A FIELD GUIDE TO MEDICINAL PLANTS SURVEY AND MAPPING

METHOD TO IDENTIFICATION



Tshering Wangchuk
Jambay Dorji

COMMEMORATING 50 YEARS OF DEDICATED SERVICE TO TSA-WA-SUM

DEDICATION

"To His Majesty the 4th Druk Gyalpo Jigme Singye Wangchuck for his selfless endeavour to promote and preserve Traditional Medicine and His Majesty the 5th Druk Gyalpo Jigme Khesar Namgyel Wangchuck for his unflagging support and guidance to further strengthen the Traditional Medicine System and His Highness Gyalsey Jigme Namgyel Wangchuck, the repository of all our hopes and dreams."



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Tshering Wangchuk
Jambay Dorji



Department of Traditional Medicine Services
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PUBLISHER
Menzerigpa and Zhibjuk Division
Department of Traditional Medicine Services
Ministry of Health, Thimphu, Bhutan
PO Box: 297
PABX: +9752338834
Fax No. 338837
www.health.gov.bt

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Gentiana ornata, Phajoding. Source: Tshering Wangchuk, DoTMS, MoH

LAYOUT & DESIGN
Tshering Wangchuk, MZD, DoTMS, MoH, Thimphu
Jambay Dorji, MZD, DoTMS, MoH, Thimphu

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tsheringw@health.gov.bt
jdorji22@gmail.com

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THIMPHU BHUTAN
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FOREWORD

The gSowa-Rigpa system of medicine, practised in Bhutan since time immemorial, represents one of the Kingdom's most treasured cultural and medical heritages. Long before the advent of modern medicine, it served as the principal healthcare system for many communities across the country. It has made an uninterrupted and selfless contribution to the prevention of disease, promotion of health, and alleviation of human suffering.

Recognising its immense value and enduring relevance, His Late Majesty the Third Druk Gyalpo, Jigme Dorji Wangchuck, under Royal Command, integrated Traditional Medicine into the National Healthcare System in 28th June 1968. This visionary initiative marked a historic milestone in Bhutan's health sector, laying the foundation for the systematic development, institutionalisation, and expansion of traditional medicine alongside modern healthcare services.

Since then, the Traditional Medicine has made remarkable progress in strengthening service delivery, developing human resources, expanding healthcare infrastructure, improving the quality of medicinal products, and enhancing institutional capacity. Today, Traditional Medicine services are provided through a network of 65 TM Units strategically established across the country, ensuring equitable access to quality healthcare for people in both urban and rural communities.

Over the decades, the utilisation of Traditional Medicine services has steadily increased, reflecting the continued trust and confidence of the Bhutanese people in the efficacy and safety of gSowa-Rigpa. However, this growing demand has also highlighted the pressing need to ensure a sustainable and reliable supply of quality essential traditional medicines.

However, the availability of medicinal raw materials, particularly high-altitude medicinal plants, remains one of the most significant challenges to further expanding services and strengthening pharmaceutical production. Conserving these invaluable natural resources is therefore not only essential for safeguarding Bhutan's rich biodiversity but also fundamental to ensuring the long-term sustainability and resilience of the TM system.

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In recognition of the strategic importance of medicinal resource conservation, His Majesty the Fourth Druk Gyalpo and His Majesty the Fifth Druk Gyalpo have, on numerous occasions, graciously commanded the Department of Traditional Medicine Services to strengthen the conservation, sustainable management, scientific documentation, and promotion of Bhutan's medicinal resources, with particular emphasis on high-altitude medicinal plants.

Guided by these precious Royal Commands, the Department has undertaken a series of Medicinal Resource Conservation and Promotion initiatives aimed at documenting and protecting the nation's medicinal wealth while supporting evidence-based planning, sustainable utilisation, and climate-resilient resource management in collaboration with Mejong Pahramceutical Limited, Ministry of Agriculture and Forest and other relevant stakeholders.

Among these initiatives, the resource mapping of the medicinal plants, initiated during the 12th Five-Year Plan, stands as one of the Department's most significant and strategic undertakings. This comprehensive exercise is expected to generate reliable baseline information on the distribution, diversity, density, and conservation status of medicinal plant across the country. The information generated will serve as a critical foundation for informed policy formulation, sustainable collection practices, habitat conservation, scientific research, cultivation programmes, and the long-term development of Bhutan's Traditional Medicine system.

I am confident that this important initiative will make a significant contribution towards strengthening the sustainable management of Bhutan's medicinal resources while preserving an invaluable component of our national heritage for future generations.

I extend my sincere appreciation to all officials, researchers, field survey teams, collaborating agencies, local communities, and stakeholders whose dedication and commitment will contribute to the successful implementation of this national endeavour.

I convey my best wishes to the Department of Traditional Medicine Services for the successful implementation of the resource mapping initiates and for its continued efforts in conserving, promoting, and sustainably utilising

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Bhutan's medicinal resources in fulfilment of the Royal Vision and in service of the health and well-being of the people of Bhutan.

Finally, I would like to express my appreciation and acknowledgement to Mr. Tshering Wangchuk and Mr. Jambay Dorji for spearheading this important initiative and for their dedication, commitment, and professional expertise in developing this valuable guideline. Their tireless efforts in compiling, reviewing, and developing survey materials and docuemnts are highly commendable. The publication of this guideline is both timely and significant, as it will serve as an indispensable tool for officials engaged in the resource mapping of medicinal plants, ensuring greater consistency, accuracy, and scientific rigour in resource assessment and documentation.

I am confident that this guideline will serve as a valuable reference for field survey teams, researchers, planners, and other stakeholders involved in medicinal resource conservation and management. Beyond supporting the current resource mapping programme, I hope it will continue to guide future initiatives in the sustainable conservation, documentation, and utilisation of Bhutan's medicinal plant resources, thereby contributing to the long-term strengthening of the gSowa-Rigpa system and the preservation of our nation's rich natural and medicinal heritage.



MoH/DoTMS-MZD/GC-10/2018-19/9888 Date: 29th October 2018

PREFACE

The gSowa-Rigpa system of medicine has remained an integral component of Bhutan's healthcare system and cultural heritage for centuries. It continues to provide holistic, safe, and effective healthcare services founded on the principles of prevention, promotion, and restoration of health. In recent years, rapid population ageing, the growing prevalence of chronic and lifestyle-related diseases, and increasing public awareness of the holistic benefits of Traditional Medicine have contributed to a steady rise in the utilisation of Traditional Medicine services throughout the country.

Although Bhutan's healthcare system has evolved with significant advancements in modern medicine, a substantial proportion of the population, particularly those residing in rural and remote communities, continues to rely on Traditional Medicine. The increasing demand for Traditional Medicine services has, however, placed unprecedented pressure on the medicinal resources.

Bhutan's medicinal plants, many of which are collected from fragile alpine and high-altitude ecosystems, constitute an invaluable national asset supporting both healthcare and biodiversity conservation. Unsustainable collection, habitat degradation, climate change, developmental activities, and increasing commercial demand have collectively threatened the long-term availability of these precious resources. Consequently, several medicinal plant species have experienced significant population decline, while others have been categorised as threatened or critically endangered, underscoring the urgent need for scientifically informed conservation and sustainable resource management.

Recognising the strategic importance of safeguarding Bhutan's medicinal resources, and in respect of the precious Royal Commands to conserve the medicinal resources, the Department of Traditional Medicine Services initiated the resource mapping to develop an inventory of Medicinal Resources of Bhutan.

Therefore, to ensure proper, accurate, consistent and standardised data collection, the ‘A Field Guide to Medicinal Plants Survey and Mapping’ has been developed. This guideline is the culmination of more than a year of meticulous planning, extensive literature review, technical consultations, field verification, stakeholder engagement, and pilot implementation.

Beyond supporting the national survey programme, this field guide is expected to serve as a valuable technical reference for medicinal resource managers, researchers, forestry professionals, conservation practitioners, students, and other stakeholders involved in biodiversity conservation and medicinal plant research. Furthermore, it will facilitate the achievement of the broader strategic objectives of the Traditional Medicine Strategy and strengthen the Department's mandate to ensure the sustainable management of quality medicinal raw materials for the production of essential traditional medicines.

More importantly, I trust that it will contribute meaningfully to addressing existing knowledge gaps in plant morphology, survey methods and planning. The guideline will also support the continued growth and sustainability of the gSowa-Rigpa system of medicine while contributing towards the realisation of the noble Royal Vision for environmental conservation, biodiversity protection, and the health and well-being of the people of Bhutan.

Kuenga Tshering
Director General

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1. Introduction

Bhutan is synonymously known as 'sMen Jong Gyalkhap,' the land of Medicinal Plants, owing to its copious medicinal flora and fauna. It is surrounded by verdant pasture and varied broad-leaf forest to the south. Open grassland, marshy river banks, thick undergrowth and rocky hillside to the central and alpine meadows, rocky outcrops and seraphic snowcapped mountains to the north, ranging from an altitude of 97 masl (LP-Drangme Chhu) to 7570 masl (HP-Gangkhar Puensum). This diverse climatic condition contributed to high endemism of Medicinal Resources that enabled the Traditional Medicine System to flourish with the hallmark of quality services and products, ensuring holistic health care approaches.

Since the incorporation of Traditional Medicine into the mainstream of the National Health Care System in 1968, the medicinal plants required for the production of TM products are extensively collected from Lingshi Drungkhag, Langthel and Chokhortoe Gewog, Bumthang Dzongkhag. Due to this persistent collection over the last five decades, most of the MPs have failed to regenerate, driving most of them to extinction. The most noticeable drivers and factors threatening their survival are loss of habitat, land fragmentation, over-exploitation, limited conservation activities, lack of public awareness and monitoring.

Today, with the increasing number of patients seeking quality Traditional Medicine services, the threat of extinction, in particular the HAMP, is still on a constant rise. The assessment of the biological status of the medicinal plants and their morphology through research, survey and mapping has become of paramount importance to ensure the sustainability of these medicinal resources and their biodiversity.

To maintain viable populations of these medicinal resources, the successful and effective implementation of the National Traditional Medicine Strategy 2018-2023 and the development of the Medicinal Resources Conservation and Promotion Strategy are imperative and timely, buttressed by policies and regulations developed on Traditional Medicine and the conservation of Medicinal Resources.

2. Purpose

The purpose of the guideline is to:

2.1. Guide the resource mapping and documenting the morphological characteristics of the medicinal plants.

3. Objective

The objective of conducting the resource mapping is to:

3.1. Assess the distribution, density and diversity of medicinal plants and record their morphological characteristics.

3.2. Study the conservation status of the medicinal plants and their consumption status.

3.3. Develop a database on Medicinal Resources of Bhutan.

4. Forms

Three different FORMS have been developed based on different data collection methods and expected outcomes. All the FORMS are explained and elaborated in the following chapters, along with the illustrations and definitions. Quick reference cards are also included to facilitate data collection and data recording in the field.

FORM-A

It consists of distribution, measurement, location detail, count, cover percentage and nomenclature of each medicinal plants that have to be recorded in the field, either during the systematic random or transect method.

FORM-B

It includes morphology, classification, soil type, vegetation, habitat and location details of each medicinal plant species that have to be recorded from enough and complete specimens collected from every survey plot during the systematic random or transect method, either in the field or upon returning to the base camp.

FORM-C

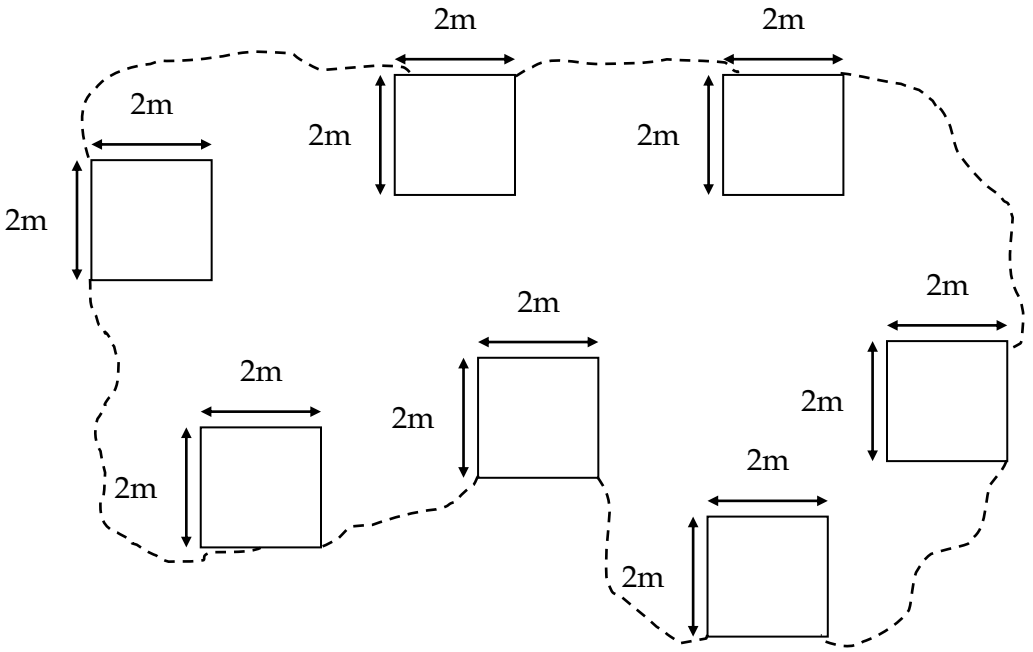
It includes usage, requirement, formulation, collection method, parts used, and collection period to be recorded either by interviewing the relevant stakeholders, firm or any respondent in the field or upon returning to the respective Dzongkhag, where S&M is being carried out.

5. Methods

Survey and mapping are the methods of studying the distribution and availability of vegetation, natural resources and their conservation status in the wild. It is carried out using different methods and equipment depending on the different expected outcomes and the geographical type. The following methods have been adopted, considering the feasibility and economic advantages. Garmin GPS and other relevant equipment will be used.

5.1. Systematic Random Sampling

Systematic random sampling is a method where the location of the quadrat or survey and mapping areas is planned randomly with a defined quadrat size. The details of every medicinal plant species present in each quadrat are recorded along with the distance between the plots to facilitate deducing the total survey and mapping area, as shown below (to ensure maximum inclusion of all the species).



5.2. Transect Method

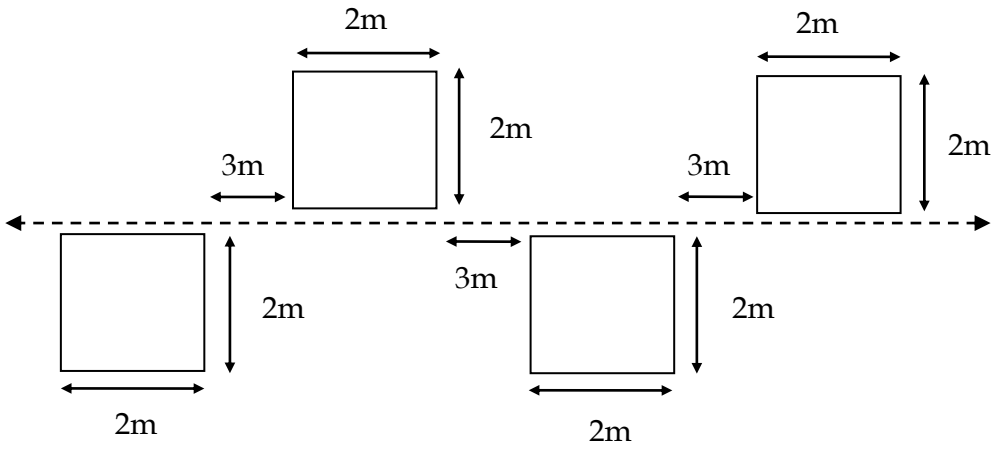
A transect is a sampling strip, tape or line extending across a stand or several stands. It is of two types.

5.2.1. Line Transect

A line transect is the process of analysing a specific area with defined quadrats and a transect line drawn with the help of a measuring tape or a rope laid across the survey area, as shown below.

Process

- Each quadrat is placed on a straight line at a specific interval from the previous quadrat in an alternate order with a defined distance (depending on the vegetation type and geographic description).
- Every survey and mapping quadrat is planned at every change of 100- 200 m in every altitude and 1-2 km distance on a horizontal plane (depending on the vegetation type and geographic description)
- The MP present within the quadrat is measured and recorded in designated forms.
- The analysis and calculations are done as per the procedure given under the quadrat method.
- Transects are drawn at a distance of 50- 100 m from the footpath.

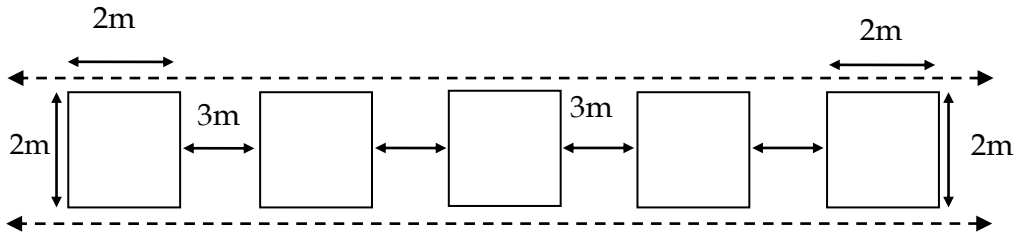


5.2.2. Belt Transect

A belt transect is the process in which two parallel lines are laid across the forest area, as shown below.

Process

- Each quadrat is placed at a specific interval from the previous quadrat in a straight line with a defined distance (depending on the vegetation type and geographic description).
- Every survey and mapping quadrat is planned at every change of 100- 200 m in every altitude and 1-2 km distance on a horizontal plane (depending on the vegetation type and geographic description).
- The MP present within the quadrat is measured and recorded in designated forms.
- The analysis and calculations are done as per the procedure given under the quadrat method.
- Transects are drawn at a distance of 50- 100 m from the footpath.



6. Quadrat

Quadrats are squares of varying size laid out to make observations. It is used to estimate abundance, density, frequency and distribution of each MP. The quadrat technique is a rapid method for recording the number and cover percentage of different species.

Quadrat frames are constructed from plastic PVC or any other materials (2m*2m, 4m*4m, 10m*10m, 16m*16m) depending on different methods. It is placed directly on top of the vegetation at specific intervals.

The quadrat method is carried out where the forest coverage is so extensive that the survey cannot cover all the area. For this, a survey is carried out in a small area (quadrat) uniformly by using both systematic random and transect methods.

During the transect method, quadrats are distributed over the planned area by plotting equal distances between each quadrat. During the systematic random method, quadrats are placed randomly without a defined distance between the quadrats.

The results then facilitate defining the condition of the forest, conservation status, MP distributions, total area of forest surveyed, etc. The number of quadrats and their sizes are important to get proper area coverage.

