

## **Rapid ethnobotanical appraisal on *Bugun*, *Sartang* and *Monpa* communities of West Kameng and Tawang Sectors of Arunachal Himalayan Region, India**

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### **Abstract**

Present paper discusses the outcome of rapid ethnobotanical appraisal made on three culturally distinct and heterogeneous communities namely, the *Bugun*, *Sartang* and *Monpa* of West Kameng and Tawang sectors of Arunachal Himalayan Region of India. The ethnobotanical resources of the local communities were documented using semi-structured questionnaire and focused group discussion session conducted in 6 selected villages of rural and semi-urban biocultural landscape. Investigation have revealed 77 ethnobotanically important species of which 71 % are harvested from the wild and only while 29 % are harvested from the cultivated sources. The most frequently used species prioritized has the potential to boost economy and ensuring rural livelihood security in the region.

**Key words:** Ethnobotany, Bugun, Sartang, Monpa, West Kameng, Tawang, Arunachal Pradesh

### **INTRODUCTION**

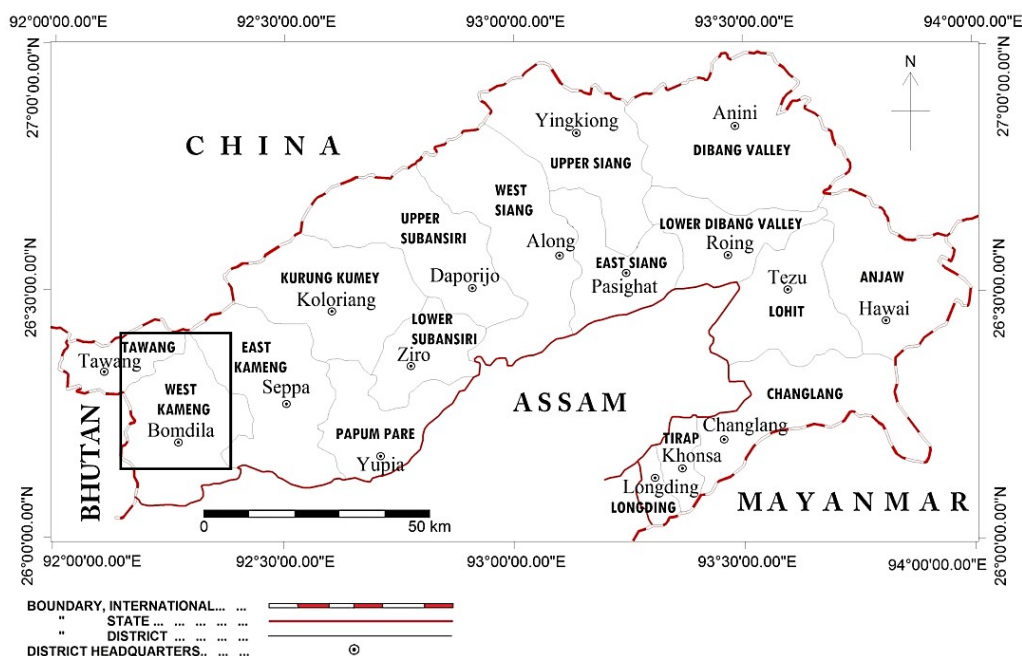
The State of Arunachal Pradesh is a part of the Eastern Himalaya, which is located within IUCN recognized Himalaya Biodiversity Hotspot, rich in ethnobotanical and cultural diversity (Mazhar *et al.* 2007). Arunachal Pradesh is a home to 26 major tribes and 110 subtribes with unique and rich indigenous knowledge system related to utilization of plant resources of their local biocultural landscape for sustenance of livelihood (Srivastava *et al.* 2010). West Kameng and Tawang Districts of Arunachal Pradesh is rich in forest, biodiversity and ethnobotanical heritages which are nurtured by the indigenous communities, namely, *Monpa*, *Bugun*, *Sartang*, *Sherdukpen*, *Aka* and *Miji* in their traditional ethnocultural landscape since time immemorial. The *Monpa* is the largest ethnic group with a population of around 0.8 lakh souls (Anonymous 2011). Perusal of literature have revealed that no such ethnobotanical information are available to date on the target lesser known local communities namely, *Bugun* and *Sartang* tribes of West Kameng District, whereas few literature evidences are available on *Monpa* communities reported by Tag *et al.* (2014) and Tsering *et al.* (2016, 2017). However, these literatures on *Monpa* have suggested that further cross-cultural ethnobotanical studies focused on food, medicinal and other livelihood plants of culturally distinct heterogeneous local communities of the region is essential which would throw more light on

diversity, distribution and economic potential of the important ethnobotanical heritage of the region. Therefore, present study has been conducted with aims to document ethnobotanical heritage and associated traditional knowledge of three culturally and dialectically distinct local communities, namely, *Bugun*, *Sartang* and *Monpa* of West Kameng and Tawang Districts of Arunachal Pradesh, India and to prioritize the economically and commercially viable ethnobotanical resources of the region for ensuring rural livelihood security.

