elaeocarpeceae	Indian olive	Chüyechüku (Ang)	NU-BOT-UC-NK-1083
43	***Oxalis corniculata* Linn.**	Oxalidaceae	Creeping wood sorrel, Yellow sorrel, sleeping	Thevotsütuo (Ang)	NU-BOT-UC-NK-1084

			beauty		
44	***Pyrus pashia* Buch-Ham. Ex D. Don**	Rosaceae	Indian Wild pear, Himalayan Wild pear	Ketsa naspati (Ang)	NU-BOT-UC-NK-1085
45	***Cornus capitata* Wall**	Cornaceae	Benthem's cornel, Evergreen dogwood, Himalayan flowering dogwood	NA	NU-BOT-UC-NK-1086
46	***Hovenia dulcis* Thunb.**	Rhamnaceae	Japanese raisin tree, Oriental raisin tree	Chelisei (Ang)	NU-BOT-UC-NK-1087
47	***Livistona jenkinsiana* Grifff**	Araceae	Fan palm	Niezorobo (Ang)	NU-BOT-UC-NK-1089
48	***Passiflora subpeltata* Ortege**	Passifloraceae	White passionflower	Ketsa bell (Ang)	NU-BOT-UC-NK-1090
49	***Elaeagnus umbellata* Thunb.**	Elaeagnaceae	Japanese Silverberry, Umbellata oleaster, autumn olive	Pesü ketsüyo (Ang)	NU-BOT-UC-NK-1097
50	***Canavalia gladiata* (Jacq.) DC.**	Fabaceae	Sword bean	Zaprie sei (Ang)	NU-BOT-UC-NK-1099
51	***Melastoma malabathricum* L.**	Melastomataceae	Indian rhododendron, Singapore rhododendron	Tehelakhu (Ang)	NU-BOT-UC-NK-1100
52	***Morus alba* L.**	Moraceae	White mulberry	Khravü (Ang)	NU-BOT-UC-NK-1116
53	***Morus nigra* L.**	Moraceae	Black mulberry	Khravü (Ang)	NU-BOT-UC-NK-1117
54	***Caryota urens* L.**	Arecaceae	Fisgtail palm	Tepfisupari (Ang)	NU-BOT-UC-NK-1118
55	***Tetrastigma lanceolarium* (Roxb.) Planch.**	Vitaceae	Indian chestnut vine	Thevomhachübo (Ang)	NU-BOT-UC-NK-1127
56	***Physalis minima* L**	Solanaceae	Sunberry, Ground berry	Chahamiaca (Ang)	NU-BOT-UC-NK-1132

57	***Zanthoxylum acanthopodium* DC.**	Rutaceae	Andaliman	Ganyasei (Ang)	NU-BOT-UC-NK-1133
58	***Nephelium lappacium* L.**	Sapindaceae	Rambutan	Ketsa lichu (Ang)	NU-BOT-UC-NK-1134
59	***Viburnum mullaha* Buch-Ham. ex D. Don**	Adoxaceae	Starry viburnum	Tsakhasei (Ang)	NU-BOT-UC-NK-1139
60	***Baccaurea ramiflora* Lour.**	Phyllantheceae	Burmese grape	Ziedisei (Ang)	NU-BOT-UC-NK-1140
61	***Ardisia Crispa* (Thunb.)**	Primulaceae	Coralberry	Tevümhachübo (Ang)	NU-BOT-UC-NK-1141
62	***Calamus tenuis* Roxb.**	Arecaceae	Slander Ratten Cane	Tekhrasei (Ang)	NU-BOT-UC-NK-1142
Stem, Flower and Inflorescence					
1	***Amomum dealbatum* Roxb.**	Zingiberaceae	Javda Cardamon	Sokrünuo (Ang)	NU-BOT-UC-NK-1001
2	***Bauhinia variegata* L.**	Fabaceae	Orchid tree, Mountain Ebony	Teguo (Ang)	NU-BOT-UC-NK-1023
3	***Curcuma angustifolia* Roxb.**	Zingiberaceae	East Indian Rrrowroot, Narrow-leaved Turmeric	Hupfü (Ang)	NU-BOT-UC-NK-1031
4	***Chimonobambusa callosa* (Munro) Nakai**	Poaceae	Small bamboo	Kerie ketsüyo (Ang)	NU-BOT-UC-NK-1046
5	***Musa sikkimensis* Kurz.**	Musaceae	Darjeeling banana	Tepfhe (Ang)	NU-BOT-UC-NK-1047
6	***Musa thomsonii* (King ex Baker) A.M. Cowan & Cowan**	Musaceae	Musa	Ruochünuo (Ang)	NU-BOT-UC-NK-1048
7	***Bauhinia purpurea* L.**	Fabeceae	Purple orchid tree, Purple bauhinia	Teguo (Ang)	NU-BOT-UC-NK-1108
8	***Dendrocalamus giganteus* Munro**	Poaceae	Giant bamboo	Vümi (Ang)	NU-BOT-UC-NK-1138
Root, Tuber, Rhizome and Bulb					
1	***Allium tuberosum* Rottler ex Spreng.**	Amaryllisaceae	Garlic chives, Asian chives	Chümerie (Ang)	NU-BOT-UC-NK-1088

2	***Dioscorea bulbifera* L.**	Dioscoreaceae	Air yam, Aerial yam	Rüphie (Ang)	NU-BOT-UC-NK-1107
3	***Cinnamomum verum* J.Presl**	Lauraceae	Cinnamon	Seichü (Ang)	NU-BOT-UC-NK-1119
Mushroom					
1	***Auricularia auricula-judae* (Bull.) Quél.**	Auriculariaceae	Jew's Ear, Tree Ear, Wood Ear	Thezunyieto (Ang)	NU-BOT-UC-NK-1072
2	***Auricularia polytricha* (Mont.) Sacc**.	Auriculariaceae	Cloud ear fungus	Thezunyieto (Ang)	NU-BOT-UC-NK-1073
3	***Laetiporus sulphureus* (Bull.) Murr.**	Polyporaceae	Crab of the wood, chicken of the wood, Sulphur Polypore	NA	NU-BOT-UC-NK-1074
4	***Lactarius volemus* (Fr.) Kuntze**	Russulaceae	Weeping milk cap	Cietou (Ang)	NU-BOT-UC-NK-1075
5	***Laccaria tortilis* (Bolton) Cooke**	Hydnangiaceae	Twisted Deceiver	Ciene (Ang)	NU-BOT-UC-NK-1076
6	***Lentinula edodes* (Berk.) Pegler**	Marasmiaceae	Shiitake	Cietou (Ang)	NU-BOT-UC-NK-1077
7	***Lactarius piperatus* (L.) Pers**	Russulaceae	Peppery Milk-cap	Cietou (Ang)	NU-BOT-UC-NK-1078
8	***Pleurotus pulmonarius* (Fr.) Quél.**	Pleurotaceae	Indian Oyster, Italian Oyster, Phoenix Mushroom, Lung Oyster	NA	NU-BOT-UC-NK-1079
9	***Schizophyllum commune* Fr.**	Schizophyllaceae	Split gill fungus	Cieso (Ang)	NU-BOT-UC-NK-1080
10	***Macrolepiota albuminosa* (Berk.) Pegler**	Agaricaceae	Termitimyces	Rüpucie (Ang)	NU-BOT-UC-NK-1081
11	***Termitomyces heimii* Natarajan**	Lyophyllaceae	Termitomyces	Rüpucie (Ang)	NU-BOT-UC-NK-1082
12	***Melanoleuca grammopodia* (Bull.) Fayod**	Tricholomataceae	Melanoleuca	Ciekro (Ang)	NU-BOT-UC-NK-1121
13	***Cantharellus cibarius* (Fr.)**	Cantharellaceae	Chanterelle	NA	NU-BOT-UC-NK-1122
14	***Lentinus squarrosulus* Mont. Singer**	Polyporaceae	Lentinus	NA	NU-BOT-UC-NK-1123

15	***Tricholoma imbricatum* (Fr.) P. Kumm.**	Tricholomataceae	Matt knight	Mene cie (Ang)	NU-BOT-UC-NK-1124
16	***Termitomyces microcarpus* (Berk. &Broome) R.Heim**	Lyophyllaceae	Termitomyces	Zogacie (Ang).	NU-BOT-UC-NK-1125

Note: Ang: Angami tribe.

Cereal Plants

***Coix-lacryma jobi* L.**

Accession Number: NU-BOT-UC-NK-1016

Family: Poaceae

Common name: Job's Tears

Vernacular name: Kesi (Ang)

Habitat: Cultivated along with other crops in Jhum cultivation, in open sunny places in the foothills.

Description: A tall and erect grain-bearing perennial cereal plant. Stem turfed, inter-nodes prominent, nodes swollen or brittle, sometimes rooting at nodes. Leavea 50-60 cm long, flat, lanceolate, base coredate, sheath at base, sheath glabrous. Inflorescence single raceme, fascicle or spike with 2-10 branches, racemes enclosed within the utricle around female spikelets. Flower unisexual, fruits caryopsis, subglobose or ellipsoid which is blue-purplish, shiny or polished pear shape.

Distribution: Kohima, Phek, Tuensang. (25˚35'13.73N 94˚22'1.60E)

Part use: The mature bead-like seeds.

Uses: The mature seed/grain is cooked and eaten alone or cooked with rice and eaten.

Figure: 2.1(1).

***Setaria italica* (L.) P. Beauv.**

Accession Number: NU-BOT-UC-NK-1017

Family: Poaceae

Common name: Foxtail Millet

Vernacular name: Chütienuo (Ang)

Habitat: Cultivated with other crops in the Jhum cultivation on the foothills

Description: A slim, vertical annual grain-bearing cereal grass with leafy stems growing up to 4-7 m tall. The plant has dense root system bearing numerous thin adventitious roots. Leaves are alternate with 20-40 cm long and 2-4 cm broad, lanceolate, serrated blade. The inflorescence is pendulous spike-like bristle panicle, 10-25 cm long, bearing 6-12 spikelets. The seeds or grain are ovoid in shape and golden yellow in color, enclosed in thin hulls.

Distribution: Kohima, Phek, Tuensang. (25˚35.22N 94˚22.02E)

Part use: The mature seeds or grain.

Uses: The mature seed/grain is cooked and eaten alone or cooked with rice and eaten.

Figure: 2.1(2)

***Sorghum bicolor* (L.) Moench**

Accession Number: NU-BOT-UC-NK-1094

Family: Poaceae

Common Name: Great millet.

Vernacular Name: Menyi thesü (Ang)

Habitat: Mostly cultivated in the jhum cultivation, kitchen garden,

Description: An annual large grass plant growing up to 5 m tall. Culms erect and robust, nodes glabrous; leaves elongated, parallel venation, pubescent; racemes tough at maturity, 2-6 spikelets pairs, sessile, broadly ovate to subglose, glumes leathery to papery, pale green to dark brown when mature, caryopsis large and exposed between the gasping glumes.

Distribution: Kohima, Phek, Tuensang. (25˚.7646 N 94˚.2331 E)

Parts use: Seeds.

Uses: Seeds are cooked and eaten, roasted and eaten, cooked with rice.

Figure: 2.1(3)

Figure 2.1: Cereal Crops 1. *Coix-lacryma jobi* L. 2. *Setaria italica* L. 3. *Sorghum bicolor* L.

Leafy Vegetables

***Antidesma bunius* (L.) Spreng.**

Accession Number: NU-BOT-UC-NK-1002

Family: Phyllanthaceae

Common name: Salamander tree

Vernacular name: Gaja sei (Ang)

Habitat: Medium tree grown in the wet forest, on river bank, along roadsides, or in shady or open habitat.

Description: Medium undemanding, evergreen, ornamental tree that can grow up to 30 m long. Leaves are elliptic to obovate, alternate, 10-17 cm long and 3-6 cm wide, petiole with 3mm-1.5 cm long, dioecious with male flower sessile and female flower pedicelled. Fruits found in groups and change color from yellowish-red when unripe to bluish-violet when ripe. The berries do not ripe evenly and stain the finger and mouth when eaten.

Distribution: Kohima, Phek, Tuensang. (26˚16.345N 94˚36.31E)

Part use: Young shoots, leaves and, fruits.

Uses: The young shoots and leaves are taken as vegetables, mature fruits are taken raw.

Figure: 2.2(1)

***Centella asiatica* (L.) Urb.**

Accession Number: NU-BOT-UC-NK-1003

Family: Apiaceae

Common name: Indian Pennywort

Vernacular name: Gara (Ang)

Habitat: Widespread in low, wet and wasteland in moist places.

Description: A prostrate herb rooting at the nodes, stems are slender, creeping stolons. Leaves simple, stipulate around 2-5 cm. Flowers are whitish to red color, born in small, rounded bunches or umbels. Fruits oblong densely reticulate.

Distribution: Kohima, Phek, Tuensang (25˚.6746 N 94˚.1066E)

Part use: Whole plant

Uses: The whole plant is taken as vegetable and also eaten in salad. The plant is used for the treatment of various skin diseases such as leprosy, wound, boils, and diarrhea and also to improve memory**.**

Figure: 2.2(2)

***Clerodendrum glandulosum* Lindl.**

Accession Number: NU-BOT-UC-NK-1004

Family: Lamiaceae

Common name: Glory Hill Bower

Vernacular name: Gathere (Ang)

Habitat: The shrub found growing on the waste places, hillsides and damp roadsides.

Description: A shrub or a small tree reaching up to a height of 3-5m. Branchlets are usually 4-angled when young, leaves are simple, opposite, ovate, serrate, with leaf base as wedge-shaped to heart-shape. Flowers are white and borne in 4-6 branched capitates cymes, corolla white. Fruit is a drupe, bluish purple enclosed in an accrescent calyx.

Distribution: Kohima, Phek, Tuensang (25˚42.59N 94˚6.1829E)

Part use: Young shoot and leave.

Uses: Young shoot and leave is cooked and eaten as vegetable. The decoction of the leave is taken for the treatment of diabetes, malaria, rheumatism. Leave used as antiseptic, anti-inflammatory.

Figure: 2.2(3)

***Houttuynia cordata* Thunb**

Accession Number: NU-BOT-UC-NK-1005

Family: Saururaceae

Common name: Fishy mint, Stink plant, Chameleon plant.

Vernacular name: Gatha (Ang)

Habitat: Grows well in moist to wet soil.

Description: Herbaceous perennial plant with creeping rootstock growing to 20-70cm. The proximal part of stem produces adventitious roots while the distal part grows vertically deep down the root. Leaves are broadly ovate, alternate, 4-7cm long and 4-6cm broad. Flowers are greenish-yellow, borne on a terminal spike with 4 long white basal bracts.

Distribution: Kohima, Phek, Tuensang. (25˚.6743 N 94˚.106E)

Part use: Whole plant.

Uses: Whole plant part is used in salad or pickle, also eaten as vegetable. Leave juice is used in stomachache by Ao-Naga, diabetes, diuretic, pneumonia.

Figure: 2.2(4)

***Gynura bicolor* (**Roxb. Ex Willd.) DC.

Accession Number: **NU-BOT-UC-NK-1006**

Family: Asteraceae

Common name: Valvet plant

Vernacular name: Liezienuo (Ang)

Habitat: Grows well in the shady area, slopes or rocky wet areas.

Description: A perennial bushy herb growing up to 1-2.5 m tall. Leaves subglabrous, ovate to oblanceolate, acuminate, margin serrated, base rounded or cuneate, shortly petiolated or subsessile; capitula numerous, phyllaries glabrous, floret orange , achenes cylindric, glabrous, pappus white, easily deciduous.

Distribution: Kohima, Phek, Tuensang. (25˚42.59N 94˚6.1829E)

Part use: Young shoots and leaves.

Uses: Young shoots and leaves are taken as vegetables or use in salads.

Figure: 2.2(5)

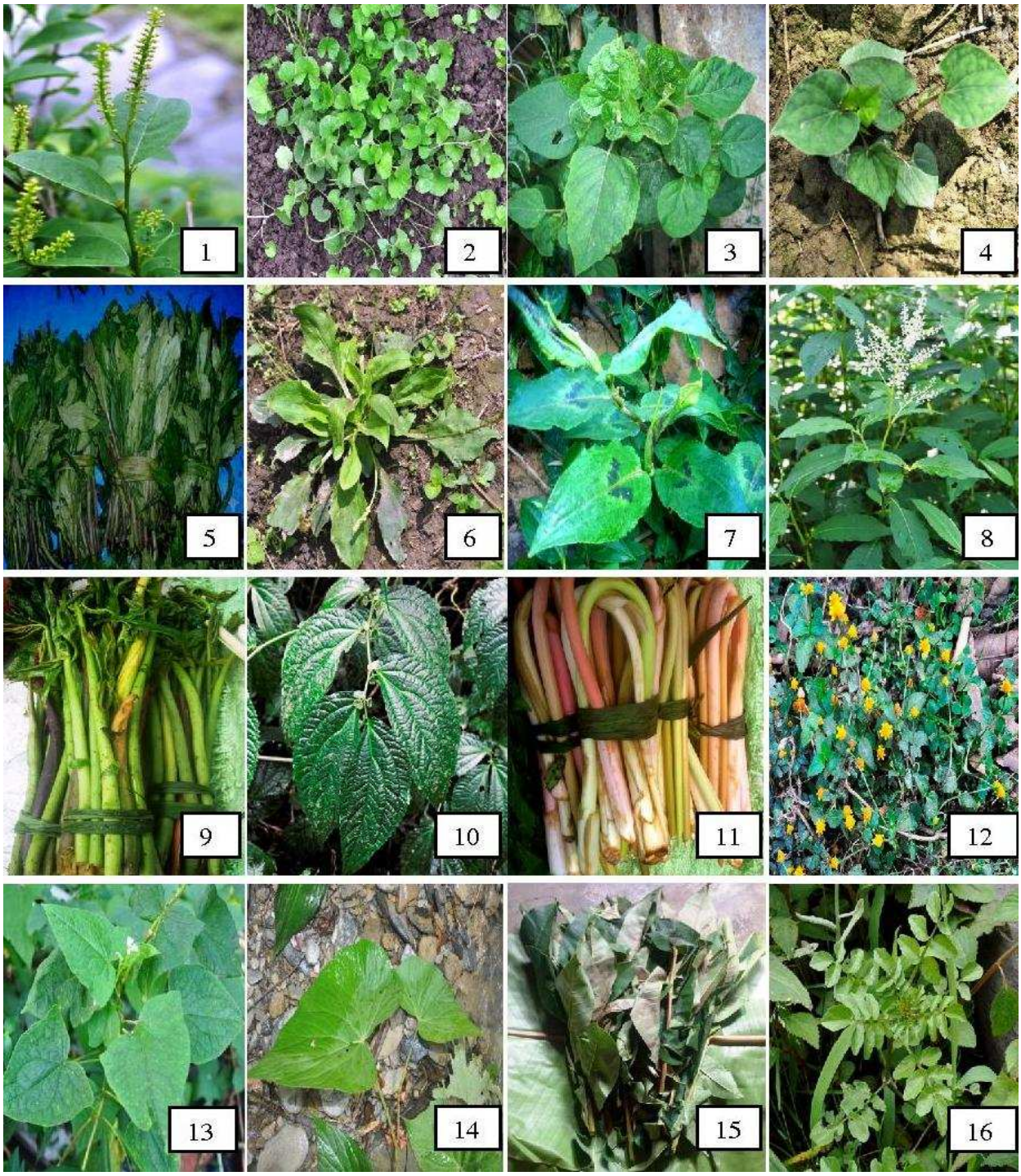


Figure 2.2: Leafy vegetables, 1. *Antidesma bunius,* 2. *Centella asiatica,* 3. *Clerodendrum glandulosum,* 4. *Houttuynia cordata,* 5. *Gynura bicolor,* 6. *Plantago erosa,* 7. *Polygonum chinense,* 8. *P. molle,* 9. *Lasia spinosa,* 10. *Elatostema lineolatum,* 11. *Alpinia nigra,* 12. *Spilanthes acmella,* 13.*Fagopyrum esculentum,* 14. *Begonia palmata,* 15. *Zanthoxylum oxyphyllum,* 16. *Cardamine hirsuta.*

***Plantago erosa* Wall**

Accession Number: NU-BOT-UC-NK-1007

Family: Plantaginaceae

Common name: Common plaintain

Vernacular name: Gapa (Ang)

Habitat: Herb grows well in open area, road side**.**

Description: Small perennial herb, Stem short or absent, leaves 6x4 cm, base attenuate, elliptical, shallowly dentate, winged petiole 4-6 cm long, flowers densely spike, bracts ovate, keeled, corolla whitish, lobes ovate, obtuse, seeds 6-9, angular or compressed, brown.

Distribution: Kohima, Phek and Tuensang (25˚.6743 N 94˚.106E)

Part use: Whole plant taken as vegetable**.**

Uses: The whole plant is taken as vegetable as a boil vegetable.

Figure: 2.2(6)

***Polygonum chinense* L.**

Accession Number: NU-BOT-UC-NK-1008

Family: Polygonaceae

Common name: Chinese Knotweed

Vernacular name: Gare (Ang)

Habitat: Herb found in group, in shady and grassy places.

Description: Twining herbaceous perennial plant that grows to 2-4m long with prominent nodes, stem and branches are red-brownish, glabrous. Leaves ovate shape, alternate, 8-10 cm long, 4-5 cm wide, entire, acuminate, petiole 6mm-1cm long, attenuate, sour in taste. Stipule sheath just below the petiole and membranous. Flowers are small white in color, ovoid or rounded heads, 3-5 or more at branch ends, parianth white-pinkish, 5-parted, fruits are berries, globose, seeds small and black.

Distribution: Kohima, Phek and Tuensang (25˚42.59N 94˚6.182E)

Part use: young shoot and leaves, young stem.

Uses: Young shoot and leaves are taken raw or as vegetables, use as a special ingredient in making Galho (Angami cuisine)

Figure: 2.2(7).

***Polygonum molle* D. Don**

Accession Number: NU-BOT-UC-NK-1009

Family: Polygonaceae

Common name: Soft knot grass

Vernacular name: Gazie (Ang)

Habitat: Herb found in scrub and damp ground, slopes and grassy places.

Description: Perennial herbs that can grow 3-4m m long, stems erect, reddish, glabrous, prominent nodes, petiole 1.5-3 cm long, membranous. Leaves are ovate shape, entire, acuminate, alternate, leaf base rounded with red-greenish mid-rib. Flowers are borne in a large, richly branched, tepals are white, 5-parted, and seeds are included within the reddish black fleshy tepals which turn black or brown after maturity.

Distribution: Kohima, Phek and Tuensang (25˚42.59N 94˚6.182E)

Part use: Young shoot and leaves, young stem.

Uses: Young shoot and leaves, young stem taken raw or as vegetables, and use as a special ingredient in making Galho (Angami cuisine)

Figure: 2.2(8)

***Lasia spinosa* (L.) Thwaites**

Accession Number: NU-BOT-UC-NK-1010

Family: Araceae

Common name: Queen Flower

Vernacular name: Telega (Ang)

Habitat: The herb is found growing on the riverbanks, swamps, ditches and moist places.

Description: An herbaceous perennial, evergreen plant which can grow up to 1- 2 m tall, able to spread by means of creeping, stoloniferous stem. The stem has internodes with stout, intensely prickly. Leaves are 16-45 cm long, petioled, segments lanceolate, acuminate. Spathe 20-35 cm, spirally twisted above the spadix (about 2.5 cm long), scarlet-color, fruit is densely warty-aculeate. Seeds are ovoid-cordate.

Distribution: Kohima, Phek, Tuensang (26˚17.722N 94˚35.399E)

Part use: Young leaves and shoots.

Uses: Young leaves and shoots are taken as vegetables.

Figure: 2.2(9)

***Elatostema lineolatum* Wight**

Accession Number: NU-BOT-UC-NK-1021

Family: Urticaceae

Common name: Elatostema

Vernacular name: Jotho (Ang)

Habitat: Found growing in deep forest, shady, moist ground, on the river banks.

Description: A small sub-shrub growing up to 50-500 cm tall, densely bushed. Stems are ascending or erect dark fleshy green bristle. Leaves alternate, stipules linear or

narrowly triangular. Leave blade obovate-oblong, prominent veins, margin toothed. Inflorescence are solitary, simple, seed-pods are ellipsoid.

Distribution: Kohima, Phek, Tuensang (25˚.59N 94˚.1264E)

Part use: Young leaves and shoots.

Uses: The young leaves and shoots are taken as vegetable and also cooked as vegetable in making Galho (Angami cuisine).

Figure: 2.2(10)

***Alpinia nigra* (Gaertn.) Burtt**

Accession Number: NU-BOT-UC-NK-1022

Family: Zingiberaceae

Common name: Black Galangal, Wild ginger.

Vernacular name: Sokrünuo (Ang)

Habitat: Grows well on moist land and river side.

Description: A biennial medium size herbaceous plant growing up to 1.5 m tall. Underground stem is rhizome and the aerial stem is pseudo-stem consists of leaf sheath. Leafy stem are loosely clumped. Rhizome is horizontal, simple, thickness 2 cm or more. Leaves are sessile or sub-sessile, 30-45 cm long, acuminate, sparsely hairy below, bracts spathaceous, flower solitary in a bract. Fruit is a berry having many seeds, paricarp thin and green when young turn black and bristle when matured.

Distribution: Kohima, Phek, Tuensang (25˚.6746 N 94˚.1066E)

Part use: Young shoots, pseudo-stem and rhizome.

Uses: Young shoots, stems and rhizome are taken as vegetable.

Figure: 2.2(11)

***Spilanthes acmella* (L.) L.**

Accession Number: NU-BOT-UC-NK-1025

Family: Asteraceae

Common name: Toothache plant.

Vernacular name: Kevenha (Ang)

Habitat: Found on the open, moist weedy area, abundant on roadsides.

Description: A small perennial trailing herb with triangular ovate or lanceolate leaves, serrate, leaves opposite, petiole 1-2 cm long, margin toothed. Stem is reddish, slightly pubescent, flowers-head arise singly, yellow in long terminal panicles. Disc florets are many. The taste of the flower gives a prinking sentation.

Distribution: Kohima, Phek, Tuensang (25˚.6746 N 94˚.1066E)

Part use: Young leaves and shoots.

Uses: The young leaves and shoot are taken as vegetables.

Figure: 2.2(12)

***Fagopyrum esculentum* Moench**

Accession Number: NU-BOT-UC-NK-1026

Family: Polygonaceae

Common name: Buckwheat

Vernacular name: Garei (Ang)

Habitat: Found in moist waste ground as an escape from cultivation.

Description: A branching annual herb growing up to 1 m tall, pubescent. Leaves are stalked; cordate, basal lobes rounded; stem internodes prominent, pubescent, and hollowed. Flowers borne on stalked, in paniculate cymes, small white flower, corym-like clustered. Nuts triangular, angles acute, brown, flat sides.

Distribution: Kohima, Phek, Tuensang (25˚.6746 N 94˚.1066E)

Part use: Young leaves and shoots.

Uses: Young leaves and shoots are taken as vegetable.

Figure: 2.2(13)

***Begonia palmata* D.Don**

Accession Number: NU-BOT-UC-NK-1028

Family: Begoniaceae

Common name: Begonia

Vernacular name: Rhichü (Ang)

Habitat: Found in moist areas by the streams or slopes in valleys and hills, on rocks.

Description: A small herb growing up to 20-90 cm tall. Rootstock rhizomatous, very short stem, finely pubescent; leaves ovate, lobed, asymmetrical, acuminate,obliquely cordate, elongated petiolate; flower light pink or white, bracts obovate, perianth segmented, capsule inverted with 1 long wing and 2 smaller wings.

Distribution: Kohima, Phek, Tuensang (25˚.5893N 94˚.12653E)

Part use: Young leaves and shoots.

Uses: Young leaves and shoots are taken as vegetable.

Figure: 2.2(14)

***Zanthoxylum oxyphyllum* (Roxb.) DC.**

Accession Number: NU-BOT-UC-NK-1033

Family: Rutaceae

Common name: Cape Yellow, Indian Ivy-rue, Indian pepper.

Vernacular name: Ganyanyü (Ang)

Habitat: Mostly found on open slopes and rock edges, thickets, rain forest and at higher elevation.

Description: An erect deciduous tree growing up to 30 m tall. Stem thorny or spiny with broad base, branches spiny; leaves odd-pinnate, glabrous, leaflets 5-10 pairs, ovate-elliptic, acuminate, margin somewhat crenate, base rounded; flower and leaves appearing crowded at the base of the branch, corymbose, small yellow white, panicles terminal and axillary, sepal (lobed) and petals 4, oblong, seed-pods spherical, 1 seeded, smooth, black.

Distribution: Kohima, Phek, Tuensang (25˚31.15N 94˚12.299E)

Part use: Young leave and mature fruit.

Uses: Young leave is taken as vegetable and mature fruit is used as condiment.

Figure: 2.2(15)

***Cardamine hirsuta* L.**

Accession Number: NU-BOT-UC-NK-1034

Family: Brassicaceae

Common name: Hairy bittercress

Vernacular name: Seguoga (Ang)

Habitat: Mostly found in damp, open ground, waste places and riversides.

Description: It is an erect annual plant growing up to 30 cm tall, branched or unbranched near the base. Leaves of the seedlings are simple while leaves that develop later are compound; most of the leaves are part of the basal rosette. Small white flower are borne in a raceme without bracts followed by seed development and often continuing to flower as the first seeds ripen.

Distribution: Kohima, Phek, Tuensang (25˚.6733N 94˚.1023E)

Part use: Whole plant.

Uses: The whole plant when young is taken as vegetable.

Figure: 2.2(16)

***Pseudognaphalium affine* (D. Don) Anderb.**

Accession Number: NU-BOT-UC-NK-1038

Family: Asteraceae

Common name: Jersey cudweed.

Vernacular name: Chienega (Ang)

Habitat: Found abundant on the roadside, open area, waste area etc.

Description: It is an erect herb growing up to 30-40 cm tall. The plant is soft-woolly all over. Stems are often several from the base, pubescent, hardly branched. Leave is 4-7 cm long lanceolate above and oblanceolate below, pubescent, apex acute. Flower are small yellow, pistillate florets numerous, corolla tubular, lobes 5, pappus seriate, bristle basilly free.

Distribution: Kohima, Phek, Tuensang (25˚.6083N 94˚.1264E)

Part use: Young leave and shoot.

Uses: Young leave and shoot taken as vegetable.

Figure: 2.3(1)

***Amorphophallus nepalensis* (Wall.) Bogner & Mayo**

Accession Number: NU-BOT-UC-NK-1045

Family: Araceae

Common Name: Nepalese voodoo lily

Vernacular Name: Teinhyiemidu (Ang)

Habitat: Found in sheltered, moist, humus, shady areas, riversides etc.

Description: A perennial herb growing up to 1-1.5 m tall. Leave has a large umbrella like shape with mottled leopard-spotted petiole which is follow on after the inflorescence emerged. Inflorescence has a large sail-like spathe with pale creamy yellow inside and greenish on the outside. The juice can be very itchy when in contact with the skin.

Distribution: Kohima, Phek, Tuensang (25˚53.6207N 94˚12.2416E)

Parts use: Young leave and petiole.

Uses: Young leave and petiole are taken as vegetable.

Figure: 2.3(2)

***Cheilocostus speciosus* (J. König) C. Specht**

Accession Number: NU-BOT-UC-NK-1049

Family: Costaceae

Common Name: Crepe ginger, Malay ginger, Cane ginger, Wild ginger.

Vernacular Name: Thevobuoto (Ang)

Habitat: Mostly found growing on the roadside ditches, low-lying areas in the forest.