There are two methods for determining the number and size of the quadrat, as shown below:

a. 1x1m for grasses
b. 2x2m for herbaceous
c. 5x5 m for shrubs
d. 10x10m for trees

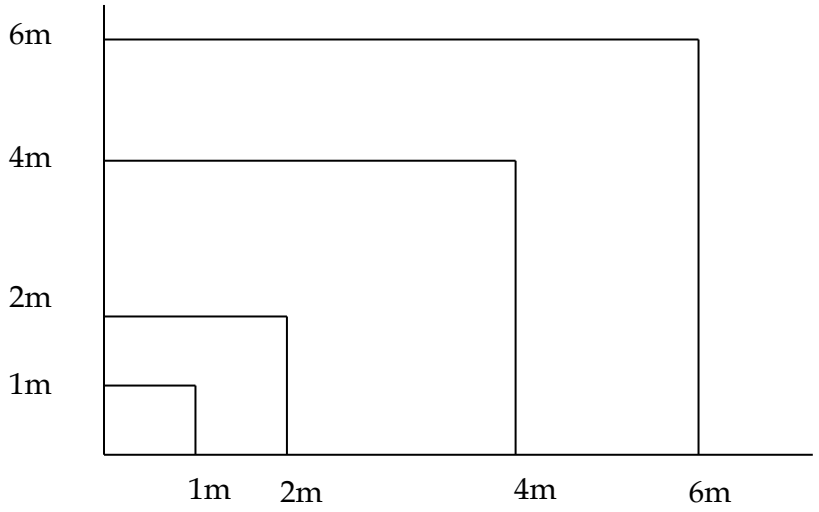
Singhal's method, 1996

a. 16x16 m for trees (>2m height)
b. 5x5 m for shrubs (1-2 m height)
c. 2x2m for ground flora (< 1m height)

(The number of the quadrat and its size will depend on the decision of the sample size to be surveyed.)

6.1. Size of the Quadrat

To determine the quadrat size for survey and mapping, a quadrat size of 1x1m is laid out and the number of species present is recorded. The quadrat size is then increased to 2x2m, and the number of species present is recorded again. The quadrat size is further increased to 4x4m and 6x6m, where the number of species present is recorded as before.
The number of species obtained per quadrat is analysed and plotted against the size of the quadrat as follows.



Result - The no. of species recorded in a 2x2m quadrat shows the same distribution as that of 4x4m and 6x6m. The species recorded in a 1x1 m quadrat is less than 2x2m, which indicates the optimum size for the quadrat should be 2x2m.

6.2. Number of Quadrats

6.2.1. The number of quadrats will determine the accuracy of the survey and mapping, which depends on the resource availability and the intensity of sampling.

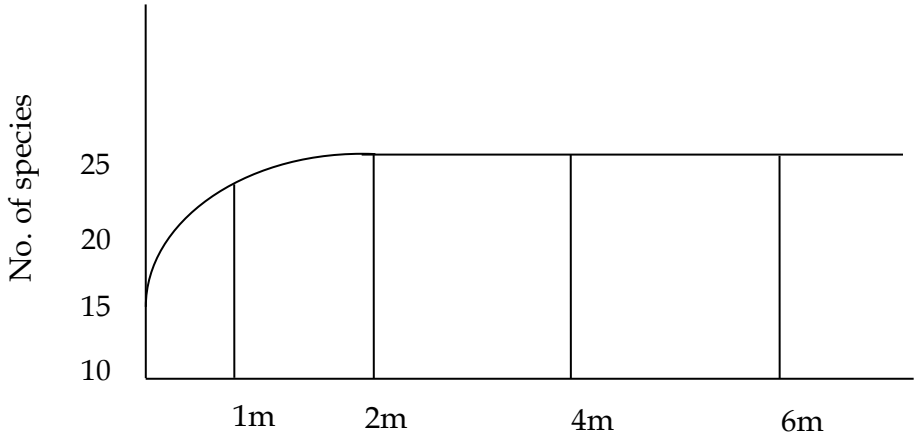
6.2.2. The higher the intensity, the higher the survey and mapping accuracy.

6.2.3. In general, the intensity is restricted to 10-15% of the total area for the survey.

6.2.4. The number can be determined by laying out 30-50 quadrats, and the species occurring in each quadrat are noted.

6.2.5. The data are plotted with the number of quadrats on the x-axis and the number of species on the y-axis.

6.2.6. The point at which the curve flattens indicates the minimum number of quadrats needed to undertake the survey adequately.



Species-area curve

Result - The no. of species recorded in a quadrat size of 2x2m shows the same distribution as that of quadrat sizes 4x4m and 6x6m. The species recorded in the 1x1 m quadrat show fewer than those of the 2x2 m quadrat, which means the optimum quadrat number should be calculated from the survey and mapping area.

Example:

- If the intensity of survey and mapping is to be done in an area of 10 hectares, the area coverage for the survey and mapping should be 12% of the 1 hectare, where the recommended quadrat size is 4x4m.

- The number of quadrats will then be:
  - 12% of 1hectare = (12/100) x 10000 = 1200 m^2
    Therefore to cover 1200m^2 by 4x4m quadrat = 1200/4x4 = 75 quadrats.
  - For 10 hectares. = 75 × 10 = 750 quadrats.

6.3. Diversity and Density of the Forest

6.3.1. Once the number and size of quadrats are fixed, the quadrats are randomly distributed in the forest.

FORM-A

1. Location Detail

The demographic details of each MP species, along with an accurate GPS coordinate and elevation defined on page no. 32 should be recorded as displayed on the Garmin GPS. Slope, aspect and gradient are defined on page no. 32 should also be mentioned clearly after proper assessment or using relevant tools and equipment.

Different types of forests and habitat mentioned below and further elaborated on page no. 33-38 should be recorded after careful observation. Other forest types and habitat those are not mentioned should be specified in the other (specify) column.

Dzongkhag	
Drungkhag	
Gewog	
Village/Chiwog	
GPS Coordinate	
Elevation	
Slope Aspect	
Slope Gradient	
Forest Type	
Habitat	
Date (dd/mm/yyyy)	
Other (specify)	

Forest Type: A-Fir forest, B-Mixed Conifer forest, C-Blue Alpine forest D-Chir-pine forest E-Broad-leaved conifer forest F-Broad-leaved hardwood forest G-Evergreen oak forests H-Cool broad-leaved forests I-Forest Scrub

Habitat: A-Scree B-Meadow C-Grasslands D-Woodland E-Wetland F-Shrubland

2. Plot

The measurement, count, cover percentage and nomenclature of different medicinal plants present in every quadrat or plot are defined on page no. 12-15 and 22, respectively, should be recorded. The distribution codes A, B or C should be recorded for Sporadic, Patchy and Uniform, respectively.

PLOT Number:						
TRANSECT POSITION (M):						
Sl. #	**NAMING**		**DISTRIBUTION**	**HEIGHT (mm/cm/m)**	**COUNT**	**COVER %**
	Sorig	**Botanical**				
Distribution: A- Sporadic B- Patchy C–Uniform						

3. Enumerators Detail

The details of the enumerator must be specified as follows.

Collection Date (dd/mm/yyyy)	
Name and Designation	
Mobile no.	
Work Station	
Other Remarks	

4. Plot Number

A square frame drawn to isolate a standard unit of area to study the distribution of a specimen over a large area or plot is defined as a quadrat or plot number. A proper sequential or serial number should be assigned to each quadrat and plot identified for the specific area.

5. Transect Position

Transect position is the total distance of each quadrat measured from the previous quadrat. It must be measured accurately and should be recorded in meters.

6. Distribution

Distribution, also known as the pattern of dispersion, is the frequency of each medicinal plant present in each quadrat. It should be recorded as (A-Sporadic, B-Patchy, C-Uniform) after proper assessment and observation, as elaborated below.

6.1. Sporadic

Medicinal Plant distributed at irregular intervals or occurring occasionally and is scattered or isolated everywhere.

6.2. Patchy

Medicinal plant distributed in small, isolated areas or occurs in small numbers and inconsistently.

6.3. Uniform

Medicinal plant distributed in uniform intervals or consistently and constantly.

7. Height

The height of each plant should be measured from the bottom of the plant (ground level) to the extreme top. It should be recorded in mm, cm or m

8. Count

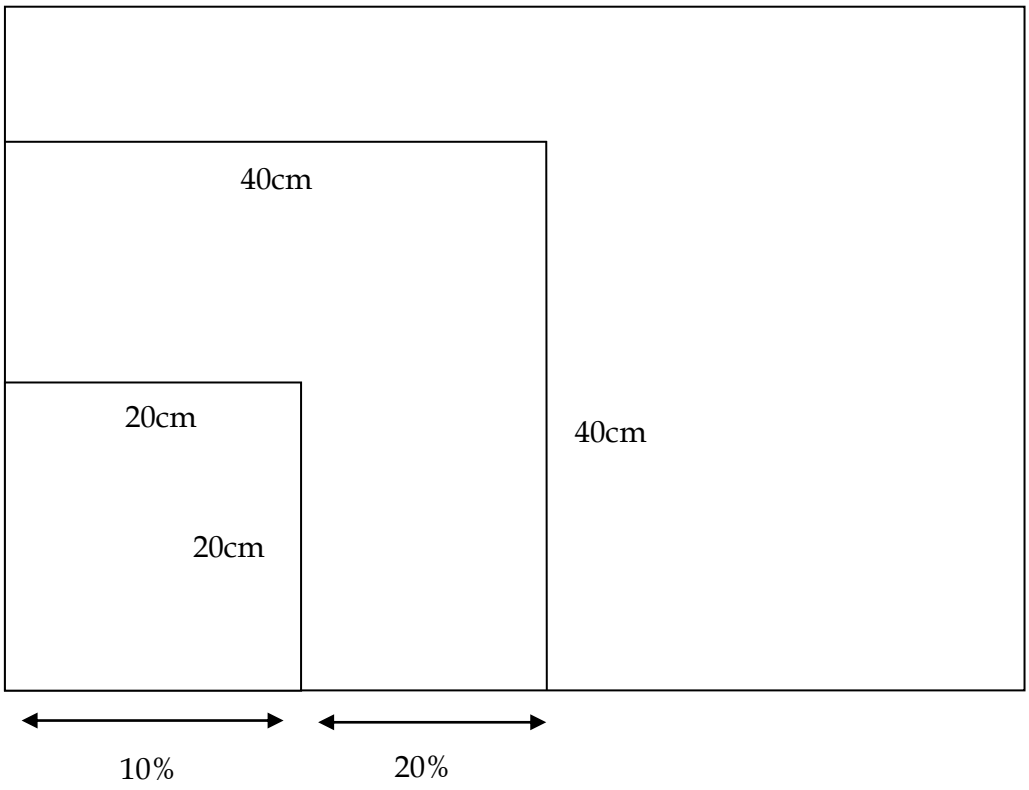
The total number of medicinal plants present in every plot or quadrat is defined as the total count. They should be enumerated accurately and must be recorded clearly in the designated column.

9. Cover Percentage

The cover percentage is the ground area obscured by the MP biomass when viewed from the top (as per Tom Jurik and Arnold Van Dar Valk). Any of the following methods must be followed.

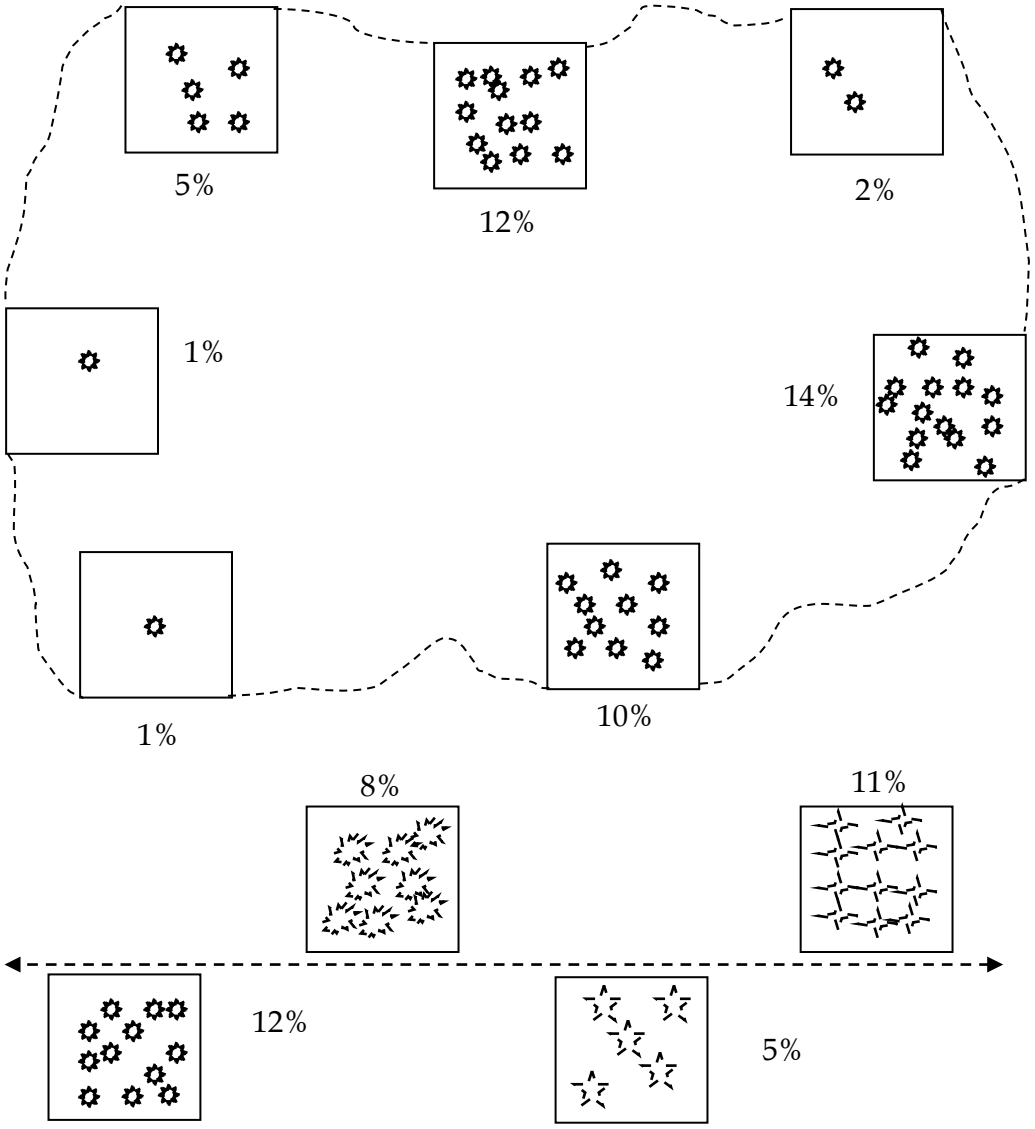
9.1. Visual Consolidation

It is the process where the specimens are visually consolidated into a grid of 20x20cm of the quadrat size 2x2m, and the cover percentage is then calculated as 10%, 20% during the grid size of 40x40cm and 30%during the grid size of 60x60cm, as shown below.



9.2. Cumulative Sampling

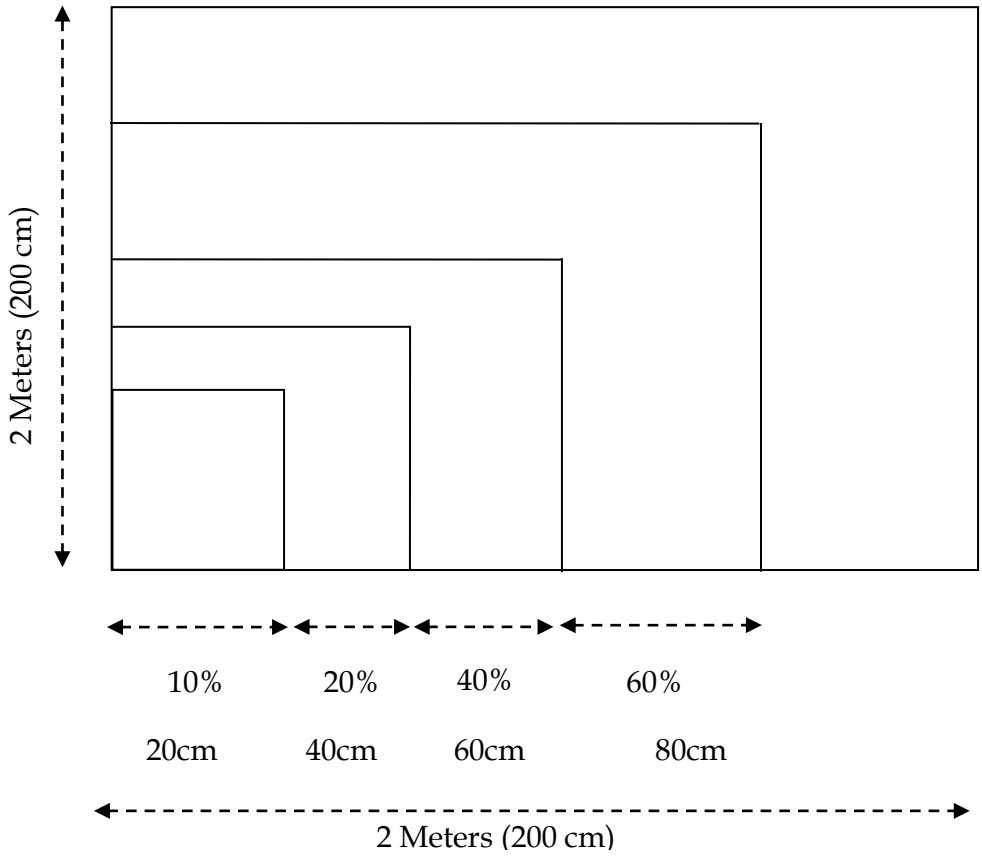
Cumulative sampling is the process in which the medicinal plants present within the quadrat are sampled sequentially. The cover percentage is then deduced from the number of counts, i.e. if the total no. of medicinal plants present within the defined quadrat is 60, then the cover percentage is considered 60%; if the count is 30, then the cover percentage is considered 30%.



9.3. Visual Imaging

The process, where the percentage of the medicinal plants distribution is deduced through visual assessment of the specific measurement developed in a defined quadrat size, as indicated below.

The cover percentage is recorded as 10% with an increase of every 20 cm during the quadrat size of 2x2m, 40 cm during the quadrat size of 4x4m and 60 cm during the quadrat size of 6x6m.



FORM-B

1. Naming

Assigning an appropriate name to the MP is crucial. It is a key step for accurate identification and classification. It should be either guided by proper identification knowledge or by referring to different guidelines and relevant sources. The naming should not be limited only to *gSoba-Rigpa* and Botanical names, but different synonyms and local terms used by different regions and ethnic groups should also be mentioned.