## MATERIALS AND METHODS

### Study area and Local communities

The study sites, Tawang and West Kameng districts of Arunachal Pradesh represents 11.35 % of the total geographical area of the state (83,743 sq km). It is located between geographical coordinates of 26°55' N to 27°52' N latitudes and 91°32' E to 92°55' E longitudes (Figure 1) covering an area of 9,507 sq km with elevations ranging from 200 m in the foothill region, which gradually ascends to about 7,750 m above mean sea level. These two districts are bounded by China (Tibet) in the North and Bhutan in the West, and East Kameng in the Eastern side (Anonymous 2011). The vegetation are tropical semi-evergreen forest (300 – 800 m), sub-tropical broad-leaved forest (800 – 1800), pine forest (1200 – 2400 m), temperate



**Figure 1.** Map of Arunachal Pradesh showing encircled study area in West Kameng and Tawang District of Arunachal Pradesh

broad-leaved forest (1800 – 2800 m), temperate coniferous forest (2800 – 3500 m) and alpine forest above 3500 m (Tag *et al.* 2014). The climate in summer is pleasant and extreme chilling during the winter, and receives rainfall from both Northeast and Southwest Monsoon during May to September. Tawang is mainly inhabited by *Monpa* whereas West Kameng District is inhabited by *Bugun*, *Sartang*, *Monpa*, *Sherdukpen*, *Sajolang*, and *Hrusso*. Among them, the *Monpa* is the largest community in terms of population and area of occupancy, whereas, *Bugun* and *Sartang* are lesser known tribes having very less number

of population (Norbu 2008). The target communities, namely *Bugun (Khowa)* is culturally distinct from rest of their counterpart tribes which has a population of around 3000 souls and they follow indigenous religion which are mainly found in Sinchung Circle of West Kameng District. *Pham kho* is the community festival celebrated every calendar year to worship the nature. *Sartang* is another culturally distinct tribe previously known as *Bhut Monpa* is scattered over Nafra Circle of West Kameng District and their population is around 5000 souls who follow both Buddhism and animistic religious practices. *Monpa* is the major tribal community scattering over Tawang and West Kameng Districts of Arunachal with total population of around 80,000 souls who mostly follow Buddhism and Lamaism. Losar is their major community festival dedicated to worshipping the nature for bountiful harvest (Tsering & Tag 2015).

### Survey Method

The rapid ethnobotanical field survey was conducted in 06 villages of West Kameng and Tawang Districts of Arunachal Pradesh, namely, *Lumla (Monpa tribe)* under Lumla circle of Twang District, *Darbu* and *Salari (Sartang tribe)* under Dirang circle of West Kameng District, *Singchung*, *Ramayan* and *Wanghoo (Bugun tribe)* under Singchung circle of West Kameng District of Arunachal Pradesh during June 2017 to October 2018 following the method suggested by Martin (2008). The traditional uses of ethnobotanical resources were documented using semi-structured questionnaire and a focused group discussion session conducted in 6 selected villages of rural and semi-urban biocultural landscape inhabited by three culturally distinct heterogeneous local communities namely, Bugun, Sartang and Monpa. In all, 30 informants of age between 20 – 80 years were selected for the interview of which 13 were female and 17 male members. Prior Informed Consent (PIC) were obtained from the knowledgeable local informants prior to extensive field work. Translation of local nomenclature of plants and associated traditional knowledge were assisted by local knowledge holders of the three target communities. The ethnobotanical uses, local names, parts used, mode of use, habits, and habitats and altitudinal range of each plant species were recorded in *Field Note Book*. Botanical name of each species were identified by consultation of standard floristic literatures such as *Flora of Assam* (Kanjilal *et al.* 1934 – 1940), *Flora of British India* (Hooker 1875 – 1897), *e-Flora of China*, and e-Herbarium of Kew. The accepted names were verified in the website [www.theplantlist.org](http://www.theplantlist.org) hosted by RBG Kew and Missouri Botanical Garden, St. Louis, USA. The voucher specimens were prepared following the method suggested by Jain & Rao (1977) which were deposited in the Herbarium of Arunachal University (HAU), Department of Botany, Rajiv Gandhi University, Rono Hills, Doimukh, Arunachal Pradesh for future reference.

## RESULT & DISCUSSION

Rapid appraisal has revealed 77 species of ethnobotanical resources belonging to 69 genera and 45 plant families which is presented in Table 1. Among these, herbs represent highest number of 34 (45 %) species which is followed by trees with 20 (36 %) species, shrubs 13 (17 %), climbers 7 (9 %), creepers 2 (3 %) (Figure 2).

### Diverse uses of ethnobotanical species

Of the total 77 species reported, majority of the 49 (48 %) ethnobotanical species are used for ensuring rural food security, while 23 (22 %) species are used as medicinal agents to cure local ailments, 12 (12 %) species are used for ritual and other purposes, 8 (8 %) species are used for rural fencing and construction, 6 (6 %) species are used as spice and condiments, and at least 4 (4%) species are used in handicrafts (Figure 3).

**Table 2.** Ethnobotanical Resources used by the Bugun, Sartang and Monpa Communities of West Kameng and Tawang Regions of Arunachal Pradesh