Description: An aromatic herd growing up to 10 ft tall, with hairy, fleshy, branched underground rhizome. Leaves are green dark arrange on the stalk in a spiral, leaves oblong, acute. Flowers form in cone shape bracts, white wrinkled flowers protruding from each cone; true petals are inconspicuous and almost hidden by the bell shapes stamen.

Distribution: Kohima, Phek, Tuensang (25˚41.3449N 94˚6.007E)

Parts use: Young leaves and shoots.

Uses: Young leaves and shoots are taken as vegetable. Decoction of the rhizome is taken as a traditional treatment by diabetic patient.

Figure: 2.3(3)

Figure 2.3: Leafy vegetables, 1. *Pseudognaphalium affine,* 2. *Amorphophallus nepalensis,* 3. *Cheilocostus speciosus,* 4. *Herpatospermum pedunculosum,* 5. *Colocasia antiquorum,* 6. *Elatostema platyphyllum,* 7. *Ficus geniculata,* 8. *Trichodesma khasianum,* 9. *Diplazium esculentum,* 10. *Gynura nepalensis,* 11. *Crassocephalum crepidiodes,* 12. *Asparagus officinalis,* 13. *Trevesia sundaica,* 14. *Gnaphalium uliginosum,* 15. *Paederia foetida,* 16. *Rumex patientia*

***Herpetospermum pedunculosum* (Ser.) C.B. Clearke**

Accession Number: NU-BOT-UC-NK-1050

Family: Cucurbitaceae

Common Name: Himalayan Gourd.

Vernacular Name: Galü (Ang)

Habitat: Mostly found on the open secondary forest, open sunny areas, forest edges

Description: A creeping and climbing herb; leaves are ovate, heart-like shape, acute, hairy pubescent, margin dentate, base cordate; stem and branches long and slander; flower dioecious , both male and female flower are big, yellow corolla, corolla elliptic (male) and oblong (female). Fruits oblong, 3 valved to base, fibrous; seeds oblong, pale grey.

Distribution: Kohima, Phek, Tuensang (25˚38.019N 94˚29.106E)

Parts use: Young leaves and shoots.

Uses: Young shoot and leaves are taken a vegetable.

Figure: 2.3(4)

***Colocasia antiquorum* Schott.**

Accession Number: NU-BOT-UC-NK-1051

Family: Araceae

Common Name: Eddoe or Eddo.

Vernacular Name: Thekrü (Ang)

Habitat: Mostly found in the riversides or edges, shady, humus and moist areas, watershed.

Description: A medium size herb growing up to 1 m tall. Leaves are small, ovate with a triangular basal sinus; comparatively smaller leaves, pseudostem and corm then *C. esculenta.* Inflorescence is spadix.

Distribution: Kohima, Phek, Tuensang (25˚58.883N 94˚12.7421E)

Parts use: Young leaves and pseudostem.

Uses: Young leaves and pseudostem are taken as vegetable.

Figure: 2.3(5)

***Elatostema platyphyllum* Wedd.**

Accession Number: NU-BOT-UC-NK-1052

Family: Urticaceae

Common Name: Elatostema.

Vernacular Name: Johunyü (Ang)

Habitat: Mostly found near the stream side, riversides or edges, shady moist areas.

Description: A small shrub, branching from the base, glabrous; leaves alternate, narrowly elliptic, 10-15 cm long, apex acuminate, base obtuse to shallow, margin serrate, prominent veins, very small petiole 2 mm. Male flower solitary or in pairs while female flower in solitary.

Distribution: Kohima, Phek, Tuensang (25˚.6083N 94˚.1275E)

Parts use: Young leaves and shoots.

Uses: Young leaves and shoots is taken as vegetables and also use as a special ingredient in making Galho (Angami cuisine).

Figure: 2.3(6)

***Ficus geniculata* Kurz.**

Accession Number: NU-BOT-UC-NK-1091

Family: Moraceae

Common Name: Wild fig

Vernacular Name: Chiedebo (Ang)

Habitat: Mostly found in the mountains, hilly areas and medium elevation.

Description: A deciduous tree growing up to 30 m tall with whitish grey bark. Leaves are clustered apically on branchlets, elliptic to broadly ovate, glabrous, cuspidate, base rounded to cuneate, prominent secondary veins and midvein, petiole 4-5 cm. Fig in clustered, axillary on the woody branchlets or on the lifeless older branchlets, green to red when mature, numerous seeds inside the fruit.

Distribution: Kohima, Phek, Tuensang (25˚67.2215N 94˚12.001E)

Parts use: Young leaves and shoots.

Uses: Young leaves and shoots are taken as vegetables.

Figure: 2.3(7)

***Trichodesma khasianum* C. B. Cl.**

Accession Number: NU-BOT-UC-NK-1092

Family: Boraginaceae

Common Name: Trichodesma.

Vernacular Name: Sekisekuo (Ang)

Habitat: Mostly found growing under the deciduous tree, shady, cold areas.

Description: A medium size shrub growing up to 6 m tall. Leaves are opposite, sparing pubescent, elliptic, acute, base cuneate, margin entire, petiole 1-1.5 cm; flower terminal, corymbose racemes, calyx 4 lobed, maroon brown, ovate, petal creamy white with light purple at tip.

Distribution: Kohima, Phek, Tuensang (25˚38.0192N 94˚29.1061E)

Parts use: Young leave and shoot; inflorescence.

Uses: Young leave and shoot, inflorescence are taken as vegetables.

Figure: 2.3(8)

***Diplazium esculentum* (Ritz.) Sw.**

Accession Number: NU-BOT-UC-NK-1093

Family: Athyriaceae

Common Name: Vegetable fern

Vernacular Name: Gasülo (Ang)

Habitat: Mostly found on the riverbank, streams, in open spaces on wet ground.

Description: A large perennial fern growing up to 30 cm tall with ascending rhizome. Leaves are covered with rufous scales about 1 cm long, bipinnate, lanceolate, serrate margin, acuminate, veins pinnate, rachis glabrous or hairy, sori linear, spore granular or tubular.

Distribution: Kohima, Phek, Tuensang (25˚54.4313N 94˚12.5298E)

Parts use: Frond.

Uses: Frond is eaten as vegetable, also use as garnish in salad.

Figure: 2.3(9)

***Gynura nepalensis* DC.**

Accession Number: NU-BOT-UC-NK-1095

Family: Asteraceae

Common Name: Nepal gynura.

Vernacular Name: Liezienuo (Ang)

Habitat: Mostly found in the forest sheds, river bank, stream sides and shady places.

Description: A perennial herb with erect or ascending stem growing up to 30-45 cm tall. Stem grayish-brown pubescent, woody at base, stem leaves numerous, leaves narrowly elliptic, ovate or oblong-lanceshaped, acute or acuminate, margin entire or serrate; numerous flower-heads, phallaries uniseriate, linear-lanceolate, densely tomentose or

subglobose, margin scarious, apically tapering, florets are yellow, slander, lobes triangular-ovate; achenes cylindric, glabrous or sparsely hairy, numerous pappus hair, white, silky.

Distribution: Kohima, Phek, Tuensang (25˚35.1373N 94˚22.1602E)

Parts use: Young leaves and shoots.

Uses: Young leaves and shoots are taken as vegetables.

Figure: 2.3(10)

***Crassocephalum crepidioides* (Benth.) S. Moore**

Accession Number: NU-BOT-UC-NK-1096

Family: Asteraceae

Common Name: Ragleaf, Fireweed, Thickhead.

Vernacular Name: Nhasa (Ang)

Habitat: Mostly found on the roadsides, waste lands, disturbed areas.

Description: An erect herb growing up to 1 m tall with stem glabrous or finely hairs. Leaves alternate, slightly pubescent, elliptic or oblong elliptic, acuminate, base cuneate, margin serrate, petiolate. Capitula few to numerous in terminal corymbiform cymes, flowerheads are cylindrical with red florets, achenes brownish, narrowly oblong, hairy, pappus white numerous hairs.

Distribution: Kohima, Phek, Tuensang (25˚41.3941N 94˚6.0993E)

Parts use: Young leaves and shoots.

Uses: Young leaves and shoots are taken as vegetables.

Figure: 2.3(11)

***Asparagus officinalis* L.**

Accession Number: NU-BOT-UC-NK-1098

Family: Asparagaceae

Common Name: Asparagus, sparrow grass.

Vernacular Name: Shiehou (Ang)

Habitat: Mostly found on river banks, stream sides, fertile and sandy soils.

Description: A dioecious tall upright herb with suberect stem usually slightly pendent apically. Cladodes in fascicles in 4-6, subterete, slightly flattened, irregularly grooved. Inflorescence developing after cladodes, both flowers solitary, small flowers with two yellow-green petals-like tepals, small red berry.

Distribution: Kohima, Phek, Tuensang (25˚35.20.001N 94˚22.0234E)

Parts use: Young shoot.

Uses: Young shoot is taken as vegetable.

Figure: 2.3(12)

***Trevesia sundaica* Miq.**

Accession Number: NU-BOT-UC-NK-1101

Family: Araliaceae

Common Name: Trevesia, Snowflake Aralia

Vernacular Name: Teirhünyü (Ang)

Habitat: Mostly found in the understory trees of evergreen forest.

Description: A small evergreen tree growing up to 6-8 m tall with strong spiny bark and somewhat unbranched. Leaves palmately 7-9 lobed from base, oblong-elliptic, acuminate, coarsely serrate, prominent midrib, sparsely stellate-pubescent at first and shiny glabrous at maturity. Inflorescence umbels, densely stallate, fruit sunblobose, stout, persistant.

Distribution: Kohima, Phek, Tuensang (25˚51.2471N 94˚9.3225E)

Parts use: Young leaves and shoots.

Uses: Young leaves and shoots are taken as vegetable.

Figure: 2.3(13)

***Gnaphalium uliginosum* L.**

Accession Number: NU-BOT-UC-NK-1102

Family: Asteraceae

Common Name: Marsh cudweed.

Vernacular Name: Cienega (Ang)

Habitat: Mostly found on the marshes, paddy field, riversides.

Description: A wooly annual small herb growing up to 10-30 cm. Stem erect, usually branched from base, alternate, oblanceolate, margin entire, acuminate, base attenuate, sessile; phyllaries brownish, flower heads arrange in clusters, corolla yellow brown, achenes oblong, pappus white, falling separately when mature.

Distribution: Kohima, Phek (25˚38.019N 94˚29.106E)

Parts use: Whole plant.

Uses: Whole plant when young is taken as vegetable.

Figure: 2.3(14)

***Paederia foetida* L.**

Accession Number: NU-BOT-UC-NK-1103

Family: Rubeaceae

Common Name: Skunk vine, Stink vine, Chinese fever vine.

Vernacular Name: Menyi (Ang)

Habitat: Mostly found in the thickets, along the forest edges, clearing in primary forest, forested slopes and steep.

Description: A perennial twining vine growing up to 5-7 m tall. Stem glabrous or puberulent, exuded strong sulphurous odour when bruised, leaves alternate, ovate or lanceolate, acute or acuminate, base cuneate, margin flat, petiolate; flower violet, axillary or terminal, shortly pedicelled, often branched panicled cymes, petal funnelform with 5 spreading petals; fruit globose, glabrescent, wings pale.

Distribution: Kohima, Phek, Tuensang (26˚11.132N 94˚43.519E)

Parts use: Young leaves and shoots.

Uses: Young leaves and shoots are taken as vegetables. The decoction of the leaves is taken during severe diarrhea by the locals.

Figure: 2.3(15)

***Rumex patientia* L.**

Accession Number: NU-BOT-UC-NK-1104

Family: Polygonaceae

Common Name: Patience dock, garden patience, herb patience.

Vernacular Name: Meza gakrie (Ang)

Habitat: Mostly found along the ditches, water sides, paddy fields, moist and open area.

Description: A perennial herb growing up to 90-150 cm tall. Root vertical tap, stout erect stem with nodes, hollow, branching mostly on top, leaves oblong-lanceolate, acute, margin entire, base cuneate, petiolate; Inflorescence peniculate, flower small, bisexual, yellowish-green, pedicel slander, outer tepals oblong, inner tepals enlarged in fruit,; achenes brown, ovoid, winged.

Distribution: Kohima, Phek, Tuensang (25˚41.4864N 94˚6.1516E)

Parts use: Young leaves and shoots.

Uses: Young leaves and shoots are eaten as vegetables.

Figure: 2.3(16)

***Chenopodium album* L.**

Accession Number: NU-BOT-UC-NK-1105

Family: Amarantheceae.

Common Name: Fat hen, lamb's quarter, white goosefoot, pigweed.

Vernacular Name: Terhuotiepfü (Ang)

Habitat: A common weed mostly found on the cultivated ground of rich soil and old humus heaps.

Description: An annual herb growing up to 25-150 tall. Stem erect, branching above, leaves powder white coated, ovate-deltoid, unlobed or waekly 3-lobed, subobtuse or acute, base cuneate, margin entire or sometime shallowly dentate; flowers bisexual, densely clustered, parienth segmented, pericarp adnate to seed, seed black with radial striation.

Distribution: Kohima, Phek, Tuensang (25˚35.2289N 94˚22.0267E)

Parts use: Young leaves and shoots.

Uses: Young leaves and shoots are taken as vegetables.

Figure: 2.4(1)

***Chenopodium gigangeum* D. Don**

Accession Number: NU-BOT-UC-NK-1106

Family: Amaratheceae

Common Name: Tree, spinach, Magenta spreen, Purple Goosefoot, Giant Lambsquarters.

Vernacular Name: Terhuotiepfü (Ang)

Habitat: Mostly found in the weed infested places, kitchen garden, open fertile an old humus places.

Description: An annual herb growing up to 1-3 m tall. Stem erect, mostly branched above, red purple straite; leaves rhombic-ovate, powder white coated, unlobed or shallowly 3-lobed, margin serrate or coarsely irregularly dentate, base cuneate, petiolate; inflorescence terminal penicles, usually pendulous in fruit, seed small, black or red-black.

Distribution: Kohima, Phek, Tuensang (25˚53.6207N 94˚12.2416E)

Parts use: Young leaves and shoots.

Uses: Young leaves and shoots taken as vegetable.

Figure: 2.4(2)

***Amarathus viridis* L.**

Accession Number: NU-BOT-UC-NK-1109

Family: Amarantheceae

Common Name: Green Amaranth, slander amaranth.

Vernacular Name: Niedza (Ang)

Habitat: A common weed mostly found on the waste ground and roadsides.

Description: A small erect shrub growing up to 20-50 cm tall. Leaves broadly ovate, acute or subobtuse, base cuneate, margin entire, spikes slander, parienth segment, capsule warty, bursting irregularly or indehiscent, seeds glossy black or brownish black, sudglobose.

Distribution: Kohima, Phek, Tuensang (25˚.6589N 94˚.0966E)

Parts use: Young leaves and shoots.

Uses: Young leaves and shoots are taken as vegetables.

Figure: 2.4(3)

***Amaranthus tricolor* L.**

Accession Number: NU-BOT-UC-NK-1110

Family: Amarantheceae.

Common Name: Chinese spinach

Vernacular Name: Niedza (Ang)

Habitat: Mostly cultivated but occur on the roadsides, wasteland and humus rich soil as a common weed.

Description: An annual shrub growing up to 50- 100 cm tall with a stout red stem. Leaves red, ovate-rhombic, glabrous, obtuse, margin entire, base cuneate; flowers very small, in dense clusters on the spikes at apex or leaf axil, bracts and bracteoles ovate, capsule circumscissile, seeds small, brownish black, obovoid.

Distribution: Kohima, Phek, Tuensang (25˚.6589N 94˚.0966E)

Parts use: Young leaves and shoots.

Uses: Young leaves and shoots are taken as vegetables.

Figure: 2.4(4)

Figure 2.4: Leafy vegetables, 1. *Chenopodium album,* 2. *Chenopodium gigangeum,* 3. *Amaranthus viridis,* 4. *A. tricolor,* 5. *Pilea scripta,* 6. *Lacanthus peduncularis,* 7. *Elatostema sessile,* 8. *Ficus fistulosa,* 9. *Impatiens latifolia,* 10. *A. spinosus,* 11. *Begonia roxburghii,* 12.*Oenanthe javanica*

***Pilea scripta* (Buch-Ham. ex D. Don) Webb.**

Accession Number: NU-BOT-UC-NK-1111

Family: Urticaceae

Common Name: Himalayan Clearweed

Vernacular Name: Therhie (Ang)

Habitat: Mostly found on the shaded wet places, moist places, understory trees, riversides, streams sides.

Description: A perennial stout flashy herb growing up to 2 m tall. Branching mostly at base, woody at base, glabrous, swollen above the nodes; laves elliptic or lanceolate, acuminate, margin serrate, base cuneate, petiolate, stipulate; inflorescence solitary, flowers pale yellow white, male panicles larger, in lower axil, female in upper axil, achenes ovoid, compressed, oblique.

Distribution: Kohima, Phek, Tuensang (25˚.6589N 94˚.0966E)

Parts use: Young leaves and shoots.

Uses: Young leaves and shoots are taken as vegetables.

Figure: 2.4(5)

***Lecanthus peduncularis* (Wall. Ex Royle)**

Accession Number: NU-BOT-UC-NK-1112

Family: Urticaceae

Common Name: Stalked dischead

Vernacular Name: Gabo (Ang)

Habitat: Mostly found in the stream sides, moist and shady places, riversides,

Description: A creeping or spreading perennial herb growing up to 20-90 cm tall with a succulent stem. Leaves ovate to lanceolate, acuminate, base rounded, margin serrate;

flowers unisexual in capitates heads, male flower pedicellate, parianth 5 lobe, female flowers 3-5 lobe, achenes brownish red, ellipsoid-ovoid.

Distribution: Kohima, Phek, Tuensang (26˚16.403N 94˚38.372)

Parts use: Young leaves and shoots.

Uses: Young leaves and shoots are taken as vegetables.

Figure: 2.4(6)

***Elatostema sessile* J.R Forst. & G Forst.**

Accession Number: NU-BOT-UC-NK-1113

Family: Urticaceae

Common Name: Stalkless elatostema

Vernacular Name: Gajo (Ang)

Habitat: Mostly found on the moist and shady places, wet rocks, stream edges, rocky slopes.

Description: A dioecious small herb growing up to 60 cm tall with a succulent stem. Leaves asymmetrically elliptic, acuminate, margin coarsely and sharply serrate, base cuneate, petiole absent or stalkless, stipule oblong; inflorescence axillary, flower heads either sessile or shortly peduncled, male flower perianth oblong and segment, female flower hispid, achenes ellipsoid, angular.

Distribution: Kohima, Phek, Tuensang (25˚.6083N 94˚.1275E)

Parts use: Young leaves and shoots.

Uses: Young leaves and shoots are taken as vegetables.

Figure: 2.4(7)

***Ficus fistulosa* Reinw. Ex. Blime**

Accession Number: NU-BOT-UC-NK-1114

Family: Moraceae

Common Name: Yellow stem fig

Vernacular Name: Khrübvü Kecüu (Ang)

Habitat: Mostly found on the understory trees, along stream sides, undisturbed forest, on rocky slopes.

Description: A shrub or small, evergreen tree growing up to 5 m tall. Leaves alternate, elliptic-obovate, glabrous, acuminate, margin entire, base cuneate or rounded; male flower shortly pedicellate, calyx 3 or 4 lobed, female flower enclosing base at pedicel, style persistent, achenes cubic with small tubercles, figs globose, reddish orange when mature.

Distribution: Kohima, Phek, Tuensang (25˚31.466N 94˚12.299E)

Parts use: Young leaves and shoots.

Uses: Young leaves and shoot are taken as vegetables.

Figure: 2.4(8)

***Impatiens latifolia* L.**

Accession Number: NU-BOT-UC-NK-1115

Family: Begoniaceae

Common Name: Indian Angel Balsam, Baba budan balsam.

Vernacular Name: Gasa (Ang)

Habitat: Mostly found on the river banks, stream sides, moist, wet and shady places.

Description: A perennial herb growing up to 40-80 cm tall with slightly swollen nodes. Leaves elliptic-oblanceolate, glabrous or pubescent nerves beneath, acuminate, margin

crenate, base cuneate; flowers borne in 2-3 clusters, raceme, pink or light purple,long peduncle, lateral lobes winged obovate, terminals lobes semi-ovate, upper petal round winged behind, spur slander, curved inward, capsule subfusiform, glabrous.

Distribution: Kohima, Phek, Tuensang (25˚52.6207N 94˚12.2416E)

Parts use: Young leaves and shoots.

Uses: Young leaves and shoots are taken as vegetables.

Figure: 2.4(9)

***Amaranthus spinosus* L.**

Accession Number: NU-BOT-UC-NK-11120

Family: Amarantheceae

Common Name: Spiny Amaranth, Prickly Amaranth.

Vernacular Name: Niedza (Ang)

Habitat: A common weed mostly found on the waste lands, roadsides, rich soil.

Description: An annual small shrub growing up to 30-100 cm tall. Leaves are rhombic or ovate with a pair of axillary spines, glabrous, obtuse, margin entire, base cuneate, petiolate, spiked, flowers in axillary clustered or terminal cylindric spikes, parianth segments 5, capsule ovoid, circumscissile, seeds subglobose, brownish black.

Distribution: Kohima, Phek, Tuensang (25˚53.6207N 94˚12.2416E)

Parts use: Young leaves and shoots.

Uses: Young leaves and shoots are taken as vegetable.

Figure: 2.4(10)

***Begonia roxburghii* A.DC.**

Accession Number: NU-BOT-UC-NK-1126

Family: Bogoniaceae

Common Name: East Himalayan Begonia.

Vernacular Name: Rhichü (Ang)

Habitat: Mostly found on the stream sides, slopes of rock, river sides.

Description: A medium size herb growing up to 120 cm tall with elongated red dots on stem. Leaves broadly or narrowly ovate, succulent, sometimes 3-5 lobed, acuminate, margin dentate, base obliquely cordate; petiole elongated, stipule lanceolate, fruit white to light pink, short axillary cymes, pendent, borne close to main stem on pedicels, 4 lobed with red dots.

Distribution: Kohima, Phek, Tuensang. (26˚16.384N, 94˚27.572E)

Parts use: Young leaves and shoots.

Uses: Young leaves and shoots are taken as vegetables.

Figure: 2.4(11)

***Oenanthe javanica* (Blume) DC.**

Accession Number: NU-BOT-UC-NK-1128

Family: Apiaceae

Common Name: Java water dropwort, water dropwort

Vernacular Name: Gakra (Ang)

Habitat: Mostly found on wet or moist places, shady places, riversides, streamsides.

Description: An aromatic perennial herb growing up to 1 m tall with often rootings on the lower nodes of the plant. Leaflets bipinnate, ovate, acute, serrate margin, base cuneate; inflorescence umbel, small white flowers, calyx teeth, fruit ellipsoid.

Distribution: Kohima, Phek, Tuensang (25˚53.6207N 94˚12.2416E)

Parts use: Whole plant.

Uses: Whole plant is taken in salad or as vegetable.

Figure: 2.4(12)

***Justicia santapaui* Bennet**

Accession Number: NU-BOT-UC-NK-1129

Family: Acantheceae

Common Name: Santapau's Justicia

Vernacular Name: Gapfü (Ang)

Habitat: Mostly found on the shady, wet and moist places, riverbanks, stream sides.

Description: An erect herb growing up to 1-2 m tall. Leaves opposite, ovate-elliptic to elliptic lanceolate, dark green in older leaves, veins almost opposite, acute, entire margin, base cuneate, petiolate; flowers clustered in paniculate spikes, bractaite, flower white with pink streaks, pubescent, calyx creamy green, sepal 5, flowers 2 lipped; capsule clavate, pubescent, 4 seeded, rugose.

Distribution: Kohima, Phek, Tuensang (26˚18.150 N, 94˚29.774E)

Parts use: Young leaves and shoots.

Uses: Young leaves and shoots are taken as vegetables.

Figure: 2.5(1)

***Urtica ardens* Link**

Accession Number: NU-BOT-UC-NK-1130

Family: Urticaceae

Common Name: Himalayan Nettle.

Vernacular Name: Zozie (Ang)

Habitat: Mostly found in thickets, stream banks, and moist places in forest.

Description: A perennial herb growing up to 100 cm tall with stem and petiole covered by sparsely by stinging hairs. Leaves ovate, adaxial and abaxial surface covered with stinging hairs, serrate margin, acuminate, base cordate; inflorescence paniculate, fruit drooping, achenes ovoid, slightly compressed, smooth.

Distribution: Kohima, Phek, Tuensang (25˚.5736N 94˚.1112E)

Parts use: Young leaves and shoots.

Uses: Young leaves and shoots are taken as vegetables with care as the stinging hair can sting when touched.

Figure: 2.5(2)

***Urtica dioica* L.**

Accession Number: NU-BOT-UC-NK-1131
Family: Urticaceae
Common Name: Stinging Nettle
Vernacular Name: Zozie (Ang)
Habitat: Mostly found on the waste ground, hedgerows, shrubby vegetations, woods.

Description: A stout perennial herb growing up to 20-100 cm tall. Rhizome woody, stem and petiole densely or sparsely covered with stinging hair, stipule free; leaves ovate, acuminate, adaxial and abaxial surface densely covered with stinging hairs, margin serrate or dentate, base cordate,; inflorescence paniculate, female flower slander with drooping fruit, male flower in bud, achene ovoid, slightly compressed.

Distribution: Kohima, Phek, Tuensang (26˚18.150 N, 94˚29.774E)
Parts use: Young leaves and shoots.
Uses: Young leaves and shoot are taken as vegetable.
Figure: 2.5(3)

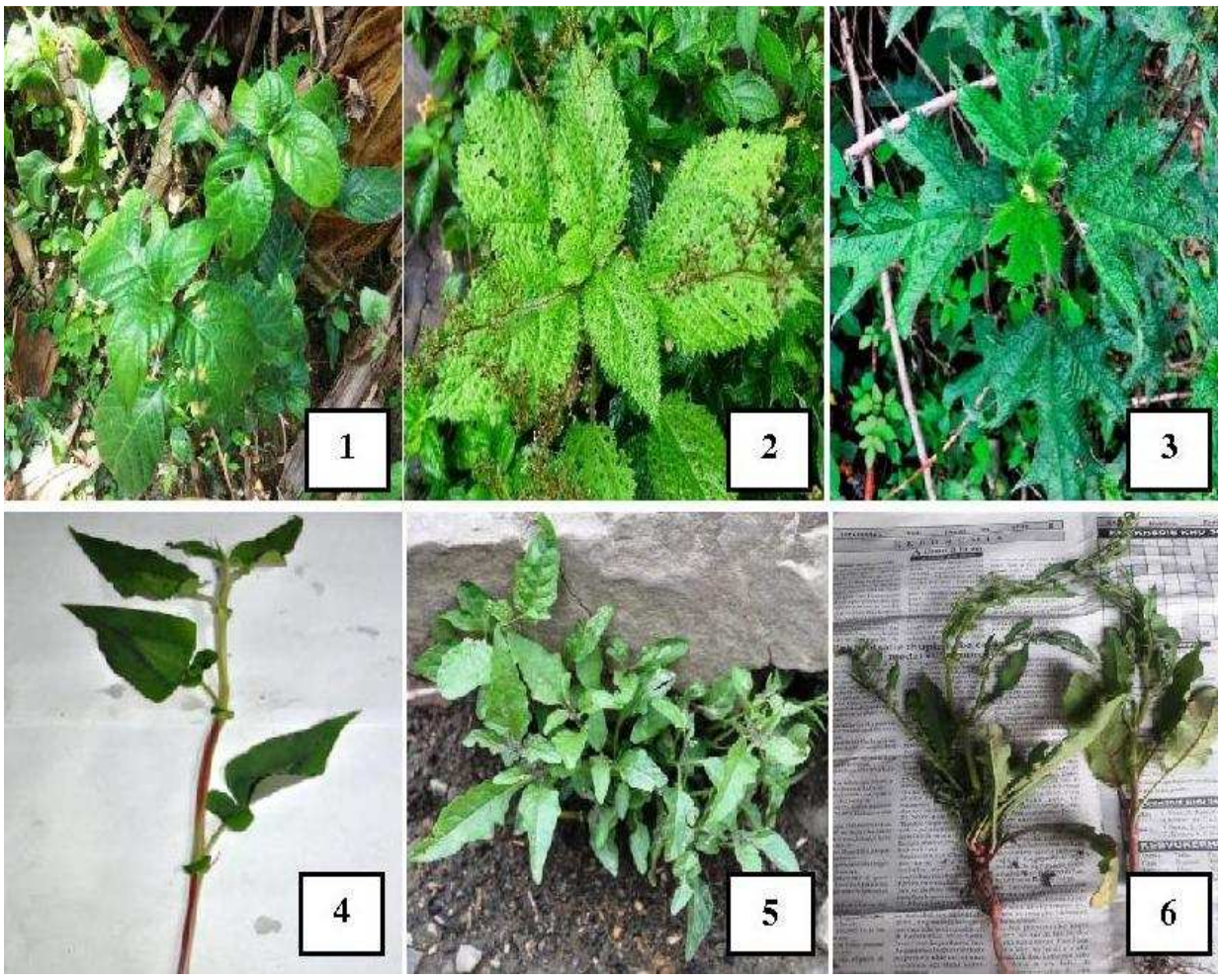


Figure 2.5: Leafy vegetable, 1. *Justicia santapaui,* 2. *Urtica ardens,* 3. *U. fissa,* 4. *Persicaria nepalensis,* 5. *Solanum nigrum,* 6. *Rumex crispa*

***Persicaria nepalensis* (Meisn.) Miyabe**

Accession Number: NU-BOT-UC-NK-1135

Family: Polygonaceae

Common Name: Nepal Knotweed

Vernacular Name: Pruzie (Ang)

Habitat: Mostly found in the humus rich soil, waste areas, kitchen garden.

Description: A small diffuse herbaceous growing up to 30-60 cm long. Rooting from lower nodes, reddish color, glabrous; leaves deltoid, acute, glabrous or sparsely hairy along the nerves, margin entire, base cuneate, petiolate; spike on the axil of terminal leaf, conical, bracts elliptic, flower solitary or in small groups, pale pink or purple or white, glabrous, seed biconvex, brown.

Distribution: Kohima, Phek, Tuensang (25˚53.6207N 94˚12.2416E)

Parts use: Young leaves and shoots.

Uses: Young leaves and shots are taken as vegetables.

Figure: 2.5(4)

***Solanum nigrum* L.**

Accession Number: NU-BOT-UC-NK-1136

Family: Solanaceae

Common Name: Black Nightshade

Vernacular Name: Gatsi (Ang)

Habitat: Mostly found on the waste lands, disturbed areas, gardens.

Description: A short live perennial herb growing up to 100 cm tall with profuse branching. Leaves pubescent, ovate, acuminate, entire or dentate margin, petiolate;

flower white, petals 5, recurved when mature with yellow anthers; berry dark blue-black, spherical and in clusters.

Distribution: Kohima, Phek, Tuensang (25˚53.6207N 94˚12.2416E)

Parts use: Young leaves and shoots.

Uses: Young leaves and shoots are taken as vegetables.

Figure: 2.5(5)

***Rumex crispus* L.**

Accession Number: NU-BOT-UC-NK-1137

Family: Polygonaceae

Common Name: Curly dock, yellow dock

Vernacular Name: Meza gakrie (Ang)

Habitat: Mostly found on the grassy places, waste lands, roadsides, paddy fields.

Description: A perennial herb growing up to 60 cm tall with large roots and erect stem. Leaves from basal rosette, glabrous, oblong or lanceolate, acuminate upper leaves apex and obtuse lower basal leaves, base cuneate, petiolate; flower occur in clusters on the branched stem, achenes dark brown, ovoid.

Distribution: Kohima, Phek, Tuensang (25˚.5736N 94˚.1112E)

Parts use: Young leaves and shoots.