Sorig	
Botanical	
Local/Common	
Synonym	

2. Classification

Classification is of paramount importance to ensure proper grouping and categorisation into specific genera and species. Each MP should be assigned to the proper Family, Genus and Species, referring to the proper guidelines and references. Monocot and Dicot categorisation defined on page no. 31 should also be recorded to assist further classification.

Note: The classification of the plants can be done either in the field, if the enumerator is well informed about the medicinal plants classification system or can be recorded later using relevant sources upon returning to the base camp or office.

Family	
Genus	
Species	
Monocot	
Dicot	

3. Location Detail

Demographic information of each medicinal plant should include Dzongkhag, Drungkhag, Gewog, Chiwog and Village. An accurate GPS coordinate and elevation for each medicinal plants defined on page no.

32 should be recorded as displayed on the Garmin GPS. Slope aspect and slope gradient are defined on page no. 32 should also be mentioned clearly after proper assessment and observation.

Dzongkhag	
Drungkhag	
Gewog	
Chiwog/Village	
GPS Coordinate	
Elevation (masl)	
Slope Aspect	
Slope Gradient	

4. Vegetation Description

Each medicinal plant acclimates to different vegetation and forest types, as defined on page no. 33-36. The precise vegetation type should be recorded (tick) after careful observation. The dominant species of the area should also be recorded after proper assessment and observation.
Other forest types that are not mentioned should be specified in the other (specify) column with a proper definition.

Forest type	
Dominant species	
Others (specify)	

5. Habitat

Each medicinal plant has specific characteristics that pair well with different habitats. Different types of habitats are defined on page no. 37-38 should be recorded (tick) after proper assessment.
Other habitats that are not mentioned should be specified in the " others (specify) column.

Scree	Meadow	Grassland	Woodland	Wet land
Shrub	Other (specify)			

6. Flower Description

Flowers are the reproductive organs of any angiosperm plant. Every species has different shapes described on page no. 39-45. Any of the given shapes should be recorded (tick) after careful observation and assessment. Other shapes that are not mentioned should be specified in the " others (specify) column.

6.1. Shapes		
Campanulate	Cruciform	Head
Paailionaceous	Funnel form	Spurred
Stellate	Trumpet	Tubular
Libiate	Urceolate	Coronate
Rotate	Salver form	Caryophyllaceous
Rosaceous	Personate	Ligulate
Others (specify)		

Flowers of any medicinal plants constitute petals, anthers, ovary, sepals, filaments, and stigma, designated with specific functions defined on page no. 46-48. Each flower present in medicinal plants should be dissected to record all the details after careful measurement and assessment.
Other types of flower those are not mentioned should be specified in the " Others (specify) column.

Note: As some of the medicinal plants has allergy causing agent and poisonous flowers, enumerators are asked to be cautious while assessing.

6.2. Characteristics							
Classification	Sepal	Petal	Anther	Filament	Ovary	Style	Stigma
Yes/No							
Color							
Measurement							
Count							
Others (specify)							
Unit of Measurement = (mm/cm)							

7. Leaf Description

Leaves are appendages of a stem characterised by various shapes, phyllotaxy, surface features, apex, margin, vein and textures that are covered by a dense network of xylem and phloem. They are generally located on the upper side of the ground to absorb light energy. Each medicinal plant has different types of leaf formation, as defined on page no. 49-52. An appropriate type should be recorded (tick) after careful assessment and observation.

Other types of leaf that are not mentioned should be specified in the " others (specify) column.

7.1. Type		
Simple	Ternately Compound	Palmately or Digitately Compound
Pinnately Compound	Bipinnately Compound	Tripinnately Compound
Others (specify)		

Depending on the adaptation and habitat, different medicinal plants have different leaf arrangement (phyllotaxy), as defined on page no. 52-59. After proper observation, any of the below-mentioned arrangements should be recorded (tick).

Other arrangements that are not mentioned should be specified in the others (specify) column.

7.2. Arrangement			
Alternate	Alternative Decussate	Opposite Decussate	Bipinnate
Even Pinnate	Fascicled	Odd Pinnate	Perfoliate
Opposite	Rosette	Tripinnate	Peltate
Unifoliate	Trifoliate/Ternate	Whorled	
Others (specify)			

Depending on the geographical location and habitat, different MPs have different shapes of a leaf defined on page no. 59-68. An appropriate shape should be recorded (tick) after careful assessment. Other shapes those are not mentioned should be specified in others (specify) column.

7.3. Shapes				
Acicular	Cordate	Deltoid	Elliptic	Ensiform
Lanceolate	Linear	Lyrate	Obcordate	Oblong
Obovate	Orbicular	Palmate	Pectinate	Pinnatifid
Reniform	Renucinate	Spatulate	Others (specify)	

Each medicinal plant has a different leaf surface feature defined on page no. 69-71. Each leaf should be observed properly to record all the details of its features.
Other surface features that are not mentioned should be specified in the others (specify) column.

7.4. Surface Features			
Glabrous	Glarbrate (Glabrescent)	Glaucous	Glaucescent
Resinous	Pubescent	Puberulent	Tomentose
Others (specify)			

Most of the medicinal plants have distinctive leaf apex formation, as defined on page no. 72-78. Different types of apex mentioned should be recorded (tick) after careful assessment.
Other types of apex that are not mentioned should be specified in the others (specify) column.

7.5. Apex			
Acuminate	Acute	Apiculate	Aristate
Emarginate	Mucronate	Obtuse	Retuse
Rounded	Tridentate	Truncate	
Others (specify)			

Any of the leaf margins defined on page no. 78-84 should be selected and recorded (tick) after proper observation and comparison. Other margins that are not mentioned should be specified in the others (specify) column.

7.6. Margin			
Ciliate	Crenate	Dentate	Denticulate
Entire	Lobate	Serrate	Sinuate
Serrulate	Spiny	Doubly Serrate	Undulate
Others (specify)			

Any of the veins or blade systems of the medicinal plants defined on page no. 85-89 should be selected and recorded (tick) after proper assessment and comparison.
Other leaf blades or veins that are not mentioned should be specified in the others (specify) column.

7.7. Venation (tick)		
Arcuate	Cross-venulate	Dichotomous
Longitudinal	Palmate	Parallel
Pinnate	Reticulate	Rotate
Others (specify)		

A different medicinal plant has a different leaf attachment system, as defined on page no. 89-90. An appropriate attachment system should be recorded (tick) after careful assessment and observation.
Other petiole (leaf) attachments to the stem that are not mentioned should be specified in the others (specify) column.

7.8. Leaf Attachment to the Stem		
Petiolate	Sessile	Clasping
Others (specify)		

Every medicinal plant has different types of leaf bases and attachment systems, as defined on page no. 91-97. After proper observation, record (tick) an appropriate attachment type as tabulated below.
Other leaf bases and attachment systems that are not mentioned should be specified in the " others (specify) column.

7.9. Leaf Base			
Attenuate	Auriculate	Connate Perfoliate	Cordate
Cuneate	Decurrent	Hastate	Oblique
Obtuse	Peltate	Perfoliate	Sagittate
Sheathing	Truncate	Others (specify)	

8. Stem Description

The stem of any vascular plant is one of the main structural axes, often specialised for storage, asexual reproduction, protection and transportation of food and water. It is divided into nodes and internodes.
Various inflorescence type defined on page no. 97-100 should be recorded (tick) after careful observation. Their characteristics are also defined on page no. 108-109.
Other stem or inflorescence types that are not mentioned should be specified in the others (specify) column.

8.1. Inflorescence Type		
Spike	Receme	Panicle
Corymb	Umbel	Helicoid Cyme
Head	Others (specify)	

Different stem systems found above and below the ground are defined on page no. 101-104 and 105-106, respectively, should be recorded after careful assessment and observation.
Other stem systems that are not mentioned should be specified in the others (specify) column.

8.2. Above-Ground Stem System			
Ascendent	Decumbent	Erect and Caulescent	Erect and Acaulescent (Scapose)
Procumbent	Repent	Stolon	Thorn
Others (specify)			

8.3. Underground Stem System			
Bulb	Corm	Rhizome	Tuber
Others (specify)			

Each medicinal plant has a different stem surface texture. Each stem should be observed and assessed properly to record all the details.
Other stem surface textures that are not mentioned should be specified in the others (specify) column.
Note: The definitions of the stem surface features are similar to those of leaf surface features defined on page no. 69-71.

8.4. Stem Surface Features			
Glabrous	Glarbrate (Glabrescent)	Glaucous	Glaucescent
Resinous	Pubescent	Puberulent	Tomentose
Others (specify)			

An accurate height of the plant measured from the apex of the stem to the area above the ground should be mentioned in mm, cm or meters.

8.5. Measurements	
Height of the plant	
Unit of Measurement = (mm/cm/m)	

9. Seed Description

Seeds are the unit of reproduction of any phanerogamic plant, consisting of epicotyl, hypocotyl, cotyledon and radicle, as defined on page no. 109. Each part should be measured and assessed properly to record the colour, measurement and presence of the aforementioned features.

Other characteristics of the seed that are not mentioned should be specified in the others (specify) column.

Note: As some of the medicinal plants has allergy causing agent and poisonous seeds, enumerators are asked to be cautious while taking measurements and assessing.

9.1. Characteristics				
Classification	Epicotyl	Hypocotyl	Cotyledon	Radicle
Yes/No				
Color				
Measurement				
Others (specify)				
Unit of Measurement = (mm/cm)				

10. Fruits Description

Fruits are seed-bearing structures of flowering plants that are developed from an ovary with different characteristics defined on page no. 109-110. Accurate data on the colour, measurement and presence of Endocarp, exocarp, and Mesocarp should be recorded after proper assessment and measurement.

Other fruit types that are not mentioned should be specified in others (specify) column.
Note: As some of the medicinal plants has allergy causing agent and poisonous fruits, enumerators are asked to be cautious while assessing.

10.1. Characteristics			
Classification	Endocarp	Exocarp	Mesocarp
Yes/No			
Color			
Measurements			
Others (specify)			
Unit of Measurement = (mm/cm)			

11. Roots Description

Each plant has a different root formation and structure that provides support and nutrients required for better growth and adaptation. After proper observation and assessment, an appropriate root type is defined on page no. 111-115 should be recorded (tick).
Other types that are not mentioned should be specified in the others (specify) column.

11.1. Type		
Fleshy Roots	Tuberous Roots	Contractile Roots
Haustoria	Buttress Roots	Prop Roots
Aerial Roots	Pneumatophores	
Others (specify)		

Different parts of the roots are defined on page no. 110-114. After proper observation and assessment, the colour, height, length, breadth, circumference and taste of the primary, lateral and root hairs of the medicinal plants should be measured and recorded.
Other root descriptions that are not mentioned should be specified in the others (specify) column.

Note: As some of the medicinal plants have poisonous roots and tubers, enumerators are asked to be cautious while assessing.

11.2. Characteristics			
Classification	Primary	Lateral	Root Hairs
Yes/No			
Color			
Measurement			
Others (specify)			
Unit of Measurement = (mm/cm)			

12. Soil Description

Each medicinal plant requires different types of soil depending on its physical and internal structure for better growth and adaptation. Disparate soil types are defined on page no. 115-118 should be recorded (tick) after careful examination of the immediate area.
Other soil types that are not mentioned should be specified in the others (specify) column.

12.1. Type			
Loamy	Sandy Loam	Sandy Clay Loam	Clay Loam
Clay	Silty Clay	Sandy Clay	Sandy
Silty	Peaty	Chalky	
Others (specify)			

Hardness and pH of the immediate soil are defined on page no. 118 should be tested using analog soil hardness meter, a digital soil compaction test meter and a soil pH meter, respectively. The details should be recorded as follows.

12.2. Characteristics	
Soil pH	
Soil Hardness	

13. Life Span

Each part of the plant has a different life span depending on the season, biological characteristics, and natural forces. Most of the flower

completes its cycle within 2-3 months, leaves within 3-4 months and stems within 4-6 months. An appropriate life span is defined on page no. 119-121 should be recorded (tick) after adequate data and careful assessment.

Other life span types that are not mentioned should be specified in the others (specify) column.

13.1. Flower			
Herbaceous	Annual	Biennial	Perennial
Woody	Evergreen	Deciduous	
Others (specify)			
13.2. Leaf			
Herbaceous	Annual	Biennial	Perennial
Woody	Evergreen	Deciduous	
Others (specify)			
13.3. Stem			
Herbaceous	Annual	Biennial	Perennial
Woody	Evergreen	Deciduous	
Others (specify)			

14. Part Used

Different parts of the medicinal plants are defined on page no. 121-123 are used to formulate different Traditional Medicine products. An appropriate part used should be recorded (tick).

Other parts used that are not mentioned should be specified in the others (specify) column.

Flower	Bulb	Stem	Inner Bark
Outer Bark	Tuber	Rhizomes	Leaves
Seeds	Fruits	Resin	Whole Plants
Aerial part	Others (Specify)		

15. Propagation Method

Each medicinal plant is propagated using different methods depending on its biological structure. An appropriate method is defined on page no. 123-124 should be recorded (tick) after proper authentication.

Other methods that are not mentioned should be specified in the others (specify) column.

15.1. Sexual		
Seed	Wilding	
15.2. Asexual		
Cutting (Stem, Root and Leaf)	Division	Layering
Tissue Culture	Budding	Grafting
Others (specify)		

16. Conservation status

The conservation status defined on pages 124-126 is an indicator of how likely the MP will remain alive at present or in the near future. The IUCN Red List of Threatened Species is a worldwide conservation status listing and ranking system. It divides species into ten categories as mentioned below. It should be recorded after proper data analysis, referring to relevant guidelines, books, references and publications.

Extinct	Extinct in the Wild	Critically Endangered
Endangered	Vulnerable	Near-Threatened
Conservation Dependent	Least-Concern	Data Deficient
Not Evaluated	Others (specify)	

17. Enumerator Detail

The details of the enumerator must be mentioned as follows, for future reference and consultation.

Collection Date (dd/mm/yyyy)	
Name and Designation	
Mobile no.	
Work Station	
Other Remarks	

FORM-C

1. Respondent Detail

The details of the respondent should be recorded as follows (if the data has to be collected from the community or a specific stakeholder)

Name	
Age	
Occupation	
Gender	
Village	
Gewog	
Dzongkhag	
Contact/Mobile No.	

2. Naming

Refer to page no. 15 - Naming.

Sorig	
Botanical	
Local/Common	
Synonym	

3. Part Used and Collection Period.

Different parts of the medicinal plants, like flower, leaf, root, and tuber, are collected and harvested during a specific period (month) depending on the needs of each part and its maturity.

Any of the parts defined on page no. 121-123 should be recorded and mentioned in a specific collection period/month.

Collection Period	J	F	M	A	M	J	J	A	S	O	N	D
Aerial Parts												
Whole Plant												
Underground Parts												
Other (specify)												
A-Bulb B-Stem C-Bark (outer/inner) D-Tuber E-Rhizomes F-Leaves G-Seeds H-Fruits I-Flower J-Resin												

4. Collection Methods

Medicinal Plants are collected using different collection or harvesting methods depending on their morphology. A different method should be specified after proper assessment and interrogation.

5. Propagation and Cultivation Methods

Each medicinal plant is cultivated using different propagation methods defined on pages 123-124. After proper assessment and interrogation, the different propagation methods adopted should be mentioned.

Other propagation methods that are not mentioned should be specified in the other (specify) column.

5.1. Sexual		
Seed	Wilding	
5.2. Asexual		
Cutting (Stem, Root and Leaf)	Division	Layering
Tissue Culture	Budding	Grafting
Others (specify)		

6. Health Benefit

The usage and health benefits of each medicinal plant used for specific treatment or ailments should be mentioned.

Disease/Ailment	

7. Value (Nu. Per Kg)

The value of each medicinal plant should be mentioned in Nu. Per kg when they are marketed in wet and dry form.

Wet	
Dry	

8. Annual Requirement (Kg)

The annual requirement of the medicinal plant used to formulate TM drugs and other commercial products, either by MSPCL or by private firms, should be specified in kilograms.

Name of the Company	Quantity (kg)

9. Annual Collection

The annual quantity collected either by MSPCL or by other private firms should be mentioned in kilograms.

Name of the Company	Year	Quantity (kg)

10. Formulation (TM - Drugs)

The details of TM drugs or other herbal products manufactured using this particular MP, either by MSPCL or by private firms, should be mentioned along with their classification as vital, essential and non-essential. The classification shall not be applied to private firms.

Name of the Drugs/Herbal Products	Vital	Essential	Non-Essential
Others (specify)			

11. Formulation (Commercial Products)

To deduce the percentage of utilisation for the production of commercial products either by MSPCL or other private firms. The name of the products, along with the quantity produced annually and their value, should be mentioned in kilograms and Nu per product, respectively.

Name of the Product	Value (Nu)	Annual Production (Kgs)

12. Enumerators Detail

The details of the enumerator must be mentioned as follow.

Collection Date (dd/mm/yyyy)	
Name and Designation	
Mobile no	
Work Station	
Other Remarks	

DEFINITIONS

1. Family

Among the taxonomic classifications, family is the eighth major taxonomic rank, which is classified among order, genus and species that may be further divided into subfamilies.

Cryptogams and Phanerogams are two sub-kingdoms of the Kingdom Plantae. Cryptogams are non-flowering plants which mainly reproduce by the production of spores. They do not produce fruits and are seedless plants like algae, mosses, and ferns. Phanerogams are gymnosperm and angiosperm plants, where gymnosperm plants are non-flowering plants with naked seeds, and angiosperms are flowering plants that produce seeds covered by a fruit.

2. Genus

The first part of the botanical name, which follows the sub-tribe and precedes the name of the species, is defined as Genera (plural) and Genus (singular). It is written in capital letters (first letter), and the rest are written in small letters in Italic form, or it is underlined.

3. Species

The second part of the botanical name, which precedes the subspecies. It is written in Italic form.

4. Monocot

Monocots are flowering plants that have a single embryonic seed leaf. Monocotyledon (mono-one, cotyledon-seed, and don-leaf) has a simple branch structure and parallel-veined leaves. Its floral parts are present in multiples of 3, 6, 9, and 12, mostly found in the lily and grass families, called a trimerous flower.

5. Dicot

Are flowering plants that have two embryonic seed leaves (di-two, cotyle-seed and don-leaf). It has a complex branch structure and has net-veined leaves. Its floral parts are present in multiples of 4 or 5, 8, 10, 12, 15, found in rose, pea, parsley and mint families, called pentamerous flowers. The inflorescence, such as sepals, petals, and stamens present in multiples of 4, is called a tetramerous flower.

6. Geographic Information System

Geographic Information System is used for storage, retrieval, mapping, and analysis of any geographic data. Spatial features are stored in a coordinate system (latitude or longitude, state plane, UTM, etc.) that represents a particular place on Earth.