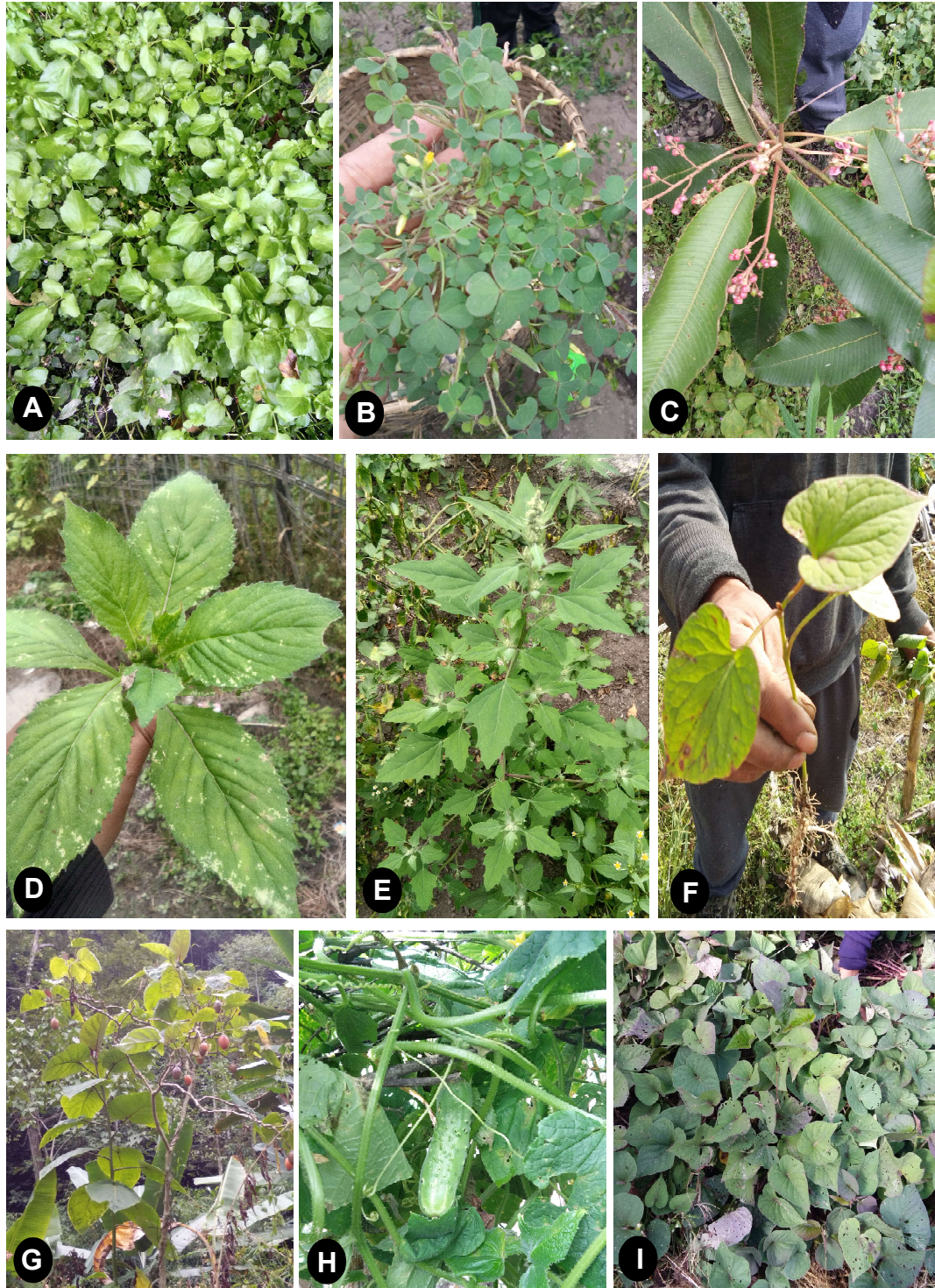
Botanical Name [Family]; Collection No.	Local Name	Habit	Altitude (m)	Part used	Traditional uses	Mode of uses
<i>Acmella oleracea</i> (L.) R.K. Jansen [Asteraceae]; DT/HT/620/2018	Mersang (M)	Herb	100 - 2500	Young stem and leaf	Food security; Medicinal	Young shoots are boiled and eaten. Raw leaf is chewed to cure toothache.
<i>Acorus calamus</i> L. [Acoraceae]; DT/HT/670/2018	Shueta (M) Zingche (S)	Herb	100 - 2500	Rhizome	Medicinal	Paste of rhizome are applied on knee to relieve inflammation. Rhizomes are used against dysentery and also used in rituals.
<i>Allium cepa</i> L. [Amaryllidaceae]; DT/HT/650/2018	Mong (B) Bzap (S)	Herb	100 - 1000	Leaf and Bulb	Food security	Leaves are eaten raw as salad. Bulb are consumed as spice.
<i>Allium hookeri</i> Thwaites [Amaryllidaceae]; SD/HT/703/2017	Tongpsi (B) Tschong (M)	Herb	400 - 3000	Rhizome	Spice, rituals	Leaves and rhizome are crushed and used as salad. Rhizome is boiled and water is used for bathing among the Monk to clean the body before proceeding for ritual ceremony.
<i>Atnus nepalensis</i> D. Don [Betulaceae]; DT/HT/658/2018	Hincha (S)	Tree	600 - 2800	Wood	Timber, firewood	Wood is used as household firewood and local fencing materials.
<i>Alpinia galanga</i> (L.) Willd. [Zingiberaceae]; DT/HT/690/2018	Skeh (B)	Herb	100 - 1800	Fruit	Food security	Ripe fruits are sweet and edible.
<i>Arenga micrantha</i> C.F. Wei [Arecaceae]; DT/HT/740/2018	Nap (B) Nuek (S)	Tree	1500 - 2500	Leaf & Stem	Food security, house construction, handicraft	The leaves are used for construction of roof and wall and fencing. The midrib of the leaves are used as broom. The stems are beaten and ground to flour, roasted, cooked and consumed.
<i>Artemisia nilagirica</i> (C.B. Clarke) Pamp. [Asteraceae]; DT/HT/709/2018	Masiang (B), Nei (S), Hyeman (S)	Herb	100 - 2500	Leaf	Medicinal, insecticidal, rituals	Water of boiled leaves are used for bathing to cure body itching. Use as Antiseptic for freshly cut wound. Also used as air purifier during rituals and is used as an insecticides.
<i>Bambusa tulda</i> Roxb. [Poaceae]; DT/HT/715/2018	Mayui (B) Me-Meyo (S)	Grass (Tree)	100 - 2000	Tender shoot and culm	Food security, handicraft	Stem is used to make traditional hat. Leaves are used in rituals.