Uses: Young leaves and shoots are taken as vegeyables.

Figure: 2.5(6)

Fruit and Nut

***Ficus auriculata* Lour.**

Accession Number: NU-BOT-UC-NK-1011

Family: Moraceae

Common name: Roxburg fig, Elephant ear fig.

Vernacular name: Khrübvü Kezhau (Ang)

Habitat: Found in moist valley, forests and along the stream banks.

Description: A wide-spreading, evergreen tree which can grow 3-10 m tall with large broadly ovate leaves, acute, shallowly or coarsely toothed margins, prominent midribs with 5-7paired veins, prominent base with 5-veins at base, glabrous above with softly pubescent beneath, petiole 7-9 cm, stipule triangular, peduncle 3-5 cm, leafless branches on the tree trunk bearing clustered fruits. Fruit bears sticky latex covered with soft hairs, dark red when matures.

Distribution: Kohima, Phek, Tuensang (25˚41.3449N 94˚6.0078E)

Part use: Young Leaves, Fruits.

Uses: Young leaves are taken as vegetables and fruit is eaten raw when mature.

Figure: 2.6(1)

***Ficus semicordata* Buch-Ham ex J.E. Smith**

Accession Number: NU-BOT-UC-NK-1012

Family: Moraceae

Common name: Wedgeleaf fig, Drooping fig

Vernacular name: Chiede (Ang)

Habitat: Mostly found valleys, slopes, and forest margins.

Description: A medium size tree growing up to 10 m tall. Leaves distichous, pubescent, ovate to lanceolate, acuminate, base obliquely cordate beneath and auriculate above, margin entire or toothed. Figs on peduncle, numerous on the leafless branch of the branches or on the stem, globose, green to red when mature.

Distribution: Kohima, Phek, Tuensang (25˚35.1998N 94˚20.1726E)

Part use: Mature fruits.

Uses: Mature fruits are eaten raw.

Figure: 2.6(2)

***Juglans regia* Linn.**

Accession Number: NU-BOT-UC-NK-1013

Family: Juglandaceae

Common name: Persian walnut, Butter nut.

Vernacular name: Pfhüsei (Ang)

Habitat: Found mostly in sheltered sites that prefer moisture with lot of sunny light and deep soil for its optimal growth. Found in unmixed or in isolated zones.

Description: A deciduous tree growing to up to 25 m tall, leaflets in 2-5 pairs , opposite to sub-opposite 5-20 cm long, acute to acuminate, elliptic to lanceolate, entire margins, petiole 2-4 mm, stem glabrous. Male catkins 7-14 cm long, stamens 10-20 subsessile, female flowers 1-3, terminal on short spikes, ripening into a fruit with green husk and a brown, corrugated nut. When the nut matures, it breaks the husk open and falls down on the ground.

Distribution: Kohima, Phek, Tuensang (25˚52.4440N 94˚10.8201E)

Part use: Mature nuts

Uses: The mature nut is eaten raw or taken as pickle pounded with chilli, garlic, ginger and salt**.**

Figure: 2.6(3)

Figure 2.6: Fruits and Nuts, 1. *Ficus auriculata,* 2. *F. semicordata,* 3. *Juglans regia,* 4. *Rhus chinensis,* 5. *Terminalia chebula,* 6. *Choerospondias axillaris,* 7. *Stixis suaveolens,* 8. *Spondias pinnata,* 9. *Elaeagnus latifolia,* 10. *Diospyros kaki,* 11. *Abelmoschus moschasta,* 12. *Cucumis hystrix,* 13. *Docynia indica,* 14. *Mahonia nepalensis,* 15. *Myrica esculenta,* 16. *Physalis peruviana*

***Rhus chinense* Murr.**

Accession Number: NU-BOT-UC-NK-1014

Family: Anacardiaceae

Common name: Nutgall tree

Vernacular name: Zomhusei (Ang)

Habitat: Often occurs on old cultivation and occurring near forest boundaries.

Description: A small deciduous tree growing up to the height of 10 m tall with branchlets ash grey and warty. Leaves are imparipinnately compound, winged between upper leaflets, leaflets 3-7 pairs, opposite, leaflet blade ovate to oblong, prominent reddish mid-ribs, serrated. Flowers borne on many branched clustered, male flower 30-40cm, female flower shorter, flower whitish or pale yellowish-green. Drupes are subglobose, spherical, slightly compressed and reddish at maturity.

Distribution: Kohima, Phek, Tuensang (25˚35.4115N 94˚16.1635E)

Part use: Drupes or mature fruits.

Uses: Powdered fruits are eaten raw; drinks are also made from the fruits.

Figure: 2.6(4)

***Terminalia chebula* Retz.**

Accession Number: NU-BOT-UC-NK-1015

Family: Combretaceae

Common name: Myrobalan

Vernacular name: Mhiechüsei (Ang)

Habitat: Occurs in mixed deciduous forest, extending into forests of comparatively dry type.

Description: A medium to a large deciduous tree growing up to 30 m tall. Leaves are alternate or subopposite, clustered at the apex of each branch, ovate-obovate o elliptic, coriaceous, acute and base rounded or cordate, margin entire, often with hairs on the margin or in the veins, petiole 1-3 cm long. Flower white to pale yellow, spikes axillary or terminal. Fruit is drupe-like 2-4 cm broad, glabrous with 5-redge, turns green to brown-blackish when mature.

Distribution: Kohima, Phek, Tuensang (25˚35.1373N 94˚22.1601E)

Part use: Young and mature fruit**.**

Uses: The fruit is eaten raw. The fruit is boiled with salt, chilli and dried and eaten. The dried product of *T. chebula* fruit is sold in the local market in a packet form.

Figure: 2.6(5)

***Choerospondias axillaris* (Roxb.) B.L Burtt & A.W. Hill**

Accession Number: NU-BOT-UC-NK-1018

Family: Anarcardiaceae

Common name: Nepali Hog Plum

Vernacular name: Khola (Ang)

Habitat: Found in the lowland, hills and mountain forests and secondary forests.

Description: A deciduous tree growing up to 20 m tall. Compound leaves 30-40 cm long, 3-6 pair's leaflets, ovate, acuminate, glabrous, entire, base rounded. The tree is dioescious with female flowers on peduncles, female flowers larger then male flowers yielding edible drupe. Fruit is ovoid or oblong, yellow-brownish in color bearing fleshy endosperm.

Distribution: Kohima, Phek, Tuensang (26˚18.1510N 94˚27.7547E)

Part use: The fleshy mature fruit.

Uses: The fruit is eaten raw or cooked in curry. The mature fruits are sun dried and use as spice. The fruit is also taken as pickle pounded with chilli, ginger and salt.

Figure: 2.6(6)

***Stixis suaveolens* (Roxburgh) Pierre**

Accession Number: NU-BOT-UC-NK-1019

Family: Capparaceae

Common name: Rokasei (Ang)

Vernacular name: Rokasei (Ang)

Habitat: Found growing on the roadsides, shady forest.

Description: A large unarmed woody climber. Leave simple, alternate, coriaceous, oblong or obovate, 8-20 cm long, acuminate, and base cuneate, glabrous, entire, petiole 1-4 cm long. Inflorescence axillary or supra-axillary, clustered racemes or panicles, flower white fragrant, sepals elliptic, olive-green, petal absent. Fruit obovoid or ellipsoid, 3-4 mm thick wall, orange-brown, spongy, surface covered with whitish warts, pulp aromatic, orange-yellow and sweet.

Distribution: Kohima, Phek, Tuensang (26˚57.051N 94˚44.423E)

Part use: Mature orangey fruit and the seed.

Uses: Mature fruit is eaten raw. The seed is removed from the fruit, sun dried and eaten or is boiled with salt, sun dried and eaten.

Figure: 2.6(7)

***Spondias pinnata* (L. f.) Kurz**

Accession Number: NU-BOT-UC-NK-1020

Family: Anacardiaceae

Common name: Wild Mango

Vernacular name: Mezisei (Ang)

Habitat: Found in primary or mixed forest, in dry areas, lowland and hill forests.

Description: A deciduous tree growing up to 40 m tall. Leaves are large, alternate, 2-6 leaflets, ovate-oblong to elliptic, acuminate, base rounded or cuneate, and petiole 1-2 cm long, glabrous, leave entire with distinct intra-marginal vein. Inflorescence is paniculate, flower sessile and small, white and glabrous, petal ovate-oblong. Fruit is yellow-orange when mature, ellipsoid, sweet fragrant.

Distribution: Kohima, Phek, Tuensang (26˚16.3849N 94˚27.5723E)

Part use: Mature fruit.

Uses: The mature fruit is eaten raw. The mature fruit is sun dried and taken in curry.

Figure: 2.6(8)

***Elaeagnus latifolia* L.**

Accession Number: NU-BOT-UC-NK-1024

Family: Elaeagnaceae

Common name: Bastard Oleaster

Vernacular name: Pesü (Ang)

Habitat: Found on swamps, forest openings.

Description: A deciduous or evergreen shrub or a small tree growing up to 3 m tall. Leaves alternate, glabrous, pale green above and clothed beneath with silvery scales, elliptic-lancolate, acuminate, base cuneate, margin entire, prominent veins and midrib; flower hermaphrodite, fragrant, small white flower; fruit 2-5 cm, obovoid, fleshy red color, 1 seeded.

Distribution: Kohima, Phek, Tuensang (25˚58.905N 94˚12.6474E)

Part use: Mature fruits.

Uses: Mature fruits eaten raw and also made into a pickle and taken.

Figure: 2.6(9)

***Diospyros kaki* L.F**

Accession Number: NU-BOT-UC-NK-1027

Family: Ebenaceae

Common name: Japanese Persimmon.

Vernacular name: Ziedi (Ang)

Habitat: Found growing on the roadsides, in open areas.

Description: A deciduous tree growing up to 10-25 m tall. Leaves are ovate or obovate, 6-15 cm long, pubescent beneath, acuminate, borne on pubescent branches, base cuneate, petiole 2-3 cm long. Flowers are yellowish white where male flowers have 16-24 stamens and female have 8 staminoids. Fruits are yellow or orange with a large persistent calyx on the base, 3-7 seeded.

Distribution: Kohima, Phek, Tuensang (26˚10.567N 94.44.058E)

Part use: Mature fruit.

Uses: Mature yellow-orangey fruit eaten raw; seeds also taken raw or roasted.

Figure: 2.6(10)

***Abelmoschus moschasta* Medik.**

Accession Number: NU-BOT-UC-NK-1029

Family: Malvaceae

Common name: Musk Mellow

Vernacular name: Gakhokoka (Ang)

Habitat: Found in open spaces, roadsides, by the stream, areas of seasonal rainfall.

Description: A medium size herb growing up to 2-6 m tall with soft hairy or pubescent stem. Leaves polymorphic, palmately 5-7 lobed, upper leave often narrower and coarsely toothed, 5-9 nerved at base, petiole with deflected hairs. Flower occurs singly in leaf axils, yellow with purple shade in the center. Fruits or pods are hirsute capsule, ovoid-cylindrical, 6-8 cm long

Distribution: Kohima, Phek, Tuensang (25˚35.1375N 94˚22.1607E)

Part use: Young fruits or pods.

Uses: Young fruits or pods are taken as vegetable.

Figure: 2.6(11)

***Cucumis hystrix* Chakrav.**

Accession Number: NU-BOT-UC-NK-1030
Family: Cucurbitaceae
Common name: Wild cucumber.
Vernacular name: Ketsa tsütuo (Ang)
Habitat: Mostly found on the forests, thickets, valleys, slopes of hills.

Description: A small scandent plant growing up to 6-10 m tall. Stems and branches are angular, scabrous, white pubescent hair; leaves are broadly ovate or triangular-ovate, irregularly 3 lobed, acute, base cuneate, margin dentate, petiole 5-8 cm; monoecious plant, both flowers solitary, flower yellow, segment linear and ovate, pedicels 3-5 mm (female), densely yellow-brown hispid; fruit oblong, numerous spikes when young, seeds narrowly ovate, emarginated.

Distribution: Kohima, Phek, Tuensang (26˚16.3849N 94˚27.5723E)
Part use: Young fruit.
Uses: Young fruit is eaten raw.
Figure: 2.6(12)

***Docynia indica* (Wall.) Decne.**

Accession Number: NU-BOT-UC-NK-1032

Family: Rosaceae

Common name: Wild Apple, Assam Apple

Vernacular name: Ciepho (Ang)

Habitat: Found in open spaces, slopes, streamsides.

Description: A perennial woody evergreen tree growing up to 5-13 m tall. Leaves are ovate, acuminate, rounded base with margin entire or shallowly crenate, petiole, glabrous. Stipule is small, apex acute or acuminate, peduncle short. Flowers are whitish and fragrant. Pomes greenish yellow and fruit is 10-15 seeded.

Distribution: Kohima, Phek, Tuensang (25˚58.905N 94˚12.6474E)

Part use: Mature fruits

Uses: Mature fruits are eaten raw. Fruits are also boiled with sugar, sun dried and eaten. Juice is also made from the fruits.

Figure: 2.6(13)

***Mahonia nepalensis* DC.**

Accession Number: NU-BOT-UC-NK-1035

Family: Berberidaceae

Common name: Mahonia

Vernacular name: Athuo (Ang)

Habitat: Garden shrub found shady areas, forest edges.

Description: An unarmed shrub growing up to 3 m tall, leafy near the apex, leaves coriaceous up to 45 cm long, leaflet opposite up to 13-pairs, pinnate, spinose dentate,

glabrous. Flowers are racemes, yellow and berries are ellipsoid, blue purplish black, glabrous.

Distribution: Kohima, Phek, Tuensang (25˚41.5681N 94˚6.21437E)

Part use: Mature fruits.

Uses: Mature fruits are eaten raw.

Figure: 2.6(14)

***Myrica esculenta* Buch-Ham ex. D. Don**

Accession Number: NU-BOT-UC-NK-1036

Family: Myricaceae

Common name: Box- myrtle, bayberry.

Vernacular name: Thuge (Ang)

Habitat: Mostly found in the hilly areas.

Description: A tree growing up to 12 m tall. Leaves are elliptic to obovate, 6-12 cm long, acute, base cuneate, margin entire. Female flower are very small, subglocose heads, solitary, male flower numerous in axillary racemes. Fruits are ellipsoid, turns fleshy red drupe when matured.

Distribution: Kohima, Phek, Tuensang (25˚31˝15.0N 94˚12˝29.9E)

Part use: Mature fruits**.**

Uses: Mature fruit is eaten raw. Juice is also made from the mature fruits.

Figure: 2.6(15)

***Physalis peruviana* L.**

Accession Number: NU-BOT-UC-NK-1037

Family: Solanacae

Common name: Cape goose berry, Goldenberry.

Vernacular name: Chahamiacasei (Ang)

Habitat: Found mostly in open areas, disturbed areas, roadsides etc.

Description: A bushy herbaceous annual plant growing up to 1-2 m tall, develop into a diffusely branched shrub, leaves are ovate, sinuate or shallowly lobed, pubescent, petiole 3-6 cm long. Flowers are yellow colored with purple-brown spot internally, bell-shaped, solitary, axillary. Calyx is inflated, papery, and bladder-like enclosing the fruit/berry. Berries are globose, turns green to yellow orange after mature.

Distribution: Kohima, Phek, Tuensang (25˚.6083N 94˚.1275E)

Part use: Young shoot and leave mature fruit.

Uses: Young shoot and leave taken as vegetable. The mature yellow orange berries are eaten raw when mature.

Figure: 2.6(16)

***Rubus niveus* Thunb.**

Accession Number: NU-BOT-UC-NK-1039

Family: Rosaceae

Common name: Ceylon Raspberry

Vernacular name: Temeirom (Ang)

Habitat: Found on the hilly slopes, forest clearings, roadsides etc.

Description: A small prickly shrub growing up to 1-3 m tall. Presence of numerous thorns on the stem and branches. Leave are rough pinnately 3-4 pair leaflets, 2-7 cm long, dark green above but densely pale grey to white beneath, serrated usually prickly, prominent mid-rib and veins. Flowers are small, short with five pink to red petals, in clusters. Berries densely grey tomemtose, dark red to black when ripen.

Distribution: Kohima, Phek, Tuensang (26˚18.1504N 94˚29.7740E)

Part use: Mature fruits/berries.

Uses: Mature fruits or berries are eaten raw.

Figure: 2.7(1)

***Rubus ellipticus* Sm.**

Accession Number: NU-BOT-UC-NK-1040

Family: Rosaceae

Common name: Golden Himalayan Raspberry, Yellow Himalayan Raspberry.

Vernacular name: Rom (Ang)

Habitat: Found in slopes, riversides, roadsides, forests clearings etc.

Description: A large straggling prickly shrub with stout stems growing up to 5-7 m tall, profusely branched, pubescent, numerous thorns. Leaves are pinnately trifoliate, elliptical, or obovate and toothed with long bristles. Flowers are small whitish with 5 petals, grow in cluster. Fruits/berries are orange yellow, succulent, detachable.

Distribution: Kohima, Phek, Tuensang (26˚18.1504N 94˚29.7740E)

Part use: Mature Fruits/berries.

Uses: Mature fruits/berries are eaten raw.

Figure: 2.7(2)

***Castanopsis indica* (Roxb. ex Lindl.) A.DC.**

Accession Number: NU-BOT-UC-NK-1041

Family: Fagaceae

Common name: Indian chestnut.

Vernacular name: Thezüsei (Ang)

Habitat: Found scattered in the primary and secondary forests.

Description: A large tree growing up to 20 m tall, rough and grey with dense crown. Leaves leathery or papery, glabrous, ovate-elliptic, margin serrate, acuminate, petiolate, base cuneate to rounded; Flowers small, yellow white, female inflorescence infructescence dense, cupule globose, spiky, green to yellow brown when mature, crowded; nut per cupule, black to brown, broadly conical, endocarp white.

Distribution: Kohima, Phek, Tuensang (25˚42.6241N 94˚6.2807E)

Part use: Mature nuts.

Uses: Mature nuts are eaten raw or roasted and eaten.

Figure: 2.7(3)

***Syzygium cumini* (L.) Skeels**

Accession Number: NU-BOT-UC-NK-1042

Family: Myrtaceae

Common name: Black plum, Java plum, Jambolan.

Vernacular name: Keloguo (Ang)

Habitat: Mostly found in the dense and deep hilly forests.

Description: A large evergreen tree growing up to 25-30 m tall. Leaves are opposite, elliptic, ovate or oblong; acuminate petiole 2-4 cm long. Flowers are small white, sweet scented, sessile, calyx funnel-shape, tapering into stalk-like base. Fruits are smooth, rounded, obovoid, turn green to dark purple black when mature.

Distribution: Kohima, Phek, Tuensang (25˚.6083N 94˚.1275E)

Part use: Mature fruits.

Uses: Mature fruits eaten raw.

Figure: 2.7(4)

***Prunus nepalensis* (Ser.) Steud.**

Accession Number: NU-BOT-UC-NK-1043

Family: Rosaceae

Common name: Wild black berry.

Vernacular name: Rünyüsei (Ang)

Habitat: Found mostly in deep and dense forests.

Description: A large tree growing up to 20-25 m tall. Leaves are elliptic to lanceolate, petiole 1-1.5 cm long bearing pair of glands at the apex or on margin of lamina at its base. Flowers are white pinkish, calyx cups shape, lobes glandular, petals are obovate. Fruits ovoid, juicy, turns black purplish when mature.

Distribution: Kohima, Phek, Tuensang (25˚.6083N 94˚.1275E)

Part use: Mature fruits.

Uses: Mature fruit is eaten raw. It is also use in making fruit juices.

Figure: 2.7(5)

***Garcinia xanthochymus* Hook.f. ex T.Anderson**

Accession Number: NU-BOT-UC-NK-1044

Family: Clusiaceae

Common Name: Mysore Gamboge, Sour mangosteen, False mangosteen.

Vernacular Name: Chierie (Ang)

Habitat: Found in dense humid forests, valleys or on hills.

Description: It is a small evergreen tree growing up to 15-20 m tall. Leaves are narrowly oblong, 12-15 cm long, globrous, entire, shortly acuminate, base cuneate, numerous veins, petiole 1-2 cm long. Flower rise from the leaf axils in 3-8 groups, 5 sepals, 5 white

petals. Fruits subglobose, pointed, pale orange to yellow, found in groups, pleasant acid taste.

Distribution: Kohima, Phek, Tuensang (25˚.6083N 94˚.1275E)

Parts use: Mature fruits.

Uses: Mature fruit is eaten raw and is also used in making juices.

Figure: 2.7(6)

***Prunus carmesina* H. Hara**

Accession Number: NU-BOT-UC-NK-1053

Family: Rosaceae

Common Name: Wild cherry

Vernacular Name: Kezie (Ang)

Habitat: Mostly found in primary and secondary forests.

Description: A large tree growing up to 30 m tall. Leaves ovate or oblong, acuminate, base rounded or cuneate, serrated margin, petiolate bearing disc-like glands, glabrous, stipulate. Flower precocious, calyx tube crimsome, petals deep pink; fruits green to green orange to red when mature.

Distribution: Kohima, Phek, Tuensang (25˚31.466N 94˚12.2205E)

Parts use: Mature fruits.

Uses: Mature fruit is eaten raw.

Figure: 2.7(7)

***Zanthoxylum armatum* DC.**

Accession Number: NU-BOT-UC-NK-1054

Family: Rutaceae

Common Name: Winged prickly ash.

Vernacular Name: Ganyasei (Ang)

Habitat: Mostly found open slopes, rock ledges, both primary and secondary forest.

Description: An aromatic, spiny shrub or small tree growing up to 7-8 m tall. Leaves are pinnate, leaflet 3-9 pairs, glarous, stalkless, elliptic to lanceolate, acuminate, margin entire to slightly toothed, base rounded or cuneate; tiny yellow flowers arising from leaf axils, in dense panicles. Fruits reddish when mature, seeds rounded, shinny black.

Distribution: Kohima, Phek, Tuensang (26˚34.6250N 94˚18.325E)

Parts use: Young leaves and shoots and mature fruits.

Uses: Young leaves and shoots are taken as vegetables. Mature fruits are also taken as a spice.

Figure: 2.7(8)

***Duchesnia indica* (Andrews) Th. Wolf**

Accession Number: NU-BOT-UC-NK-1055

Family: Rosaceae

Common Name: Mock strawberry, Indian strawberry or false strawberry.

Vernacular Name: Kijirümvü (Ang)

Habitat: Mostly found in the open areas, roadsides.

Description: A small perennial herb that spread along creeping stolons, rooting and producing crowns at each nodes. Leaves are trifoliate, pubescent on both surfaces, obovate to oblong, margin serrate, prominent veins. Flowers are yellow, sepals hairy, ovate with pointed tip, 5 petals, yellow, oblong to obovate, slightly longer then the sepals. Fruits are rounde, like strawberry, fleshy red entirely covered with red aches each containing a seed.

Distribution: Kohima, Phek, Tuensang (26˚34.6250N 94˚18.325E)

Parts use: Mature fruits.

Uses: Mature fruits are eaten raw.

Figure: 2.7(9)

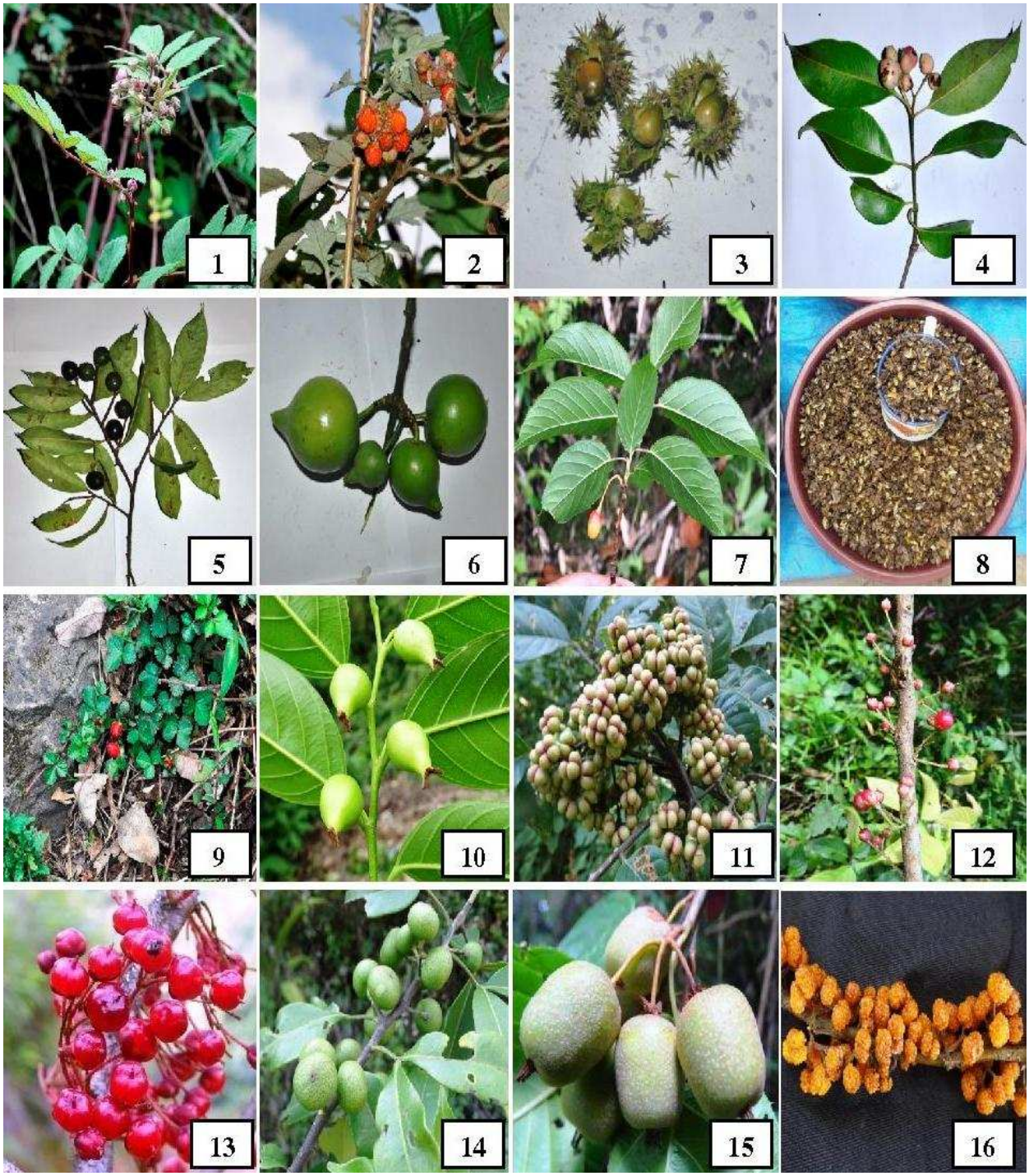


Figure 2.7: Fruits and Nuts, 1. *Rubus niveus,* 2. *R. ellipticus,* 3. *Castanopsis indica,* 4. *Syzygium cuminii,* 5. *Prunus nepalensis,* 6. *Garcinia xanthochymus,* 7. *P. carmesina,* 8. *Zanthoxylum armatum,* 9. *Duchesnia indica,* 10. *Aphananthe cuspidata,* 11. *Evodia fraxinifolia,* 12. *Saurauia punduana,* 13. *S. macrotricha,* 14. *Toddalia asiatica,* 15. *Actinidia callosa,* 16. *Debregeasia longifolia*

***Aphananthe cuspidata* (Blume) Planch.**

Accession Number: NU-BOT-UC-NK-1056

Family: Ulmaceae

Common Name: Aphananthe

Vernacular Name: Npyonpyosei (Ang)

Habitat: Mostly found in primary or secondary forest, slopes on hills.

Description: A large deciduous or semi-deciduous tree growing up to 30 m tall. Leaves simple, alternate, ovate-oblong to elliptic, glabrous, base rounded to slightly attenuate, apex cuspidate to acuminate, margin entire, petiole 1cm long. Flowers unisexual, male in axillary cymes and female solitary; fruit drupe, ovoid, glabrous, 1 seeded.

Distribution: Kohima, Phek, Tuensang (26˚16.403N 94˚38.372E)

Parts use: Mature fruits.

Uses: Mature fruits are eaten raw.

Figure: 2.7(10)

***Evodia fraxinifolia* (Hook.) Benth**.

Accession Number: NU-BOT-UC-NK-1057

Family: Rutaceae

Common Name: Evodia

Vernacular Name: Vokusei (Ang)

Habitat: Mostly found blank spaces, primary or secondary forest.

Description: A small tree with densely branching, strong smelling when bruised, growing up to 10 m tall. Branchlets are thick terete; leaves bearing 6-9 pair of leaflets, spreading, shortly petiole, pinnate, acuminate, quite entire or crenulate margin, base

rounded. Fruits small, rounded that appear in packed umbels, turning dark red when mature; seeds broadly elliptic.

Distribution: Kohima, Phek, Tuensang (26˚16.403N 94˚38.372E)

Parts use: Mature fruits.

Uses: Mature fruits are used as spice.

Figure: 2.7(11)

***Saurauia punduana* Wall.**

Accession Number: NU-BOT-UC-NK-1058

Family: Actinidaceae

Common Name: Saurauia , Gogan.

Vernacular Name: Ketsa tsakhosei (Ang)

Habitat: Mostly found in moist places, hilly slopes, dense forest and forest in open places.

Description: A small tomentose tree growing up to 10 m tall with densely scaly branchlets. Leaves are large, elliptic-ovate to lanceolate, acute or short acuminate at the apex, cuspidate serrate margin, whitish or brownish tomentose with scales on mid-ribs beneath; flowers small, white to pink color, sepals elliptic, petal white pink, rounded, berries globose.

Distribution: Kohima, Phek, Tuensang (26˚17.800N 94˚36.3703E)

Parts use: Mature fruits/berries.

Uses: Mature fruits/berries are eaten raw.

Figure: 2.7(12)

***Saurauia macrotricha* Kurt ex Dyer**

Accession Number: NU-BOT-UC-NK-1059

Family: Actinidiaceae

Common Name: Saurauia

Vernacular Name: Ketsa tsakhosei (Ang)

Habitat: Mostly found in the forest of open spaces, roadsides, slopes of hills.

Description: A small tree growing up to 5 m tall. Young stems and branches pubescent with brown and black setose hairs. Leaves large, narrowly lanceolate to elliptic, pappery both surface, acute to rounded at base, shorly acuminate at the apex, setose-serrate margin. Inflorescence axillary cymes, 2-4 flowers, sepals are elliptic or broadly ovate, petals are pink, ovate-rounded; berries globose.

Distribution: Kohima, Phek, Tuensang (26˚17.800N 94˚36.3703E)

Parts use: Mature fruits/berries.

Uses: Mature fruits/berries are eaten raw.

Figure: 2.7(13)

***Toddalia asiatica* (L.) Lam.**

Accession Number: NU-BOT-UC-NK-1060

Family: Rutaceae

Common Name: Orange climber, Forest pepper, wild orange tree

Vernacular Name: Ketsa sehuo (Ang)

Habitat: Mostly found in forest near riversides or stream, humid forest.

Description: A liana plant with corky, woody, thorny stems that climbs on the nearby tress around it, reaching up to 10 m tall. Leaves are shiny green citrus-scented, 5-9 cm long, elliptic-ovate, margin entire. Flowers creamish white, very small sepals, petals

ovate to elliptic; fruits green to orange when mature that taste like orange-lemon peel, with many seeds.

Distribution: Kohima, Phek, Tuensang (26˚17.800N 94˚36.3703E)

Parts use: Mature fruits.

Uses: Mature fruits are eaten raw.