7. Global Positioning System and Coordinates

Global Positioning System is used to record the precise location of any object on Earth by a set of numbers, letters or symbols, those requiring accurate tracking and navigation.

The coordinates are often chosen such that one of the numbers represents a vertical position (longitude) and two or three of the numbers represent a horizontal position (latitude). GPS Garmin eTrex 10 and 20 are some well-known pieces of equipment. Common choices of coordinates are displayed as N 27°28′48.30″ E 089°37′46.54″ (Coordinates of *Punica granatum* at the Department of Traditional Medicine Services, MoH, Kawang-Jangsa, Thimphu)

8. Elevation

Elevation of any geographic location is the height above or below a fixed reference point taken with the help of a Garmin. It is mentioned as masl.

9. Slope Aspect

Slope aspects are specific compass directions in which MPs or vegetation are facing (cardinal directions east, west, north and south) or the direction/slope facing the sun.

10. Slope Gradient

Slope gradients refer to the tangent of the angle of the particular surface to the horizontal plane. Slope angle ≤ 0° indicates a plain. It is measured by an inclinometer. However, an estimate can be made using visual observation.

11. Forest Type

11.1. Fir Forest

Fir forests are characterised by high precipitation, a thick layer of moss with rhododendron and sub-alpine bamboo as dominant species. They are found at altitudes between 2700 and 3800 masl. A few hemlocks and birches are also present in some places. It becomes stunted towards the tree line (3600-3800 masl) and grades into juniper and rhododendron scrub.



11.2. Mixed Conifer Forest

The mixed conifer forest ranges from an altitude of 2000 to 2700 masl. Dominant species are spruce, hemlock and larch. Hemlock tends to be found on wetter slopes. The undergrowth consists of rhododendrons, bamboo and other shrubs. Mixed conifer forest occupies the largest portion of the alpine regions.



11.3. Blue Alpine Forest

Blue alpine forest occurs in the temperate regions between 1800 - 3000 masl, like Haa, Paro, Thimphu and Bumthang. Blue pine is found dominating most of the areas, demonstrating fast colonisation. Blue Alpine is sometimes found mixed with oak and rhododendron.




11.4. Chir-Pine Forest

The Chir-pine forests are found at an altitude of 900-1800 masl in deep dry valleys of Punakha, Sunkosh, Kurichhu, Kulong Chhu and Serichhu under sub-tropical conditions. It is characterised by a long dry season with annual precipitation of 1000-1300 mm during the summer monsoon.




11.5. Broadleaved Conifer Forest

The broad-leaved conifer forest consists of an oak mixed with blue pine or mixed with spruce or hemlock.



11.6. Broadleaved Hardwood Forest

The broadleaved hardwood forest is divided into two subcategories: evergreen hardwood forest and cool broadleaved forest.

11.6.1. Evergreen Oak Forest

Evergreen oak forests are common in dry areas of Trongsa and Mongar. *Maple* and *Castonopsis spp.* predominate in the lower altitudes, while oak predominates in the higher altitudes. With increasing altitude, these forests grade towards blue pine with *xerophytic oaks.*



11.6.2. Cool Broadleaved Forest

Cool broad-leaved forests are located on damp hills and in species-rich areas. The lowland hardwood forest occupies the subtropical hills between 1000-2,000 masl. It is rich in species of both subtropical and temperate genera. The tropical lowland forests are multistoried and are very rich in species diversity below 700 masl.



11.7. Forest Shrub

Forest shrubs include alpine and temperate shrubs occurring naturally between the limits of the tree line and barren rocks. The juniper (*J. squamata*), *Rhododendron setosum, R. lepidotum*, dwarf oaks and willows are some common species.



12. Dominant Species

Flora distribution, which is more abundant than its competitors in an ecological community, is defined as a dominant species.

13. Habitat

13.1. Grassland

Grassland is an area where the vegetation is dominated by grasses with no or only sparse trees or shrubs that contain a diversity of other herbs. Secondary or derived grasslands are those in which the woody species (trees and/or shrubs) have been removed, leaving only the native herbaceous ground layer. Grassy woodlands are communities which have trees in the overstorey that are widely spaced, not overlapping; shrub cover is sparse. The predominant vegetation is grasses, herbs, forbs, etc.



13.2. Wetland

Wetlands are either seasonal or permanent, depending on the water available in their ecosystem. The main wetland types are swamp, marsh, bog, fen and peatland. Sub-types include mangrove forest, flood plain, Carr and Pocosin.



13.3. Marsh

A marsh is a wetland that is dominated by herbaceous vegetation rather than woody plant species. Marshes are found at the edges of lakes and streams. Grasses, rushes, or reeds often dominate the area. If woody plants are present, they tend to be low-growing shrubs. There are three types of marsh: freshwater tidal marshes, salt marshes and freshwater marshes.



13.4. Scree

Scree is the mass of loose rocks and stones formed from the collection of broken rock fragments that has accumulated through periodic rock fall from the adjacent cliff or persistent weathering.



14. Flower Description

14.1. Shape

14.1.1. Campanulate

Campanulate flowers are bell-shaped flowers with a round base, mostly found in medicinal plants like *Gentiana urnula* and *Codonopsis bhutanica*.



14.1.2. Cruciform

Cruciform flowers are cross-shaped tetramerous flowers arranged in the shape of a cross. It is commonly found in medicinal plants like *Rosa sericea* and *Rosa macrophylla*.



14.1.3. Asteraceae

Asteraceae , or Compositae, commonly referred to as the aster, daisy, composite or sunflower family are one of the largest and most widespread families of flowering plants. Most members of Asteraceae are herbaceous, but a significant number are also shrubs, vines, or trees. It is mostly found in HAMP.



14.1.4. Plantagincaeae

These are low green plants with inconspicuous flowers, also called spurred. The leaves appear to have parallel venation like monocots, but there are smaller, netted veins between the main veins. The flowers are greenish and small, forming on a slender stalk. They are regular and bisexual with four united sepals and four stamens. The ovary is positioned superior (hypogynous) and consists of two united carpels forming a single chamber. It matures as a circumscissile (-lidded) capsule with one or more seeds per cell or sometimes as a nut.



14.1.5. Cup Shaped

Cup-shaped flowers, also called cupulate, have petals resembling the shape of a bowl or a cup with the tips of the petals pointed upwards, leading to an upright, bowl-like rim. Common medicinal plants with cupulate flowers are *Potentilla arbuscula* and *Saxifraga moorcroftiana.*



14.1.6. Flat-Faced

Flat-faced flowers have a very narrow tube with a salver form and open into a flat face with the petals at right angles to the tube.



14.1.7. Funnel Shaped

Flowers that have a narrow base and widen gradually like a cone resembling a funnel, which doesn't flare suddenly. *Rhododendron anthopogon* and *Primula sikkimensis, Primula capitata* and *denticulata* are some of the funnel-shaped medicinal plants.




14.1.8. Papilionaceous

Flowers that are pea-shaped with a pentamerous corolla, one at the top called the standard or banner, two side ones called wings and two fused ones below, which form the keel. It is found in medicinal plants like *Pisum sativum.*




14.1.9. Acetabuli

Flowers with a flat, shallow depression in the middle, where the tips of the petals are pointed outwards, leading to a flat, saucer-like rim (saucer-shaped). Some common medicinal plants are *Parnassia nubicola, Parnassia chinensis, Meconopsis discigera, Meconopsis paniculata* and *Potentilla arbusculata.*



14.1.10. Stellate

Stellate flowers are star-shaped flowers that resemble a star with many individual petals radiating outwards from the centre. It is found in medicinal plants like *Codonopsis vinciflora.*



14.1.11. Trumpet-Shaped

Flowers that are trumpet-shaped with a narrow base flaring into a wide trumpet-like mouth. Common medicinal plants with trumpet-shaped flowers are *Datura stramonium* and *Beaumontia grandiflora*.



14.1.12. Tubular

Tubular flowers are formed into a narrow shape of a tube, barely opening at the mouth with small petals. *Gentiana algida* and *Rhododendron tubular* are some common medicinal plants.



14.1.13. Labiate

The flowers, which are divided into two unequal lips, where the upper two petals are joined to form a hood while the lower three form a broad lip for the pollinating insects to land. It is common in medicinal plants like *Corydalis juncea* and *Corydalis crispa.*



14.1.14. Urceolate

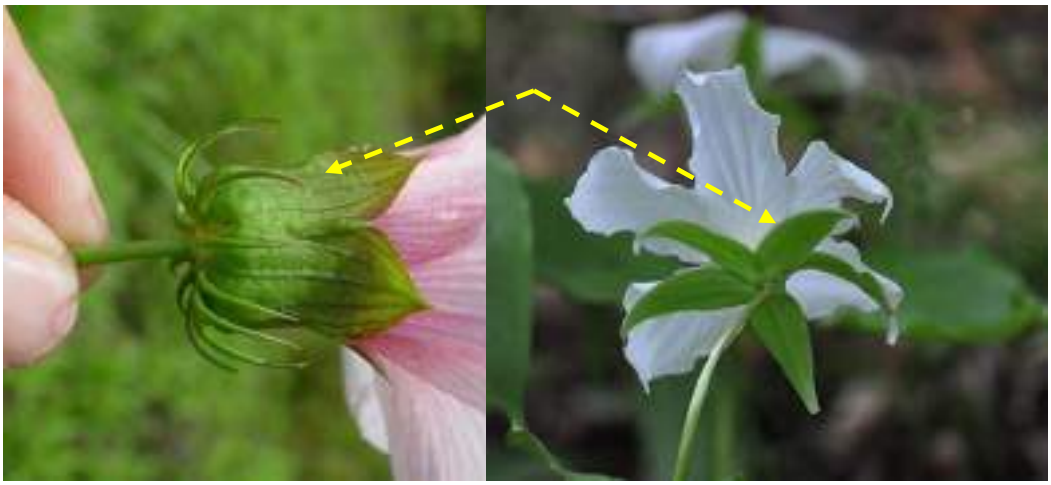
Urceolate flowers are in the form of a pitcher or urn with a swollen tube. Common medicinal plants with urceolate flowers are *Silene purii* and *Cyananthus inflatus.*



14.2. Characteristics

14.2.1. Sepal

Sepals are known as the calyx. They are green leaf that functions as protection for the flower and often provides support for the petals when in bloom. It lies just beneath the corolla.



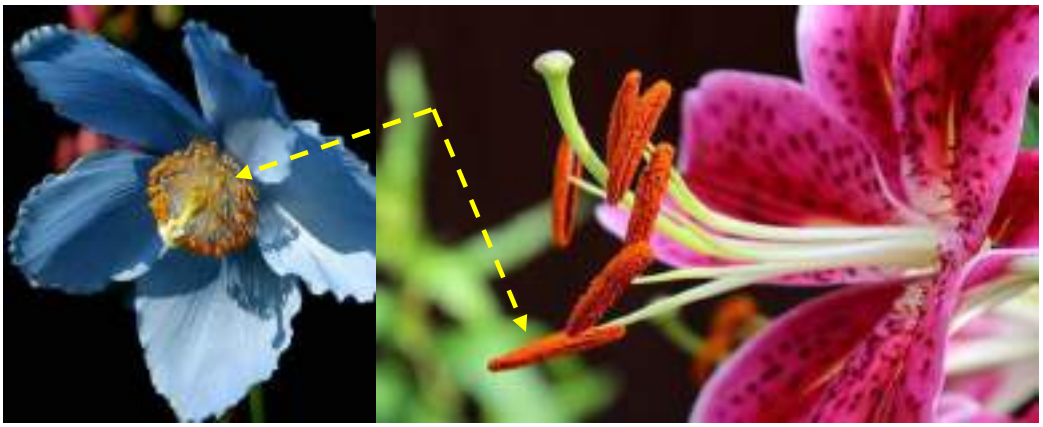
14.2.2. Petal

Petals are the modified leaves that surround the reproductive parts of the flowers. They are often brightly coloured to attract pollinators. Together, all the petals of a flower are known as the corolla.



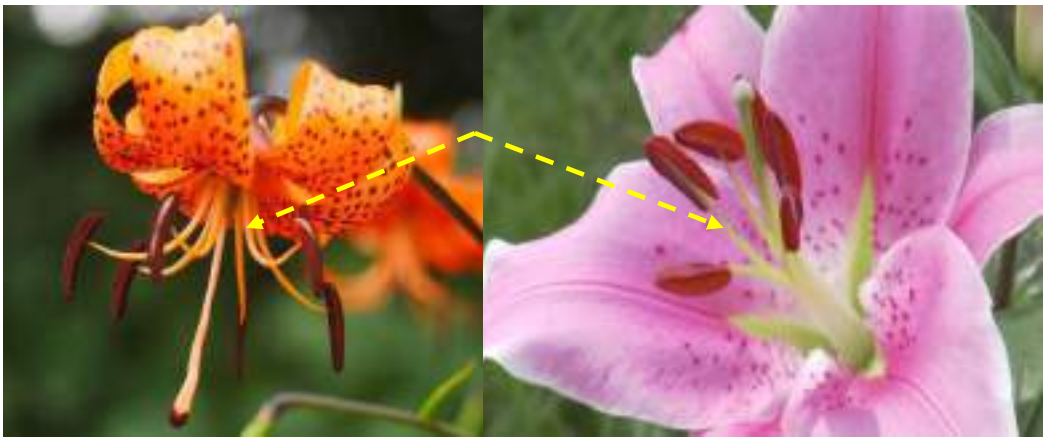
14.2.3. Anther

Anthers are the oval-shaped structures on top of the filament. They are crucial in the reproduction of flowering plants, as it produces the male gametophyte, known as pollen.



14.2.4. Filament

The male reproductive part of any flowering plant is called a stamen. It is composed of a long tube with an anther attached on top.



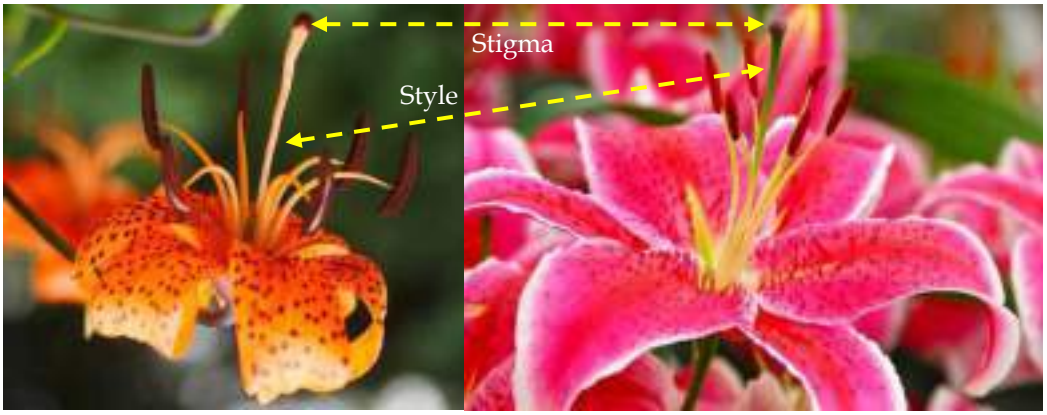
14.2.5. Ovary

Ovary are the part of the female reproductive organ of flowering plants, or the gynoecium. It is where ovules are produced at the enlarged basal portion of the pistil.



14.2.6. Stigma and Style

The stigma is the receptive tip of a style in the gynoecium of a flower. The stigma, together with the style and ovary, comprises the pistil.



15. Leaf Description

15.1. Types

15.1.1. Simple Leaf

Simple leaves have an undivided blade without leaflets. They are commonly found in medicinal plants like *Punica granatum, Juglans regia* and *Fraxinus paxiana.*



15.1.2. Ternately Compound Leaf

Ternately compound leaves are characterised by an arrangement of three leaflets or of leaves whorled in three. If three divisions of a ternate leaf are subdivided into three leaflets each, it is called bi-ternate, and still further subdivision produces a tri-ternate leaf. Some of the medicinal plants with ternately compound leaves are *Selinum wallichianum, Heracleum obtusifolium and Fragaria nubicola.*



15.1.3. Palmately Compound Leaf

Palmately or digitately compound leaves grow from the same or common stalk, having a shape similar to that of a hand with the fingers extended, with three or more veins, leaflets, or lobes radiating from one point. It is found in medicinal plants like *Podophyllum hexandrum.*




15.1.4. Pinnately Compound Leaf

Pinnately compound leaves have feather-like or multi-divided features arising from both sides of a common axis. Medicinal plants like *Robinia pseudoacacia* and *Canarium strictum* are found with pinnately compound leaves.




15.1.5. Bipinnately Compound Leaf

Bipinnately compound leaves have pinnately compound leaflets called twice-pinnate.



15.1.6. Tripinnately Compound Leaf

Tripinnately compound leaves are pinnately compound leaves in which the leaflets are themselves bipinnate; also called "thrice-pinnate." Medicinal plants like *Carum carvi* are found with tripinnately compound leaves.



15.2. Arrangement

15.2.1. Alternate

In an alternative leaf arrangement, a single leaf is attached at the node, arranged alternately on a stem or twig, in which the leaves emerge from the stem one at a time. Some of the common medicinal plants with alternative leaf arrangement are *Thlaspi arvense, Knema tenuinervia* and *Amomum subulatum.*



15.2.2. Alternate Decussate

In an alternate decussate arrangement, the leaflets are paired on two vertical rows on opposite sides of the axis, commonly found in medicinal plants like *Vincetoxicum canescens* and *Silene gonosperma*.



15.2.3. Opposite Decussate

In the opposite decussate arrangement, the leaflets rotate by 90° at adjacent nodes that are opposite, with successive pairs crossing at right angles. It is found in medicinal plants like *Mentha.*



15.2.4. Bipinnate

Arrangement where leaflets are paired opposite to each other, and more than two pairs are arranged on a single twig stem.



15.2.5. Even Pinnate

In an even pinnate arrangement, the leaflets are paired opposite in a row on a single twig stem with two leaflets at the tip.



15.2.6. Fascicled

In a fascicled arrangement, a bundle of leaves grow together that are usually crowded. It is common in medicinal plants like *Pinus densiflora*.



15.2.7. Odd Pinnate

In an odd pinnate arrangement, the leaflets are paired opposite in a row on a single twig stem with one leaflet at the tip. It is found in medicinal plants like *Zanthoxylum armatum.*



15.2.8. Perfoliate

In a perfoliate arrangement, the stem seems to pierce the leaflets, commonly found in medicinal plants like *Pisum sativum.*



15.2.9. Opposite

In an opposite arrangement, the leaflets are paired in adjacent order, one on each side of the twig or stem. Medicinal plants like *Astragalus tongolensis* are found with opposite leaf arrangement.