Botanical Name [Family]; Collection No.	Local Name	Habit	Altitude (m)	Part used	Traditional uses	Mode of uses
<i>Bitens pilosa</i> L. [Asteraceae] SD/HT/722/2018	Rhobashing (M)	Herb	100 - 2000	Leaf	Food security	Tender shoots are boiled and consumed as vegetable along with rice.
<i>Brugmansia suaveolens</i> (Humb. & Bonpl. ex Willd.) Bercht. & J.Presl [Solanaceae]; DT/HT/743/2018	Zanlin minthu (S)	Shrub	100 - 2500	Whole plant	Fencing	The plant is grown as barricade in the kitchen garden to prevent trespassing of animal.
<i>Calamus rotang</i> L. [Arecaceae]; DT/HT/735/2018	Rai-lyo (B) Chunui (S)	Climber	1000 - 2000	Tender shoot	Food security, medicinal	Young tender shoot are taken to cure stomach pain and for cleaning the stomach. The tender shoots are also consumed as vegetable which enables easy delivery of child used among the Sartang community.
<i>Capsicum annuum</i> L.; [Solanaceae]; SD/HT/602/2017	Chilliau (B)	Herb	100 - 2800	Fruit	Spice, food security	Fruit is used as spice with rice and vegetable.
<i>Capsicum annuum</i> var. <i>glabriusculum</i> (Dunal) Heiser & Pickersgill [Solanaceae]; SD/HT/618/2017	Kiai-chilliau (B)	Herb	100 - 2800	Fruit	Food security	Fruit are consumed as spice along with rice and vegetable.
<i>Castanopsis indica</i> (Roxb. ex Lindl.) A.DC. [Fagaceae]; SD/HT/643/2017	Khe-shing (M)	Tree	800 - 2000	Leaf	Food security, medicinal	The leaves are consumed as a vegetable either in boiled or raw. It is used against cough and cold.
<i>Chenopodium album</i> L. [Amaranthaceae]; SD/HT/620/2017	Kungzo (S) Blamon (M)	Herb	100 - 2500	Young shoot and grains	Food security	Young shoot and grain are used as vegetable and food stuff.
<i>Citrus aurantiifolia</i> (Christm.) Swingle [Rutaceae]; DT/HT/739/2018	Chulukzapa (M)	Shrub	800 - 2000	Fruit	Food security	Fruits are processed into pickle and consumed along with rice.
<i>Citrus sinensis</i> (L.) Osbeck [Rutaceae]; DT/HT/761/2018	Chalik (S)	Tree	800 - 2000	Fruit	Food security	Fruit sweet in taste which is consumed.
<i>Clerodendrum glandulosum</i> Lindl. [Lamiaceae]; SD/HT/627/2018	Khangjela-Shing (M)	Shrub	100 - 1500	Leaf	Food security, medicinal	Young leaves are cooked and consumed as vegetable. Soup are taken to cure hypertension.
<i>Colocasia esculenta</i> (L.) Schott [Araceae]; SD/HT/799/2018	Ngaglin (M) Chowk-pema (B) Chak (S)	Herb	100 - 2500	Fruit	Food security	Corm are cooked and eaten as staple food.

Botanical Name [Family]; Collection No.	Local Name	Habit	Altitude (m)	Part used	Traditional uses	Mode of uses
<i>Cornus capitata</i> Wall. [Cornaceae]; SD/HT/786/2018	Krama (M)	Tree	1500 - 3000	Fruit	Food security	Ripe fruits are sweet and edible in raw after removing the peel.
<i>Crassocephalum crepidioides</i> (Benth.) S.Moore [Asteraceae]; DT/HT/744/2018	Manchala (B)	Herb	100 - 2500	Leaf	Food security	Leaves are cooked and consumed as vegetable.
<i>Cucumis sativus</i> L. [Cucurbitaceae]; DT/HT/749/2018	Bizie (B)	Climber	100 - 2500	Fruit	Food security	Fruit are eaten raw as salad.
<i>Cucurbita maxima</i> Duchesne [Cucurbitaceae]; DT/HT/752/2018	Mirasami (B)	Creeping	100 - 2500	Fruit & leaf	Food security	Leaves and fruits are cooked and consumed as vegetable.
<i>Curcuma longa</i> L. [Zingiberaceae]; DT/HT/733/2018	Zuing (S)	Herb	100 - 2000	Rhizome	Medicinal	Rhizome is consumed to relieve stomach pain or sore throat.
<i>Daphne papyracea</i> Wall. ex G.Don [Thymelaeaceae]; SD/HT/882/2018	Shugu-sheng (M)	Shrub	1800 - 3500	Bark	Fibre & paper	Fibre extracted from bark is processed into paper and used for writing purpose.
<i>Dendrocalamus hamiltonii</i> Nees & Arn. ex Munro [Poaceae]; DT/HT/755/2018	Muai-mu (B) Igzone (S)	Grass (Tree)	500 - 2000	Stem, leaf	Handicraft, rituals	Stem is used for crafting baskets. Leaves are used during rituals and also used as an accessory in traditional hat.
<i>Dioscorea alata</i> L. [Dioscoreaceae]; DT/HT/764/2018	Jiring (B)	Climber	100 - 2000	Tuber	Food security	The tuber is consumed either roasted or boiled.
<i>Diplazium esculentum</i> (Retz.) Sw. [Athyriaceae]; DT/HT/769/2018	Dangsom (S), Pamsam (B)	Herb	100 - 2800	Tender frond	Food security	Tender frond are cooked and consumed as vegetable along with fish.
<i>Diploknema butyracea</i> (Roxb.) H.J. Lam [Sapotaceae]; DT/HT/877/2018	Finsheng (M)	Tree	1000 - 2800	Fruit	Food security	Ripe fruits edible; oil extracted from seeds used for cooking
<i>Elatostema sessile</i> J.R. Forst. & G. Forst [Urticaceae]; SD/HT/730/2018	Chulukpa (M)	Herb	100 - 2000	Leaf	Food security	Young shoot and leaves are cooked and consumed as vegetable.
<i>Erythrina stricta</i> Roxb. [Leguminosae]; DT/HT/756/2018	Charow(S)	Tree	1000 - 2800	Stem	Fencing	Stem is used for fencing of kitchen garden to prevent trespassing of animal.
<i>Fagopyrum esculentum</i> Moench [Polygonaceae]; DT/HT/762/2018	Mamey(B)	Herb	1000 - 2800	Leaf, Seed	Food security	Leaves are cooked and consumed as vegetable. Seeds are crushed into flour, cooked and consumed.
<i>Ficus auriculata</i> Lour. [Moraceae]; DT/HT/841/2018	Choma (M)	Tree	800 - 2500	Inflorescence	Medicinal, rituals	Mature inflorescence are sweet in taste which is consumed to removed fish bone hooked up in throat.