Figure: 2.7(14)

***Actinidia callosa* Lindl.**

Accession Number: NU-BOT-UC-NK-1061

Family: Actinidiaceae

Common Name: Wild kiwi

Vernacular Name: Ketsa kiwi (Ang)

Habitat: Mostly found in the forest, thickets, slopes, streams sides, forest margins.

Description: A large climbing shrub with glabrous stem or slightly with simple soft hairs with conspicuous lenticels; leaves are opposite, usually broad ovate to elliptic, acuminate, base rounded or cuneate, margin serrate, petiole 2-7 cm; inflorescence cymose, flowers solitary, sepals ovate, glabrous, obtuse, petals white, obovate, filamentous; fruit grayish green, oblong, cylindrical, bear reflexed persistent sepal at the base, numerous seeds

Distribution: Kohima, Phek, Tuensang (26˚11.049N 94˚44.055E)

Parts use: Mature fruit.

Uses: Mature fruits are eaten raw.

Figure: 2.7(15)

***Debregeasia longifolia* (Burm.f.) Wedd**

Accession Number: NU-BOT-UC-NK-1062

Family: Urticaceae

Common Name: Orange Wild Rhea

Vernacular Name: Zhüdu (Ang)

Habitat: Mostly found on old cultivated areas, roadsides, streamsides.

Description: It is a shrub or a small tree growin up to 3-8 m tall, branchlets slander, and reddish brown. Leaves are oblong or elliptic-lanceolate, pappery, acuminate, base rounded, margin serrate, 3-veined, green rugose above and white tomemtose beneath, petiole small, stipule 5-7cm; both flowers (male and female) forming clustered cymes; fruits achene along the branch, orange.

Distribution: Kohima, Phek, Tuensang (26˚11.049N 94˚44.055E)

Parts use: Mature fruits.

Uses: Mature fruits are eaten raw.

Figure: 2.7(16)

***Hodgsonia macrocarpa* (Blume) Cogn.**

Accession Number: NU-BOT-UC-NK-1063

Family: Cucurbitaceae

Common Name: Lard seed

Vernacular Name: Ketsamo (Ang)

Habitat: Mostly found in the river banks, moist in primary or disturb areas, roadsides, fringes.

Description: It is a large climber growing up to 20-25 m tall. Leaves are large, simple with 3-5 lobed, tendrils bifid, glabrous, margin entire on the lobes, acuminate; flower

dioecious, male flower in racemes and female flower solitary, calyx 5 lobed with fimbriate segment, corolla white, rotate; fruits large, green to yellow orange when mature, subglobose, seed 5-6 with barren seed attached at the side.

Distribution: Kohima, Phek, Tuensang (26˚11.049N 94˚44.055E)

Parts use: Mature seed (kernel)

Uses: Mature seed (kernel) is roasted and eaten, also can be taken as pickle pounded with chilli, ginger, garlic and salt.

Figure: 2.8(1)

***Litsea cubeba* (Lour.) Pers**

Accession Number: NU-BOT-UC-NK-1064

Family: Lauraceae

Common Name: Aromatic Litsea, May chang

Vernacular Name: Cie (Ang)

Habitat: Mostly found in open sunny slopes, roadsides, riversides, thickets, sparse forest.

Description: It is an evergreen shrub or small tree growing up to 8-10 m tall, glabrous branchlets. Leaves aromatic when crushes, pale green, glabrous, lanceolate, base cumeate, apex acuminate, petiole short; umbels clustered, 4-1 flowered, reflexed or straight; fruit subglose, green to black when mature, aromatic, pedicle 3-5mm.

Distribution: Kohima, Phek, Tuensang (26˚11.049N 94˚44.055E)

Parts use: Mature or young fruit.

Uses: Fresh mature or young fruit is taken as spice and also fruit either fresh or cooked taken as pickle pounded with chilli, ginger, garlic and salt.

Figure: 2.8(2)

***Carallia brachiata* (Lour.) Merr.**

Accession Number: NU-BOT-UC-NK-1065

Family: Rhizophoraceae

Common Name: Carallia

Vernacular Name: Meho (Ang)

Habitat: Mostly found in the lowland, roadside, disturb forest, secondary forest.

Description: An evergreen tree growing up to 10 m tall. Leaves elliptic-oblong, papery to thinly leathery, acute or shortly acuminate, base cuneate, margin entire; inflorescence often resinous, flowers in bracteate clustered, calyx triangular lobe, sepals white, fimbriate at apex; fruits green to dark pink when mature, globose, seeds reniform.

Distribution: Kohima, Phek, Tuesang (26˚10.567N 94˚44.058E)

Parts use: Mature fruits.

Uses: Mature fruits are eaten raw.

Figure: 2.8(3)

***Trichosanthes dunniana* H. Lév.**

Accession Number: NU-BOT-UC-NK-1066

Family: Cucurbitaceae

Common Name: Trichosanthes

Vernacular Name: Dzorume (Ang)

Habitat: Mostly found hanging on the wall or nearby trees, roadside slopes.

Description: A spreading climber growing up to 15 m long. Stem moderately rubost, glabrous; leaves pale to dark green with light white sheath like beneath, glabrous, papery, palmate, 3 -5 lobed, elliptic obovate, margin entire, acuminate; flower white, fruit green to orange when mature, oblong, numerous seeds.

Distribution: Kohima, Phek, Tuensang (26˚10.567N 94˚44.058E)

Parts use: Young Fruit.

Uses: Young fruit is eaten raw.

Figure: 2.8(4)

***Terminalia bellirica* (Gaertn.) Roxb.**

Accession Number: NU-BOT-UC-NK-1067

Family: Combretaceae

Common Name: Myrobalan

Vernacular Name: Mhiechüsei (Ang)

Habitat: Mostly found in sunny mountain slopes, primary forest, scattered forest.

Description: A large deciduous tree growing up to 30-35 m tall. Leaves are clustered at the apicces of the branch, elliptic to obovate, glossy, glabrous, base cuneate, margin subentire; inflorescence axillary, simple spike 4-10 cm, calyx pubescent, broadly cup-shape above constriction, lobe 5; fruit drupe, subglobose to ovoid.

Distribution: Kohima, Phek, Tuensang (26˚57.051N 94˚44.423E)

Parts use: Mature fruits.

Uses: Mature fruits are eaten raw.

Figure: 2.8(5)

***Rubus sumatranus* Miq**

Accession Number: NU-BOT-UC-NK-1068

Family: Rosaceae

Common Name: Rom (Ang)

Vernacular Name: Rom (Ang)

Habitat: Mostly found on the roadsides, edge of stream, clearings, slopes, open disturb areas.

Description: It is an erect shrub with profuse branching; leaves imparipinnate, 4-7 foliotate, ovate-lanceolate, serrate margin, prominant veins and midrib, small prickly along the midrib, base round, petiole 1-2cm; inflorescence corymbose, several flowers, calyx abaxially with soft hair, petal white, narrowly obovate, base clawed; aggregate fruit, orange red, oblong.

Distribution: Kohima, Phek, Tuensang (26˚10.567N 94˚44.058E)

Parts use: Mature fruit

Uses: Mature fruit are eaten raw.

Figure: 2.8(6)

***Ficus hispida* L.f.**

Accession Number: NU-BOT-UC-NK-1069

Family: Moraceae

Common Name: Wild fig

Vernacular Name: Ketsa chiede (Ang)

Habitat: Mostly found in the base of the foothills, open spaces of the forest, along riversides and stream.

Description: A shrub or a small tree growing up to 10 m tall. Leaves obovate-oblong, thickly papery, acute or acuminate, base round, coarsely hirsute, margin serrulate, petiole 2-5 cm; calyx absent, figs axillary, solitary or several, globose, green to yellow when mature, hirsute, pedunculate

Distribution: Kohima, Phek, Tuesang (26˚16.3849N 94˚27.5723E)

Parts use: Mature fruit.

Uses: Mature fruits are eaten raw.

Figure: 2.8(7)

***Phyllanthus emblica* L.**

Accession Number: NU-BOT-UC-NK-1070

Family: Phyllantheceae

Common Name: Indian gooseberry, Emblic myrobalan

Vernacular Name: Ciehusei (Ang)

Habitat: Mostly found in the mixed forest, dry open forest, sparse forest or scrub, slopes of hills.

Description: A large shrub or a tree growing up to 10 m tall, main stem terete, sparsely lenticellate with reduced shoot producing groups of small leaf shoots, shoots slander, pubescent bearing leaves and flowers; leaves opposite, distichous, numerous, linear, oblong, glabrous, margin entire, stipule triangular; male flowers densely clustered at base of young leafy shoots, yellow, female few, borne above male flowers, 6 sepals; fruit drupe, globose, exocarp flashy, 3 seeded.

Distribution: Kohima, Phek, Tuensang (25˚55.8810N 94˚12.9141E)

Parts use: Mature fruit.

Uses: Mature fruit is eaten raw. Fruit is boiled with sugar, sun dried and eaten; also fruit is used in making juices.

Figure: 2.8(8)

***Olax imbricata* Roxb.**

Accession Number: NU-BOT-UC-NK-1071

Family: Olaceae

Common Name: Olax

Vernacular Name: Puyano (Ang)

Habitat: Mostly found in primary or secondary forest, in dry bushwood.

Description: A shrub or a large climber growing up 5-8 m tall. Branchlets brown, glabrous, leaves elliptic to ovate, base rounded, acute, leathery, margin entire; inflorescence unbranched, peduncle 2-10 mm, calyx small, petals white or yellow, 1 entire and 2 2-lobed; fruit drupe, globose, orange, covered by accrescent orange calyx.

Distribution: Kohima, Phek, Tuensang (25˚41.3941N 94˚6.0993E)

Parts use: Mature ripe fruit.

Uses: Mature ripe fruit is eaten raw.

Figure: 2.8(9)

***Elaeocarpus floribundus* Blume**

Accession Number: NU-BOT-UC-NK-1083

Family: Elaeocarpeceae

Common Name: Indian olive

Vernacular Name: Chüyechüku (Ang)

Habitat: Mostly found in lowland rain forest, primary or secondary forest.

Description: An evergreen tree growing up to 20 m tall. Leaves ovate to elliptic, glabrous, thinly leathery, acute to acuminate, base rounded or cuneate, margin serrate, short petiole; flowers racemes, white several flowered, sepals 5, white petals 5, hairy on margins, divided into many frilly segments; fruit drupe, ellipsoid to obovoid, stone smooth.

Distribution: Kohima, Phek, Tuensang (25˚51.2471N 94˚9.3225E)

Parts use: Mature fruit.

Uses: Mature fruit is eaten raw, mixed with sugar solution, sun dried and eaten.

Figure: 2.8(10)

***Oxalis corniculata* Linn.**

Accession Number: NU-BOT-UC-NK-1084

Family: Oxalidaceae

Common Name: Creeping wood sorrel, Yellow sorrel, sleeping beauty.

Vernacular Name: Thevotsütuo (Ang)

Habitat: A common garden weed, found in waste places, shady places

Description: A low growing short perennial herb with narrow, creeping stem that roots at the nodes. Leaves are trifoliate which are divided into rounded leaflets like heart shape, pubescent, petiole 3-6 cm; inflorescence umbellate, peduncle slightly longer than petioles, bracts linear-lanceolate, sepals oblong-lanceolate, margin ciliated at apex, 5 yellow petals with many simple hairs, fruit long cylindric, ovoid-oblong, burst open when mature, seeds tiny brown.

Distribution: Kohima, Phek, Tuensang (25˚41.3941N 94˚6.0993E)

Parts use: Young fruits.

Uses: Young fruits are eaten raw.

Figure: 2.8(11)

***Pyrus pashia* Buch-Ham. Ex D. Don**

Accession Number: NU-BOT-UC-NK-1085

Family: Rosaceae

Common Name: Indian Wild pear, Himalayan Wild pear.

Vernacular Name: Ketsa naspati (Ang)

Habitat: Mostly found in moist, near small streams or swamp areas, open shrub places

Description: A small deciduous tree growing up to 12 m tall. Leaves ovate, acuminate, base rounded or rarely cuneate, serrate margin, white powdery pubescent when young, petiole 1-2 cm, short stipule; inflorescence corymbs, clustered flowers, calyx brownish pubescent within, 3 sepals, petals white, obovate, apex rounded; fruit pome brown with pale white dots, subglobose, turn brown to black when mature.

Distribution: Kohima, Phek, Tuensang (25˚51.2471N 94˚9.3225E)

Parts use: Mature ripe fruit.

Uses: Mature ripe fruit is eaten raw.

Figure: 2.8(12)

***Cornus capitata* Wall**

Accession Number: NU-BOT-UC-NK-1086

Family: Cornaceae

Common Name: Benthem's cornel, Evergreen dogwood, Himalayan flowering dogwood.

Vernacular Name: NA

Habitat: Mostly found in evergreen and mixed forest.

Description: An evergreen tree growing up to 20 m tall. Leaves are elliptic or oblong-lanceolate, acuminate to caudate, base cuneate, thinly leathery; inflorescence cymes globose, bracts obovate to broadly obovate, calyx 4 lobed, rounded, petals pale white yellow, oblong, infructescences compresses or subglobose, succulent, red.

Distribution: Kohima, Phek, Tuensang (26˚11.1320N 94˚43.519E)

Parts use: Mature ripe fruit.

Uses: Mature ripe fruist are eaten raw.

Figure: 2.8(13)

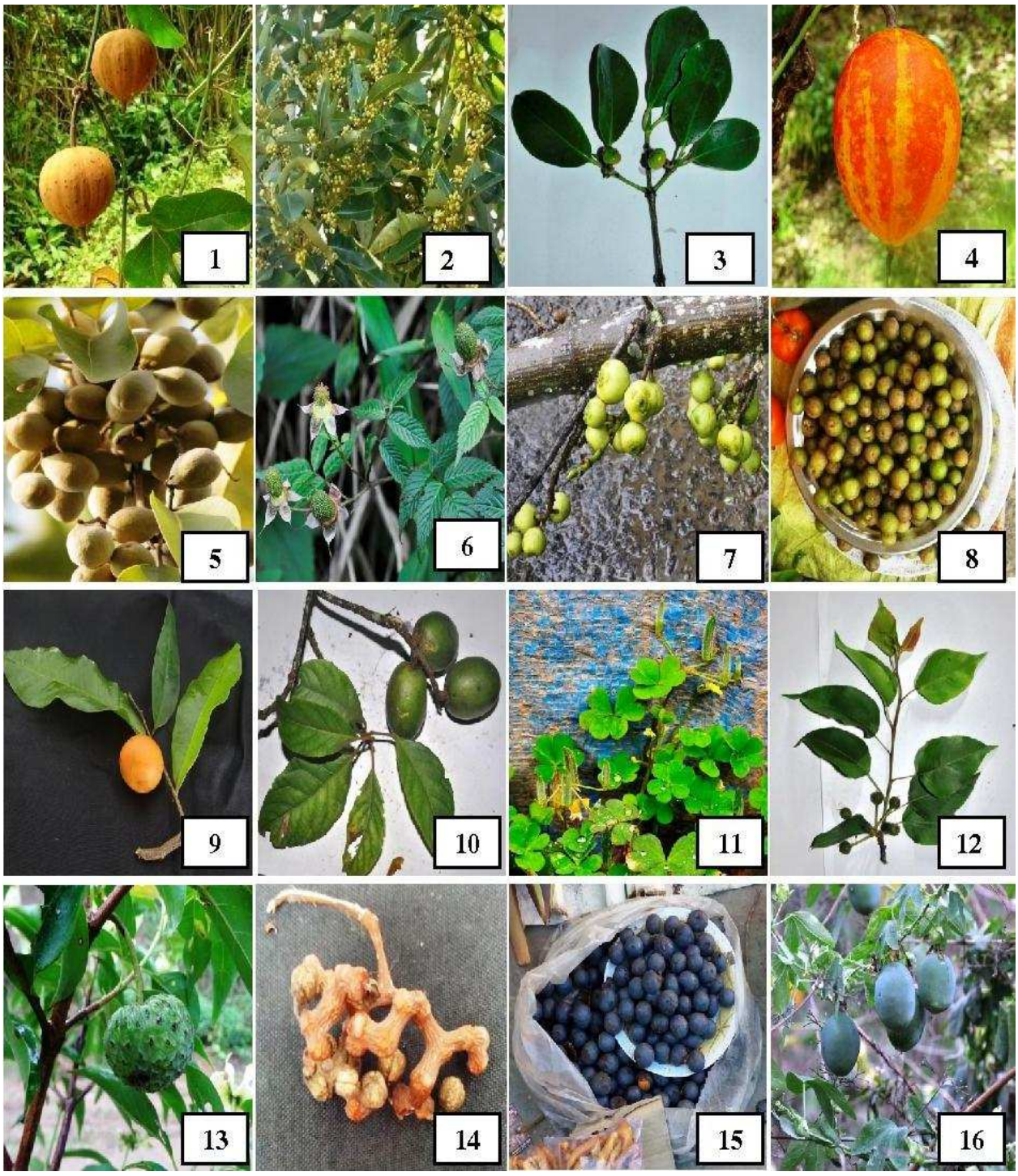


Figure 2.8: Fruits and Nuts, 1. *Hodgsonia macrocarpa,* 2. *Litsea cubeba,* 3. *Carallia brachiata,* 4. *Trichosanthes dunniana,* 5. *Terminalia bellirica,* 6. *Rubus sumatranus,* 7. *Ficus hispida,* 8. *Phyllanthus emblica,* 9. *Olax imbricata,* 10. *Elaeocarpus floribundus,* 11. *Oxalis corniculata,* 12. *Pyrus pashia,* 13. *Cornus capitata,* 14. *Hovenia dulcis,* 15. *Livistona jenkinsiana,* 16. *Passiflora subpeltata*

***Hovenia dulcis* Thunb.**

Accession Number: NU-BOT-UC-NK-1087

Family: Rhamnaceae.

Common Name: Japanese raisin tree, Oriental raisin tree.

Vernacular Name: Chelisei (Ang)

Habitat: Mostly found in moist, sunny places, primary or secondary forest.

Description: A deciduous tree growing up to 10 m tall. Leaves are ovate or elliptic, glabrous, base truncate, margin coarsely serrate, apex acuminate; flower terminal, asymmetrical cymose panicles, glabrous, sepals ovate, petals obovate, yellow green, fruit drupes, globose, borne on swollen fleshy branched peduncles, peduncles sweet juicy.

Distribution: Kohima, Phek, Tuensang (25˚31.1501N 94˚12.299E)

Parts use: Fleshy sweet peduncles.

Uses: Fleshy sweet mature peduncle is eaten raw.

Figure: 2.8(14)

***Livistona jenkinsiana* Grifff**

Accession Number: NU-BOT-UC-NK-1089

Family: Araceae

Common Name: Fan palm.

Vernacular Name: Niezorobo (Ang)

Habitat: Mostly found in sunny, moist areas with high rainfall, also cultivated by farmers.

Description: The palm plant grows up to a height of 6-10 m tall. Leaf scars prominent, petiole bases persistant in the lower portion, leaves in globose crown, wide distally, adaxially slightly concave, margin armed throughout the edge of the leave, spikes on

petiole, petiole 100-150 cm. flowers small, clustered on the swollen stalk, greenish cream in inconspicuous bracteoles, sepal and petal basically fused, fruit drupe, purple, rounded, endocarp fibrous.

Distribution: Kohima, Phek, Tuensang (26˚10.567N 94˚44.058E)

Parts use: Mature fruit, dry leave.

Uses: Mature fruit are eaten raw. The dry leaves are commonly used in making hard broom and hut roof.

Figure: 2.8(15)

***Passiflora subpeltata* Ortege**

Accession Number: NU-BOT-UC-NK-1090

Family: Passifloraceae

Common Name: White passionflower

Vernacular Name: Ketsa bell (Ang)

Habitat: Mostly found hanging on trees of oak trees in the open forest, roadsides, disturbed shady localities, secondary forest.

Description: A profusely branching climber or creeper growing up to 15 m tall. Leaves are deeply 3-lobed, glabrous, oblong-elliptic, rounded apices, margin serrate, base cuneate, petiole 4-7 cm, stipule extremely large and prominent; sepals and petal white, corolla filaments are fairly long giving the flower a fluffy appearance; fruit spherical.

Distribution: Kohima, Phek, Tuensang (25˚31.1501N 94˚12.299E)

Parts use: Mature ripe fruit.

Uses: Mature ripe fruit is eaten raw.

Figure: 2.8(16)

***Elaeagnus umbellata* Thunb.**

Accession Number: NU-BOT-UC-NK-1097

Family: Elaeagnaceae

Common Name: Japanese Silverberry, Umbellata oleaster, autumn olive.

Vernacular Name: Pesü ketsüyo (Ang)

Habitat: Mostly found in the thickets, forest narrow roads, bamboo grooves.

Description: A deciduous erect shrub with branchlet spreading growing up to 3 m tall. New branches, leaves and buds are silvery, alternate, obovate, acute, silver papery, base cuneate, margin entire, petiole 3-7 mm; flowers silvery white, calyx tube fennel-shape, slander; fruit drupe red in cluster, nearly globose.

Distribution: Kohima, Phek, Tuensang (25˚31.1501N 94˚12.299E)

Parts use: Mature ripe fruit.

Uses: Mature ripe fruit is eaten raw.

Figure: 2.9(1)

***Canavalia gladiata* (Jacq.) DC.**

Accession Number: NU-BOT-UC-NK-1099

Family: Fabaceae

Common Name: Sword bean.

Vernacular Name: Zaprie sei (Ang)

Habitat: Mostly cultivated by farmers, or found in the open waste areas.

Description: A twinning nearly erect annual herb growing up to 6-10 m tall. Leaves are trifoliate, ovate, pubescent, acuminate, base rounded or cuneate, petiolate. Racemes 10-20 flowers, pink and white, peduncle long 20-25 cm, calyx pubescent, upper lip rounded, lower lip 3 acute teeth., petals clawed and auriculate, pods oblong, flatten, contain 6-10 seeds.

Distribution: Kohima, Phek, Tuensang (25˚.6083N 94˚.1275E)

Parts use: Young pods.

Uses: Young pods are eaten raw or in salad and also eaten as vegetable.

Figure: 2.9(2)

***Melastoma malabathricum* L.**

Accession Number: NU-BOT-UC-NK-1100

Family: Melastomataceae

Common Name: Indian rhododendron, Singapore rhododendron.

Vernacular Name: Tehelakhu (Ang)

Habitat: Mostly found in disturbed areas, open fields, thickets, shrub and sparse forest.

Description: An evergreen erect shrub growing up to 5 m tall. Stem is 4-sided covered with numerous flattened hairs scales like scabrous; leaves elliptic to lanceolate, papery, acuminate, margin entire, base rounded to subcordate. Inflorescence subcapitate corymbose, terminal, flower purple, obovate; fruit subglobose, succulent, densely squamose.

Distribution: Kohima, Phek, Tuensang (26˚10.567N 94˚43.519E)

Parts use: Young stem and ripe fruit.

Uses: Young stem and ripe fruits are eaten raw.

Figure: 2.9(3)

***Morus alba* L.**

Accession Number: NU-BOT-UC-NK-1116

Family: Moraceae

Common Name: White mulberry

Vernacular Name: Khravü (Ang)

Habitat: Cultivated, also found in the wild, open disturbed forest, roadsides.

Description: A small tree growing up to 10 m tall, profusely branch. Leaves ovate, unlobe or irregularly 3 lobed, sparsely pubescent, acuminate, margin coarsely serrate, base round or cordate; male flower - calyx lobes pale green, catkins densely white, filament inflexed in bud, female flower – calyx lobes sessile, ovoid; syncarp red to black purple when mature, cylindric.

Distribution: Kohima, Phek, Tuensang (25˚31.150N 94˚29.109E)

Parts use: Young leaves and shoots and mature fruits.

Uses: Young leaves and shoots are taken as vegetables. Mature fruits are eaten raw.

Figure: 2.9(4)

***Morus nigra* L.**

Accession Number: NU-BOT-UC-NK-1117

Family: Moraceae.

Common Name: Black mulberry.

Vernacular Name: Khravü (Ang)

Habitat: Cultivated, also found in the open undisturbed forest, riversides and roadsides.

Description: A medium size tree growing up to 10 m tall. Leaves broadly ovate, unlobed, shortly pubescent, acuminate, margin serrate, base cordate; male flower cylindric, female flower ellipsoid, fruit turns black purple when mature, elliptic.

Distribution: Kohima, Phek, Tuensang (26˚10.567N 94˚44.058E)

Parts use: Young Leaves and shoots and mature fruits.

Uses: Young leaves and shoots are taken as vegetables. Mature fruits are eaten raw.

Figure: 2.9(5)

***Caryota urens* L.**

Accession Number: NU-BOT-UC-NK-1118

Family: Arecaceae

Common Name: Fishtail palm

Vernacular Name: Tepfisupari (Ang)

Habitat: Mostly found in the valley forests, understory tree in moist lowland.

Description: A solitary trunk tree growing up to 12 – 30 m tall. widely spaces leaf-scar rings are covered its trunk, bipinnate leaves triangular, dark green, long petiolated, pinnae pointed edge and a jagged edge; flowers produce on top of the trunk producing pendent clusters of white unisexual flowers, subsequent flowers produce at the lower part of the trunk, flowers long plait like bunches hanging down; fruits drupe, round, 1 seeded.

Distribution: Kohima, Phek, Tuensang (25˚35.2289N 94˚22.0267E)

Parts use: Young and mature seeds.

Uses: Young and mature seeds are eaten raw and also eaten in place of beetle nut.

Figure: 2.9(6)

***Tetrastigma lanceolarium* (Roxb.) Planch.**

Accession Number: NU-BOT-UC-NK-1127

Family: Vitaceae

Common Name: Indian chestnut vine.

Vernacular Name: Thevomhachübo (Ang)

Habitat: Mostly found in thickets, riversides, slope of hills, slopes on the rocks.

Description: A large climbing shrub growing up to 6-10 m tall with smooth branches. Leaves pedate 5-foliolate, glabrous, narrowly ovate, acuminate, margin serrate, base

cuneate, petiole stout; flowers small, yellow-green, umbellately branched, calyx minute, petal flask-like shape, fruit globose, green to yellow when mature,1-4 seeded.

Distribution: Kohima, Phek, Tuensang (25˚11.049N 94˚44.055E)

Parts use: Mature fruits.

Uses: Mature fruits are eaten raw.

Figure: 2.9(7)

***Physalis minima* L.**

Accession Number: NU-BOT-UC-NK-1132

Family: Solanaceae

Common Name: Sunberry, Ground berry.

Vernacular Name: Chahamiaca (Ang)

Habitat: Mostly found on the field edges, waste ground near houses, roadsides.

Description: An annual herb growing up to 50-70 cm tall with a prostrate or erect stem. Stem and branch glabrous, leaves alternate, ovate, acuminate, serrate margin, glabrous, base cuneate; flowers cream to yellow colour, united; fruit encapsulated in a papery like cover, fruit globose, green to yellow when mature, fleshy and numerous seeds.

Distribution: Kohima, Phek, Tuensang (26˚17.2059N 94˚28.8854E)

Parts use: Mature ripe fruit.

Uses: Mature ripe fruit are eaten raw.

Figure: 2.9(8)

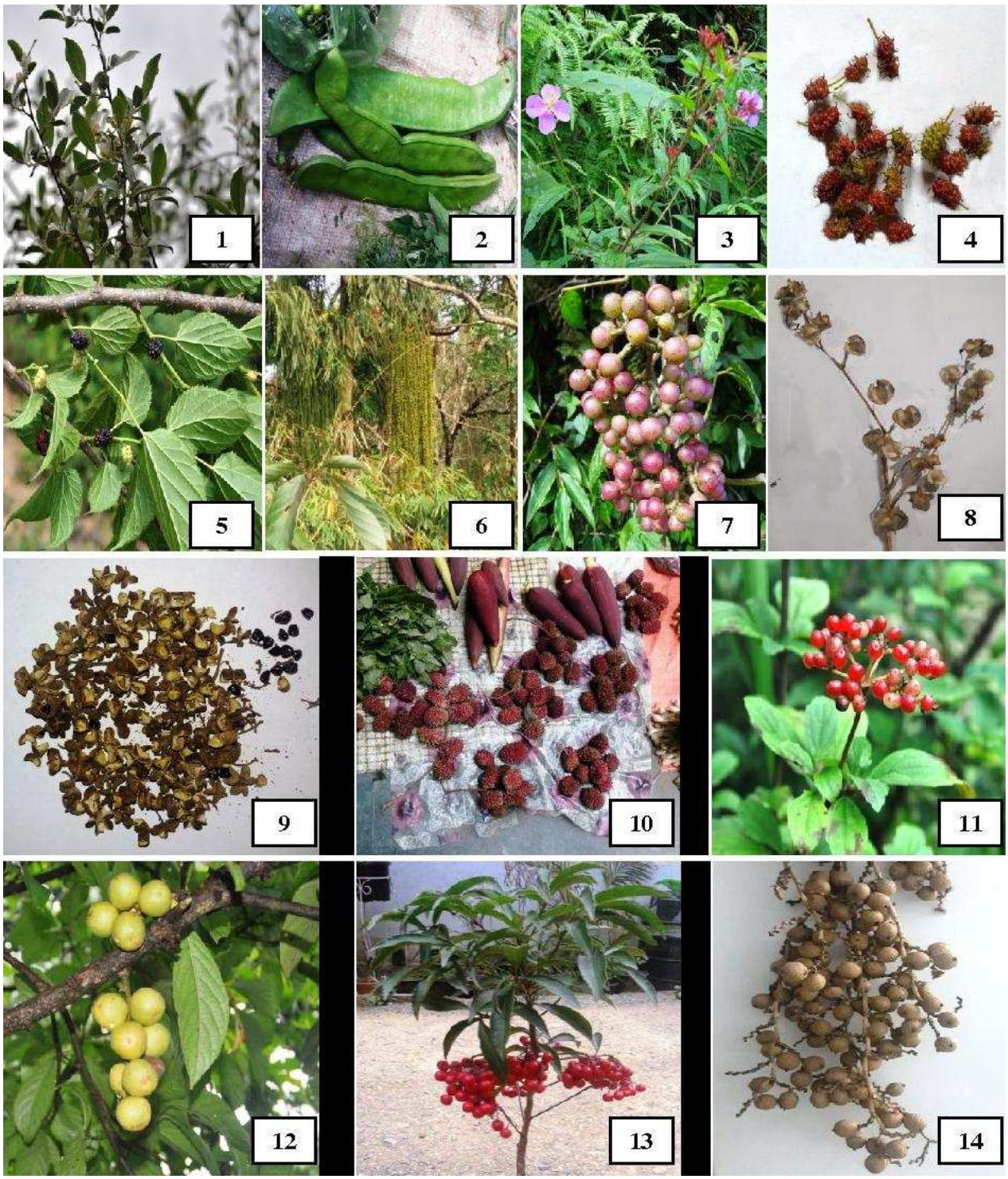


Figure 2.9: Fruits and Nuts, 1. *Elaeagnus umbellata,* 2. *Canavalia gladiata,* 3. *Melastoma malabathricum,* 4. *Morus alba,* 5. *M. nigra,* 6. *Caryota urens,* 7. *Tetrastigma lanceolarium,* 8. *Physalis minima,* 9. *Zanthoxylum acanthopodium,* 10. *Nephelium lappacium,* 11. *Viburnum mullaha,* 12. *Baccaurea ramiflora,* 13. *Ardisia crispa,* 14. *Calamus tenuis*

***Zanthoxylum acanthopodium* DC.**

Accession Number: NU-BOT-UC-NK-1133

Family: Rutaceae.

Common Name: Andalima.

Vernacular Name: Ganyasei (Ang)

Habitat: Mostly found in the primary and secondary forest, deciduous forests, forest edge.