15.2.10. Rosette

In a rosette arrangement, the leaflets are clustered in a tight circular ring. It is commonly found in medicinal plants like *Plantago derpessa* and *Taraxacum officinalis.*



15.2.11. Tripinnate

In a tripinnate arrangement, more than one bipinnate system is found on a single stem. It is sometimes found in medicinal plants like *Myricaria rosea.*



15.2.12. Peltate

In the peltate arrangement, more than one perfoliate system is found on a single stem. Common medicinal plants with peltate leaves are *Podophyllum hexandrum* and *Macaranga tanarius.*



15.2.13. Unifoliate

In a unifoliate arrangement, only one leaflet grows from a single stem. It is sometimes found in medicinal plants like *Lepisorus contortus.*



15.2.14. Trifoliate (Ternate)

Trifoliate is also known as a ternate arrangement. Three leaflets are grown into a single stem. Medicinal plants like *Fragaria ananassa* and *Clover* are found with trifoliate leaves.



15.2.15. Whorled

In a whorled arrangement, more than two leaflets are found at the same node. Common medicinal plants are *Paris polyphylla, Euphorbia atropurpurea,* and *Arisaema flavum.*



15.3. Shapes

15.3.1. Acicular

Acicular-shaped leaves are commonly found in medicinal plants like *Ephedra gerardiana, Pinus densiflora, Abies delavayi* and *Lilium nanum.* It is characterised by needle shaped leaf that are slender and narrow.



15.3.2. Cordate

Cordate leaves are heart-shaped leaves that are extended more near the base. They are found in medicinal plants like *Aristolochia griffithii, Rhuem austral, Salvia castanea* and *Vitis vinifera.*



15.3.3. Deltoid

Deltoids are a triangular shaped leaf like the Greek letter delta. It has rounded corners with a flat base. It is commonly found in medicinal plants like *Populus deltoids.*



15.3.4. Elliptic

Elliptics are oval-shaped leaves with a short or no point on the apex. Common medicinal plants are *Terminalia bellerica, Piper pedicellatum, Piper nigrum, Phlogacanthus thyrsiformis* and *Rosa macrophylla.*




15.3.5. Ensiform

An Ensiform shape is found in medicinal plants like *Polygonatum verticillatum, Hippophae salicifolia* and *Gentiana robusta*, characterised by a spear - shaped leaf gradually extending to the apex.




15.3.6. Lanceolate

Lanceolate are a spear-shaped leaf, gradually extending at the base and lessening to the apex. *Lepisorus contortus, Salix babylonica and Fritillaria delavayi* are found with lanceolate leaves.



15.3.7. Linear

Liner shaped leave are found in medicinal plants like *Galium aparine* and *Dracocephalum tanguiticum*. It is characterised by a long and very narrow margin that runs parallel with a sudden bend at the apex, like a blade of grass.



15.3.8. Lyrate

Lyrate leaves are found in medicinal plants like *Quercus griffithii* and *Corydalis cornuta,* characterised by a shape of a lyre, i.e., a pinnately lobed leaf with an enlarged terminal lobe and smaller lateral lobes.



15.3.9. Obcordate

Obcordate leaves are heart-shaped leaves, where the stem is attached to the tapering end. It is found in medicinal plants like *Oxalis* and *Eucalyptus camphora*.



15.3.10. Oblong

Oblong leaves are simple leaves that are rounded at each end with undivided parallel sides. It bears short-stalked ovate or oblong leaves with strongly marked veins and covered with a soft tomentum. Medicinal plants like C*inamomum zeylancium* and *Cathaurea spicata* have oblong leaves.



15.3.11. Obovate

Obovate leaves are shaped in the form of a teardrop with a stem attached to the tapering end. It is reversed ovate. Some species of *Rhododendron* and *Cotoneaster microphyllus* are common examples.



15.3.12. Orbicular

Orbicular leaves are commonly found in medicinal plants like *Strychnos nux-vomica* and *Robus ellipticus.* It is characterised by a round-shaped leaf; the stem attaches to the extending end.




15.3.13. Ovate

Ovate leaves are oval or egg-shaped leaves with a larger base and smaller apex. It is characterised by a tapering point and the widest portion near the petiole. It is also reversed ovate.




15.3.14. Palmate

Palm shaped leaf have lobes or leaflets stemming from the leaf base. It is commonly found in medicinal plants like *Panax pseudo-ginseng, Malva sylvestris, Podophyllum hexandrum* and *Delphinium nepalense.*



15.3.15. Pectinate

Pectinate leaves are comb-shaped leaves with a margin having a fringed or scalloped edge. Medicinal plants like *Phyllanthus emblica* and *Abies delavayi* are found with pectinate leaves.



15.3.16. Pinnatifid

Pinnatifid leaves have lobes with incisions that extend less than halfway toward the midrib. It also has a feather-like arrangement with narrow lobes whose clefts extend more than halfway to the axis.



15.3.17. Reniform

Reniform leaves are found in medicinal plants like *Asarum canadense* and *Houttuynia cordata.* It is characterised by a kidney-shaped leaf with an inward curve on one side.



15.3.18. Renucinate

Renucinate leaves have incised margins with the lobes or teeth curved toward the base. It is commonly found in medicinal plants like *Taraxacum officinalis, Taraxacum ceratophorum* and some species of *Primula.*





15.3.19. Spatulate

A spoon-shaped leaf has a broad flat end which tapers to the base. It is found in species of *Primula, Rhododendron* and *Chrysanthemoides monilifera.*





15.4. Surface feature

15.4.1. Glabrous

Glabrous leaves are characterized with smooth surface without hairs. It is found in medicinal plants like *Zanthoxylum armatum*, *Syzygium cumini* and *Jatropha curcas.*



15.4.2. Glaucous

Glaucous leaves are covered with a whitish (usually) waxy coating (bloom) as on the surface of a plum called glaucous. It is commonly found in medicinal plants like *Verbascum thapsus*, *Tanacetum nubigenum, Leontopodium himalayanum* and some species of *Artemisia.*



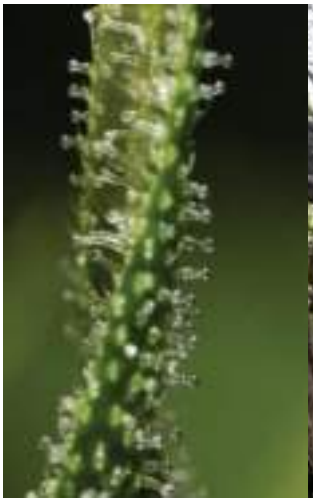
15.4.3. Glaucescent

Glaucescent leaves have dull greyish-green or blue colour, covered with a powdery bloom like that on grapes. It is commonly found in medicinal plants like *Plomis rotate* and *Heracleum obtusifolium.*




15.4.4. Resinous

Resins are clear to translucent yellow or brown, solid or semisolid, viscous substances, such as copal, rosin and amber, often sticky, found in medicinal plants like *Pinus densiflora, Commiphora mukul* and *Canarium strictum.*





15.4.5. Pubescent

Pubescent leaves are covered with short, soft hair called pubescent, commonly found in medicinal plants like *Verbascum thapsus* and some species of *Meconopsis*.



15.4.6. Tomentose

Tomentose leaves are found in medicinal plants like *Soroseris hookeriana*, *Saussurea gossypiphora* and some species of *Tanacetum* and *Anaphalis*. It is characterised by densely matted, woolly or tangled soft.



15.5. Apex

15.5.1. Accuminate

An acuminate leaf has a long, drawn-out pointed apex, where the sides are curved concavely or inward toward the tip and taper to a fine point on the leaf apex. It is commonly found in medicinal plants like *Vincetoxicum canescens.*



15.5.2. Acute

An acute apex has an angle that is less than 90^{o}, with straight lines having a point. The term acute is most often applied to apices, but it is sometimes used for bases, where it refers to a wider base than cuneate.



15.5.3. Apiculate

An apiculate apex ends in a short protruding point or ends abruptly with a sharp, flexible tip. It is commonly found in *Rhododendron* species and some medicinal plants like *Parnassia nubicola* and *Piper pedicellatum.*



15.5.4. Aristate

A long bristle apex commonly found in medicinal plants like *Otochilus lancitabius, Myrsine semiserrata, Piptanthus nepalensis* and *Mangifera indica.*



15.5.5. Caudate

Caudate apex tapers into a long tail-like extension, indicating an anatomical structure with a tail-like extension. It is found in medicinal plants like *Jatropha curcas* and *Populus davidana.*



15.5.6. Emarginate

Emarginate are downward notched apex (towards the petiole) at the mid-vein, commonly found in medicinal plants like *Oxalis corniculata* and some species of *Desmodium styracifolium.*



15.5.7. Mucronate

A mucronate apex is abruptly tipped with a bristly midrib extension (mucro). It is found in some species of *Rhododendron* and *Aristolochia griffithii.*



15.5.8. Obtuse

An apex with sides forming an angle greater than 90°, but not quite as smooth or wide as a rounded leaf apex commonly found in medicinal plants like *Aegle marmelons* and *Aquilaria malaccensis.*



15.5.9. Retuse

A retuse apex has a narrow notch in the centre, found in some species of *Phlogacanthus.*



15.5.10. Tridentate

Tridentate leaves are three teeth shape leave commonly found in medicinal plants like *Ranunculus tricuspis* and some species of *Artemisia*, *Tanacetum* and *Pedicularis*.



15.5.11. Truncate

Truncate are a broad, flat apex, abruptly ending at right angles to the mid-vein. It is common in plants like *Liriodendron tulipifera.*



15.5.12. Obcordate

An obcordate apex has two flattened sides, which are at a straight angle less than 90°. It is commonly found in medicinal plants like *Oxalis articulata* and *Robinia pseudoacacia.*



15.5.13. Cuspidate

Cuspidate have a markedly notched apex, found in medicinal plants like *Gossypium hirsutum, Vincetoxicum canescens,* and some species of *Erythrina variegate.*



15.6. Margin

15.6.1. Ciliate

Cilia are long hairs found on the margin. It is found in medicinal plants like *Delphinium bhutanicum*, *Saxifraga moorcroftiana, Onosma hookeri*, *Urtica dioica* and some species of *Meconopsis*.



15.6.2. Crenate

Crenate are rounded margins commonly found in medicinal plants like *Verbascum thapsus, Salvia castanea, Rheum australe,* and *Veronica cephaloides.*



15.6.3. Dentate

Dentate margins are finely toothed and symmetrical. Medicinal plants like *Rubus niveus, Rubus subornatus* and *Ulmus pumila* are commonly found with dentate margins.



15.6.4. Denticulate

A denticulate margin has fine teeth and fine dentition. It is found in medicinal plants like *Saivia prattii, Rosa sericea* and *Phlomis* species.



15.6.5. Entire

Margin without teeth or serrations, instead having an even and smooth margin, commonly found in medicinal plants like *Polygonatum verticillatum, Gentiana robusta, Acorus calamus, Iris kemaonensis* and some *Rhododendron* species.



15.6.6. Lobate

Lobate has an indented margin without any midline. It is found in medicinal plants like *Drynaria propingua, Monachosorum henryi, Raphanus sativus, Drynaria sinica* and *Pterocephalus hookeri*.



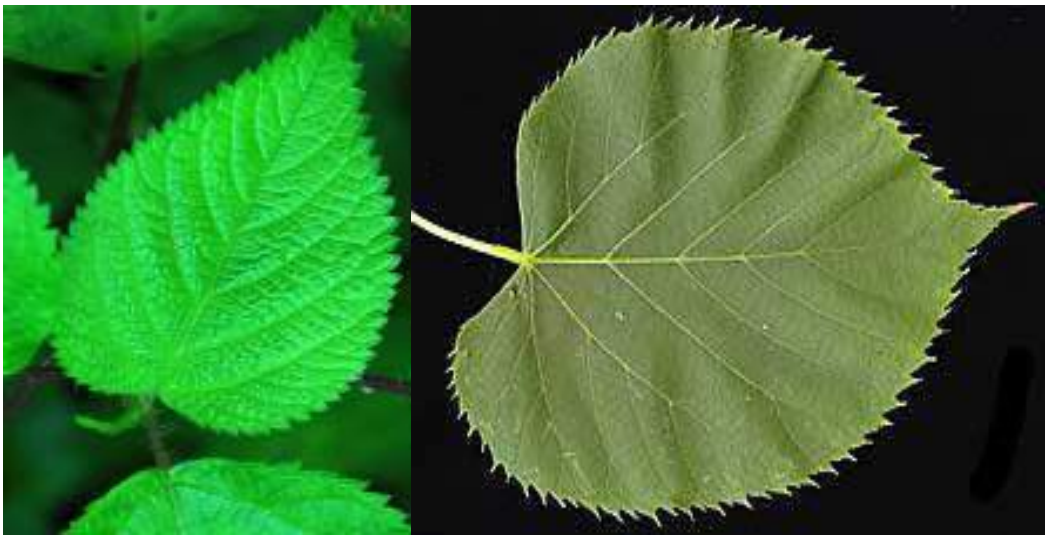

15.6.7. Serrate

Serrate margins are notched, like a saw with teeth pointing toward the apex, commonly found in medicinal plants like *Neopicrorhiza scrophulariiflora* and *Fragaria nubicola.*




15.6.8. Serrulate

Serrulate margins have small, fine serrations, commonly found in medicinal plants like *Morus macroura* and some species of *Potentilla.*



15.6.9. Doubly serrated

A doubly serrated margin has pointed teeth, with each tooth (serration) having smaller serrations on it. It is common in medicinal plants like *Saussurea kotochaetoides, Rubus biflorus* and *Veronica cephaloides.*



15.6.10. Sinuate

Sinuate margins are wavy margins with shallowly rounded divisions within the same plane of the blade. In contrast, an undulate margin has wavy margins that occur above and below the plane of the leaf. It is found in medicinal plants like *Begonia annulata* and *Leibnitzia anandria.*



15.6.11. Undulate

Undulate margins are widely wavy margins with wide waves that give a more three-dimensional appearance to the margin of the leaf. This characteristic makes a leaf hard to flatten or press. It is found in medicinal plants like *Plantago major* and some species of *Quercus robur* and *Rumex.*



15.6.12. Spiny

A margin with sharp, stiff points commonly found in medicinal plants like *Acanthocalyx nepalensis, Morina kokonorica, Carthamus tinctorius* and some species of *Juniperus* and *Quercus robur.*




15.7. Venation

15.7.1. Arcuate

Arcuate veins curve at their ends as they approach the leaf margin, or all the secondary veins bend to the lower apex. It is commonly found in the MP, like *Piper pedicellatum* and *Piper nigrum.*




15.7.2. Cross Venulate

Cross venules are small veins connecting the secondary veins. It is commonly found in medicinal plants like *Aiuga ovalifolia, Jatropha curcas* and *Juglans regia.*



15.7.3. Dichotomous

Dichotomous veins branch symmetrically in pairs, divided into two parts. It is mostly found in medicinal plants like *Terminalia chebula, Butea parviflora* and *Fragaria nubicola.*



15.7.4. Longitudinal

Longitudinal veins are aligned mostly along the axis and are commonly found in medicinal plants like *Thysanolaena latifolia.*



15.7.5. Palmate

Palmate veins have several main ribs branching out from the base of the leaf at the stem. Very small veins branch off from each of the main ribs, resembling the fingers. It is found in medicinal plants like *Malva sylvestris.*



15.7.6. Parallel

Parallel veins are mostly found in medicinal plants like *Canarium strictum*, where the large main veins run parallel to the axially that do not cross each other.



15.7.7. Pinnate

Pinnate veins are also known as net-veined found in the majority of broad leaves. The word pinnate means feather-like. It is characterised by secondary veins paired oppositely. It is found in medicinal plants like *Rosa macrophylla, Panax pseudo-ginseng,* and some species of *Primula.*



15.7.8. Reticulate

Reticulate veins are found in medicinal plants like *Anisodus luridus, Saussurea obvallata, Phlomis rotate, Jatropha curcas, Luffa aegyptiaca, Lagenaria siceraria* and *Phytolacca acinosa.* It is characterized with smaller veins forming a network pattern.



15.7.9. Rotate

Rotate veins are found in medicinal plants like *Malva sylvestris* and *Nelumbo nucifera,* where the veins radiate and diverge in different directions, forming a network.



15.8. Leaf attachment to stem

15.8.1. Petiolate

Is a small stalk that connects leaves to the stem. It is of two types: long-stalk and short-stalk.



15.8.2. Sessile

Sessile leaves are attached directly to the stem without a petiole. It is commonly found in medicinal plants like *Aster neoelegans, Euphrasia melanosticta, Otochilus lancitabius,* and *Capsella bursa-pastoris*.



15.8.3. Clasping

A leaf that partially or surrounds a stem as if it's clasping. It is generally found in medicinal plants like *Gymnadenia orchidis, Fritillaria delavayi, Gentiana robusta, Thysanolaena latifolia* and *Halenia elliptica.*



15.9. Leaf base

15.9.1. Attenuate

The attenuate base is a small tissue tapering down the petiole (towards the base), having some fleshy leaves on either side of the petiole. It is found in medicinal plants like *Aegle marmelos, Meconopsis simplicifolia* and some species of *Primula.*



15.9.2. Auriculate

Auriculate leaves are ear-lobe-shaped leaf bases attached to a petiole, commonly found in medicinal plants like *Aristolochia griffithii*, *Luffa aegyptiaca* and *Nymphaea sp.*





15.9.3. Connate Perfoliate

Connate perfoliate leaf bases are found in medicinal plants like *Pisum sativum*. It is characterised by a leaf surrounding the stem, directly attached to it. The stem appears to go through the centre of the leaf, where there is no visual of the petiole other than the stem.





15.9.4. Cordate

Cordate leaves are heart shape leave attached to the petiole. It is common in medicinal plants like *Rubia manjith* and *Tinospora cordifolia.*



15.9.5. Cuneate

Cuneate leaves are narrow, wedge-shaped with essentially straight sides, tapering to the base with the leaf attached at the narrow end. It is found in medicinal plants like *Rosa macrophylla, Myrsine semiserrata, Juglans regia, Zanthoxylum armatum* and *Polygonatum verticillatum.*



15.9.6. Decurrent

The decurrent leaf base extends downward from the point of attachment. It is commonly found in medicinal plants like *Silene gonosperma, Bistorta macrophylla, Lilium nanum, Amomum subulatum* and *Onosma hookeri.*



15.9.7. Hastate

Hastate bases have pointed and flaring lobes at the base, commonly found in medicinal plants like *Persicaria arifolia, Fagopyrum cymosum* and *Syngonium podophyllum.*



15.9.8. Oblique

Oblique bases are found in medicinal plants like *Ulmus americana* and *American Elm,* with one leaf base lower than the other.