**PLATE - I.** Some ethnobotanical plants of Bugun, Sartang and Monpa biocultural landscape: **A.** *Nasturtium officinale*; **B.** *Oxalis corniculata*; **C.** *Saurauia napaulensis*; **D.** *Crassocephalum crepidioides*; **E.** *Chenopodium album*; **F.** *Houttuynia cordata*; **G.** *Solanum betaceum*; **H.** *Cucumis sativa*; **I.** *Ipomoea batatas*

Botanical Name [Family]; Collection No.	Local Name	Habit	Altitude (m)	Part used	Traditional uses	Mode of uses
<i>Girardinia diversifolia</i> (Link) Friis [Urticaceae]; SD/HT/737/2018	Oguma (M)	Shrub	100 - 2500	Root	Food security	Leaves are cooked and consumed as vegetable.
<i>Glycine max</i> (L.) Merr. [Leguminosae]; DT/HT/772/2018	Mawsung (B), Suk (S)	Herb	400 - 2800	Seed	Food security	Seed are cooked, fermented and consumed as vegetable along with rice
<i>Gonostegia hirta</i> (Blume ex Hassk.) Miq. [Urticaceae]; DT/HT/784/2018	Masaipuk-irap (B) Dankhuchu (S)	Herb	100 - 1800	Young stem, Leaf	Food security	Leaves and young stem are boiled and consumed as a vegetable.
<i>Gynura cusimbua</i> (D.Don) S. Moore [Asteraceae]; DT/HT/773/2018	Munryo-rap (B) Machilow (S)	Herb	1000 - 2500	Leaf	Medicinal, anti-inflammatory	Leaves are heated under fire until warm and is applied at the site of fractured bone and dislocated joint to fastening healing.
<i>Houttuynia cordata</i> Thunb. [Saururaceae]; SD/HT/645/2017	Matring (B) Chumong (S)	Herb	100 - 2500	Whole plant	Food security; medicinal	Whole plant including root, stem and leaves are crushed to paste and consumed as salad along with rice. Juice is useful against dysentery.
<i>Illicium griffithii</i> Hook.f. & Thomson [Schizandraceae]; SD/HT/659/2017	Lisi (M)	Tree	2000 - 3000	Leaf	Spice, medicinal	Dried fruit is used as spice. It is also used against cough and cold.
<i>Ipomoea batatas</i> (L.) Lam. [Convolvulaceae]; DT/HT/785/2018	Alau (B)	Creepers	100 - 2500	Tuber	Food security	Tuber are sweet in taste, consumed after boiled or roasted.
<i>Juglans regia</i> L. [Juglandaceae]; DT/HT/788/2018	Man-gou (B)	Tree	1500 - 3000	Fruit	Food security	Nut of the fruit is eaten. Bark of stem is chewed to treat toothache and gum infection.
<i>Litsea cubeba</i> (Lour.) Pers. [Lauraceae]; SD/HT/688/2017	Nyangshing (M)	Tree	100 - 2000	Fruit, Leaf, wood	Spice, medicinal	Fruits are used as spice. Leaves and wood are burn to purify the air.
<i>Mahonia napaulensis</i> DC. [Berberidaceae]; SD/HT/671/2017	Tsot Sheng (M)	Shrub	1500 - 2800	Bark, Fruit	Dye; food security	Bark is used as dye stuff. Ripe fruit is sweet and edible.
<i>Musa × paradisiaca</i> L. [Musaceae]; DT/HT/789/2018	Musung (S) (Banana)	Herb	100 - 2000	Fruit	Food security, medicinal	Ripe fruit is consumed as source of carbohydrate. Unripe fruits are used against dysentery.
<i>Nasturtium officinale</i> R.Br. [Brassicaceae]; DT/HT/790/2018	Silang-sag (M), Merek Mare (B) Asak doho (S)	Herb	100 - 3000	Young shoot	Food security, fodder	Young shoots are cooked and eaten as vegetable and also used as fodder for livestock such as Pig and Cow.