Description: A shrub or a small tree growing up to 6 m tall. Leaflets rust colored, 3-7 foliolate, opposite, sessile, ovate to lanceolate, rachis winged, prickle, acuminate, margin serrate, base cuneate; inflorescence axillary, in dense clusters, male flowers arrange globose pistillode, female flower ovoid carpel with a style; fruit reddish, ovoid.

Distribution: Kohima, Phek, Tuensang (26˚18.15104N 94˚29.75471E)

Parts use: Young and mature fruits.

Uses: Young and mature fruit are use as spice (fresh and dried).

Figure: 2.9(9)

***Nephelium lappacium* L.**

Accession Number: NU-BOT-UC-NK-1134

Family: Sapindaceae

Common Name: Rambutan

Vernacular Name: Ketsa lichu (Ang)

Habitat: Mostly found in thickets, deciduous forests, undisturbed forests.

Description: An evergreen tree growing up to 12-20 cm tall with dense spreading crowns. Leaves alternate, pinnate, leaflets 1 to 5 pairs opposite, acute, margin entire,

base cuneate, petiolate; flowers borne on panicles, clustered, small yellow color; fruit oval to elliptiv, red color when mature, spiny, white translucent juicy flesh, 1 seeded.

Distribution: Kohima, Tuensang (26˚16.38493N 94˚57239E)

Parts use: Mature ripe fruit and seed.

Uses: Mature fruits are eaten raw and seed can be eaten after roast or cooked.

Figure: 2.9(10)

***Viburnum mullaha* Buch-Ham. ex D. Don**

Accession Number: NU-BOT-UC-NK-1139

Family: Adoxaceae

Common Name: Starry viburnum

Vernacular Name: Tsakhasei (Ang)

Habitat: Mostly found in the deciduous forests,

Description: A large shrub growing up to 4 m tall. Leaves are opposite, ovate-lanceolate, acuminate, pubescent, margin serrate, base cuneate and petiolated. Flowers in umbel like cyme, terminal, small in cluster, white, sepal green, petals 5; fruit drupe, red when mature, rounded, clustered in cyme.

Distribution: Kohima, Phek, Tuensang (26˚18.15104N 94˚29.75471E)

Parts use: Ripe fruits.

Uses: Ripe fruits are eaten raw.

Figure: 2.9(11)

***Baccaurea ramiflora* Lour.**

Accession Number: NU-BOT-UC-NK-1140

Family: Phyllantheceae

Common Name: Burmese Grape.

Vernacular Name: Ziedisei (Ang)

Habitat: Mostly found in understorey tree in primary or secondary forest, on slopes, evergreen forests and also cultivated.

Description: A tree growing up to 15-20 m tall. Leaves obovate, glabrous, acuminate, margin entire or sinuate, acuminate, base cuneate; flower small, dioecious, in raceme; fruit yellow, globose, fleshy fibre, 2-4 celled.

Distribution: Kohima, Tuensang (25˚.6083N 94˚.1275E)

Parts use: Mature ripe fruit.

Uses: Mature ripe fruit is eaten raw.

Figure: 2.9(12)

***Ardisia crispa (Thunb.)* A. DC.**

Accession Number: NU-BOT-UC-NK-1141

Family: Primulaceae

Common Name: Coralberry

Vernacular Name: Tevümhachübo (Ang)

Habitat: Mostly found in thickets, primary or secondary forests, valleys, shaddy and shruby places.

Description: A sub-shrub growing up to 1.5 m tall with branching at the apex. Leaves elliptic to lanceolate, glabrous, margin entire, acuminate, base cuneate; inflorescence terminal, umbels on short peduncle, flower white or pink, sepals and petals ovate; fruit reddish, globose.

Distribution: Kohima, Phek, Tuensang (25˚.6083N 94˚.1275E)

Parts use: Mature ripe fruit.

Uses: Mature ripe fruit is eaten raw.

Figure: 2.9(13)

***Calamus tenuis* Roxb.**

Accession Number: NU-BOT-UC-NK-1142

Family: Arecaceae

Common Name: Slander Ratten Cane

Vernacular Name: Tekhrasei (Ang)

Habitat: Mostly found in the moist areas, river sides, streams sides, hilly areas.

Description: A large climber growing up to 6-10 m tall. Stem slander, numerous spines, leaves pinnate, leaflets 20-30 pairs, glabrous, lanceolate, acuminate, base cuneate, entire margin, flat spines on leaf sheath; inflorescence numerous, small flower, fruit subglobose, scales green to brown when mature, fleshy.

Distribution: Kohima, Phek, Tuensang (25˚42.6241N 94˚6.2807E)

Parts use: Mature ripe fruit.

Uses: Mature ripe fruit is eaten raw.

Figure: 2.9(14)

Stem, Flower and Inflorescence

***Amomum dealbatum* Roxb.**

Accession Number: NU-BOT-UC-NK-1001

Family: Zingiberaceae

Common name: Javda Cardamon

Vernacular name: Sokrünuo (Ang)

Habitat: Mostly found scattered in forests especially in moist, humus rich areas, shady areas and hill slopes.

Description: A small shrub growing up to 3 m tall. Leave adaxial surface glabrous, abaxial surface pubescent, oblong-lanceolate, acuminate, margin entire, base cuneate,

spike subglobose, bracts ovate, reddish; inflorescence bracts red brown, calyx lobed, petals white; capsule purple-green, ellipsoid, indehiscent.

Distribution: Kohima, Phek, Tuensang (25˚42.5903N 94˚6.1829E)

Part use: Inflorescence.

Uses: Inflorescence is taken as vegetable.

Figure: 2.10(1)

***Bauhinia variegata* L.**

Accession Number: NU-BOT-UC-NK-1023

Family: Fabaceae

Common name: Orchid tree, Mountain Ebony

Vernacular name: Teguo (Ang)

Habitat: Found in mixed deciduous forest, bamboo forests and open areas, on dry types.

Description: A small to medium tree growing up to 15 m tall. Leaves broadly ovate, 7-18 cm long, lobes obtuse, cordate, coriaceous. Flower sessile, large, white pink. Pods 15-25 cm long, flat, glabrous, and turn brown when mature.

Distribution: Kohima, Phek, Tuensang (25˚41.56811N 94˚6.21437E)

Part use: Flower and Young pods.

Uses: Flowers and young pods are used as vegetables. Young pods are also used in salad.

Figure: 2.10(2)

***Curcuma angustifolia* Roxb.**

Accession Number: NU-BOT-UC-NK-1031

Family: Zingiberaceae

Common name: East Indian Rrrowroot, Narrow-leaved Turmeric

Vernacular name: Hupfü (Ang)

Habitat: Mostly found under moist shades of trees and bamboos.

Description: A perennial, flowering ginger with stout underground rhizome which lies dormant in the winter, leaves grows 25-30 cm long, pubescent with prominent veins, small spiked inflorescence of three or four yellow funnel-shaped flower enclose within turfs of pink terminal bracts, flowers with double anthers, a slander style and a globular stigma.

Distribution: Kohima, Phek, Tuensang (25˚41.4864N 94˚6.1516E)

Part use: Inflorescence.

Uses: The inflorescence is taken as vegetable. The inflorescence is boiled, sun dried and cooked in the curry.

Figure: 2.10(3)

***Chimonobambusa callosa* (Munro) Nakai**

Accession Number: NU-BOT-UC-NK-1046

Family: Poaceae

Common Name: Small bamboo.

Vernacular Name: Kerie ketsüyo (Ang)

Habitat: Found mostly in the dense forset

Description: A medium size annual or perennial spreading bamboo, turfed, rhizomatous or stoloniferous. Culms erect, thin walled, culm nodes swollen with thorns on the nodes, pubescent, hairy at the base, culm sheath ligulen, and blade linear. Leave blade with strong cross veins, inflorescence bracteates, mainly exerted from broad, persistant, branching racemose or paniculate, glumes with small vestigial buds, florets fewer than 10, lemma glabrous.

Distribution: Kohima, Phek, Tuensang (25˚42.5903N 94˚6.1829E)

Parts use: young shoot and stem.

Uses: Young stem and shoot is cooked and taken in curry and also used in making fermented bamboo shoot.

Figure: 2.10(4)

***Musa sikkimensis* Kurz.**

Accession Number: NU-BOT-UC-NK-1047

Family: Musaceae

Common Name: Darjeeling banana

Vernacular Name: Tepfhe (Ang)

Habitat: Found in open warm area in the forest, slopes of hilly areas.

Description: It is robust and grows up to 4 m tall, yellow-green foliage with reddish tinged pseudostem. Sheath smudged with blackish-brown without wax when mature. Lamina base bear red purple color which fades away when mature. Inflorescence outshot the pseudostem by producing an oblique fruit bunch. The fruit has numerous seeds.

Distribution: Kohima, Phek, Tuensang (25˚42.5903N 94˚6.1829E)

Parts use: Inflorescence and stem.

Uses: Inflorescence and young stem is cooked and taken as vegetable.

Figure: 2.10(5)

***Musa thomsonii* (King ex Baker) A.M. Cowan & Cowan**

Accession Number: NU-BOT-UC-NK-1048

Family: Musaceae

Common Name: Musa

Vernacular Name: Ruochünuo (Ang)

Habitat: Found mostly in open sunny area, humus rich areas, semi-shade areas.

Description: A large slander green herb growing up to 4-5 m tall with spreading form on top of the plant. Leaves are large with paddle-shape, asymmetrical cordate at the base, young new leave usually reddish on the under side, prominent veins, veins somewhat reddish when red but turn green when mature.

Distribution: Kohima, Phek, Tuensang (25˚41.4864N 94˚6.1516E)

Parts use: Inflorescence.

Uses: The inflorescence is cooked and taken as vegetable and also taken in tickle.

Figure: 2.10(6)

***Bauhinia purpurea* L.**

Accession Number: NU-BOT-UC-NK-1108

Family: Fabeceae

Common Name: Purple orchid tree, Purple bauhinia.

Vernacular Name: Teguo (Ang)

Habitat: Mostly found in mixed forest, occurring often in dry type and hill slopes, valley and streams.

Description: An erect shrub or tree growing up to 12 m tall. Leaves bilobed, broadly orbicular, obtuse, margin entire, base cordate, glabrous or slightly puberulous beneath; inflorescence raceme with few flowers or panicle with up to 20 flowers, axillary or solitary, buds fisiform, 5-ridge with obtuse apex, calyx spathe-like into 2 lobes, petal pink, oblanceolate, borne on claw, pods compressed, 6-12 seeds.

Distribution: Kohima, Phek, Tuensang (25˚41.4864N 94˚6.1516E)

Parts use: Young pods, young buds and flowers

Uses: Young pods, young buds and flowers are taken as vegetables.

Figure: 2.10(7)

***Dendrocalamus giganteus* Munro**

Accession Number: NU-BOT-UC-NK-1138

Family: Poaceae

Common Name: Giant bamboo

Vernacular Name: Vümi (Ang)

Habitat: Cultivated mostly near river banks and home gardens.

Description: A large culmed greyish green growing up to 30 m tall with internodes 30-40 cm long. Culm sheath deciduous, thickly leathery covered with numerous small brown hairy around, margin rounded; auricles small, crisped, legule serrulate; leaves oblong-lanceolate, entire margin, base cuneath, acuminate; inflorescence branches pendulous, caryopsis oblong.

Distribution: Kohima, Phek, Tuensang (25˚35.2289N 94˚22.0267E)

Parts use: Young Shoot.

Uses: Fresh young shoot is cooked and eaten or fermented and eaten.

Figure: 2.10(8)

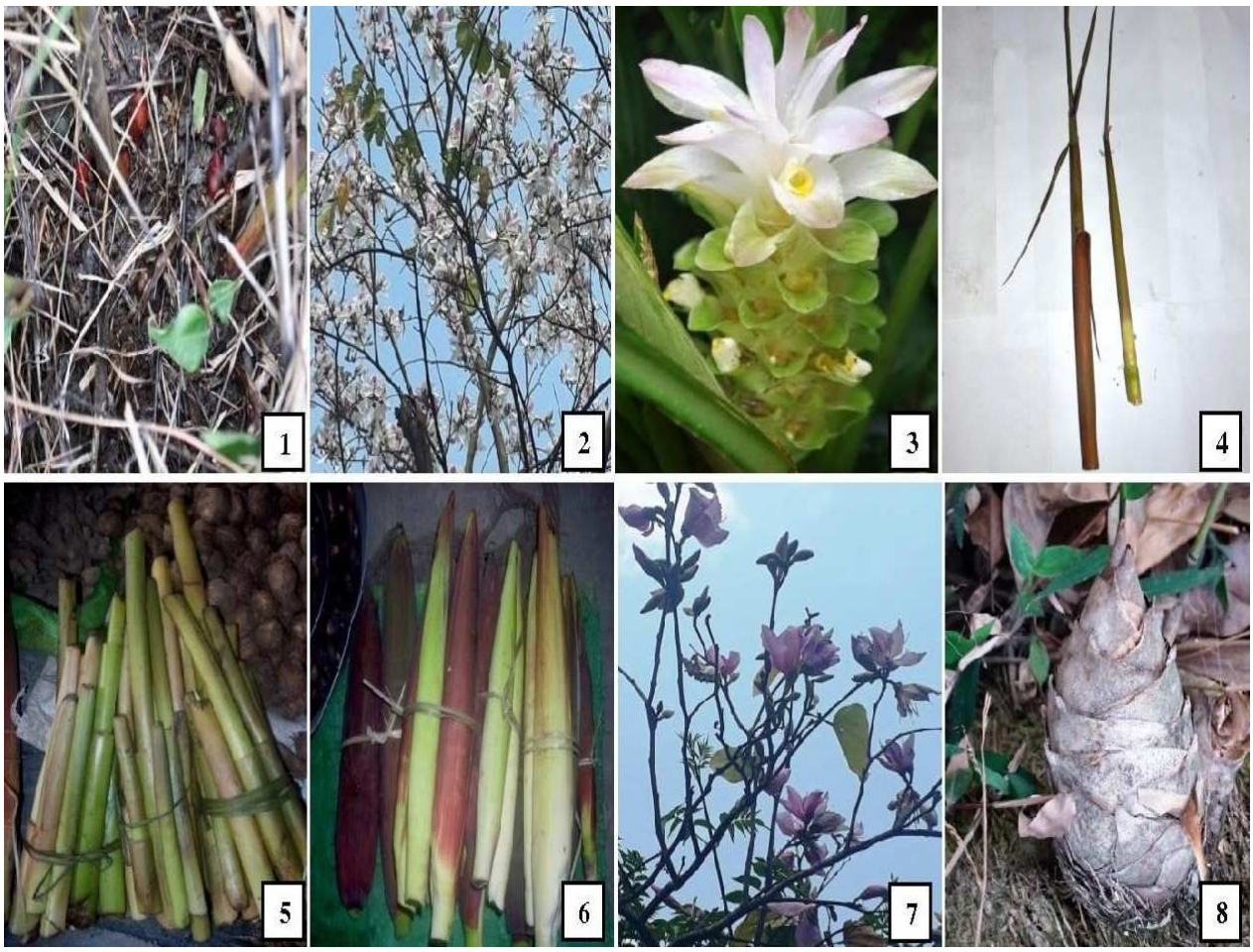


Figure 2.10: Stem, Flower and Inflorescence, 1. *Amomum dealbatum,* 2. *Bauhinia variegata,* 3. *Curcuma angustifolia,* 4. *Chimonobambusa callosa,* 5. *Musa sikkimensis,* 6. *M. thomsonii,* 7. *B. purpurea,* 8. *Dendrocalamus giganteus*

Root, Tuber, Rhizome and Bulb

***Allium tuberosum* Rottler ex Spreng.**

Accession Number: NU-BOT-UC-NK-1088

Family: Amaryllidaceae

Common Name: Garlic chives

Vernacular Name: Chümerie kezhau (Ang)

Habitat: Rarely cultivated in the kitchen gardens, grows well in warm areas.

Description: It is a bulbous perennial herb growing up to 20-50 cm tall with the flowering scape growing taller (20-60 cm) than the mother plant. Leaves slander, strap-shape, linear, acute, margin entire, covered with a leave sheath at the base. Flowers borne in clusters in dense flower umbels, white color; bulb clustered, cylindric, bulb clusters formed along the rhizome.

Distribution: Kohima, Phek, Tuensang (25˚41.4864N 94˚6.1516E)

Parts use: Young leaves and bulb.

Uses: Young leaves are taken as vegetables or uses as garnish in salad. Bulb is taken as vegetables, garnish in pickle and salad.

Figure: 2.11(1 a & b)

***Dioscorea bulbifera* L.**

Accession Number: NU-BOT-UC-NK-1107

Family: Dioscoreaceae

Common Name: Air yam, Aerial yam.

Vernacular Name: Rüphie (Ang)

Habitat: Cultivated, found growing well in moist areas, in the kitchen garden.

Description: A large vine growing up to 15 m tall. Leaves are large, alternate, glabrous, broadly cordate, margin entire, acuminate, prominent midveins, base cordate, petiolate;

flower unisexual, male spikes drooping and female spikes fascicled in leaf axil; bulbs form both in the leaf axils of the twinning vine and also tuber beneath the soil, above bulb are usually smaller then the one beneath, oblong, rough surface, purple beneath the surface.

Distribution: Kohima, Phek, Tuensang (26˚18.15043N 94˚29.7740E)

Parts use: Bulb.

Uses: The bulb is cooked or fresh and eaten in pickle or curry.

Figure: 2.11(2).

***Cinnamomum verum* J.Presl**

Accession Number: NU-BOT-UC-NK-1119

Family: Lauraceae

Common Name: Cinnamon.

Vernacular Name: Seichü (Ang)

Habitat: Mostly found in undisturbed forest, shady, moist and well drained soil.

Description: An evergreen small tree growing up to 10 m tall, inner bark with cinnamic aldehyde flovor. Leaves opposite, ovate to ovate-lanceolate, leathery or papery, glabrous, margin entire, acuminate, base round or cuneate; flowers arranged in panicle, penicle axillary or terminal, small yellow color, perianth lobes 6, oblong; fruit ovoid, dentate, black at maturity.

Distribution: Kohima, Phek, Tuensang (25˚42.6241N 94˚6.2807E)

Parts use: Bark and root.

Uses: Bark and roots are eaten raw and also used as spice and medicinally very important.

Figure: 2.11(3)

Figure 2.11: Root, Rhizome, Tuber and Bulb, 1 (a & b). *Allium tuberosum,* 2. *Dioscorea bulbifera,* 3. *Cinnamomum verum*

Mushroom

***Auricularia auricula-judae* (Bull.) Quél.**

Accession Number: NU-BOT-UC-NK-1072

Family: Auriculariaceae.

Common Name: Jew's Ear, Tree Ear, Wood Ear.

Vernacular Name: Thevonyieto (Ang)

Habitat: Grows on stump and dead branches.

Description: The fruit body is 2-8 cm broad with jelly-like texture and ear-shaped appearance, outer surface brown with minute hair, inner surface tan-brown.

Distribution: Kohima, Phek, Tuensang (25˚38.019N 94˚29.106E)

Parts use: Whole fruit body.

Uses: The fresh or dried fruit body part is cooked and eaten.

Figure: 2.12(1)

***Auricularia polytricha* (Mont.) Sacc**.

Accession Number: NU-BOT-UC-NK-1073

Family: Auriculariaceae

Common Name: Cloud ear fungus.

Vernacular Name: Thevonyieto (Ang)

Habitat: Occurs in clusters on rooting branches, twigs, stumps and log.

Description: The fruit body is 1-8 cm broad, loosely attached, ear-shaped, upper surface sterile, covered with dense silky coat of minute grey hairs, lower surface fertile, smooth, hairless.

Distribution: Kohima, Phek, Tuensang (25˚52.44409N 94˚10.82014E)

Parts use: Whole fruit body.

Uses: Fresh or dried fruit body is cooked and eaten.

Figure: 2.12(2)

***Laetiporus sulphureus* (Bull.) Murr.**

Accession Number: NU-BOT-UC-NK-1074

Family: Polyporaceae.

Common Name: Crab of the wood, chicken of the wood, Sulphur Polypore.

Vernacular Name: NA

Habitat: Grows on dead or mature hardwood.

Description: The bracket 15-50 cm broad. Cap initially knob-like shape followed by fan-shape growing in overlapping tiers, colours are sulphur yellow or lemon to orange yellow, small spore on fertile surface, flesh succulent which exudes yellow pungent juice.

Distribution: Kohima, Phek, Tuensang (25˚52.44409N 94˚10.82014E)

Parts use: Young fruit body.

Uses: The young fruit body is clean properly, cooked and eaten.

Figure: 2.12(3)

***Lactarius volemus* (Fr.) Kuntze**

Accession Number: NU-BOT-UC-NK-1075

Family: Russulaceae

Common Name: Weeping milk cap.

Vernacular Name: Cietou (Ang)

Habitat: Found growing commonly in deciduous woods, at the base of both coniferous and broas-leaved trees, solitary or in groups.

Description: Cap 5-10 cm wide, tawny orange to reddish orange, slightly depressed, surface minutely cracking; gills adenate-decurrent, exude milky latex when bruised; stipe stout, firm, slightly hollow.

Distribution: Kohima, Phek, Tuensang (25˚52.44409N 94˚10.82014E)

Parts use: Whole Fruit body.

Uses: Fresh or dried fruit body is cooked and eaten.

Figure: 2.12(4)

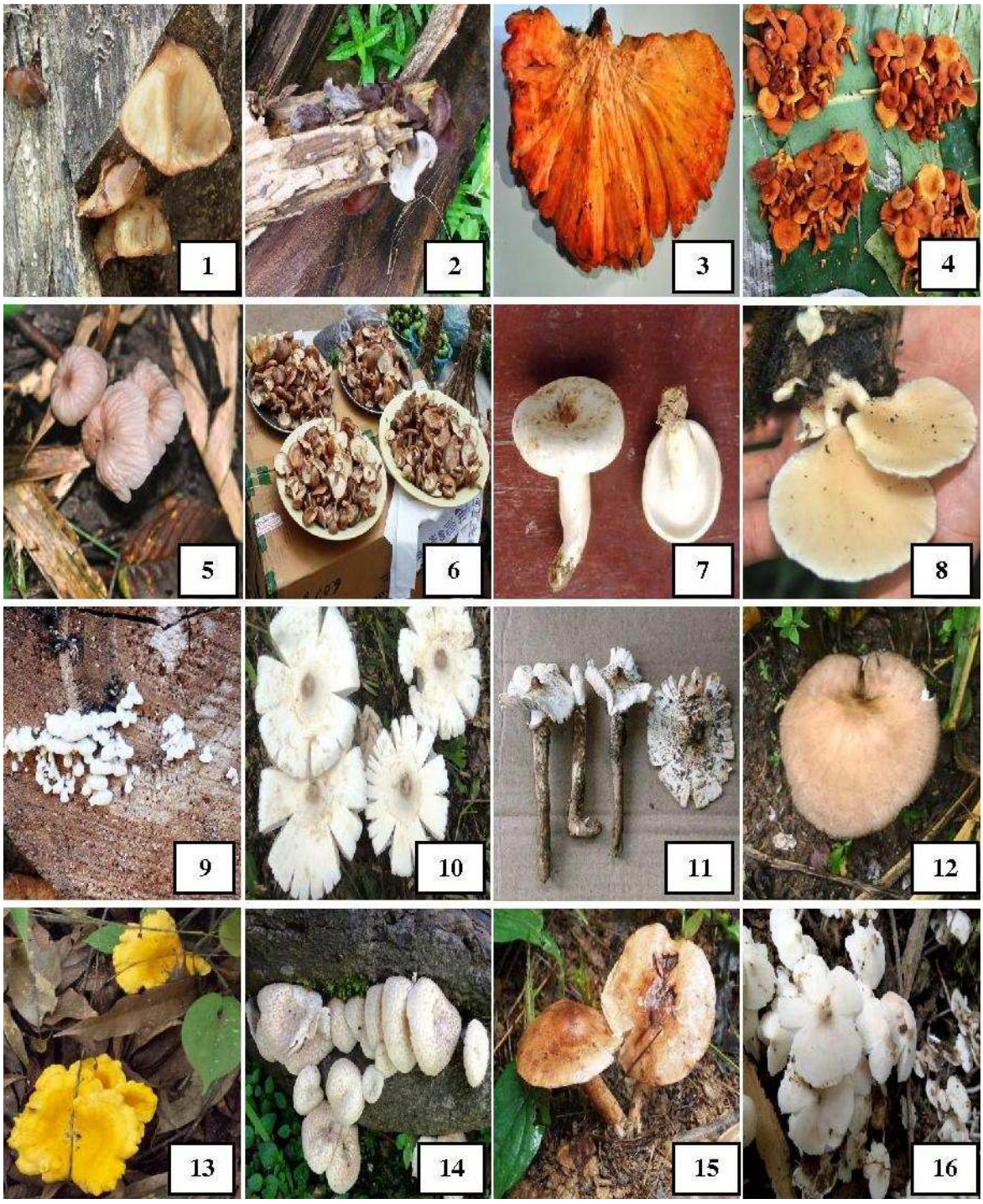


Figure 2.12: Wild edible mushrooms, 1. *Auricularia auricula-judae,* 2. *A. polytricha,* 3. *Laetiporus sulphureus,* 4. *Lactarius volemus,* 5. *Laccaria tortilis,* 6. *Lentinula edodes, 7. Lactarius piperatus, 8. Pleurotus pulmonarius, 9. Schizophyllum commune,* 10. *Macrolepiota albuminosa,* 11. *Termitomyces heimii,* 12. *Melanoleuca grammopodia,* 13. *Cantherellus cibarius,* 14. *Lentinus squarrosulus,* 15. *Tricholoma imbricatum,* 16. *T. microcarpus*

***Laccaria tortilis* (Bolton) Cooke**

Accession Number: NU-BOT-UC-NK-1076

Family: Hydnangiaceae

Common Name: Twisted Deceiver.

Vernacular Name: Ciene (Ang)

Habitat: Grows on humus rich places, moist and shady places and deciduous woods.

Description: Cap 1-5 cm wide, convex and flattening, pale brown; stipe hollow, 5-10 cm, same colour with the cap, twisted, gill spread.

Distribution: Kohima, phek, Tuensang (26˚57.051N 94˚44.423)

Parts use: Whole fruit body.

Uses: Fresh or dried fruit body thoroughly washed, cooked and eaten.

Figure: 2.12(5)

***Lentinula edodes* (Berk.) Pegler**

Accession Number: NU-BOT-UC-NK-1077

Family: Marasmiaceae

Common Name: Shiitake

Vernacular Name: Cietou (Ang)

Habitat: Grows in groups in decaying wood of deciduous trees.

Description: Cap 5-15 cm broad, black to dark or light brown when mature, hemispheric, expanding to convex and planar at maturity; gills white, serrate when mature; stipe stout, firm, fibrous.

Distribution: Kohima, Phek, Tuensang (26˚01.755N 94˚38.372E)

Parts use: Whole fruit body.

Uses: Fresh or dried fruit body washed thoroughly, cooked and eaten.

Figure: 2.12(6)

***Lactarius piperatus* (L.) Pers**

Accession Number: NU-BOT-UC-NK-1078

Family: Russulaceae

Common Name: Peppery Milk-cap

Vernacular Name: Cietou (Ang)

Habitat: Grow in large group in deciduous woods.

Description: Cap 5-15 cm broad, convex and depressed at maturity, creamy white, glabrous; gill decurrent, crowed, very forked, become creamy with age, exude milky latex; stipe stout, firm, tapering downward.

Distribution: Kohima, Phek, Tuensang (25˚55.88106N 94˚1291415E)

Parts use: Whole fruit body.

Uses: Fresh or dried fruit body is cooked and eaten.

Figure: 2.12(7)

***Pleurotus pulmonarius* (Fr.) Quél.**

Accession Number: NU-BOT-UC-NK-1079

Family: Pleurotaceae

Common Name: Indian Oyster, Italian Oyster, Phoenix Mushroom, Lung Oyster.

Vernacular Name: NA

Habitat: Grow in small groups or clusters on standing trees, stumps or log, fallen trees.

Description: Cap 2-10 cm, white to cream, convex, fan-like shape, overlapping in tiers; gill run down the stem, white, unserrate; stem very short, firm.

Distribution: Kohima, Phek, Tuensang (26˚01.755N 94˚38.372E)

Parts use: Whole fruit body.

Uses: Fresh fruit body is cooked and eaten.

Figure: 2.12(8)

***Schizophyllum commune* Fr.**

Accession Number: NU-BOT-UC-NK-1080

Family: Schizophyllaceae.

Common Name: Split gill fungus.

Vernacular Name: Cieso (Ang)

Habitat: Grow scattered or in clusters in dead wood, hardwood logs and branches.

Description: Cap 1-3 cm wide, pale white, leathery, lobed but united at the base; upper surface densely hairy, light to dark brown when wet, ash grey when dry; gill serrate, distinctly split; stipt rudimentary or absent.

Distribution: Kohima, Phek, Tuensang (25˚55.88106N 94˚1291415E)

Parts use: Whole fruit body.

Uses: Fresh or dried fruit body is cooked and eaten.

Figure: 2.12(9)

***Macrolepiota albuminosa* (Berk.) Pegler**

Accession Number: NU-BOT-UC-NK-1081

Family: Agaricaceae

Common Name: Termitimyces.

Vernacular Name: Rüpucie (Ang)

Habitat: grows on the termite's mounds and clayey soil.

Description: Cap 5-15 cm wide, convex expanding out with a central boss, umbonate when mature, brown white; gill white crowed, free, adnexed; stipe somewhat hollow, elongated up to 20 cm, white to brown stipe.

Distribution: Kohima, Phek, Tuensang (25˚51.24715N 94˚9.32252E)

Parts use: Whole fruit body.

Uses: Fresh fruit body is cooked and eaten.

Figure: 2.12(10)

***Termitomyces heimii* Natarajan**

Accession Number: NU-BOT-UC-NK-1082

Family: Lyophyllaceae

Common Name: Termitomyces.

Vernacular Name: Rüpucie (Ang)

Habitat: Grow on the termite's mounds soil.

Description: Cap 5-15 cm, convex to umbonate when mature, white, striated; gill white, crowded; stipe white, ring, elongate up to 20 cm, fibrillose, slander.

Distribution: Kohima, Phek, Tuensang (25˚51.24715N 94˚9.32252E)

Parts use: Whole fruit body.

Uses: Fresh fruit body is cooked and eaten.

Figure: 2.12(11)

***Melanoleuca grammopodia* (Bull.) Fayod**

Accession Number: NU-BOT-UC-NK-1121

Family: Tricholomataceae

Common Name: Melanoleuca

Vernacular Name: Ciepro (Ang)

Habitat: Grow on leaf mulch and decomposed soil.

Description: Cap 7-15 cm, convex to depressed at maturity, surface smooth and wetish; gill white or creamy, broad, adnexed; stipe fibrillose, club-shaped, brown colour.

Distribution: Kohima, Phek, Tuensang (25˚42.62413N 94˚6.2807E)

Parts use: Whole fruit body.

Uses: Fresh fruit body is cooked and eaten.

Figure: 2.12(12)

***Cantharellus cibarius* (Fr.)**

Accession Number: NU-BOT-UC-NK-1122

Family: Cantharellaceae

Common Name: Chanterelle.

Vernacular Name: NA

Habitat: Grow attached to the hardwood, singly or clustered.

Description: Cap 3-10 cm wide, somewhat funnel shaped to shallowly vase-shaped, bright golden yellow, decurrent fold resembling gills under the cap; stipe tapering towards the base, sometimes the fruit bodies fused together at the base.

Distribution: Kohima, Phek, Tuensang (25˚54.43138N 94˚1252982E)

Parts use: Whole fruit body.

Uses: Fresh or dried fruit body is cooked and eaten.