15.9.9. Obtuse

An obtuse leaf base has a blunt or rounded point of attachment to the petiole and is not acute in form. It is commonly found in medicinal plants like *Jatropha curcas*, *Robinia pseudoacacia* and in some species of *Quercus.*



15.9.10. Peltate

Pelate usually has a petiole attached near the centre on the abaxial side. It is usually found in medicinal plants like *Podophyllum hexandrum, Tropaeolum majus, Sinopodophyllum hexandrum* and *Nelumbo nucifera.*



15.9.11. Perfoliate

In a perfoliate base, the stem appears to go through the centre of the leaf. It is commonly found in medicinal plants like *Penstemon Pseudospectabilis*, *Pisum sativum* and *Lonicera caprifolium.*



15.9.12. Sagittate

In Sagittate, the base of the lower lobes of the leaf is folded or pointed down. It is commonly found in medicinal plants like *Viola biflora, Salvia castanea* and *Petasites tricholobus.*




15.9.13. Sheathing

A sheathing leaf base has a broad base or petiole that surrounds the stem or overlaps other leaf bases or petioles. It is mostly found in medicinal plants like *Sonchus brachyotus.*




15.9.14. Truncate

The truncated base has a square shape at the base. It is commonly found in medicinal plants like *Chenopodium album* and *Mirabilis himalaica.*



16. Stem description

16.1. Inflorescence Type

16.1.1. Spike

Spikes are elongated, unbranched and indeterminate inflorescences consisting of a main stalk with stemless florets attached along its length with sessile flowers. It is found in medicinal plants like *Verbascum thapsus, Gymnadenia orchidis* and *Pedicularis prainiana.*



16.1.2. Receme

Raceme is an elongate, unbranched, indeterminate inflorescence consisting of a main stalk with florets attached along its length by short pedicels with pedicellate flowers. It is commonly found in medicinal plants like *Aconogonon tortuosum.*



16.1.3. Panicle

Panicle is a loosely branched, pyramidal inflorescence. Medicinal plants like *Koenigia mollis, Coriandrum sativum, Sinolimprichtia alpine* and some species of *Anaphalis* are commonly found with panicle inflorescence.



16.1.4. Corymb

Corymb is characterised by a flat-topped, open flower cluster, blooming from the outside edges, growing in such a fashion that the outermost are born on longer pedicels than the inner, bringing all flowers up to a common level. It is commonly found in medicinal plants like *Senecio chrysanthemoides* and *Hymenidium amabile.*




16.1.5. Umbel

An inflorescence in the shape of an inverted umbrella having pedicels radiating from one point. Medicinal plants like *Carum carvi, Allium wallichii, Allium rhabdotum, Anaphalis cooperi, Taraxacum eriopodum, Selinum wallichianum* and *Sinolimprichtia alpine* are found with umbel-shaped inflorescence.





16.1.6. Helicoid Cyme

A type of determinate inflorescence in which the flowers develop on one side of the axis, causing the inflorescence to curve. It is found in medicinal plants like *Acanthocalyx nepalensis*, *Nardostachys jatamansi*, *Onosma hookeri* and some species of *Corydalis*.



16.1.7. Head

Inflorescence in the shape of a disc and ray, commonly found in the Aster family and medicinal plants like *Aster diplostephioides*, *Aster flaccidus, Inula grandiflora, Taraxacum eriopodum* and *Inula racemosa***.**



16.2. Above the Ground Stem Types

16.2.1. Ascendent

Ascendent stems are aerial stems horizontal to the ground, mostly erect. It is commonly found in most of the Low Altitude Medicinal Plants.



16.2.2. Decumbent

Decumbent are aerial stems horizontal to the ground, ascending near the stem apex. It is commonly found in High Altitude Medicinal Plants.



16.2.3. Erect and Caulescent

Erect and caulescent are upright aerial stems with leaves arising from the stem or from some nodes above the ground.



16.2.4. Erect and acaulescent (scapose)

Erect and acaulescent are upright stems with the leaves arising directly from an underground stem structure.



16.2.5. Procumbent

Procumbent stems are aerial stems horizontal to the ground but not rooting at the nodes. Medicinal plants like *Drosera peltata, Euphrasia melanosticta* and some species of *Corydalis* are characterised by a procumbent above-ground stem type.



16.2.6. Repent

Repent are aerial stems horizontal to the ground and rooting at the nodes. It is commonly found in medicinal plants like *Otochilus lancitabius* and *Fragaria nubicola.*



16.2.7. Stolon

Are elongate above-ground stems horizontal to the ground (may be procumbent or repent). It is commonly found in medicinal plants like *Mentha* and *Rubia manjith.*



16.2.8. Thorn

Are stiff modified stems with a sharp point. Medicinal plants like *Hippophae salicifolia* and *Rubus biflorus* are commonly found with thorns of the ground type.



16.3. Underground Stem

16.3.1. Bulb

Are short and narrow underground stems surrounded by multiple layers of thick, fleshy, nutritive, protective leaves like an onion. It is found in MP like *Allium wallichii, Allium cepa* and *Allium sativum.*



16.3.2. Corm

Are short, thick and nutritive underground stems surrounded by two to several pairs of membranous and protective leaves. It is found in MP like *Beta vulgaris, Fritillaria delavayi* and *Allium sativum.*



16.3.3. Rhizome

Are common underground stems, usually longer and slender with a creeping character from which new stems are formed that usually grow horizontally. It is commonly found in MP like *Zingiber officinale, Curcuma longa, Typha elephantia, Cautleya spicata* and *Drynaria propingua.*




16.3.4. Tuber

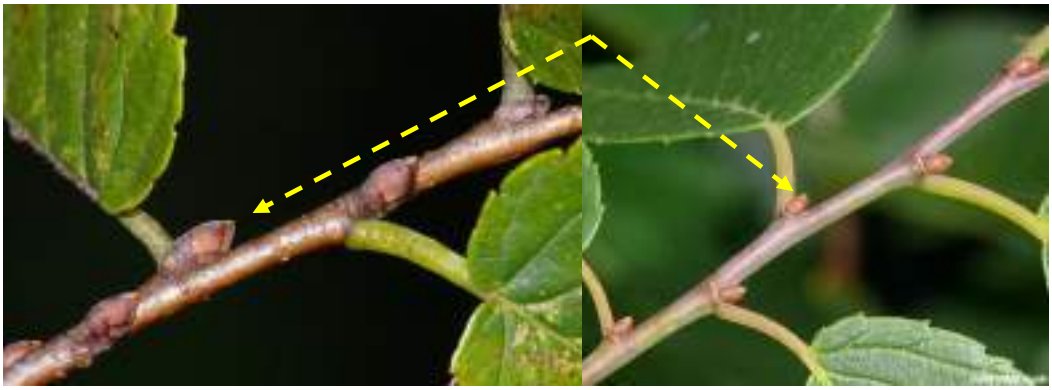
Are short, thick and nutritive underground modified stems; usually a shortened part of a rhizome that usually grows in a vertical position. Unlike rhizomes, new stems are not formed from the tuber except for some root hairs. It is commonly found in medicinal plants like *Ipomoea batatas, Aconitum laciniatum* and *Aconitum orochryseum.*




16.4. Characteristics

16.4.1. Axillary Bud

An axillary or lateral bud is an embryonic shoot located at the axil of a leaf. Each bud has the potential to form shoots and may be specialised in producing either vegetative shoots (stems and branches) or reproductive shoots (flowers). Once formed, it may remain dormant for some time, or it may form a shoot immediately.



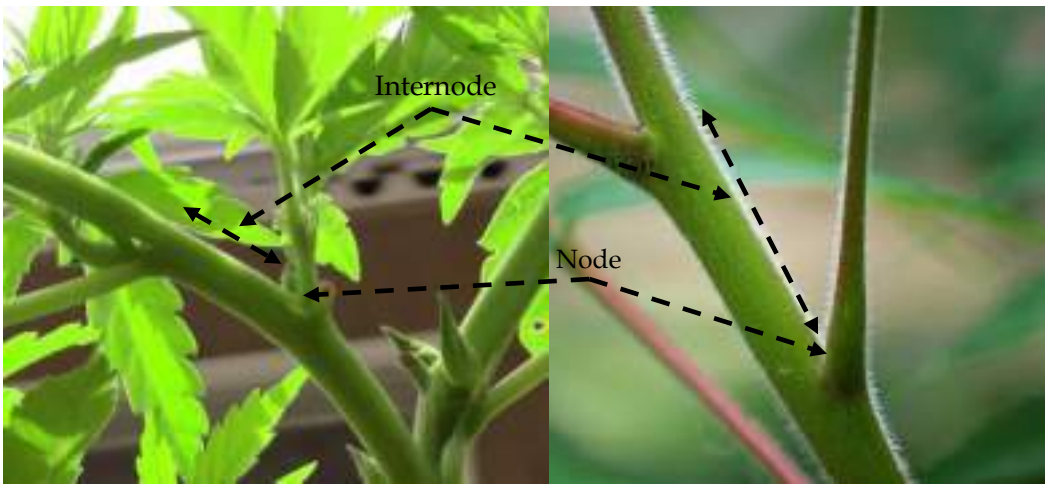
16.4.2. Terminal Bud

The terminal bud is the dominant or main bud of a plant that is responsible for all of its new growth. They are typically located at the end of a plant stem. They are the main point of growth for a plant that contains specialised tissue known as the apical meristem.



16.4.3. Node and Internode

Nodes are different segments of the stem, where the flowers, branches, and leaves first start to grow. Nodes can hold several leaves and buds that have the capacity to grow and spread into new branches. In some plants, the nodes can additionally produce adventitious roots. An internode is a part or space between two nodes, knots, or joints, as the portion of a plant stem between two nodes.



17. Seed description

17.1. Characteristics

17.1.1. Epicotyl

Epicotyls are the stem of a seed or embryo located between the cotyledons and the first true leaves.

17.1.2. Hypocotyl

Hypocotyls are the part of a plant's embryo directly below the cotyledons, forming a connection with the radicle.

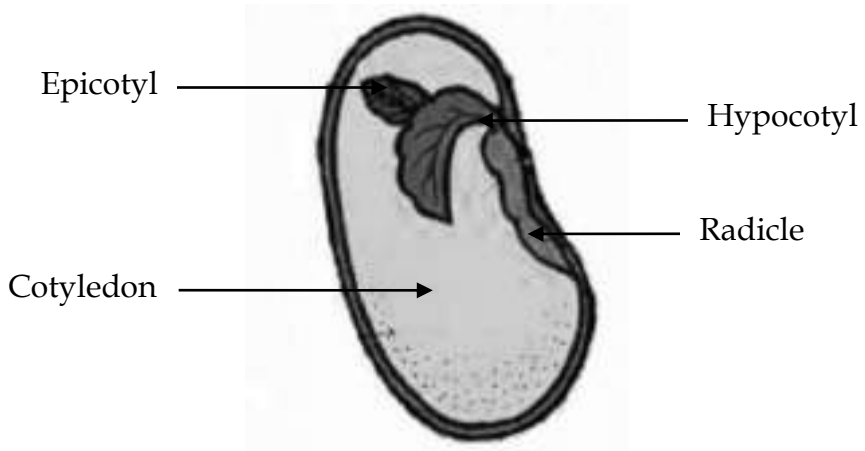
17.1.3. Cotyledon

Cotyledons are simple embryonic leaves in seed-bearing plants. In some species, it forms the first green leaf after germination. Most of the cotyledons emerge, enlarge and become green after the seed has germinated.

Cotyledons either store food for the growing embryo (as in monocotyledons) or absorb food that has been stored in the endosperm (as in other angiosperms) for eventual distribution to the growing parts of the embryo.

17.1.4. Radicle

Radicle are the part of a plant's embryo that develops into a root. In most seeds, the radicle is the first structure to emerge on germination.



18. Fruit description

18.1. Characteristics

18.1.1. Endocarp

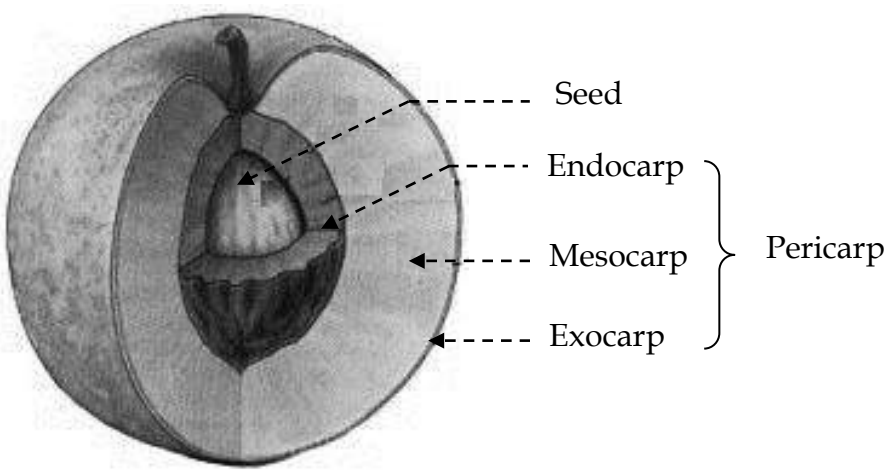
The innermost layer of the pericarp, which surrounds the seed in a fruit. It may be membranous or woody.

18.1.2. Exocarp

Exocarp is the outer layer of the pericarp of a fruit.

18.1.3. Mesocarp

The middle layer of the pericarp of a fruit, between the endocarp and the exocarp.



19. Root Description

19.1. Types

19.1.1. Fleshy Root

Are a modified form of taproot, usually covered with fleshy layers like carrots and beets. They are usually perennial and have a short life span, common in medicinal plants like *Beta vulgaris.*



19.1.2. Tuberous Root

Are thick and fleshy storage root without scale leaves or buds, which grows in a vertical position. It is commonly found in medicinal plants like *Ipomoea batatas.*



19.1.3. Aerial Root

Aerial roots are also known as adventitious roots, which are common in many epiphytes, such as in the monocot plants and the orchid family (Orchidaceae). These roots remain aerial, i.e. they do not enter the soil, depending on the plant species. Aerial roots perform special functions, such as water retention, photosynthesis and support. It is sometimes found in medicinal plants like *Lepisorus contortus.*



19.1.4. Contractile Root

As in many plants, contractile roots are fibrous roots that pull plants (bulbs/corms) downward into the soil, expanding radially and contracting longitudinally, and have a wrinkled surface. Species of *Allium* are characterised by contractile roots.



19.1.5. Haustoria Root

Haustoria are parasitic (non-epiphytic) roots that live and penetrate the tissues of a host plant for nutrients. Medicinal plants like *Drynaria propingua* have haustorial roots.



19.1.6. Prop Root

Prop roots originate above ground from the stem and subsequently sink into the soil to provide additional support to the plant. It makes it possible for the branches to extend horizontally to great distances. It is commonly found in medicinal plants like *Zea mays.*



19.1.7. Pneumatophores

Are specialised roots that grow upwards, out of the water or mud to reach the air and obtain oxygen for the root systems of trees. It lives in swampy or tidal habitats. It is sometimes found in some species of Low Altitude Medicinal Plants.



19.1.8. Buttress Root

Are enlarged, often thickened roots that spread horizontally from the base to provide additional support. In tropical trees like figs, large buttress roots (large, wide roots on all sides of a shallowly rooted tree that do not penetrate to deeper layers) are formed at the base of their trunks and are found in nutrient-poor rainforest. They prevent the tree from falling over and are also used for gathering more nutrients. It is sometimes found in some species of Low Altitude Medicinal Plants.



19.2. Characteristic of Tap Roots

19.2.1. Primary Root

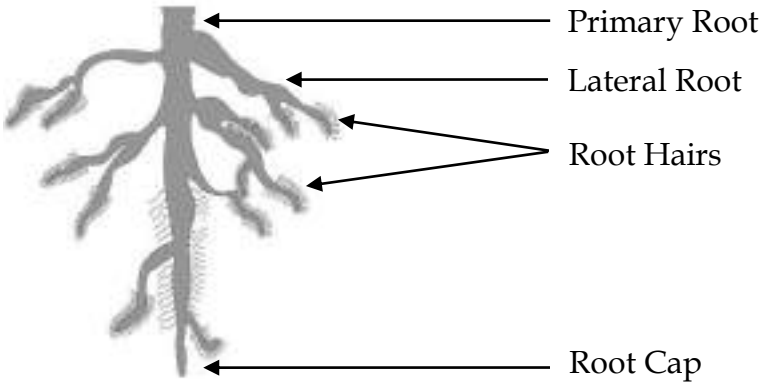
Primary roots are initiated in the embryo within the seed. It is the original root of a plant to discover its soil environment. It anchors the plant and ensures growth through uptake of water and nutrients. In gymnosperms, eudicotyledons, and magnoliids, the primary root develops into a taproot. In monocotyledons, the primary root disintegrates, as do the lateral roots.

19.2.2. Lateral Root

Lateral roots are a subdivision of the primary root that extend horizontally and serve to anchor the plant securely into the soil. It also contributes to the uptake of water and facilitate the extraction of nutrients required for the growth and development of the plant.

19.2.3. Root Hairs

Root hairs are a large number of elongated microscopic outgrowths from the outer layer of a cell. It is where most water and nutrient absorption happens. They are long and thin, so they can penetrate between soil particles and prevent harmful bacterial organisms from entering the plant through the xylem vessels.



20. Soil description

20.1. Types

20.1.1. Clay Soil

Is a heavy, slippery soil that remains wet and cold during winter and dry and brittle in summer. Due to the high density of minute air particles present in it. It is known for its capacity to retain water. A tight hardball can be formed when it is wet. It is very hard when dry and packed down.



20.1.2. Chalky Soil

Chalky soil is either light or heavy. They do not support the growth of ericaceous plants, as they are highly alkaline due to the presence of calcium carbonate (lime). These types of soils are usually found near the highways.





20.1.3. Loamy Soil

Loam or fertile soils are mixtures of sand, silt and clay. These soils are easy to work with and provide good drainage. They are good for growing crops and plants as it contains lots of decayed vegetable matter. They can be sandy or clay loam depending on their predominant composition.





20.1.4. Peaty Soil

Peat soils are dark brown or black. It is soft and can be easily compressed due to high water content and rich organic matter. Peaty soils are high in organic matter and retain large amounts of moisture. They are good for growing crops and plants.



20.1.5. Sandy Soil

Sandy soil runs loosely between the fingers when dry, and it cannot be formed into a ball or any shape. It does not hold water, but has plenty of space for oxygen. They are light, warm, dry and tend to be acidic and low in nutrients. They are often known as light soils due to their high proportion of sand and little clay. These soils have quick water drainage and are easy to work with. They warm up easily in spring and tend to dry in summer.



20.1.6. Silt Soil

Silt soils are a mixture of clay and sand. It is soft and can be formed into a loose ball when it is wet. Silt soils are light and moisture-retentive with a high fertility rate. It contains medium-sized particles and holds moisture. They can be easily compacted and are prone to rain and running water being washed away. By adding organic matter, the silt soil can be bound into more stable clumps.