Botanical Name [Family]; Collection No.	Local Name	Habit	Altitude (m)	Part used	Traditional uses	Mode of uses
<i>Oenanthe javanica</i> (Blume) DC. [Apiaceae]; SD/HT/788/2018	Dhampuk (S) Dhangbing (S) Szhing-hru (M)	Herb	1000 - 2500	Stem, Leaf	Food security	Leaves are consumed in raw as salad or chutney after mixing with salt and chilli.
<i>Opuntia dillenii</i> (Ker Gawl.) Haw. [Cactaceae]; DT/HT/793/2018	Digbazo (S)	Shrub	100 - 3000	Inflorescence	Food security, fencing	Inflorescence parts are fleshy and sweet which are edible. Planted as barricade in kitchen garden to prevent trespassing of animal.
<i>Oryza sativa</i> L. [Poaceae]; DT/HT/796/2018	Chu (S)	Herb	1000 - 2000	Grain	Food security	Grain are eaten as staple food. Consumed with varieties of vegetables.
<i>Oxalis corniculata</i> L. [Oxalidaceae]; DT/HT/796/2018	Nanchirikmu (S) Pulungsukhu (M)	Herb	100 - 2000	Leaf, Root	Food security, medicinal	Leaves and roots as consumed as vegetable after boiled or raw. Leaves are against jaundice.
<i>Paris polyphylla</i> Sm. [Melanthiaceae]; SD/HT/783/2018	Neizong(S)	Herb	1500 - 3000	Rhizome	Medicinal	Rhizome is given to children for blood purification.
<i>Pennisetum glaucum</i> (L.) R.Br. [Poaceae]; DT/HT/795/2018	Chow (B)	Herb	1000 - 3000	Seed	Food security	Seeds are grinded into flour, cooked, fermented and prepared local liquor.
<i>Phaseolus vulgaris</i> L. [Leguminosae]; DT/HT/802/2018	Lape-chiri (B) Mawai-tuk (B)	Climber	100 - 2500	Pod	Food security	Pods are cooked and consumed as vegetable.
<i>Plantago major</i> L. [Plantaginaceae]; DT/HT/810/2018	Tsa Shing (M) Germon (S)	Herb	100 - 2800	Leaf	Food security, medicinal	Leaves are eaten raw as vegetable salad. Leaves paste is used as skin ointment to cure bruises.
<i>Plumbago indica</i> L. [Plumbaginaceae]; DT/HT/804/2018	Jaundice man (S)	Herb	100 - 1500	Leaf	Medicinal	Leaf is used to treat skin diseases.
<i>Polygonum molle</i> D. Don [Polygonaceae]; DT/HT/635/2018	Sa-pheung (B), Chan-fun	Shrub	800 - 2000	Young stem and leaf	Food security	Paste of leaves is consumed with food.
<i>Psidium guajava</i> L. [Myrtaceae]; SD/HT/806/2018	Baghanse (M)	Tree	100 - 1300	Fruit & young leaf	Food security and medicinal	Fruits are sweet and edible. Young leaf is crushed and juice are used against dysentery.
<i>Pyrus pashia</i> Buch.-Ham. ex D.Don [Rosaceae]; SD/HT/883/2018	Kya toh (M)	Tree	1500 - 3000	Fruit	Food security	Fruit are used as major ingredient for preparation of traditional pickle.
<i>Quercus griffithii</i> Hook.f. & Thomson ex Miq. [Fagaceae]; DT/HT/805/2018	HingPong (B)	Tree	1500 - 3000	Wood	Firewood	Wood are dried and use as firewood among the household.
<i>Quercus semecarpifolia</i> Sm. [Fagaceae]; SD/HT/845/2018	Kethcheng (M)	Tree	1500 - 3000	Fruit	Food security	Nuts from acorn are rich in fats which are edible.

Botanical Name [Family]; Collection No.	Local Name	Habit	Altitude (m)	Part used	Traditional uses	Mode of uses
<i>Rhododendron arboreum</i> Sm. [Ericaceae]; SD/HT/866/2018	Samu (M)	Tree	2000 - 3000	Leaf & stem	Rituals	Tender leaves are cooked and consumed. Flowers are eaten raw, and prepare juice (squash) from raw flower which is used as health tonic.
<i>Rhus chinensis</i> Mill. [Anacardiaceae]; DT/HT/807/2018	Mithrek (B) Phsilun (S)	Tree	1000 - 2500	Branch, Seeds	Food security, ritual	The branches are used in rituals. Seeds are crushed into paste and use as chutney. Also used as anti-emetic and helps in cleansing of stomach. The stems are also used as a boundary fencing demarcating the area of two communities.
<i>Ricinus communis</i> L. [Euphorbiaceae]; DT/HT/809/2018	Fopo Lasa (S)	Shrub	100 - 2500	Leaf	Medicinal	Leaves are wrapped over inflamed part of body which relieves pain and inflammation.
<i>Rubia cordifolia</i> L. [Rubiaceae]; DT/HT/811/2018	Niyeo-rap (B) Chou (S)	Climber	1000 - 2800	Root & Leaf	Rituals	Roots are used to make dye (maroon colour). Leaves are used in rituals.
<i>Rubus ellipticus</i> Sm. [Rosaceae]; DT/HT/815/2018	Subohing (S)	Climber	800 - 2500	Fruit and Leaf	Food security; organic manure	Berry are sweet and edible. Leaves are used as raw material sources for production of organic manure in field.
<i>Rubus niveus</i> Thunb. [Rosaceae]; DT/HT/822/2018	Miliang-sai (B) Mulang (S)	Climber	100 - 1500	Fruit	Food security	Fruits are sweet which is eaten raw.
<i>Rubus pedunculosus</i> D. Don [Rosaceae]; DT/HT/819/2018	Bla-mrep (M)	Shrub	1000 - 2800	Fruit	Food security	Ripe fruits are sweet which is eaten raw.
<i>Rumex maritimus</i> L. [Polygonaceae]; DT/HT/828/2018	Dham-champarak (S)	Herb	100 - 3000	Roots, Leaf	Animal fodder	Leaves are used as animal fodder. Root is cut in small pieces and placed in the fishing hook to attract and catch the fishes.
<i>Saurauia napaulensis</i> DC. [Actinidiaceae]; DT/HT/824/2018	Eti-aou (B)	Tree	1000 - 2500	Fruit, leaf	Fodder	Fruits are eaten by human, and leaves are eaten by animals (cows).
<i>Solanum americanum</i> Mill. [Solanaceae]; DT/HT/826/2018	Dhangbu (S)	Herb	100 - 2000	Leaf	Food security, medicinal	Leaves are eaten raw with maize, and also cooked and consumed with staple food. It is also used as medicine for treatment of dysentery.
<i>Solanum betaceum</i> Cav. [Solanaceae]; DT/HT/835/2018	Japam-manthow (B)	Shrub	1500 - 3000	Fruit	Food security	Fruits are used as substitute to tomato and also used as chutney with main course food.
<i>Solanum vilarum</i> Dunal [Solanaceae]; DT/HT/829/2018	Tangchuk (B) Brok-bojo (S)	Herb	100 - 2500	Fruit	Medicinal	Mature fruit is yellow and is burnt to produce smoke which is inhaled under the mouth to clear out worms.