Figure: 2.12(13)

***Lentinus squarrosulus* Mont. Singer**

Accession Number: NU-BOT-UC-NK-1123

Family: Polyporaceae

Common Name: Lentinus.

Vernacular Name: NA

Habitat: Grows in small group on logs, stumps or fallen trunks.

Description: Cap 2-8 cm wide, flat to convex when young but becomes funnel shaped at maturity, white, margin tears as cap expands and split; gill white, decurrent; stipe short, tapers towards the base, flesh elastic but toughen when it ages.

Distribution: Kohima, Phek, Tuensang (25˚54.43138N 94˚1252982E)

Parts use: Whole fruit body.

Uses: Fresh or dried fruit body is cooked and eaten.

Figure: 2.12(14)

***Tricholoma imbricatum* (Fr.) P. Kumm.**

Accession Number: NU-BOT-UC-NK-1124

Family: Tricholomataceae

Common Name: Matt knight.

Vernacular Name: Mene cie (Ang)

Habitat: Grows in coniferous forests.

Description: Cap 3-10 cm, convex to umbonate when mature, smooth, brown; gill crowed, white to white brown when mature; stipe firm, stout, fibrillose, brown, sinuate.

Distribution: Kohima, Phek, Tuensang (26˚16.15104N 94˚29.75471E)

Parts use: Fresh fruit body.

Uses: Fresh fruit body is cooked and eaten.

Figure: 2.12(15)

***Termitomyces microcarpus* (Berk. & Broome) R.Heim**

Accession Number: NU-BOT-UC-NK-1125

Family: Lyophyllaceae.

Common Name: Termitomyces

Vernacular Name: Zogacie (Ang).

Habitat: Grows in groups or in clusters in deciduous forests near the roots of bamboo associated with termite nests.

Description: Cap 1-2.5 cm wide, brownish white, convex to umbonate when mature, the cap splits as it ages; gill white, un-crowed; stipe slander, white or light brown, fibrillose.

Distribution: Kohima, Phek, Tuensang (25˚51.24715N 94˚9.32252E)

Parts use: Whole fruit body.

Uses: Fresh fruit body is cooked and eaten.

Figure: 2.12(16)

Evaluation of Market Acceptability

Since time memorial, underutilized edible plants have been playing very important role in the lives of the rural people as most of the local people depends on the forest resources for supplementing their daily diet and to meet their basic need of food, medicines and also income generation. In order to understand the acceptability of these plants/local product and commercial viability, different local markets were surveyed in the district of Kohima, Phek and Tuensang during different seasons of the year. **Table 2.2** showed some of the underutilized edible plants been sold in the local markets of these three districts. They were sold as in fresh form, dried form, roasted, fermented or made into a local product and sold in packets.

Figure 2.13 showed the images taken during the market survey in the local markets of Kohima, Phek and Tuensang distict. **Figure 2.13 (A-H)** showed images of some leafy vegetables and inflorescence *viz*., Young shoot and leave of *Zanthoxylum oxyphyllum, Herpetospermum pedunculosum, Centella asiatica, Spilanthes acmella, Diplazium esculentum, Elatostema platyphyllum, Houttuynia cordata,* inflorescence of *Trichodesma khasianum* and **Figure 2.13 (I-Q)** showed the images of fruits of *Phyllanthus emblica, Livistona jenkinsiana, Spondias pinnata, Terminalia chebula, Zanthoxylum acanthopodium, Rhus chinensis* , Nuts of *Hodgsonia macrocarpa* and *Juglans regia,* Cereal - *Coix-lacryma jobi* and **Figure 2.13 (R-T)** showed the fresh and dried form of mushroom, *Schizophyllum commune, Lentinula edodes* and *Auricularia auricula-judae.*

Figure 2.13: Showing some underutilized edible plants sold in the local market of Kohima, Phek and Tuensang district

Results

The present study was the outcome of the intensive survey conducted from the three study areas *viz*., Kohima, Phek and Tuensang district, Nagaland, made during the period of 2014-2016. An attempt was made to collect, identify and document the underutilized edible plants from the district of Kohima, Phek and Tuensang of Nagaland and also to evaluate the market acceptability of the underutilized edible plants.

A total of 142 underutilized edible species were collected during the survey which consists of 126 plants species and 16 wild edible mushrooms or macrofungus species. The collected 126 underutilized edible plants belonging to 58 family and 95 genera, of which 49 family and 84 genera belongs to dicotyledones (Acantheceae, Actinidaceae, Adoxaceae, Amarantheceae, 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, Myrtaceae, Olaceae, Oxalidaceae, Passifloraceae, Phyllantheceae, Plantaginaceae, Polygonaceae, Primulaceae, Rhamnaceae, Rhizophoraceae, Rosaceae, Rubeaceae, Rutaceae, Sapindaceae, Saururaeceae, 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 generas each which was followed by Moraceae with 7 generas and Asteraceae and Polygonaceae with 6 generas each. Poaceae was found to be dominant family amongst monocotyledones with 5 generas followed by

Araceae with 4 generas, Zingiberaceae with 3 generas and Musaceae and Arecaceae with 2 generas.

From the collected 126 underutilized edible plants, 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 sikkimensis, 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.

The 16 wild edible mushrooms collected belonging to 11 families, of which 2 species belongs to the family i) Lyophyllaceae [*Termitomyces heimii* Natarajan and *Termitomyces microcarpus* (Berk. & Broome) R.Heim], ii) Auriculareaceae [*Auricularia auricula-judae* (Bull.) Quél. and *Auricularia polytricha* (Mont.) Sacc.], iii) Polyporaceae [*Laetiporus sulphureus* (Bull.) Murr. and *Lentinus squarrosulus* Mont. Singer], iv) Russulaceae [*Lactarius volemus* (Fr.) Kuntze and *Lactarius piperatus* (L.) Pers], v) Tricholomataceae [*Melanoleuca grammopodia* (Bull.) Fayod and *Tricholoma imbricatum* (Fr.) P. Kumm.], and 1 species each belonging to the family i) Hydnangiaceae [*Laccaria tortilis* (Bolton) Cooke], ii) Marassmiaceae [*Lentinula edodes* (Berk.) Pegler], iii) Pluerotaceae [*Pleurotus pulmonarius* (Fr.) Quél.], iv) Schizophyllaceae (*Schizophyllum commune* Fr.) and v) Cantherellaceae [*Cantharellus cibarius* (Fr.)], vi) Agaricaceae [*Termitomyces eurrhizus* (Berk.) R. Heim] were collected and documented.

The market survey showed that some of the collected underutilized edible plants were found selling in the local market of these districts where the price ranges from Rs. 20-200 INR per bunch/cup/plate/packet (local system of marketing) in either fresh or dried form or made into a local product.

Discussion

Nagaland states harbors one of the richest and unique biodiversity in the world and the land is inhabited by the Naga tribes. The state being very rich in its flora provides a variety of nature resources to the tribals especially in the remote areas who directly or indirectly depend on these resources for their daily needs and supply such as their food, diet supplement that provides essential micronutrients, raw materials, traditional medicines and is a source of income generation for the tribals.

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. The market survey showed that a cup or a packet approximately 500 grams could fetch around Rs. 50-100 INR. But during the study it was found that with the course of time, the cultivation 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 squirrels on *Coix-lacryma jobi* (Job's tears). 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 crops.

The 50 species of leafy vegetables both in the form of young shoots and leaves or the whole plant part that was collected and documented are mostly collected from the wild. It was found that some of the leafy vegetables were collected from the wild and cultivated in the home gardens (*Antidesma bunius, Clerodendrum glandulosum, Houttuynia cordata, Gynura bicolor, Polygonum chinense, Polygonum molle, Trichodesma khasianum, Gynura nepalensis*). Many of these leafy vegetables were also found selling in the local market costing around Rs. 20-30 INR per bunch (200-250 grams).

The 62 fruits and nuts collected and documented are mostly eaten when ripe and mature while some of them are eaten when young (*Trichosanthes dunniana, Canavalia gladiata, Oxalis corniculata*), some of them are collected from the wild and cultivated in the home gardens (*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*) and some of them are in the form of nuts (*Castanopsis indica, Juglans regia, Hodgsonia macrocarpa*). The market survey also showed that many of collected fruits and nuts were also sold in the local market of three study area. They are sold in cups, packets or plate which was the local system of measuring unit approximately 400-500 grams in weight. The fruits and nuts were found to be selling in fresh form, dried form or roasted or made into a local product which cost around Rs. 20-50 per cup/plate/packet.

The 8 species of edible stem, flower and inflorescence plant and 3 species of edible root, tuber and bulb plant collected and documented are also collected from the wild and some of which are also found cultivating in the home garden. They are also found selling in the local markets (*Amomum dealbatum, Curcuma angustifolis, Chimonobambusa callosa, Musa sikkimensis, Musa thomsonii, Dendrocalamus giganteus*) costing around Rs. 20-30 per plate (*Amomum dealbatum*), Rs. 20-50 per bunch (*Dendrocalamus giganteus, Curcuma angustifolia, Musa sikkimensis, Musa thomsonii*) and Rs. 50-100 per pack/ plate (*Chimonobambusa callosa, Cinnamomum verum, Dioscorea bulbifera*).

It was found 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 and the collected mushroom are used for their need and some are marketed. The market survey showed that the marketed mushrooms were sold both in fresh and dried form and costs around Rs.50-100 INR to even Rs. 200 INR according to the season.

The market survey showed that the price of the products varied from market to market, fluctuates according to the season to season of collection, climate and availability and also depends on the supply from the rural mass to the market. The market price ranges from Rs. 20-100 per plate/cup/bunch/packets (local system of marketing). The survey showed that there was no specific standard system of measuring unit(s) existed for the underutilized edible plants being marketed. **Table 2.2** also showed the different local measuring system/units like plate, cup, bunch or packet. Since there was no standard measurement system existed, units for sale in the markets are approximate only:

a) 1 plate – approximately 500 grams
b) 1 cup – approximately 500 grams
c) 1 bunch – approximately 250 grams
d) 1 packet – approximately 200 grams

Table 2.2: Market survey showing different underutilized edible plants with their parts sold and the rate per unit

Cereal crops		
Name of plant	**Parts sold**	**Rate per unit (INR)**
Coix-lacryma jobi	Seeds	50-100/cup or packet
Setaria italica	Seeds	50-100/cup or packet
Sorghum bicolor	Seeds	50-100/cup or packet
Leafy vegetables		
Alpinia nigra	Young shoot, branch and Inflorescence (Fresh)	20-30/bunch
Centella asiatica	Whole plant (Fresh)	20-30/bunch
Clerodendrum glandulosum	Young leaves and branch (Fresh)	20-30/bunch
Gynura bicolor	Young leaves and branch (Fresh)	20-30/bunch
Plantago erosa	Whole plant (Fresh)	20-30/bunch
Polygonum chinense	Young leaves and branch (Fresh)	20-30/bunch
Polygonum molle	Young leaves and branch (Fresh)	20-30/bunch
Lasia spinosa	Young leaves and branch (Fresh)	20-30/bunch
Elatostema lineolatum	Young leaves and branch (Fresh)	20-30/bunch
Spilanthes acmella	Young leaves and branch (Fresh)	20-30/bunch
Fagopyrum esculentum	Young leaves and branch (Fresh)	20-30/bunch
Zanthoxylum oxyphyllum	Young leaves and branch (Fresh)	20-30/bunch
Cardamine hirsuta	Young leaves and branch (Fresh)	20-30/bunch
Herpetospermum pedunculosum	Young leaves and branch (Fresh)	20-30/bunch
Elatostema platyphyllum	Young leaves and branch (Fresh)	20-30/bunch
Trichodesma khasianum	Young leaves and branch (Fresh)	20-30/bunch
Diplazium esculentum	Young leaves and branch (Fresh)	20-30/bunch
Gynura nepalensis	Young leaves and branch (Fresh)	20-30/bunch
Asparagus officinalis	Young shoot (Fresh)	20-30/bunch
Oenanthe javanica	Whole plant (Fresh)	20-30/bunch
Chenopodium album	Young leaves and branch (Fresh)	20-30/bunch
Persicaria nepalensis	Young leaves and branch (Fresh)	20-30/bunch
Fruits and nuts		
Ficus auriculata	Mature ripe fruit (Fresh)	20-30/plate
Ficus semicordata	Mature ripe fruit (Fresh)	20-30/plate
Juglans regia	Mature nuts (Dried)	50-100/plate/cup/pack
Rhus chinensis	Fruits (Fresh/Dried)	20-50/cup/pack
Terminalia chebula	Young/mature fruit (Fresh/Dried)	20-50/cup/pack
Choerospondias axillaris	Mature ripe fruit (Fresh)	20-50/cup/cup
Stixis suaveolens	Young/mature fruit (Fresh)	20-50/plate/cup
Spondias pinnata	Mature ripe fruit (Fresh)	20-50/plate
Elaeagnus latifolia	Mature ripe fruit (Fresh)	20-50/plate/cup
Diospyros kaki	Mature ripe fruit (Fresh)	20-50/plate
Docynia indica	Mature ripe fruit (Fresh/Dried)	20-50/plate/ pack
Myrica esculenta	Mature ripe fruit (Fresh)	20-50/plate
Castanopsis indica	Mature nuts (Fresh/Roast)	20-50/plate/cup/pack

Prunus nepalensis	Mature ripe fruit (Fresh)	20-50/plate/cup/bunch
Zanthoxylum armatum	Mature fruit (Dried)	20-50/plate/cup/pack
Hodgsonia macrocarpa	Mature seed/nut (Fresh/Dried)	20-50/plate/cup/bunch
Litsea cubeba	Mature ripe fruit (Fresh)	20-50/plate/cup/pack
Phyllanthus emblica	Mature ripe fruit (Fresh/Dried)	20-50/plate/cup/pack
Elaeocarpus floribundus	Mature fruit (Fresh/Dried)	20-50/plate/cup/pack
Livistona jenkinsiana	Ripe fruit (Fresh)	20-50/plate
Nephelium lappacium	Ripe fruit (Fresh)	20-50/plate/bunch
Baccaurea ramiflora	Ripe fruit (Fresh)	20-50/plate/bunch/cup
Stem, Flower and Inflorescence		
Amomum dealbatum	Inflorescence (Fresh)	20-30/plate
Curcuma angustifolis	Inflorescence (Fresh/ Dried)	20-30/plate/bunch/pack
Musa sikkimensis	Young stem (Fresh)	20-50/bunch
Musa thomsonii	Inflorescence (Fresh)	20-50/bunch
Dendrocalamus giganteus	Young shoot and stem (Fresh/fermented)	20-100/bunch/plate/pack
Root, Tuber, Rhizome and Bulb.		
Dioscorea bulbifera	Tuber (Fresh)	20-50/plate
Cinnamomum verum	Root (Fresh/Dried)	50-100/bunch
Mushroom		
Auricularia auricula-judae	Whole part (Fresh/Dried)	50-100/plate/packet
Auricularia polytricha	Whole part (Fresh/Dried)	50-100/plate/ packet
Lactarius volemus	Whole part (Fresh)	50-100/plate
Laccaria tortilis	Whole part (Fresh/Dried)	50-200/plate/ packet
Lentinula edodes	Whole part (Fresh/Dried)	50-200/plate/ packet
Schizophyllum commune	Whole part (Dried)	50-100/plate/ packet
Macrolepiota albuminosa	Whole part (Fresh)	50-200/plate/bunch
Termitomyces heimii	Whole part (Fresh)	50-200/plate/bunch

The present study aims to collect, document and also promote awareness to exploit underutilized edible plants to widen our knowledge on different types and uses of these plants as they have the potential to provide food security that can sustain the future generation. Studies needs to be carried out inorder to exploit these forest resources at the same time awareness on the conservation of these resources need to be promoted for the continuity of the plants. By selling the forest resourses, a vendor in the local market of Nagaland earns their livelihood and sustaining their livelihood – Rs. 1 lakh to 2.5 lakhs for a season (Sashimatsung et al., 2013). Since most of the products sold in the local markets are collected from forest, as such these forest resources can also contribute in

boosting the economy of the region by opening up doors for employment generation as the market survey revealed that some of underutilized plants are in high demand because of its taste, medicinal properties etc. Therefore the finding of this study can be use by the policy maker of the state for popularization and commercial scale production which will help the socio-economic status of the region.

Summary and Conclusion

A total of 142 species of underutilized edible plants were collected during the period of 2014-2016 of which 126 were plants species and 16 wild edible mushrooms or macrofungus species. The collected 126 underutilized edible plants belongs to 58 family and 95 genera, of which 49 family and 84 genera belongs to dicotyledones (Acantheceae, Actinidaceae, Adoxaceae, Amarantheceae, 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, Myrtaceae, Olaceae, Oxalidaceae, Passifloraceae, Phyllantheceae, Plantaginaceae, Polygonaceae, Primulaceae, Rhamnaceae, Rhizophoraceae, Rosaceae, Rubeaceae, Rutaceae, Sapindaceae, Saururaeceae, Solanaceae, Ulmaceae, Urticaceae, Vitaceae) and 9 family with 19 genera belonging to monocotyledones (Amaryllidaceae, Asparagaceae, Araceae, Arecaceae, Costaceae, Dioscoreaceae, Musaceae, Poaceae, Zingiberaceae). Among the dicotyledone plants, Rosaceae and Urticaceae were found to be the dominant family with 8 generas while Poaceae was found to be dominant family among monocotyledone plants with 5 generas. Of 126 collected underutilized edible plants, 50 species were leafy vegetable plants, 62 species of fruit and nut plants, 8 species of stem, flower and

florescence plants and 3 species of root, tuber and bulb plants. The 16 species of edible mushrooms were all collected from the wild. During the market survey it was found that the plant and plant products are sold either in fresh form, dried form, roasted or fermented form. The market survey showed that some of the collected underutilized edible plants are highly accepted in the local markets in the three study areas *viz*., Kohima, Phek and Tuensang district. Market survey also showed that there was no standard measurement unit existed and that the plant and plant products were sold as in cup, bunch, plate or packet (local system of marketing) that ranges from Rs. 20 to even Rs. 200 INR.

Chapter - 3

Nutritional Analysis of Selected Underutilized Edible Crops

Nutrition is defined as the science of food, the nutrient and other substances therein, their action, interaction and balance in relation to health and diseases, and the processes by which the organism ingests, absorbs, transport, utilizes and excretes food substances (Lagua and Cluadio, 1995) and nutrients are substances that are essential to life, which must be supplied by food for an organism to grow and survive. Crop improvement has played important role in sustaining and strengthening food and nutrition, health and livelihood in the world from the very beginning of domestication yet millions of people are still under-nourished (FAO 2012a, b; Black *et al*., 2003). Underutilized crops not only contribute to the human nutrient but also play a crucial role in the food security and income generation of the rural poor people (Magbagbeola *et al*., 2010). They may have lesser importance in terms of global production and consumption systems but neglected and underutilized crop species are rich in macronutrients and micronutrients (Padulosi *et al*., 1999; Johns and Eyzaguirre, 2006; Adjatin *et al*., 2013;

Dansi *et al*., 2012) and comparatively they require relatively low inputs thereby contributing to sustainable agricultural production. Though very important they are yet they have not received adequate research attention, their domestication, conservation and genetic improvement have hardly progressed (Padulosi *et al*., 2002; Vodouhe *et al*., 2011). In the present study, a total of 142 underutilized edible plants have been documented from the three study areas *viz*., Kohima, Phek and Tuensang and accordingly they were categorized according to the types of plants and parts used:

1. Cereal crops
2. Leafy vegetables
3. Fruits and nuts
4. Stem, flower and inflorescence
5. Root, tuber, rhizome and bulb.
6. Mushrooms

From the collected underutilized edible plants, 22 underutilized edible plants were selected for the nutritional analysis. The selection was done on the basis of: a) lesser cultivation and production (*Coix-lcryma jobi* and *Setaria italica*). These two cereal crops has been once the basic and daily food of the locals in these three district but with the passage of time, their cultivation and production has been reduced, difficulty in maintenance being one reason. b) Easy accessible (*Centalla asiatica, Clerodendrum glandulosum, Plantago erosa, Zanthoxylum oxyphyllum, Actinidia callosa, Phyllanthus emblica, Rhus chinensis, Stixis suaveolens*). These edible plants are abundant during their seasons in the wild and can be easily access by the local people to meet their different needs (food, income generation etc.). c) Taste and preferences by the local people (*Elatostema platyphyllum, Polygonum chinense, Polygonum molle, Trichodesma khasianum, Lasia spinosa, Zanthoxylum oxyphyllum, Hodgsonia macrocarpa, Ficus*

auriculata, Juglans regia). Different people of different areas have different food preferences, for example, many locals of Kohima prefers *Elatostema platyphyllum, Polygonum chinense* and *P. molle* for preparing their special cuisine called Galho, like wise local people of Phek prefers pickle made from the nuts of *Juglans regia* and *Hodgsonia macrocarpa*. d) Use as traditional method of medicine (*Clerodendrum glandulosum, Polygonum chinense, Polygonum molle, Ficus semicordata, Spondias pinnata, Rhus chinensis, Phyllanthus emblica, Terminalia chebula*). Local people have their own believe of traditional medicinal method on different plants, for example, *Polygonum chinense* and *P. molle* are believed to help sleep and relief stress when cooked and eaten. e) Reduced plant population (*Elatostema platyphyllum, Juglans regia, Olax imbricata*). Some of these plants were once found abundant in the forest but over the course of time their population has drastically been reduced. Some of the main reasons were over collection, over grazing, forest fire and other anthropogenic activities. Taking all this into consideration, the forth objection 'Nutritional analysis of some selected 'Underutilized Crops' to check their nutrient content such as proteins, carbohydrates, reducing sugar etc.' was taken up for the study. The 22 underutilized edible plants selected for the nutritional analysis are listed in **Table 3.1** along with the botanical name, common name, vernacular name and the parts used of the plants**;**

Table 3.1: Selected underutilized edible plants selected for nutritional analysis

Sl. No.	Botanical name	Common name	Vernacular name (Angami)	Family	Parts used
Cereal Crops					
1	*Coix-lacryma jobi* L.	Job's tears	Kesi	Poaceae	seeds
2	*Setaria italica* (L.) P. Beauv.	Foxtail millet	Chütienuo	Poaceae	seeds
Leafy Vegetables					
3	*Centella asiatica* (L.) Urb.	Indian penny wort	Gara	Apiaceae	Young leaves
4	*Clerodendrum*	Glory hill	Gathere	Verbenaceae	Young

	glandulosum Lindl.	bower			leaves
5	*Elatostema platyphyllum* Wedd.	Elatostema	Gajo	Urticaceae	Young leaves
6	*Lasia spinosa* (L.) Thwaites	Queen flower	Telega	Araceae	Young leaves
7	*Plantago erosa* Wall.	Common plaintain	Gapa	Plantaginaceae	Young leaves
8	*Polygonum chinense* L.	Chinese Knotweed	Gare	Polygonaceae	Young leaves
9	*Polygonum molle* D. Don	Soft knot grass	Gazie	Polygonaceae	Young leaves
10	*Trichodesma khasianum* C. B. Cl.	Trichodesma	Sekisekuoga	Boraginaceae	Young leaves
11	*Zanthoxylum oxyphyllum* Edgew.	Badrang (Hin)	Ganya	Rutaceae	Young leaves
Fruits and Nuts					
12	*Actinidia callosa* Lindl.	Wild kiwi	Ketsa kiwi	Actinidiaceae	Mature fruit
13	*Phyllanthus emblica* L.	Goose berry	Chiehusei	Euphorbiaceae	Mature fruit
14	*Ficus auriculata* Lour.	Roxburgh Fig		Moraceae	Mature fruit
15	*Ficus semicordata* Buch.-Ham. ex Sm.	Drooping fig	Chiedesei	Moraceae	Mature fruit
16	*Hodgsonia macrocarpa* (Blume)	Lard seed	Ketsamo	Cucurbitaceae	Nut
17	*Juglans regia* L.	Wild walnut	Pfhüsei	Juglandaceae	Nut
18	*Olax imbricata* Roxb.	Olax	Puyano	Olacaceae	Mature fruit
19	*Rhus chinensis* Mill.	Nutgall tree	Zomhusei	Anacardiaceae	Mature seed
20	*Spondias pinnata* (L. f.) Kurz	Wild mango	Mezisei	Anacardiaceae	Mature fruit
21	*Stixis suaveolens* (Roxburgh) Pierre	Stixis	Rokasei	Capparaceae	Mature fruit
22	*Terminalia chebula* Retz.	Myrobalan	Mhiechüsei	Combretaceae	Mature fruit

Collection and Preparation of Plant Samples

The fresh plant samples were harvested at mature stage from different areas in different seasons of the year from the districts of Kohima, Phek and Tuensang and brought to the laboratory. The selected plant samples consist of 2 cereal crops, 9 leafy vegetables and 11 fruits and nuts. The mature seeds of the 2 cereal crops (*Coix-lacryma jobi* and *Setaria italica*) were thoroughly windblown to remove the bran that was left after thrashing. The seeds were then oven dried at 70˚C for~8h and carefully wrapped in a zipper polybag and stored at 4˚C till use. The fruits samples (*Actinidia callosa,*

Phyllanthus emblica, Ficus auriculata, Ficus semicordata, Olax imbricata, Spondias pinnata, Stixis suaveolens) were washed with water to do away with all possible dirts on the surfaces, then with the help of a tissue paper the surfaces of the sample was dried off. The outer covering of the fruit samples was carefully peeled off and the flesh without the seed was oven dried and was stored at 4˚C till use. The fruit of *Rhus chinensis* was carefully brush off of possible dirts which was then oven dried and carefully stored at 4˚C till use. The outer shell of *Hodgsonia macrocarpa* and *Juglans regia* were carefully removed and the karnel are oven dried and stored at 4°C till use.

Methodology

Proximate Composition

Moisture content: Moisture content was estimated following Association of Official Agricultural Chemists, (AOAC, 1990) method with slight modification. Two g of the collected each sample was taken in a separate pre-weighed dish and oven dried at 70ºC for ~4 h for leafy vegetables and ~18 h for fresh fruits. The moisture content was calculated from the loss of weight.

$$\textbf{Moisture content (\%)} = \frac{\textbf{Loss of weight (g)}}{\textbf{Weight of the sample (g)}} \textbf{ x 100}$$

Protein estimation: Protein estimation was determined by using the method described by Lowry *et al*. (1951). About 500 mg of the oven dried sample was grounded and homogenized with 10 ml of 0.1M Phosphate buffer (*p*H - 7.4) (**Appendix - I**) and centrifuged the solution at 1000 rpm for 10 min. The supernatant was filtered with Whatman filter paper and the filtrate was used for protein analysis. Pipette out 1ml of the extract to which 5ml of the Lowry's regent (**Appendix - I**) was added. Mixed the solution well and allowed the mixture to stand for 10 min. Added 1N of Folin-ciocalteau reagent (**Appendix - I**) to the solution followed by incubation at room temperature in the

dark by putting it for 30 min. Absorbance was taken at 660 nm and the standard curve was prepared with Bovine Serum Albumin (BSA).

Total carbohydrate: Total carbohydrate was estimated using the Phenol-Sulphuric Acid Method (Dubois *et al*., 1956). About 300 mg of the oven dried sample was weighed and hydrolyzed by keeping it in a boiling water bath for 3 h with 5 ml of 2.5N HCl (**Appendix - II**) and cool to room temperature. The volume was made to 50 ml with distilled water and centrifuged at 1000 rpm for 10 min and the supernatant was filtered and the filtrate to be used for the estimation of total carbohydrate. To 1 ml of the extract, added 1 ml of 5% Phenol solution followed by 5ml of 96% sulphuric acid and mixed well by shaking for 10 min. The content of the tube was placed on a water bath 25˚ to 30˚ C for 20 min and the absorbance was read at 490 nm with the standard curve using glucose.

Reducing sugar: Reducing sugar was estimated using the method of 3,5- dinitrosalicylic acid reagent (DNS reagent) (Miller, 1959). Oven dried 1 g sample was weighed and grounded with 10 ml of 80% ethanol and the solution was centrifuged at 1000 rpm for 10 min. the supernatant was then filtered and the filtrate was used for estimation of reducing sugar. To 1ml of extract 3ml of DNS reagent (**Appendix – III**) was added followed by heating the solution in a boiling water bath for 5 min. Added 1 ml of 40% (v/w) Rochelle salt solution (Potassium Sodium Tartrate) in the cooled reaction mixture. The absorbance was read at 510 nm with the standard curve prepared using glucose.

Total phenolic content: Total phenolic content was determined by the Folin- Ciocalteu method (Singleton and Rossi, 1965). To 0.1 ml of the extract mixed 0.9 ml of distilled water and 1 ml of Folin-Ciocalteu reagent. The solution was allowed to stand for 5 min followed by adding 2 ml of saturated sodium carbonate (75 g L^{-1}) and incubated it at 30°C for 1.5 h with intermitting shaking. The absorbance was read at 765 nm. Gallic acid

was used as the standard which was expressed as mg Gallic Acid Equivalent (GAE) per gram of the extract.

Total flavonoid content: Total flavonoid content was determined using the Colorimetric method (Sahreen *et al*., 2010) with slight modification. In a test tube, 3.4 ml of 30% of methanol was added to 0.3ml of the extract followed by adding 0.15ml of 0.5M sodium nitrite and 0.15 ml of 0.3M aluminium chloride hexahydrate. Allowed the solution to stand for 5 min before adding 1 ml of 1M sodium hydroxide. The absorbance was read at 510 nm. Quercitin was used as the standard which was expressed as mg Quercitin per gram of the extract.

Antioxidant activity: 2,2-Diphenyl-1-picryllydazyl (DPPH) stable free radical method was used to determined the antioxidant activity of the plant extract according (Aoshima *et al*., 2004) with slight modification. The reaction mixture consists of 0.1 mM of DPPH methanol solution **(Appendix - IV)** with 10-250 µg/ml concentration of the plant extract which was mixed thoroughly and allowed it to stand in the dark for 30 min at room temperature. The absorbance was read at 517 nm. The percentage inhibition of DPPH was calculated using the formula

$$\text{\% inhibition of DPPH} = \frac{\text{O.D. control} - \text{O.D. sample} \times 100}{\text{O.D. control}}$$

Statistical Analysis

All the experiments were carried out in triplicate (n = 3) and were expressed in mean±standard deviation. The statistical analyses were done using 2007 Microsoft Office Excel.

Results

In the present study survey was made to document the underutilized wild edible crops from three districts of Nagaland and a total of 142 underutilized edible species were collected during the survey which consists of 126 plants species and 16 wild edible mushrooms or macrofungus species. The collected 126 underutilized edible plants belonging to 58 family and 95 genera, of which 49 family and 84 genera belongs to dicotyledones and 9 family with 19 genera belonging to monocotyledones was documented. All the species are subdivided according to crop types (3 cereals, 50 leafy vegetables, 8 stem, flower and inflorescence, 62 fruits and nuts, 3 root, tuber, rhizome and bulb and 16 wild edible mushrooms etc.). Of the total species, 22 most popular species were selected for analyzing nutritional composition. Different important parameters like moisture content, total protein, total carbohydrate, reducing sugar, total phenolic content, total flavonoid content and antioxidant activity were studied in all the 22 selected species. The findings of the present investigation are presented below under appropriate sub-headings.