20.2. Characteristic

20.2.1. Soil pH

Soil pH is a measure of acidity or basicity (alkalinity) of a soil. It is measured in a slurry of soil mixed with water (or a salt solution, such as 0.01 M $CaCl_2$), which normally falls between 3 and 10, with 7 being neutral. Acidic soils have a pH below 7 and alkaline soils have a pH i.e. above 7. Ultra-acidic soils (pH < 3.5) and very strongly alkaline soils (pH > 9) are rare.

20.2.2. Soil Hardness

Soil hardness is the density of the air present between the soil grains. It becomes less absorbent to rainfall, thus increasing runoff and erosion. It is calculated through a hardness meter and from the physical appearance of the soil.

21. Life span

21.1. Herbaceous

21.1.1. Annual

Annual plants complete their biological life cycle from germination to the production of seeds within one year and then die. Most of the annual plants do not regerminate from the same spot (habitat) once the biological life cycle is completed.



21.1.2. Biennial

Biennial plants complete their biological lifecycle, from germination to the production of seeds, within two years. In the first year, the plant grows leaves, stems, and roots, then it enters a period of dormancy over the colder months. During the next spring or summer, the stem elongates greatly. The plants then flower, producing fruits and seeds, and they finally die. Most of the Biennial plants do not regerminate from the same spot (habitat) once the biological life cycle is completed.



21.1.3. Perennial

Perennial plants live more than two years and complete their biological lifecycle thereafter. They are small flowering plants that grow and bloom in the spring and summer. They die back every autumn and winter, returning in every spring.



21.2. Woody

21.2.1. Deciduous

Deciduous trees and shrubs seasonally shed leaves in the autumn after bearing flowers and fruit. It is most commonly found in Low Altitude Medicinal Plants like *Terminalia chebula, Terminalia bellerica* and *Phyllanthus emblica.*



21.2.2. Evergreen

Evergreen plants bear leaves throughout the year and remain always green. It is common in medicinal plants like *Citrus sinensis, Abies delavayi* and *Pinus densiflora.*





22. Parts Used

22.1. Aerial Part

The aerial part of the plant is located above the ground level, usually exposed to direct sunlight.

22.2. Underground Part

Parts of the plant that are below the ground level, like roots, bulbs, tubers, rhizomes, etc., are called underground parts.

22.3. Bulb

Bulbs are the resting stages of a plant, usually formed underground, consisting of a short stem bearing one or more buds enclosed in an overlapping fleshy membrane.

22.4. Root

Roots are the underground part which anchors any plant to the ground and provides nutrients and support.

22.5. Stem

Stems are the aerial parts of the plants that consist of xylem and phloem. It helps to transport water and nutrients to the rest of the parts.

22.6. Bark

Bark is the outer most layering of the stem and root of a woody plant, which overlays the wood, consisting of inner and outer bark.

22.7. Tuber

Tubers are the underground stem, which contains stored food to be used during winter and the dry season. It usually grows in a vertical position from which lateral shoots are not developed.

22.8. Rhizome

Rhizomes are continuously growing horizontal underground stems, which put out lateral shoots and adventitious roots at regular intervals.

22.9. Leaf

Leaves are flattened structures of a higher plant, typically green and blade-like, that are attached to a stem directly or via a stalk. It collects energy from the sun to prepare food through the process known as photosynthesis.

22.10. Seed

Seeds are the unit of reproduction of a flowering plant, capable of developing into another plant.

22.11. Fruit

Fruits are ripened ovules or ovaries with the sweet and fleshy product of a tree or other plant. It contains a seed, and that can be eaten as food.

22.12. Shoot

Shoots are young branches or sucker springing from the main stock of a tree or other plant, together with all the parts and structure that are attached to it, such as leaves, etc.

22.13. Flower

Flowers are the seed-bearing part of a plant, consisting of reproductive organs (stamen and carpel) that are surrounded by a brightly coloured corolla (petal) and a green calyx (sepal).

22.14. Resin

Resins are sticky, flammable organic substances insoluble in water, exuded by some trees and other plants.

23. Propagation methods

Propagation is the method of plant multiplication and proliferation technique of producing two or more species from a parent plant. It is achieved through the following methods.

23.1. Sexual Reproduction

Sexual reproduction is the recombination of genetic materials to form an individual plant through the formation of a seed. It centres on the flower, where there are usually structures that produce both male and female gametes. It is achieved through seed and wilding methods as defined below.

23.1.1. Seeding

Is a method of using seeds (all the classes of phanerogamae) to introduce new plants.

23.1.2. Wilding

Is a method of using saplings that are collected from the wild, which are then introduced and domesticated in a new habitat.

23.2. Asexual Reproduction

The use of vegetative organs to create separate plantlets, genetically identical to the parent plant, because mixing of male and female gametes does not happen.

23.2.1. Cutting

The vegetative parts of the plant are derived from the parent plant to regenerate itself and form a whole new plant. The cutting methods are applied to stem, root and leaf.

23.2.2. Division
The techniques used for plants that have multiple stems emerging from the ground, which can be propagated through divisions.

23.2.3. Layering
Layering is a method of inducing root formation by providing routine medium while the stems are still attached to their parent plant.

23.2.4. Tissue Culture
Tissue culture is the growth of plant cells in an artificial medium derived from living tissue using knowledge of plant biology.

23.2.5. Budding
Budding is a method in which a plant bud is transferred or inserted onto the stem of another growing plant or rootstock.

23.2.6. Grafting
A method of joining the parts of the plant consisting of rootstock and scion (young shoot or twig of a plant, especially one cut or separated for grafting or rooting) so they will grow as one whole plant.

24. Conservation Status of the Medicinal Plants

24.1. Extinct

Extinction is the termination of an organism or of a group of organisms (taxon), normally a species. It is generally considered to be the death of the last individual of the species, and there are no surviving individuals that can reproduce and create a new generation.
More than 99% of all species, amounting to over five billion species that have ever lived on Earth, are estimated to have died out.
Estimates on the number of Earth's current species range from 10 million to 14 million, of which about 1.2 million have been documented and over 86 per cent have not yet been described.

24.2. Extinct in the Wild

Species categorised by the IUCN as known only by living members kept in captivity or as a naturalised population outside their historic range due to massive habitat loss.

24.3. Critically Endangered

Species facing an extremely high risk of extinction in the wild as categorised by the IUCN. As of 2014, there are 2104 plant species with this assessment. To be defined as CR, a species must meet any of the following criteria. (3G/10Y whichever is longer-over a maximum of 100 years; MI).

24.3.1. Occurring over less than 100 km² and two of:

- Severe habitat fragmentation or existing at just one location.
- Decline in extent of occurrence, area of occupancy, area, extent, quality of habitat, number of locations/subpopulations, or amount of MI.
- Extreme fluctuations in extent of occurrence, area of occupancy, number of locations/subpopulations, or amount of MI.

24.3.2. As above, but less than 10 km² (used to show differing levels of severity).

24.3.3. Declining population of less than 250 MI and either:

- A decline of 25% over 3G/10Y;
- Extreme fluctuations, or over 90% of MI in a single subpopulation, or no more than 50 MI in any one subpopulation.

24.3.4. Numbers less than 50 MI.

24.3.5. At least a 50% chance of going Extinct in the Wild over 3G/10Y.

24.4. Endangered

Species categorised as very likely to become extinct. It is the second most severe conservation status for wild populations in the IUCN's schema after CR. In 2012, the IUCN Red List featured 2655 plant species as EN worldwide.

24.5. Vulnerable

Species that are likely to become endangered unless the circumstances that are threatening their survival and reproduction improve. VU is mainly caused by habitat loss or destruction of the species' home. There are currently 6789 plants classified as vulnerable.

24.6. Near-Threatened

Species that may be considered threatened with extinction in the near future.

24.7. Conservation-Dependent

Species dependent on conservation efforts to prevent them from becoming threatened with extinction. As of December 2015, there remain 209 conservation-dependent plant species.

24.8. Least-Concern

Species that are evaluated but not qualified for any other category as Threatened, NT or CD. Species cannot be assigned the LC category unless they have had their population status evaluated, i.e. adequate information is needed to make a direct or indirect assessment of their risk of extinction based on their distribution or population status. There are 1500 plant taxa (1410 species, 55 subspecies and 35 varieties) under this category.

24.9. Data Deficient

Species offering insufficient information for a proper assessment of conservation status to be made. This does not necessarily indicate that the species has not been extensively studied, but it does indicate that little or no information is available on the abundance and distribution of the species.

24.10. Not Evaluated

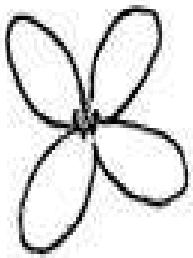
Species which have been categorised under the Red List of threatened species as not yet having been assessed. By 2015, the IUCN had assessed and allocated conservation statuses to over 76,000 species worldwide. From these, it had categorised some 24,000 species as globally threatened at one conservation level or another.

ANNEXURE-I-Quick Reference Card

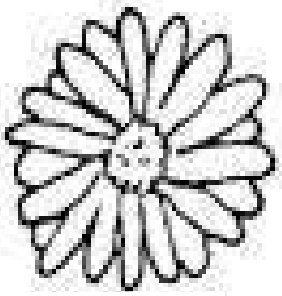
Shapes of the Flower



Campanulate



Cruciform



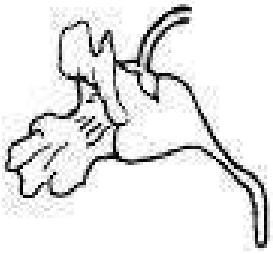
Head



Papilionaceous



Funnel-form



Spurred



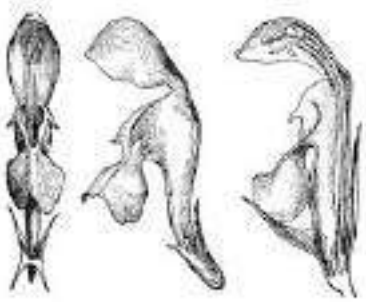
Stellate



Trumpet



Tubular



Labiate



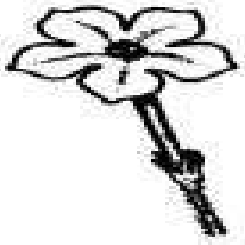
Urceolate



Coronate



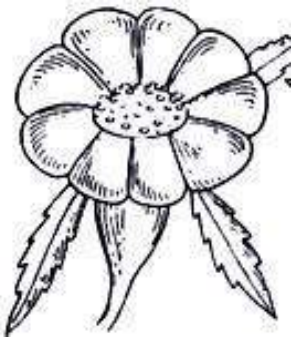
Rotate



Salver-form



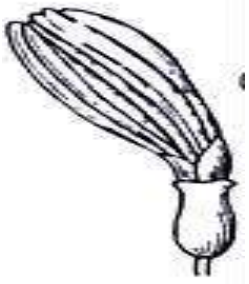
Caryophyllaceous



Rosaceous

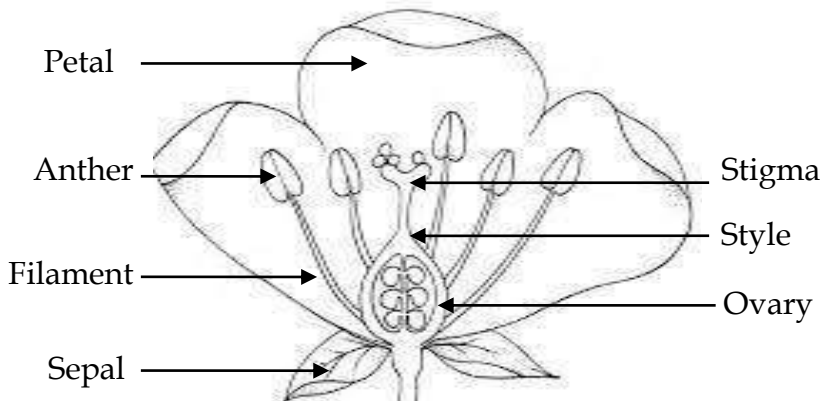


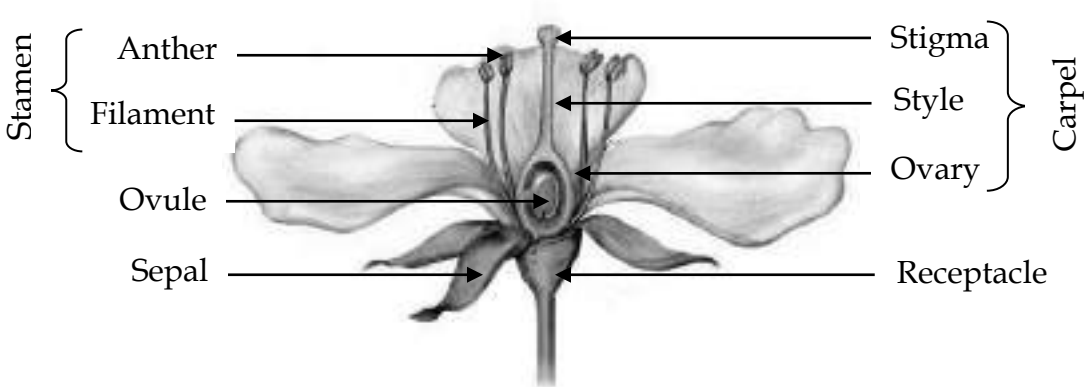
Personate



Ligulate

Characteristics of the Flower





Classification of flower based on position of Ovary



Hypogynous (Ovary Superior)

Perigynous (Ovary Half-inferior)

Epigynous (Ovary Inferior)

Type of Leaf



Simple



Ternately Compound



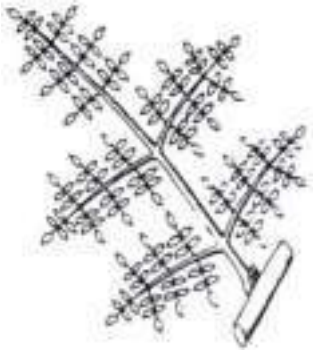
Palmately/Digitately Compound



Pinnately Compound



Bipinnately Compound



Tripinnately Compound

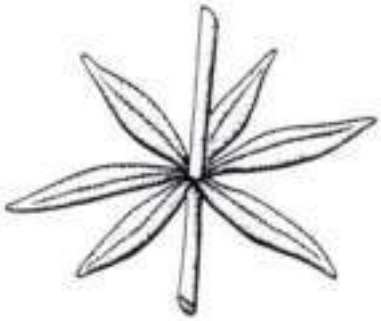
Leaf Arrangement



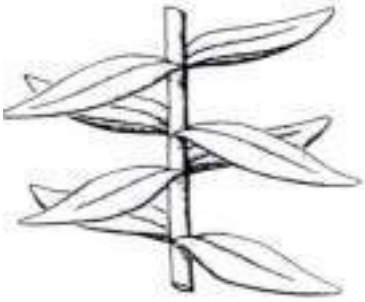
Alternate



Opposite



Whorled



Opposite and Decussate(leaves rotated at 90 degree at adjacent nodes)