Botanical Name [Family]; Collection No.	Local Name	Habit	Altitude (m)	Part used	Traditional uses	Mode of uses
<i>Thysanolaena latifolia</i> (Roxb. ex Hornem.) Honda [Poaceae]; DT/HT/833/2018	Chanchiri (B)	Shrub	100 - 2400	Inflorescence	Broom	The inflorescence are harvested and dried which is used as broom.
<i>Triticum aestivum</i> L. [Poaceae]; DT/HT/838/2018	Pheuk (B)	Herb	1500 - 2500	Seed	Food security	Flour prepared from corn are consumed after cooked.
<i>Zanthoxylum armatum</i> DC. [Rutaceae]; SD/HT/817/2018	Zabrang (M) Suiji(S)	Tree	1000 - 3000	Fruit	Spice, medicinal	Powdered dry fruits are use as spice along with stable food.
<i>Zea mays</i> L. [Poaceae]; DT/HT/818/2018	Spaw (B) Pchi (S)	Herb	100 - 2800	Corn, Leaf	Food security; fodder	Leaves are used as animal fodder and the corn is consumed in varieties of forms.
<i>Zingiber officinale</i> Roscoe [Zingiberaceae]; DT/HT/842/2018	Mongchu(S) Tatsua(B)	Herb	100 - 2500	Rhizome	Spice, medicinal	Paste of rhizome is used for treatment of blockage in nostril, clear sore throat.

### Harvesting of plant parts

Almost 33 (41 %) of the species reported from Bugun-Sartang-Monpa biocultural landscape are harvested from young shoot and leafy part, 31 (38 %) species are harvested from reproductive parts which include inflorescence, flowers, fruits and seeds, 10 (12 %) species are harvested from stem parts which include wood and bark, whereas only 7 (9 %) species are harvested from underground plant parts which include rhizome, roots, tubers, corm and bulb (Figure 4).

### Ecological status

Majority of 76 (61 %) of ethnobotanical species reported from target biocultural landscape are found growing in subtropical and temperate region with altitude ranging from 1000 – 2500 m AMSL, 40 (32 %) species are adapted to tropical and subtropical region with altitude ranging from 100 – 2500 m from mean sea level whereas only 9 (7 %) of the total species reported are capable of adapting to wide range of climatic zone ranging from both tropical and temperate region with altitude 100 – 3500 m. Of the total 77 species, 55 (71 %) species are harvested from wild sources which include wild food and medicinal plants, rituals, handicrafts and other plants while 22 (29 %) species harvested are from cultivated sources which include staple food plants such as rice, millets, Maize, Beans, Cucumber, Pumpkin, vegetable species (Figure 5).

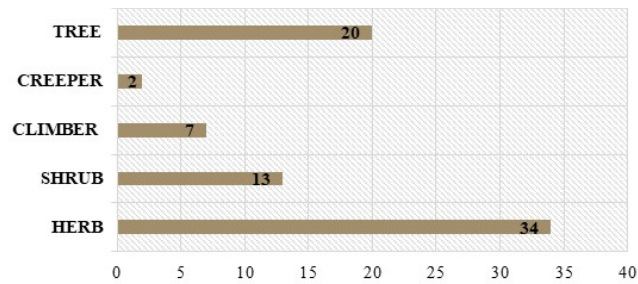
### Diversity of wild food plants

Present investigation has revealed that the *Bugun*, *Sartang* and *Monpa* biocultural landscape of West Kameng and Tawang district uses good number of wild edible plants which are collected from their community conserved forest area. Some of the commercially viable and economically significant wild food plant species found in the region are: *Arenga micrantha*, *Castanopsis indica*, *Clerodendrum glandulosum*, *Diplocknema butyracea*, *Elatostema sessile*, *Gonostegia hirta*, *Houttuynia cordata*, *Juglans regia*, *Quercus semecarpifolia*, *Quercus griffithii*, *Rhododendron arboreum*, and *Zanthoxylum armatum*. Conservation of these wild edible species are usually done in the community forest land and sacred grooves.

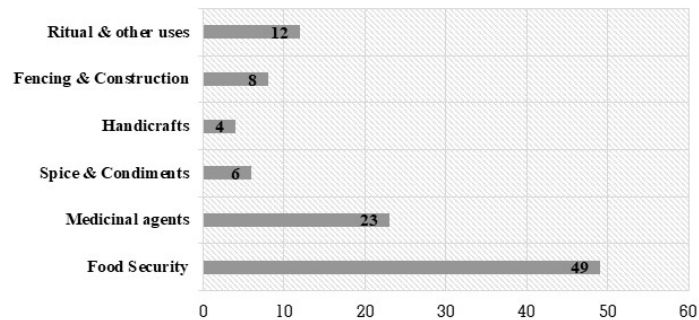
### Cultivated plants of economic and cultural significance

Statistics of ecological status revealed that 22 (29 %) species harvested from cultivated sources are mostly