Moisture Content: The moisture content of the 22 selected plants varied significantly ranging from 4.8 to 88.15%. The maximum moisture content was recorded in the leafy vegetables which were recorded as 88.15%, 85.60% and 84.90% in *Plantago erosa*, *Polygonum chinense* and *Elatostema platyphyllum* respectively. The moisture content was significantly low in the nuts of *Juglans regia* recorded as 4.8% and also cereal crop *Coix-lacryma jobi* and fruit of *Rhus chinensis* showed very low moisture content which was recorded as 8.65% and 11.5% respectively. Over all, it was found that leafy vegetable samples have the highest moisture content (50.50 – 88.15%) compare to fruit samples (4.8 – 83.2%) and cereal crop (8.65% in *Coix-lacryma jobi* and 16.25% in *Setaria italica*) which was found to be the lowest in their moisture content (**Table 3.2)**

Table 3.2: Proximate compositions of 22 selected underutilized edible plants

Cereal Crops				
Plant Species	**Parameters**			
	Moisture Content (%)	**Total Carbohydrate (mg/100g)**	**Reducing Sugar (mg/100g)**	**Protein (mg/100g)**
Coix-lacryma jobi	8.65 ±.33	4196.31±.03	7.44 ±.005	4.12 ±.004
Setaria italica	16.25 ±.42	5211.53 ±.32	14.14 ±.007	1.28 ±.003
Leafy Vegetables				
Clerodendrum glandulosum	72.45 ±0.29	1130.67 ±0.03	30.41 ±0.004	28.23 ±0.03
Elatostema platyphyllum	84.90 ±0.18	4591.58 ±0.009	44.3±0.004	12.78±0.002
Centella asiatica	80.75 ±0.4	587.01±0.01	33.61 ±0.008	151.27±0.007
Lasia spinosa	50.50 ±0.27	416.48 ±0.006	13.81 ±0.002	22.08 ±0.03
Plantago erosa	88.15 ±0.36	1720 ±0.001	56.28±0.001	182.44 ±0.01
Polygonum chinense	85.60 ±0.3	3378.47 ±0.007	39.30 ±0.009	539 ±0.04
Polygonum molle	84.75 ±0.16	768.26 ±0.001	77.9 ±0.009	70.42 ±0.005
Trichodesma khasianum	80 ±0.49	752.5 ±0.004	32.55 ±0.004	33.9 ±0.02
Zanthoxylum oxyphyllum	75.30 ±0.41	570.16 ±0.002	39.06 ±0.003	25.26±0.009
Fruits and Nuts				
Actinidia callosa	83.8 ±0.04	5134.98 ±0.004	95.06 ±.03	18.08 ±.007
Phyllanthus emblica	83.2 ±0.45	894.82 ±0.003	56.78 ±0.005	436.66 ±0.63
Ficus auriculata	78.9 ±0.12	3937.58 ±0.01	137.25 ±0.02	6.96 ±0.005
Ficus semicordata	75.15 ±0.05	847.72 ±0.02	28.81 ±0.004	60.52 ±0.12
Hodgsonia macrocarpa	36.95 ±0.03	320.90 ±0.003	10.81 ±0.008	30.81 ±0.16
Juglans regia	4.8 ±0.21	197.82 ±0.01	8.31 ±0.006	16.48 ±0.005
Olax imbricata	82.05 ±0.12	1465.18 ±0.03	36.04 ±0.002	39.66 ±0.01
Spondias pinnata	81.85 ±0.07	5134.98 ±0.01	63.47 ±0.01	76.91 ±0.11
Rhus chinensis	11.5 ±0.28	1402.25 ±0.004	18.45 ±0.005	92.46 ±0.005

Stixis suaveolens	80.2 ±0.22	2278.58 ±0.007	45.15 ±0.002	116.06 ±0.04
Terminalia chebula	68.3 ±0.29	1868.54 ±0.009	57.28 ±0.01	665.61 ±0.11

Data represents mean of three replicates (± Standard deviation)

Protein Content: The protein content of the 22 plant sample varied significantly which ranged between 1.23–665.61 mg per 100 g of the dry sample. The maximum protein content was recorded in the fruits of *Terminalia chebula* (665.61 mg/100g) which was followed by the leaves of *Polygonum chinense* (539 mg/100g) and fruits of *Phyllanthus emblica* (436.66 mg/100g) respectively. The lowest protein content was recorded in the cereal crops *Setaria italica* (1.28 mg/100g), *Coix-lacryma jobi* (4.12 mg/100g) followed by the fruits of *Ficus auriculata* (6.96 mg/100g), *Elatostema platyphyllum* (1.93 mg/100g) and *Actinidia callosa* (2.93 mg/100g) respectively. Over all, the 2 cereal crops showed the lowest protein content (1.28 mg/100g in *Setaria italica* and 4.12 mg/100g in *Coix-lacryma jobi*) among the three group of the plant sample (**Table 3.2)**.

Carbohydrate Content: Data of the present analysis revealed that, the carbohydrate content in the selected 22 plant samples shows significant variation ranging from 197.82 – 5211.53 mg per 100g sample. The maximum carbohydrate content was recorded in *Setaria italica* as 5211.53 mg per 100 g followed by the fruits of *Spondias pinnata* (5134.98 mg/100g), *Actinidia callosa* (51343.98 mg/100g) and seeds of *Coix-lacryma jobi* (4196.31 mg/100g) respectively and the lowest carbohydrate content was recorded in the fruit of *Juglans regia* (197.82 mg/100g) followed by nuts of *Hodgsonia macrocarpa* (320.90 mg/100g) and the leaves of *Lasia spinosa* (416.48 mg/100g) respectively (**Table 3.2)**. Over all, the highest carbohydrate content was recorded in the cereal crops as compare to the three groups of plant samples.

Reducing Sugar: Unlike the other nutritional parameters, the value of reducing sugar content in the 22 plant samples studied does not vary much which ranges from 7.44 – 137.25 mg per 100 g of sample. The maximum reducing sugar was recorded in fruits of

Ficus auriculata (137.25 mg/100g) which was followed by the fruits of *Actinidia callosa* (95.06 mg/100g) and the leaves of *Polygonum molle* (77.9 mg/100g). Seed of *Coix-lacryma jobi* (7.44 mg/100g) was found to have the lowest reducing sugar content followed by nuts of *Juglans regia* (8.31 mg/100g) and *Hodgsonia macrocarpa* (10.81 mg/100g) respectively (**Table 3.2**). It was established that the leafy vegetables and fruits content higher reducing sugar then the cereal crops.

Total Phenol Content (TPC): The total phenol content (TPC) of the 22 selected plant species does not show much variation except for two plant samples (*Terminalia chebula* and *Rhus chinensis*). The maximum TPC was recorded in the fruits of *Terminalia chebula* (53.11 mg GAE/g) and *Rhus chinensis* (43.99 mg GAE /g). The TPC value of *T. chebula* and *R. chinensis* varies significantly from the rest of the 20 plant samples as the value of TPC of the other samples ranges from 0.09 – 8.75 mg GAE/g. The lowest TPC was recorded in the leaves of *Elatostema platyphyllum* (0.09 mg GAE/g) followed by the fruit of *Ficus auriculata* (0.82 mg GAE/g) and seed of *Coix-lacryma jobi* (0.84 mg GAE /g) (**Table 3.3)**. Over all, the TPC of the selected plants samples are almost at the same level except for *T. chebula* and *R. chinensis*.

Table 3.3: Proximate compositions of 22 selected underutilized edible plants

Cereal Crops			
Plant Species	**Parameters**		
	Antioxidant activity IC50 µg/ml	**TPC (mg GAE /g)**	**TFC (mg QE/g)**
Coix-lacryma jobi	540.57	0.84 ±0.002	1.11 ±0.01
Setaria italica	994.36	1.01 ±0.006	0.43 ±0.006
Leafy Vegetables			
Clerodendrum glandulosum	65.29	1.71 ±0.005	43.67 ±0.06
Elatostema platyphyllum	196.36	0.09 ±0.002	0.014 ±0.05
Centella asiatica	241.6	2.32 ±0.006	0.97 ±0.14
Lasia spinosa	157.24	2.7 ±0.05	1.65 ±0.01

Plantago erosa	237.6	1.55 ±0.006	0.04 ±0.02
Polygonum chinense	151.25	4.09 ±0.005	5.24 ±0.001
Polygonum molle	121.22	8.44 ±0.06	1.8 ±0.04
Trichodesma khasianum	207.33	1.61 ±0.002	2.56 ±0.009
Zanthoxylum oxyphyllum	218.54	4.0 ±0.07	6.8 ±0.01
Fruits and Nuts			
Actinidia callosa	420.88	2.12 ±0.005	0.02 ±0.007
Phyllanthus emblica	79.08	1.39 ±0.005	4.22 ±0.06
Ficus auriculata	194.5	0.82±0.02	4.8 ±0.05
Ficus semicordata	251.07	1.24 ±0.005	0.13 ±0.003
Hodgsonia macrocarpa	698.57	1.08 ±0.003	0.004 ±0.001
Juglans regia	86.83	8.75 ±0.02	5.25 ±0.03
Olax imbricata	136	1.74 ±0.006	0.02 ±0.006
Spondias pinnata	90.86	4.31 ±0.004	2.39 ±0.007
Rhus chinensis	84.73	43.99 ±0.24	6.61 ±0.005
Stixis suaveolens	174.88	1.39 ±0.005	0.24 ±0.09
Terminalia chebula	37.49	53.11 ±0.18	27.78 ±0.24
Trolox	96.89		

Data represents mean of three replicates (± Standard deviation)

Total Flavonoid Content: The data revealed that the total flavonoid content (TFC) of the plant samples was much lesser than that of the TPC. The TFC from the leaves of *Clerodendrum glandulosum* (43.67 mg QE/g) and fruit of *Terminalia chebula* (27.78 mg QE/g) were found to be highest among the 22 plant samples. The TFC of the rest 20 plant samples does not showed much difference from each other as value ranges from 0.004 – 6.8 mg QE/g. The lowest TFC was found to be in the nut of *Hodgsonia macrocarpa* (0.004 mg QE/g) followed by the leaves of *Elatostema platyphyllum* (0.014 mg QE/g), fruit of *Olax imbricata* (0.02 mg QE/g), leaves of *plantago erosa* (0.04 mg QE/g) and seed of *Setaria italica* (0.43 mg QE/g) (**Table 3.3, Figure 3.1, 3.2, 3.3, 3.4). Figure 3.1, 3.2, 3.3** and **3.4** showed the different graphical representation of total phenol

and flavonoid of 2 cereal crops, 9 leafy vegetables and 11 fruits and nuts respectively. Over all, the TFC of the selected plant samples has very less flavonoid content except for *C. glandulosum* and *T. chebula* plant sample.

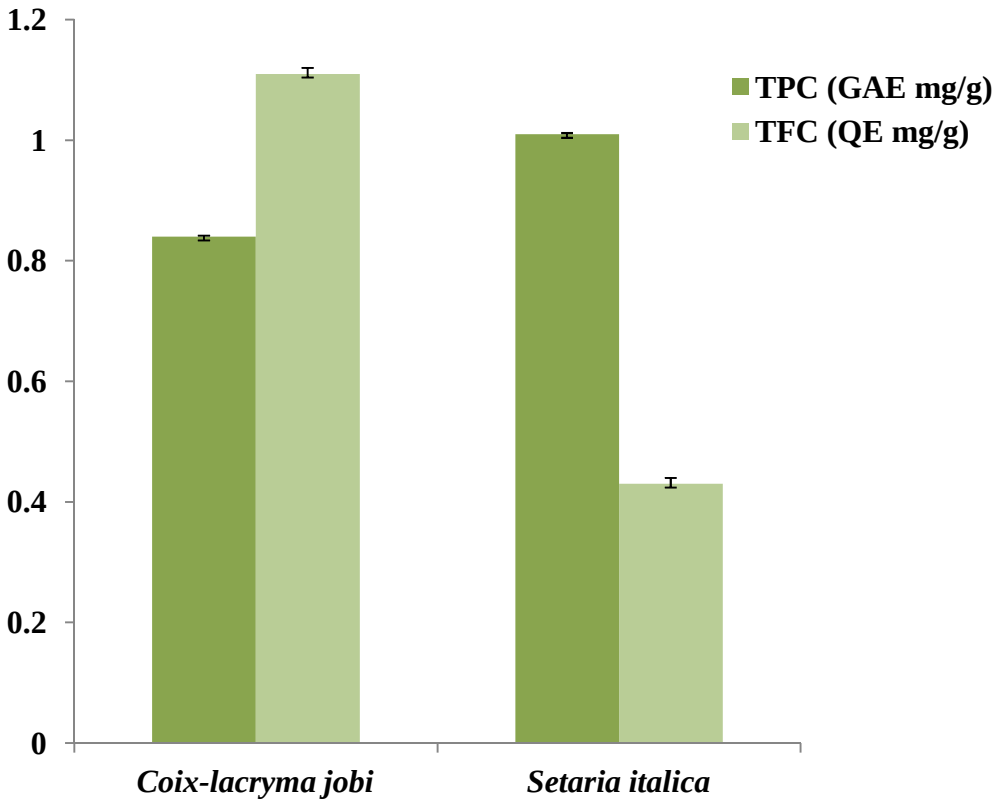


Figure 3.1: Total Phenol and Flavonoid content of 2 Cereal crops (*Coix-lacryma jobi* and *Setaria italica*)

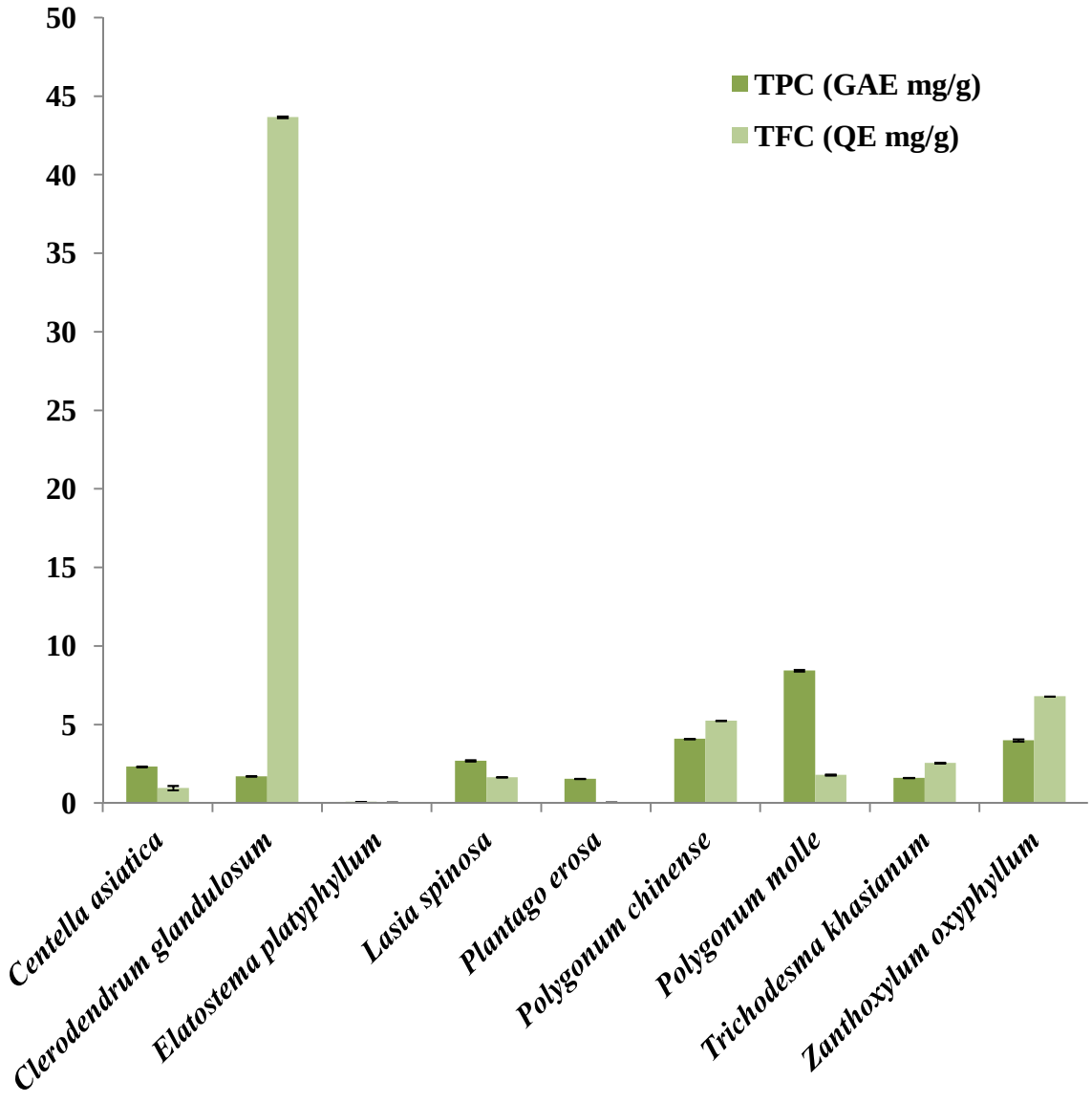


Figure 3.2: Total Phenol and Flavonoid content of 9 leafy vegetables (*Centella asiatica, Clerodendrum glandulosum, Elastostema platyphyllum, Lasia spinosa, Plantago erosa, Polygonum chinense, P. molle, Trichodesma khasianum , Zanthoxylum oxyphyllum*)

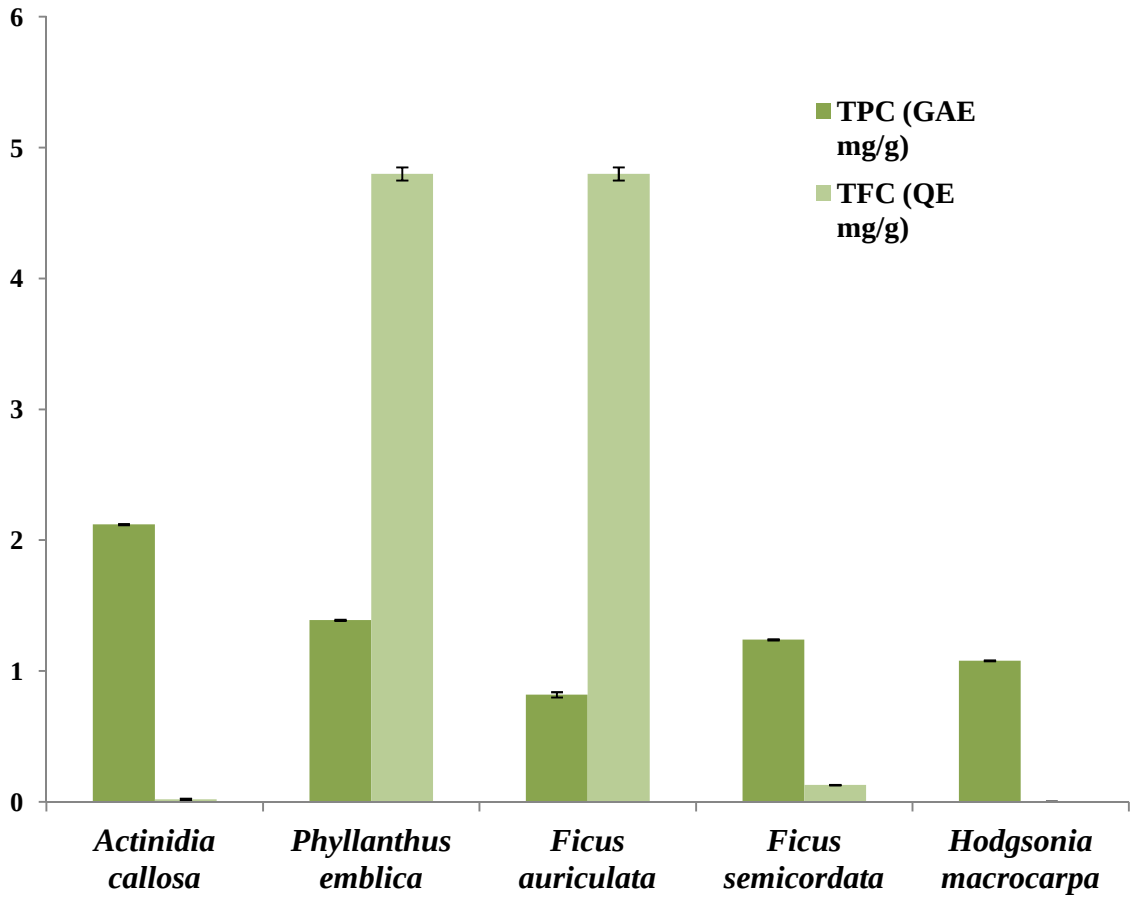


Figure 3.3: Total Phenol and Flavonoid content of 5 fruits (*Actinidia callosa, Phyllanthus emblica, Ficus auriculata, Ficus semicordata, Hodgsonia macrocarpa*)

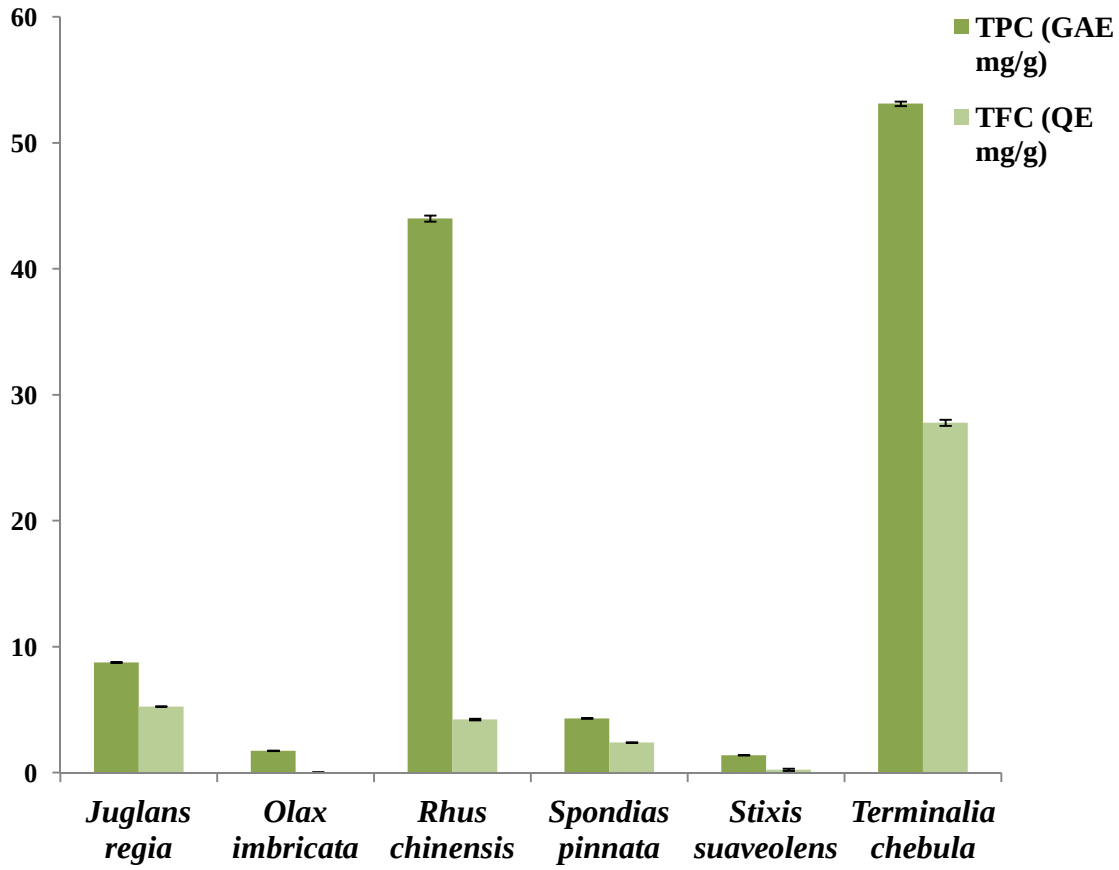


Figure 3.4: Total Phenol and Flavonoid content of 6 fruits (*Juglans regia, Olax imbricata, Rhus chinensis, Spondias pinnata, Stixis suaveolens, Terminalia chebula*)

Antioxidant Activity: Antioxidant activity was analyzed in 22 selected plant species and exhibited significant variation according to the type of the plant samples of underutilized edible plants. The variation ranged from 37-994.36 µg per ml plant extract expressed as IC50 which is the concentration required to scavenge 50% of the reaction. The maximum antioxidant activity was observed in *Terminalia chebula* fruits (37.49 µg/ml) followed by leaves of *Clerodendrum glandulosum* (65.29 µg/ml) and fruit of *Phyllanthus emblica* (79.08 µg/ml). The nut of *Juglans regia* (86.83 µg/ml), fruits of *Rhus chinensis* (84.73 µg/ml) and *Spondias pinnata* (90.86 µg/ml) also showed very high antioxidant activity after *Terminalia chebula*, *Clerodendrum glandulosum* and *Phyllanthus emblica* extracts. The lowest antioxidant activity was observed in the seed of *Setaria italica* (994.36 µg/ml), nut of *Hodgsonia macrocarpa* (698.57 µg/ml) and seed of *Coix-lacryma jobi* (540.57 µg/ml) (**Table 3.3, Figure 3.5, 3.6, 3.7). Figure 3.5, 3.6** and **3.7** showed the different graphical representation of percent inhibition of DPPH IC50 values of 2 cereal crops, 9 leafy vegetables and 11 fruits and nuts respectively. Over all, antioxidant activity was found maximum in the fruit samples followed by the leaves samples and the seed samples of cereal crops.

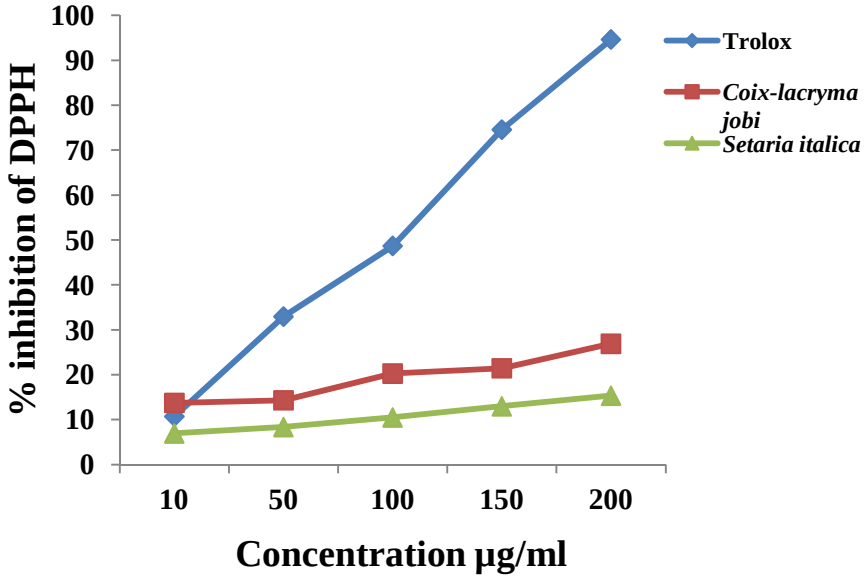


Figure 3.5: Percent inhibition of DPPH IC50 values of 2 cereal crops (*Coix-lacryma jobi* and *Setaria italica*)

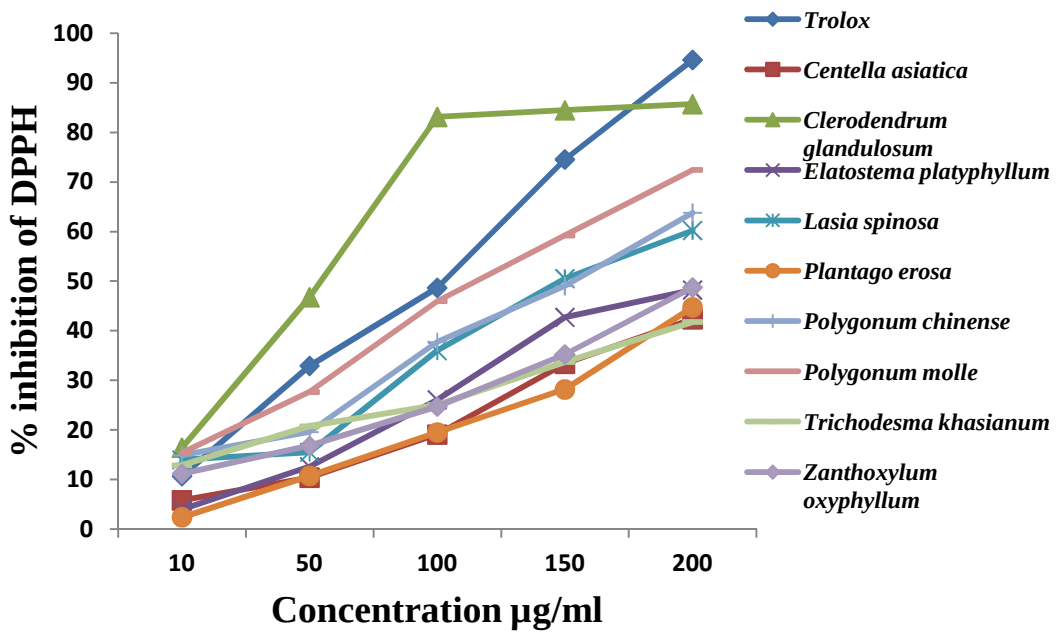


Figure 3.6: Percent inhibition of DPPH IC50 values of 9 leafy vegetables (*Centella asiatica, Clerodendrum glandulosum, Elatostema platyphyllum, Lasia spinosa, Plantago erosa, Polygonum chinense, Polygonum molle, Trichodesma khasianum* and *Zanthoxylum oxyphyllum*).

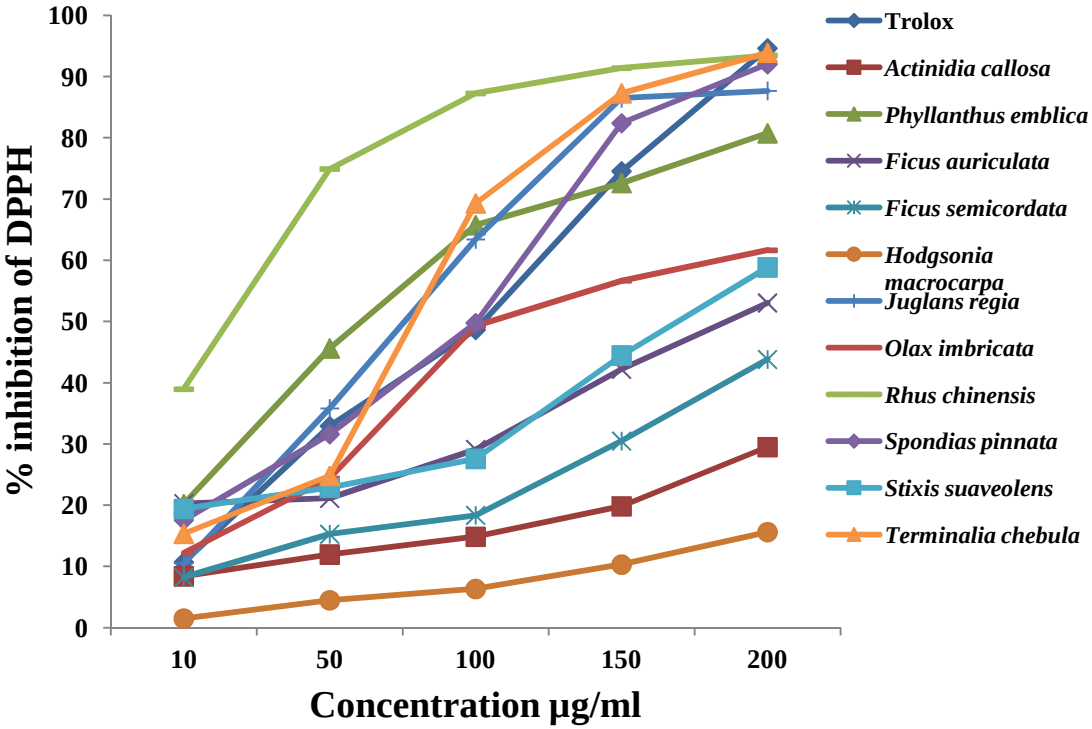


Figure 3.7: Percent inhibition of DPPH IC50 values of 11 fruits and nuts (*Actinidia callosa, Phyllanthus emblica, Ficus auriculata, Ficus semicordata, Hodgsonia macrocarpa, Juglans regia, Olax imbricata, Spondias pinnata, Rhus chinensis, Stixis suaveolens* and *Terminalia chebula*)

From the experiment performed and the result obtained in the present study reveal that many underutilized plants have high nutritional value. The data revealed that *Coix-lacryma jobi* and *Setaria italica* are good source of carbohydrate; *Terminalia chebula*, *polygonum chinense* and *Phyllanthus emblica* are good source of protein. The data also showed that *T. chebula, C. glandulosum, Rhus chinensis, Phyllanthus emblica* are good sources of antioxidant, Phenols and flavonoid. The results showed that some of these plants can offer a cheaper option against those few crop species to sustain the future generation.

Discussion

Ever since the beginning of agriculture, cereals have provided unlimited health benefits as a staple food in our daily diet. Cereal grains have been the principal component of human diet for thousands of years that have contributed immensely in shaping human civilization and they are the single most important sources of calories to a majority of the world population (Awaki, 2011). Developing countries depend more on the cereal crops for their nutritional needs then the developed countries. Apart from the three most important food crops in the world *viz*., rice, wheat and maize, other minor grains like millet, job's tear and sorghum are also major contributors of overall calorie intake in certain regions of the world, particularly semi-arid parts of Africa and India, for example sorghum and millet contribute up to 85% of daily caloric intake in Burkina Fasco and Niger (FAO, 2011). Certain whole cereal grains like sorghum and millet are rich in complex carbohydrate that provide ample energy and help prevent cancer and other chronic diseases then the consumption of refined grains (Chen *et al*., 1993). Nagaland is basically an agricultural land and cultivation of cereal crops also plays a big part in agricultural system of the state. Millets, sorghum and jobs tear are important traditional Naga cereal crops which have been passed down from generation through

traditional preservation method. Millets and jobs tear has been part of every meal among the Naga tribes but this practice has died down and replaced by other inorganic commercial food products. Their cultivation and production has also been drastically reduced due to difficulty in growing (damage caused by pests and birds) which in turn has led to low market demand. However, with the passage of time, the importance of minor cereal crops has gain much interest tribal people and many organizations have started promoting these crops e.g., North East network reintroducing and reviving millet-base biodiverse agriculture in Chizami village of Phek district.

Fruits, nuts and vegetables play a significant role in human nutrition especially as source of vitamins, minerals and dietary fiber (Craig and Beck, 1999). They offer advantages over dietary supplements because of low cost and wide availability; as such they remain an important source of nutrients in many parts of the world. Fruits are nature's marvelous gift to mankind which is packed with vitamins, minerals, antioxidant (polyphenols, flavonoids, anthocyanins etc.) and many phytonutrients. Fruits have been recognized as a good source of vitamins and minerals which help in preventing vitamin A and C deficiencies, reduce risk for stroke, other cardiovascular diseases and type-2 diabetes, protect against certain cancers and maintain optimum health due to the health promoting phytochemicals it contain (Benzie and Choi, 2014). Nuts are good source of essential fatty acid, fiber, vitamin E and mineral (Kader, 2001). Some components of fruits and vegetables are strong antioxidants and function to modify the metabolic activation and detoxification/disposition of carcinogens or even influence processes that alter the course of the tumor cell (Wargovich, 2000). Antioxidant capacity varies greatly among fruits and vegetables (Kalt, 2002). Consumption of fruit and vegetable decreases blood pressure (Alonso *et al*., 2004), lower risk of stroke development among those with the highest intake of fruits and vegetables (He *et al*., 2006). Nagaland with its diverse

flora and its forest covering 12,966 sq. km is home to a large number of underutilized wild edible plants (leafy vegetable, fruit, nuts etc.). The present investigation showed the nutritional analysis of 22 selected underutilized wild edible plants where cereal crops, leafy vegetables and fruits showed variation in their proximate composition. The cereal crops and fruits like *Spondias pinnata, Actinidia callosa* were found to be a good source of carbohydrate; fruits like *Ficus auriculata, Actinidia callosa* and leafy vegetable *Polygonum molle* were found to be a good source of reducing sugar; fruits like *Terminalia chebula, Rhus chinensis* and leafy vegetable *Clerodendrum glandulosum* were found to be a good source of phenol and flavonoid and fruits like *Terminalia chebula, Spondias pinnata, Juglans regia, Phyllanthus emblica* and leafy vegetable *Clerodendrum glandulosum* showed highest antioxidant activity among the 22 selected plants.

Proximate composition of the underutilized edible plants

The moisture content is a quality factor of food and is one of the most important attribute for determining the shelf life and quality of the foods. Water content or moisture content is the quantity of water contained in a material (crops or wood). The data revealed that the moisture content of the cereal crops ranges from 8.65% to 16.25%, 50.50% to 88.15% in leafy vegetables and 4.8% to 83.8% in fruits. The maximum moisture content was observed in the leafy vegetables among the three groups of plants with 88.15% in *Plantago erosa* followed by 85.60% in *Polygonum chinense* and 84.90% in *Elatostema platyphyllum*. The minimum moisture content was observed in the fruits and cereal with the lowest value 4.8% in *Juglans regia* followed by 8.65% in *Coix-lacryma jobi* and 11.5% in *Rhus chinensis*. Khomdram (2007) reported the moisture content of *Spondias pinnata* (77.23%), *Phyllanthus emblica* (82.65%) and *Setaria italica* (12.0%) by Koehler and Wieser, 2013 are quit close to *Spondias pinnata* (81.85%),

Phyllanthus emblica (83.2%) and *Setaria italica* (16.25%) from the present investigation however the moisture content of *Hodgsonia macrocarpa* (72.18%) (Khomdram, 2011) is comparative higher than the present investigation which is 36.95%. Firdusi (2013) reported the moisture content of *Lasia spinosa* (86.30%) which comparative higher than the present study (50.50%). The reason for this difference could be due to stage and the time of collection of the sample. Sundriyal (1999) reported the moisture content of fig (80.80%) which was very close to the moisture content observed from two fig species, *Ficus auriculata* (78.9%) and *Ficus semicordata* (75.15%) of the present study. Sundriyal and Sundriyal (2001) reported the moisture content of *Terminalia chebula* (53.00%) and which is less than the moisture content of *Terminalia chebula* (68.3%) observed in the present study.

Proteins are complex organic compound that provide energy to the body. Protein is an important component of every cell in the body as it play major role in the maintenance of body homeostasis, functions as enzymes and hormones, helps build and repair tissues and is needed for the production of neurotransmitters, vitamins, antibiotics and other important molecules (IFIC, 2011). Protein forms about 15% of the total body weight of an average adult and needs 100-150g per day in the diet (Khomdram, 2007). The deficiency of protein causes physical and mental fatigue, retarded growth, delayed healing of wounds and complications during pregnancy (Ambika, 1999; Das and Das, 2003). Protein-Energy Malnutrition (PEM) can lead to variety of ailments including mental retardation and kwashiorkor (Latham, 1997). Protein deficiency affects the transport of many essential nutrients that are normally bound to protein carriers in the plasma, and thus correction of protein synthesis improves the apparent deficiency of specific nutrient (Uauy and Hertrampf, 2009). From the present finding, the highest total protein content among the twenty two plant sample was found to be in *Terminalia*

chebula (665.61 mg/100g) followed by *Polygonum chinense* (439 mg/100g) and *Phyllanthus emblica* (436.66 mg/100g) respectively. The protein content values of *Spondias pinnata*, *Phyllanthus emblica*, *Hodgsonia macrocarpa*, *Terminalia chebula* and *Zanthoxylum oxyphyllum* were found to be much higher compare to finding of (Sundriyal and Sundriyal, 2001; Khomdram, 2007). Protein quality of a food depends on its amino acid content and the physiological utilization of specific amino acid after digestion, absorption and minimal obligatory rates of oxidation (Friedman,1996) and that hydrolysis of protein occurs during conversion of chloroplast to chromoplast which might have decreased protein content at ripening (Hegde and Chharia, 2004). Among the nine leafy vegetable samples, *Polygonum chinense, Plantago erosa* and *Centella asiatica* and among the eleven fruits/nuts, *Terminalia chebula*, *Phyllanthus emblica* and *Stixis suaveolens* were found to be a good source in protein and therefore, their use be encouraged. The two cereal crops were found to be lowest in their protein content among the selected plant samples. This may be due to the fact that when refined by removal of bran and germ, the remaining endosperm is mostly carbohydrate.

Carbohydrate is one of the main nutrients needed in large amount by the body. They are a major class of naturally occurring organic compounds that play important role as structural (e.g., cellulose, hemicellulose and pectin) components of plants and also chemical roles in all living systems. The main role of Carbohydrates is to provide the energy needed by the body as they are the main source of fuel needed for physical activity. They are also a good source of vitamins and minerals. Carbohydrate comes in simple forms such as sugar (monosaccharides) which includes sugar from fruits, vegetables and milk and in complex form such as starches (Polysaccharides) which include whole-grains breads and cereals, starchy vegetables and legumes. From the result obtained, the maximum carbohydrate content was observed in two cereal crops, *Setaria*

italica (5211.53 mg/100g) and *Coix-lacryma jobi* (4196.31 mg/100g). In cereal crops, the largest morphological component is the starchy endosperm and approximately 80% of this is starch which is the key component of carbohydrate (Evers *et al*., 1999). Among the twenty two plant samples, fruits like *Rhus chinensis*, *Ficus auriculata*, *Terminalia chebula*, *Stixis suaveolens*, *Spondias pinnata*, *Actinidia callosa*, *Olax imbricata* and leafy vegetables like *Polygonum chinense*, *Elatostema platyphyllum*, *Plantago erosa* and *Clerodendrum glandulosum* are found to be a good source of carbohydrate.

Reducing sugar is a type carbohydrate or natural sugar containing a free aldehyde or ketone group that can act as reducing agent and can donate electrons to another molecule. Reducing sugar can change the color and taste of the food when reacted with other parts of the food like amino acids. Some of the reducing sugars are glucose, fructose, galactose, lactose and maltose (Krishnaveni *et al*., 1984). The maximum reducing sugar was recorded in the fruits of *Ficus auriculata* (137.25 mg/100g), *Actinidia callosa* (94.06 mg/100g), *Spondias pinnata* (63.47 mg/100g), *Terminalia chebula* (57.78 mg/100g) and *Phyllanthus emblica* (56.78 mg/100g). Leafy vegetables like *Polygonum molle*, *Plantago erosa* and *Elatostema platyphyllum* are also found to be a good source of reducing sugar. The findings of Sundriyal and Sundriyal (2001) and Khomdram (2007) on *Spondias pinnata*, *Phyllanthus emblica*, *Hodgsonia macrocarpa*, *Terminalia chebula* and *Zanthoxylum oxyphyllum* are lower than the values obtained in the present study.

Antioxidant activity

Polyphenols are amongst the most desirable phytochemicals due to their antioxidant activity (Ignat and Popa, 2011). Antioxidants are substances that when present in low concentration compared to that of an oxidisable substrate significantly delays or inhibits the oxidation of that substrate (Halliwell *et al*., 1995). Antioxidants

provide chemical protection for biological systems against harmful effects of reaction or processes that cause excessive oxidation, protein and DNA damage and cell death (Papas, 1999; Arnao *et al*., 2001). Antioxidants are nutrients (vitamins and minerals) as well as enzymes (protein in the body that assists in chemical reactions) (Sun *et al*., 2002) that help in preventing the development of chronic diseases as cancer, heart disease, stroke, rheumatoid arthritis, and cataracts (Chu *et al*., 2002). Recently, some studies have shown that a high intake of antioxidant food may decrease the risk of incidence of deadliest diseases (Ritaro *et al*., 2008). Increased consumption of fruits and vegetables containing high levels of phytochemicals has been recommended to prevent chronic diseases related to oxidative stress in the human body (Chu *et al*., 2002). Oxidative stress occurs when the production of harmful molecules called free radicals is beyond the protective capability of the antioxidant defenses (Alia *et al*., 2003). Free radicals are chemically active atoms or molecular fragments that have a charge due to an excess or deficient number of electrons making them highly unstable that scavenge the body to grab or donate electrons, thereby damaging cells, proteins, and DNA (genetic materials) (Alia *et al*., 2003). DPPH (1,1-diphenyl-2-picrylhydrazyl) is a rapid, simple, inexpensive and widely used method to measure the ability of compounds to act as free radical scavengers or hydrogen donors, and to evaluate antioxidant activity of foods, measure the overall antioxidant capacity and free radical scavenging activities of fruits and vegetable juices (Prakash, 2001: Sendra *et al*., 2006; Kedare and Singh, 2011). The DPPH assay method is based on the reduction of DPPH giving a maximum absorption at 517 nm. When antioxidant react with DPPH, the stable free radical becomes paired off in the presence of a hydrogen donor and is reduced to DPPHH (1,1-diphenyl-2-picrylhydrazine) and as consequence the absorbance decrease from DPPH resulting in decolarization (yellow color) with respect to the number of electrons captured (Ghosh,

1998). More the decolarization more is the radical scavenging ability. In the present investigation, the primary antioxidant properties was measured by DPPH assay expressed as IC_{50} (µg/ml) value which is the concentration of the extracts required to scavenge 50% of the DPPH free radicals. Among the twenty two plant samples, the maximum antioxidant activity was recorded in *Terminalia chebula* (37.47 µg/ml) fruit extract, followed by *Clerodendrum glandulosum* (65.29 µg/ml) leaves extract and *Phyllanthus emblica* (79.08 µg/ml) fruit extract. The minimum antioxidant activity was recorded in the cereal crops, *Setaria italica* (994.36 µg/ml), *Coix-lacryma jobi* (540.57 µg/ml) seed extracts and in the nut extract of *Hodgsonia macrocarpa* (698.57 µg/ml). The present finding shows that antioxidant activity was higher in the fruit samples then the leafy vegetables and the cereal crop samples. The antioxidants from plant origin are compared to synthetic ones (Zheng and Wang, 2001; Rohman *et al*., 2010) as they do not have any side effect/genotoxic effect (Chen *et al*., 1992; Kahl and Kappus, 1993). Further, natural antioxidants are advantageous due to cost effectiveness and easy accessibility in the form of vegetables and fruits (Galketiya *et al*., 2017).

Total phenolic and flavonoid content

Naturally occurring compounds such as phenolic compounds and flavonoids, contribute to the antioxidant properties of many herbal plants, vegetables, and fruits. These natural compounds are called secondary metabolite produced from various parts of plants like stem, leaves, flowers, fruits and roots. These secondary metabolites are biologically active and show better activity. Phenolic compounds (secondary metabolites) are synthesized by plants during normal development (Pridham, 1960; Harborne, 1982) and responses to stress conditions such as infection, wounding, and UV radiation, among others (Necholson and Hammerschmidt, 1992; Beckman, 2000). Phenolic compounds are major antioxidants of our diet (Scalbert *et al*., 2005) including

anti microbial, anti-inflammatory, anti-mutagenic, anti-carcinogenic, anti-allergic, anti-platelet and vasodilatory actions (Boyer and Liu, 2004; Scalbert *et al*., 2005). Phenols are very important plant constituents because of their scavenging ability on free radicals due to their hydroxyl groups, therefore, the phenolic content of plants may contribute directly to their antioxidant action (Tosun *et al*., 2009). In the present study, the maximum total phenolic content was recorded in the fruits of *Terminalia chebula* (53.11 GAE mg/g) followed by *Rhus chinensis* (43.99 GAE mg/g) and *Juglans regia* (8.75 GAE mg/g). Among leafy vegetables sample, maximum Phenolic content was recorded in the leaves of *Polygonum molle* (8.44 GAE mg/g) followed by *Polygonum chinense* (4.09 GAE mg/g) and *Zanthoxylum oxyphyllum* (4.0 GAE mg/g). Flavonoids are pharmacological active constituents in many plant medicines having multiple biological activities including vasodilatory, anti-carcinogenic, anti-infammatory, antibacterial, immune-stimulating, anti-allergic, and anti-viral effects (Brown, 1980; Middleton, 1992; Duarte, 1993). The maximum flavonoid content was observed in the leaf sample of *Clerodendrum glandulosum* (43.67 QE mg/g) followed by *Terminalia chebula* (27.78 QE mg/g) and *Zanthoxylum oxyphyllum* (6.8 QE mg/g). Fruits samples like *Rhus chinensis*, *Juglans regia*, *Phyllanthus emblica*, *Ficus auriculata* and leaf samples like *Polygonum chinense*, *Polygonum molle* are also a good source of flavonoid. Flavonoid and phenolic content shows better antioxidant activity. As such, from the present finding the maximum antioxidant activity was found to be *Terminalia chebula*, *Rhus chinensis*, *Clerodendrum glandulosum*, *Juglans regia* and *Phyllanthus emblica* which also showed the maximum content of Phenolic and/or Flavonoid.

Phytochemicals– the bioactive non-nutrient plant compounds in fruits, vegetables, grains and other plants foods have been linked to reductions in the risk of major chronic diseases and it has been estimated that more than 5000 phytochemicals

have been identified, but still a large percentage of these remain unknown (Shahidi and Naczk, 1995). Polyphenol concentrations in foods may vary to numerous genetic, environmental and technological factors, some of which may be controlled to optimize the polyphenol contents of the food (Manach *et al*., 2004). The present finding showed that some of the underutilized edibles plants are highly nutritious which are easily accessible and offers a cheaper option over inorganic commercial food products.

Summary and Conclusion

Nagaland forests are one among those having the richest biodiversity in the world and as such it is very rich in its floristic diversity with its diverse wild edible and medicinal plants. Many of these natural resources are highly nutritional in their properties yet they are underutilized and under exploited of their potential. The local inhabitants of Nagaland mostly depend on these natural resources for their daily diet, income generation and medicine, but there is not much work done on the documentation and study of their nutritional attributes. Thus, the present investigation throws some light on the nutritional and antioxidant content of 22 selected underutilized edible plants which will help increase our knowledge on their use. Also, the result from the present investigation can contribute as nutritional support to different region of the state for health improvement and help in development of the various value added local product of the underutilized edible plants which can help up-lift the socio-economic status of the local inhabitants of the state.

Food plays a very significant role in our daily life because it is our primary requirement and all the nutrients necessary for the body comes from the food we take in. One’s food choices each day affect one’s health of the day; therefore good nutrition is an important part of leading a healthy lifestyle. The estimation of nutrient intake from food consumption requires reliable data on food composition containing necessary

information on food sources for different nutrients which can provide information on chemical forms of nutrients and the presence and amount of interacting components and thus provide information on their bioavailability (Elmadfa and Meyer, 2010). Thus, this study deals with the nutritional analysis result of the 22 selected underutilized edible plants from the three districts of Nagaland viz., 2 cereal crops (*Coix-lacryma jobi* and *Setaria italica*), 9 leafy vegetables (*Centella asiatica, Clerodendrum glandulosum, Elatostema platyphyllum, Lasia spinosa, Plantago erosa, Polygonum chinense, Polygonum molle, Trichodesma khasianum* and *Zanthoxylum oxyphyllum* and 11 fruits and nuts (*Actinidia callosa, Phyllanthus emblica, Ficus auriculata, Ficus semicordata, Hodgsonia macrocarpa, Juglans regia, Olax imbricata, Rhus chinensis, Spondias pinnata, Stixis suaveolens, Terminalia chebula*). The proximate analysis shows that leaves of *Plantago erosa, Polygonum chinense* and *Elatostema polyphyllum* has the highest moisture content respectively as compared to the other plant samples analyzed. Fruit of *Terminalia chebula*, leaf of *Polygonum chinense* and fruit of *Phyllanthus emblica* gives the highest protein content respectively among the selected plant samples. High content of carbohydrate was found in the cereal crops - *Coix-lacryama jobi* and *Setaria italica* and in the fruits of *Actinidia callosa* and *Spondias pinnata* in comparison to the other plant samples. The highest value of reducing sugar was found in the fruits of *Actinidia callosa* and *Ficus auriculata* and the leaf of *Polygonum molle*. Fruits of *Terminalia chebula, Rhus chinensis, Phyllanthus emblica* and leaf of *Clerodendrum glandulosum* shows high value of phenol and flavonoid content thus show high antioxidant activity. Thus, the present investigation will help in providing important information on nutritional content of different underutilized edible plants which can contribute to the dietary status of the region.

Chapter - 4

Summary

Underutilized edible plants plays a very vital and crucial role in the daily lives of the rural people as they directly or indirectly depends on them for the daily supplement for food, medicines and income generation. The present study entitled 'Documentation and Evaluation of Underutilized Edible Plants of Kohima, Phek and Tuensang Districts of Nagaland, India' was undertaken to explore, collect, identify and document the underutilized edible plants in these three districts of Nagaland keeping in view of the importance of underutilized edible plants with the following objectives:

1. Survey and collection of the underutilized crops/plants from three different districts of Nagaland (Kohima, Phek and Tuensang).
2. Identification and documentation of the species.
3. Evaluation of market acceptability.
4. Nutritional analysis of some selected 'Underutilized Crops' to check their nutrient content such as proteins, carbohydrates, reducing sugar etc.

Documentation and evaluation of market acceptability of underutilized edible plants

A total of 142 underutilized edible plants were collected, identified and documented. The collected plant consists of 126 species of plant and 16 wild edible mushrooms or macrofungus species. Out of 126 underutilized edible plants collected, 49 family and 84 genera belongs to dicotyledones (Acantheceae, Actinidaceae, Adoxaceae, Amarantheceae, 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, Myrtaceae, Olaceae, Oxalidaceae, Passifloraceae, Phyllantheceae, Plantaginaceae, Polygonaceae, Primulaceae, Rhamnaceae, Rhizophoraceae, Rosaceae, Rubeaceae, Rutaceae, Sapindaceae, Saururaeceae, Solanaceae, Ulmaceae, Urticaceae, Vitaceae) and 9 family with 19 genera belonging to monocotyledones (Amaryllidaceae, Asparagaceae, Araceae, Arecaceae, Costaceae, Dioscoreaceae, Musaceae, Poaceae, Zingiberaceae). Rosaceae and Urticaceae were found to be the dominant family amongst dicotyledones with 8 genera each which was followed by Moraceae with 7 generas 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 with 2 genera.

The collected plants consists of 3 cereal crops, 50 species of leafy vegetable plants, 62 species of fruit and nut plants, 8 species of edible stem, flower and inflorescence plants, 3 species of edible root, tuber and bulb plants and 16 wild edible mushrooms were documented. The 16 wild edible mushrooms collected belong to 11

families and 12 genera. The market survey showed that some of the underutilized edible plants are well accepted in the local market. The plant and plant products was sold either in fresh, dried, roasted or fermented form with no standard measurement system and the market price of the plant and the plant product ranges from Rs. 20-200 per cup, plate, bunch or packet.

Nutritional analysis of the selected underutilized edible crops

Of the total 142 underutilized edible plants, 22 plants were selected for analyzing nutritional composition. The selected plant samples were 2 cereal crops (*Coix-lacryma jobi and Setaria italica*), 9 leafy vegetable plants (*Centella asiatica, Clerodendrum glandulosum, Elatostema platyphyllum, Lasia spinosa, Plantago erosa, Polygonum chinense, Trichodesma khasianum, Polygonum molle, Zanthoxylum oxyphyllum*) and 11 fruit and nut plants (*Actinidia callosa, Phyllanthus emblica, Ficus auriculata, Ficus semicordata, Hodgsonia macrocarpa , Juglans regia, Olax imbricata, Rhus chinensis, Spondias pinnata, Stixis suaveolens, Terminalia chebula*). Different important parameters like moisture content, total protein, total carbohydrate, reducing sugar, total phenolic content, total flavonoid content and antioxidant activity were studied in all the 22 selected species.

The maximum moisture content was recorded in the leafy vegetables which were recorded as 88.15%, 85.60% and 84.90% in *Plantago erosa*, *Polygonum chinense* and *Elatostema platyphyllum* respectively and the minimum moisture content was recorded in *Juglans regia* as 4.8%, *Coix-lacryma jobi* as 8.65% and *Rhus chinensis* as11.5% respectively.

The maximum protein content was recorded in the fruits of *Terminalia chebula* (665.61 mg/100g) which was followed by the leaves of *Polygonum chinense* (539

mg/100g) and fruits of *Phyllanthus emblica* (436.66 mg/100g) respectively and the minimum protein content was recorded in the cereal crops *Setaria italica* (1.28 mg/100g), *Elatostema platyphyllum* (1.93 mg/100g) and *Actinidia callosa* (2.93 mg/100g) respectively.

The maximum carbohydrate content was recorded in *Setaria italica* as 5211.53 mg per 100 g, the fruits of *Spondias pinnata* (5134.98 mg/100g), *Actinidia callosa* (51343.98 mg/100g) and seeds of *Coix-lacryma jobi* (4196.31 mg/100g) respectively and the lowest carbohydrate content was recorded in the fruit of *Juglans regia* (197.82 mg/100g), nuts of *Hodgsonia macrocarpa* (320.90 mg/100g) and the leaves of *Lasia spinosa* (416.48 mg/100g) respectively.

The maximum reducing sugar was recorded in fruits of *Ficus auriculata* (137.25 mg/100g), the fruits of *Actinidia callosa* (95.06 mg/100g) and the leaves of *Polygonum molle* (77.9 mg/100g) respectively and the lowest reducing sugar recorded in the seed of *Coix-lacryma jobi* (7.44 mg/100g), nuts of *Juglans regia* (8.31 mg/100g) and *Hodgsonia macrocarpa* (10.81 mg/100g) respectively.

The maximum total phenol content (TPC) was recorded in the fruits of *Terminalia chebula* (53.11 mg GAE/g) and *Rhus chinensis* (43.99 mg GAE /g) while the lowest TPC was recorded in the leaves of *Elatostema platyphyllum* (0.09 mg GAE/g), the fruit of *Ficus auriculata* (0.82 mg GAE/g) and seed of *Coix-lacryma jobi* (0.84 mg GAE/g).

The maximum total flavonoid (TFC) was recorded from the leaves of *Clerodendrum glandulosum* (43.67 mg QE/g) and fruit of *Terminalia chebula* while the minimum TFC was recorded in the nut of *Hodgsonia macrocarpa* (0.004 mg QE/g), the

leaves of *Elatostema platyphyllum* (0.014 mg QE/g) and fruit of *Olax imbricata* (0.02 mg QE/g) respectively.

The maximum antioxidant activity was observed in *Terminalia chebula* fruits (37.49 µg/ml), leaves of *Clerodendrum glandulosum* (65.29 µg/ml) and fruit of *Phyllanthus emblica* (79.08 µg/ml) respectively and the minimum antioxidant activity was observed in the seed of *Setaria italica* (994.36 µg/ml), nut of *Hodgsonia macrocarpa* (698.57 µg/ml) and seed of *Coix-lacryma jobi* (540.57 µg/ml) respectively.

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. There is a need to promote crop diversification to meet the need of the hungers. The present study was an attempt made to document the underutilized edible plants of three districts of Nagaland namely Kohima, Phek and Tuensang district. The present study will help people especially those living in town areas in widening the knowledge on different types and uses of underutilized edible plants as many of these plants have poor consumer awareness and are unrecognized of their nutritional values. More research works need to be done on the survey and documentation of underutilized crops from the rest of districts in Nagaland. More research and efforts needs to be given on those plants with potential to promote them for food security and income generation through sustainable collection and trade so that they can be deployed widely both in agriculture and environmental management. For sustainable collection, various rising crisis like unplanned urbanization, over grazing, over population, deforestation, forest fire and other anthropogenic activities needs to be checked timely wise and workout proper conservation strategies to prevent depletion and lost of the natural environment caused mainly by anthropogenic activities . Many local products are made from these underutilized edible plants but due to supply chain constraints like lack of technical

information, national policy and interest from researchers and producers etc, these local products are not able to meet the large scale market standard of both national and international business. Therefore, there is a need for attention by the researchers, policy and decision makers, and technology providers for proper strategy and improve various processing steps of the local products quality for better commercial purposes and to compliment the consumer demands. Also, from the result obtained it was observed that many underutilized edible plants have high nutritional composition, it will be of great help if research works are carried out in the future to study the phytochemical and nutraceutical properties of these plants which will help improve the present day medicine. Thus, their proper exploitation, utilization and conservation could help in sustaining the coming future generation.

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Appendix - I

Biochemical Analysis Reagent

Phosphate buffers (0.1M)

NaH_2PO_4	3.1 g
$NaHPO_4$	10.9 g
Distilled	1000 ml
*p*H	7

Lowry's Reagent

Reagent A

NaOH	20 g
$NaCO_3$	4 g
Distilled Water	1000 ml

Reagent B

$KNaC_4H_4O_6.4H_2O$	10 g
$CuSO_4$	10g
Distilled Water	1000 ml

Reagent C: Folin – Ciocalteau Reagent

$Na_2WoO_4.2H_2O$	100 g
$Na_2MoO_2.2H_2O$	25 g
Distilled H_2O	700 ml
H_2SO_4	100 ml
Li_2SO_4	150 g
H_3PO_4	85 ml
Br_2 water	Few Drops

Appendix – II

HCl (2.5N)

HCl	21.6 ml
Distilled H_2O	78.4ml

Phenol 5%

Phenol	50g
Distilled H_2O	1000ml

Appendix – III

Dinitrosalicyclic Acid Reagent (DNS Reagent)

DNS	1g
Crystalline Phenol	200 g
Na_2SO_3	50 mg
NaOH	100 ml

40% Rochelle salt solution

$KNaC_4H_4O_6.\ 4H_2O$	40 g
Distilled water	100 ml

Appendix – IV

DPPH (0.1 mM)

DPPH	0.0394 g
Methanol (Pure)	100 ml

List of Paper Publication

1. Ao, T., Deb, C. R. and Khruomo, N. 2016. Wild edible mushrooms of Nagaland, India: a potential food resource. *Journal of Experimental Biology and Agricultural Sciences,* 4(1): 59-65. DOI: http://dx.doi.org/10.18006/2015.4(1).59.65.

2. Deb, C. R., Khruomo, N. and Jamir, N. S. 2016. A study on documentation and market acceptance of underutilized wild edible crops of Kohima district, Nagaland, India. *Asian Journal of Biological and Life Sciences*, 5(2): 201-206.

3. Khruomo, N. and Deb, C. R. 2018. Indigenous wild edible fruits: sustainable resources for food, medicine and income generation – a study from Nagaland, India. *Journal of Experimental Biology and Agricultural Sciences,* 6(2):405-416. . DOI: http://dx.doi.org/10.18006/2018.6(2). .

Paper Presented in Seminars and Conferences

1. Underutilized Crops: An Alternative towards Food Security. In: National Seminar 'Globalization, Development and Environment with Special reference to North-East India' at Nagaland University, Lumami on March 19-20, 2015.

2. Indigenous Wild Edible Fruits: A Sustainable Resources for Food, Medicine and Income Generation. In: National Seminar 'Inventory, Sustainable Utilization and Conservation of Bio-Resources', at Nagaland University, Lumami on February 26-27, 2016.
3. Nutritional Assessment of Some Selected Underutilized Wild Edible Plants of Kohima District, Nagaland and Their Market Acceptability. In: National Seminar on Advances in Biological Science Research, Department of Botany, Nagaland University, Lumami on February 28- March 01, 2017.
4. Underutilized Wild Edible Plants: An Alternative Towards Food Security and Income Generation. In: International Conference on Natural Resources Management and Technology Trends (ICNRM-17) Centre of Advanced Study, Department of Life Sciences, Manipur University on March 27-29, 2017.

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