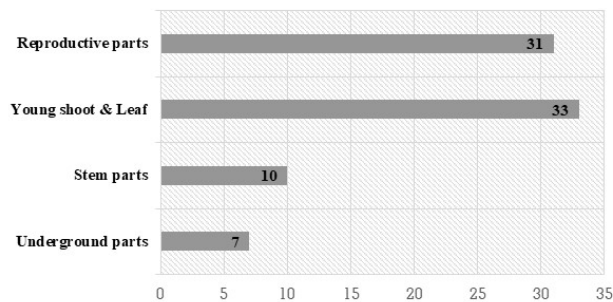




**Figure 2.** Habit status of ethnobotanical plants of Bugun, Sartang and Monpa biocultural landscape



**Figure 3.** Diverse uses of ethnobotanical species of Bugun, Sartang and Monpa biocultural landscape

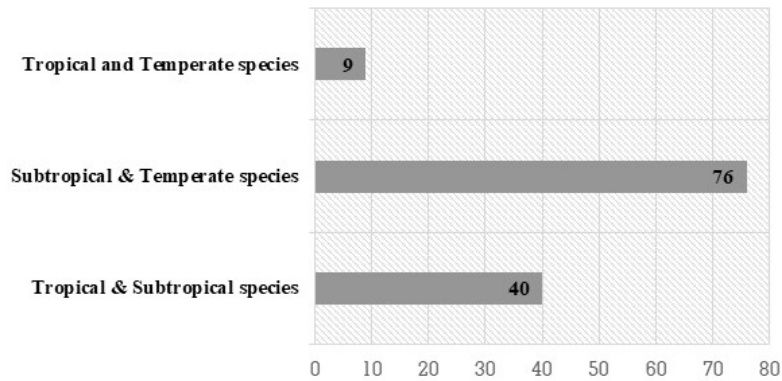


**Figure 4.** Statistics of plant parts harvested from Bugun, Sartang and Monpa biocultural landscape

stable food plants such as *Cucumis sativa*, *Curcubita maxima*, *Chenopodium album*, *Glycine max*, *Oryza sativa*, *Pennisetum macrourum*, *Phaseolus vulgaris*, *Solanum betaceum*, *Zea mays*, and other vegetable species. These staple food and vegetable plants are economically and commercially viable species which has the potential to sustain rural economy and the livelihood. Some of the cultivated plants such as rice and maize have the close cultural linkages with the target local communities (Figure 6).

#### **Plant used in traditional folk medicine, rituals and other purposes**

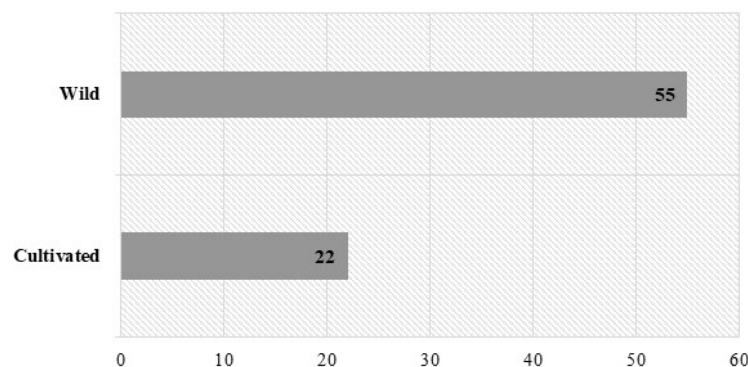
Of the 77 species reported, 23 (22 %) of the species are invariably used in traditional folk medicines. The medicinal plants of economic and commercial interest found in the Bugun, Sartang and Monpa biocultural landscape are: *Acmella oleracea*, *Polygonum molle*, *Acorus calamus*, *Allium hookeri*, *Alpinia galanga*, *Artemisia nilagirica*, *Curcuma longa*,



**Figure 5.** Distribution and altitudinal range of ethnobotanical plants of Bugun, Sartang and Monpa biocultural landscape

*Houttuynia cordata*, *Illicium griffithii*, *Litsea cubeba*, *Paris polyphylla*, *Plumbago indica*, *Rubia cordifolia*, *Ricinus cummunis*, and *Zingiber officinale*. These medicinal plants are easily available in their eco-cultural landscape which are usually nurtured by the community.

Some of the plant species used in rituals, spice and condiments, handicrafts, fencing and construction are: *Allium hookeri*, *Alnus nepalensis*, *Bambusa tulda*, *Brugmansia suaveolens*, *Daphne papyracea*, *Dendrocalmus hamiltonii*, *Ficus auriculata*, *Rhododendron arboreum*, *Rhus chinensis*, and *Rubia cordifolia*.



**Figure 6.** Cultivation status of ethnobotanical plants of Bugun, Sartang and Monpa biocultural landscape

### Species potential to ensure rural livelihood security

The species which are commonly found and frequently used by the local residents having potential to ensure rural livelihood security to the target communities and capable of transforming the rural economy by augmenting trade and commerce activities in the target biocultural landscape are: *Alnus nepalensis*, *Allium hookeri*, *Acorus calamus*, *Bambusa tulda*, *Clerodendrum glandulosum*, *Daphne papyracea*, *Elatostema sessile*, *Ficus auriculata*, *Glycine max*, *Gonostegia hirta*, *Illicium griffithii*, *Ipomoea batatas*, *Juglans regia*, *Litsea cubeba*, *Paris polyphylla*, *Quercus griffithii*, *Quercus semecarpifolia*, *Rhododendron arboreum*, *Rubia cordifolia*, *Zanthoxylum armatum* and *Zea mays*.

## CONCLUSION

It is concluded that the lesser known tribe *Bugun* and *Sartang* have their rich traditional knowledge related to diverse utilization of ethnobotanical resources of their biocultural landscape. The species found in their biocultural landscape are closely related to their local faith and belief system, and livelihood support system of the target communities. The *Monpa* community which are economically much better in the same biocultural landscape also have the strong linkages with plant resources. The food, medicinal and cultural plants used by the three culturally distinct and heterogeneous communities have deep rooted cultural connotations which are directly linked with economy, livelihood, faith and belief system of the communities. Although majority species are harvested from the wild sources but these species are also capable of adapting to wide range of agro-climatic zone ranging from tropical to temperate zones. The most commonly and frequently harvested species have the potential to boost rural economy, trade and commerce in the region. Such potential species should be encouraged for conservation in community forest land, and should be brought under cultivation trial in different agro-climatic regions to enhance productivity and to ensure rural livelihood security of economically marginalised and lesser known communities living in the target biocultural landscape.

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