Opposite and Decussate



Alternate and Distichous



Fascicied

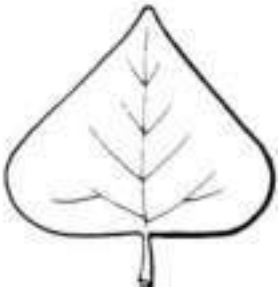
Shape of the Leaf



Acicular



Cordate



Deltoid



Elliptic



Lanceolate



Linear



Lyrate



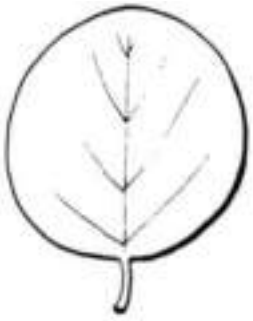
Obcordate



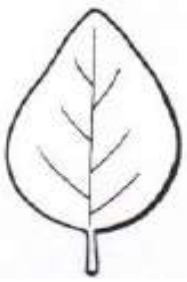
Oblong



Obovate



Orbicular



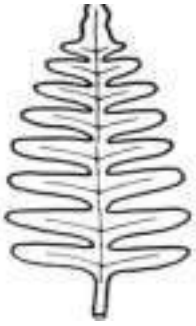
Ovate



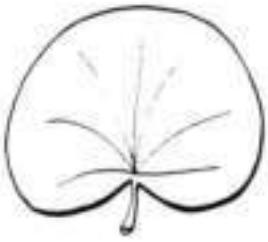
Palmate



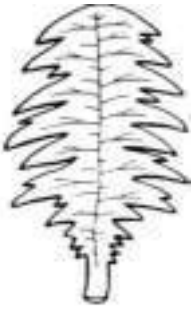
Pectinate



Pinnatified



Reniform



Runicinate



Spatulate

Leaf Apex



Acuminate



Acute



Apiculate



Aristate



Emarginate



Mucronate



Obtuse



Retuse



Rounded

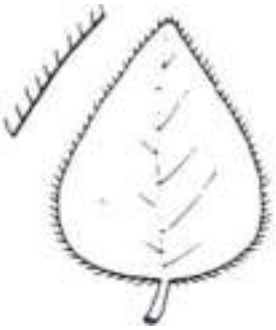


Tidentate

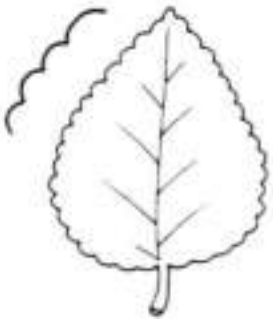


Truncate

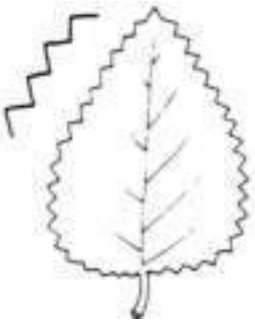
Leaf Margin



Ciliate



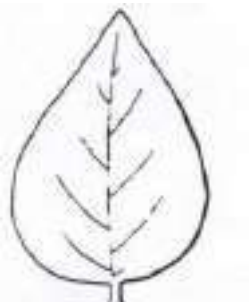
Crenate



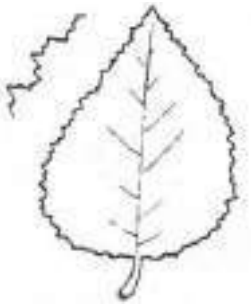
Dentate



Denticulate



Entire



Erose



Lobed



Revolute



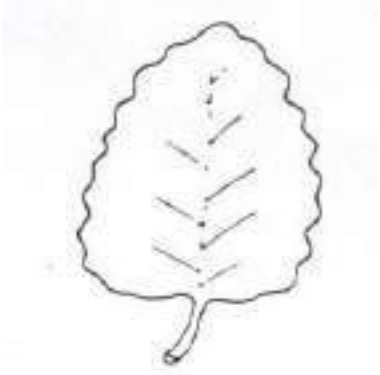
Serrate



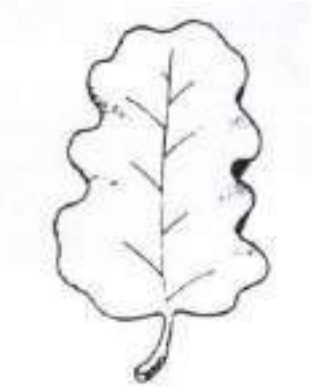
Serrulate



Doubly serrate



Sinuate



Undulate

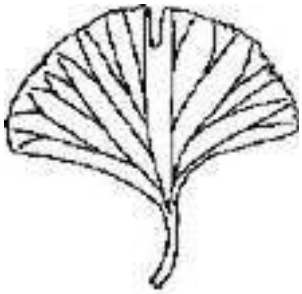
Leaf Venation



Arcuate



Cross-Venulate



Dichotomous



Longitudinal



Palmate



Parallel



Pinnate

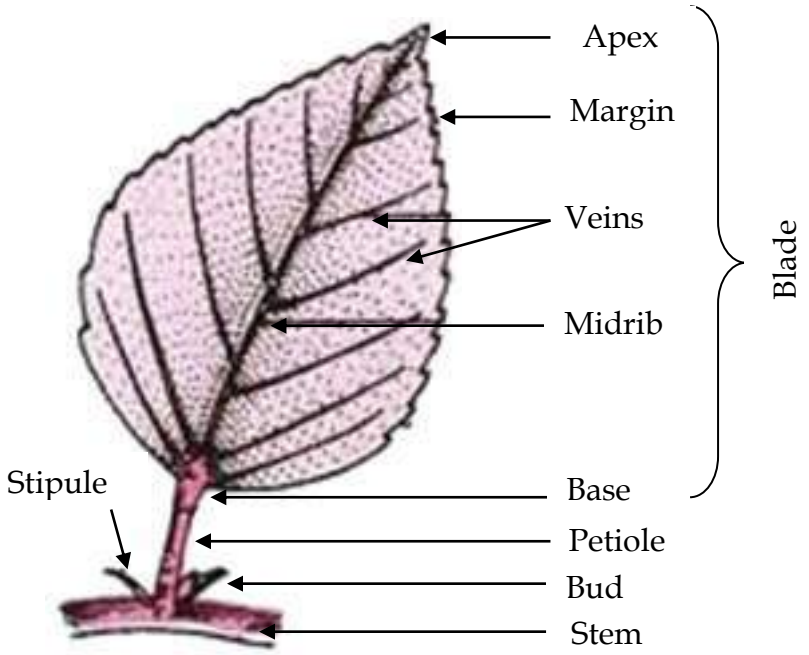


Reticulate



Rotate

Parts of a Leaf



Classification of leaf and petal based on their count



Trimerous Leaves/petal multiple of 3

Tetramerous Leaves/petal multiple of 4

Pentamerous Leaves/petal multiple of 5

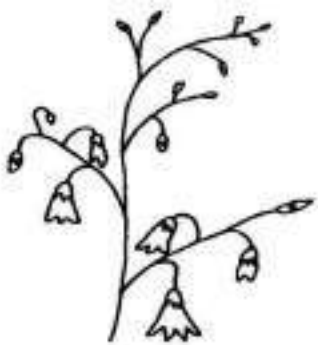
Inflorescence Type



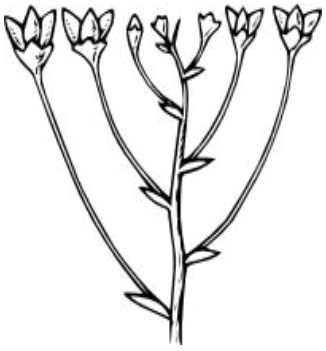
Spike



Receme



Panicle



Corymb

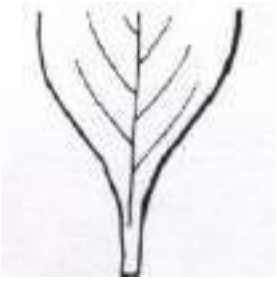


Umbel

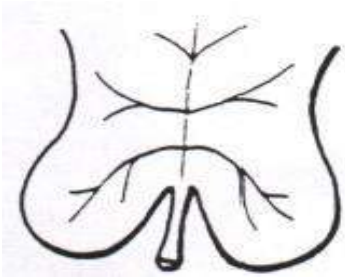


Helicoid cyme

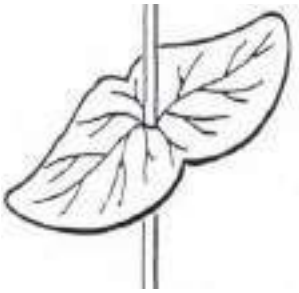
Leaf Base



Attenuate



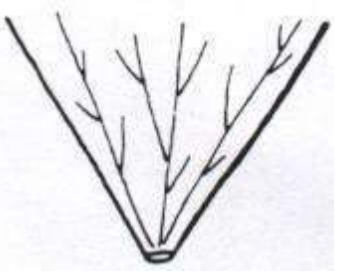
Auriculate



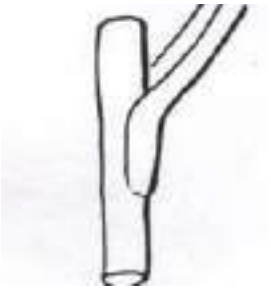
Connate Perfoliate



Cordate



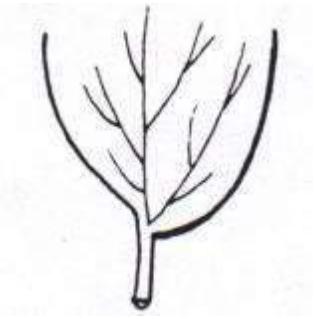
Cuneate



Decurrent



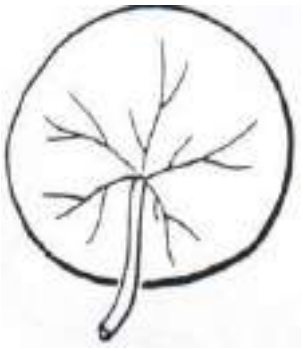
Hastate



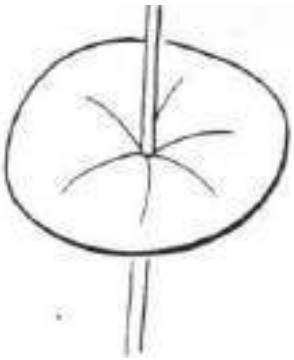
Oblique



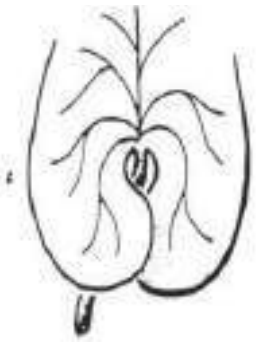
Obtuse



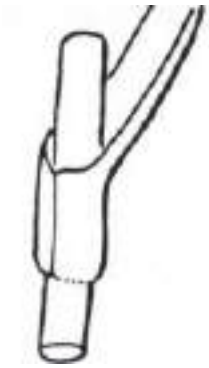
Peltate



Perfoliate



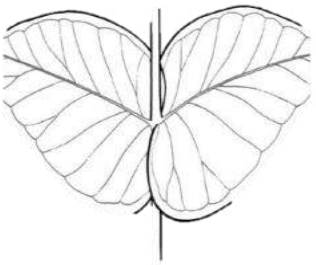
Sagittate



Sheathing

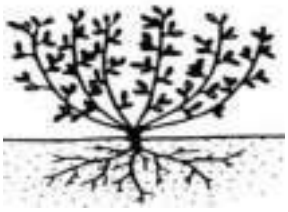


Truncate

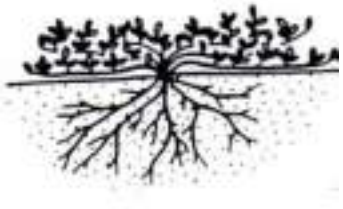


Sessile

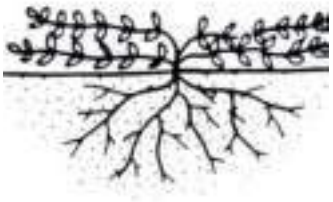
Above the Ground Stem System



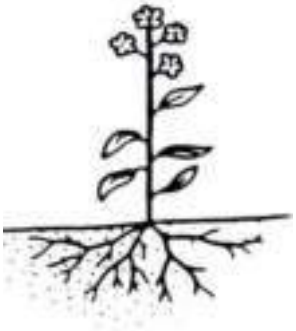
Ascendent



Decumbent



Procumbent



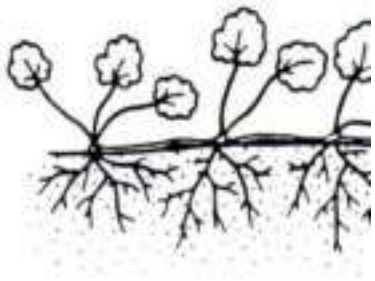
Erect and Caulescent



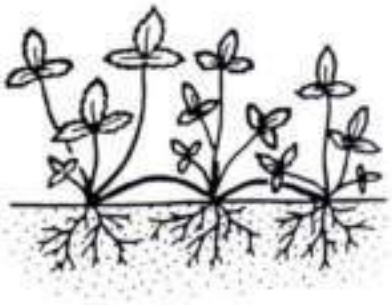
Erect and Acaulescent



Thorn

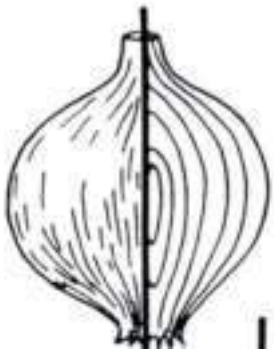


Repent

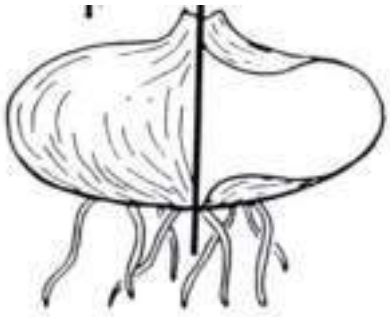


Stolon

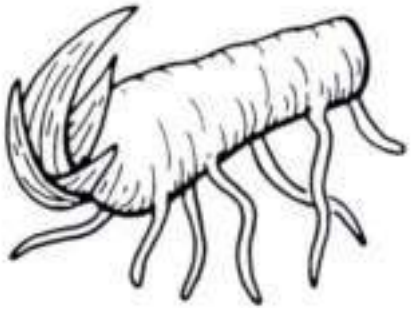
Underground Stem System



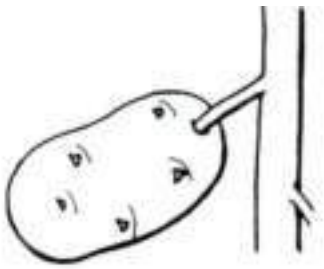
Bulb



Corm

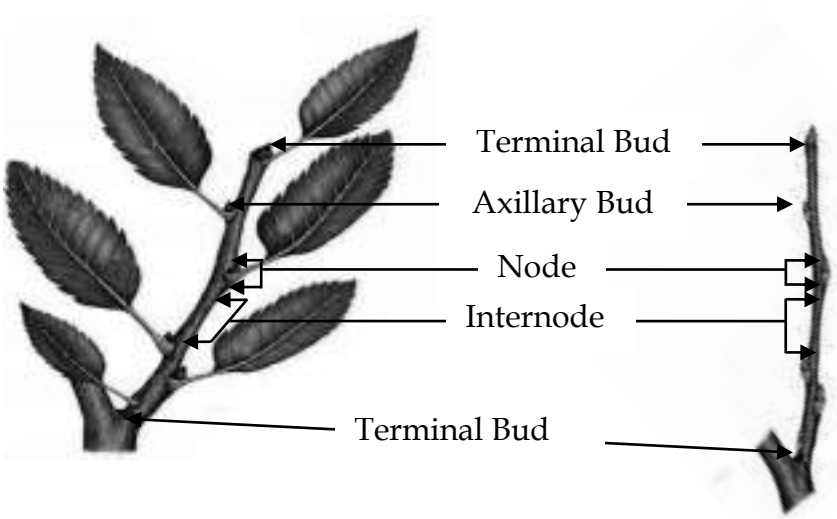


Rhizome

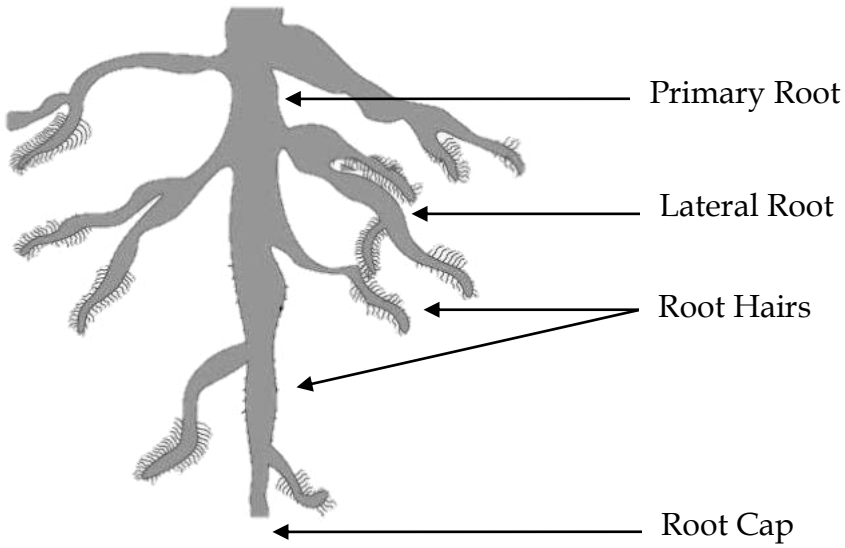


Tuber

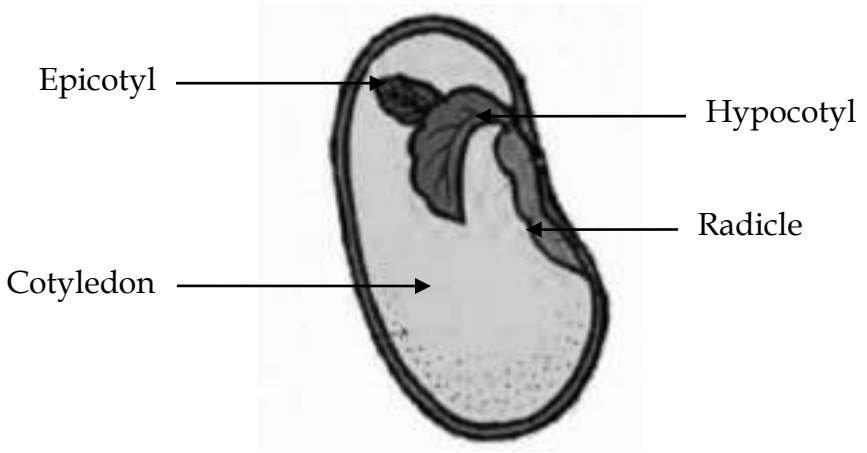
Stem - Arrangement

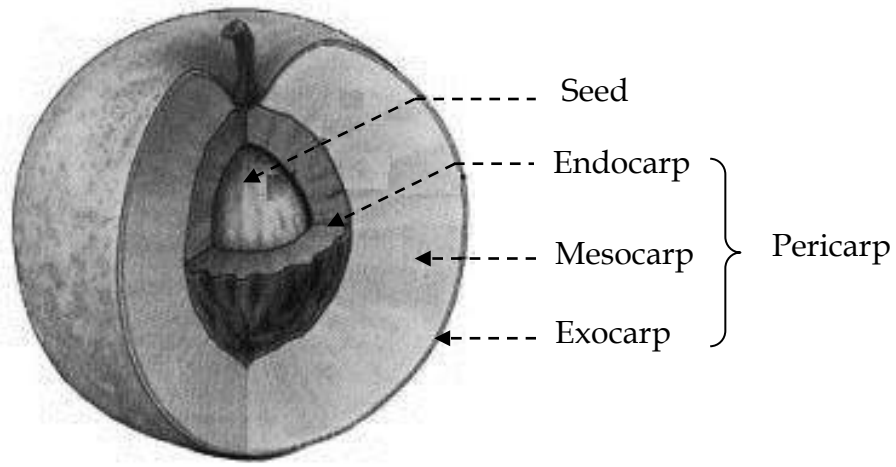


Parts of Root



Seed - Anatomy





ANNEXURE-II-Survey and Mapping FORM-I

FORM-A

1. Location Detail

Dzongkhag	
Drungkhag	
Gewog	
Village/Chiwog	
GPS Coordinate	
Elevation (masl)	
Slope Aspect	
Slope Gradient	
Forest Type	
Habitat	
Date (dd/mm/yyyy)	
Other (specify)	
Forest Type: A-Fir forest B-Mixed Conifer forest C-Blue Alpine forest D-Chir-pine forest E-Broadleaved conifer forest F-Broad-leaved hardwood forest G-Evergreen oak forests H-Cool broad-leaved forests I-Forest Scrub	
Habitat: A-Scree B-Meadow C-Grasslands D-Woodland E-Wetland F-Shrub land	

2. Plot Data

PLOT No:						
TRANSECT POSITION (M) :						
Sl #	**NAME**		**DIST**	**HEIGHT (mm/cm/m)**	**COUNT**	**COVER (%)**
	Sorig	**Botanical**				
Distribution: A- Sporadic B- Patchy C–Uniform						

3. Enumerators Detail

Assessment Date (dd/mm/yyyy)	
Name and Designation	
Mobile no	
Work Station	
Other Remarks	

ANNEXURE-III-Survey and Mapping FORM-II

FORM-B

1. Naming

Sorig	
Botanical	
Local/Common	
Synonym	

2. Classification

Family	
Genus	
Species	
Monocot	
Dicot	

3. Location Detail

Dzongkhag	
Drungkhag	
Gewog	
Village/Chiwog	
GPS Coordinate	
Elevation (masl)	
Slope Aspect	
Slope Gradient	

4. Vegetation Description

Forest Type	
Dominant Species	
Other (specify)	

5. Habitat (tick)

Scree	Meadow	Grasslands	Woodland	Wet land
Shrub land	Other (specify)			

6. Flower Description

6.1. Shape (tick)		
Campanulate	Cruciform	Head
Paailionaceous	Funnel-form	Spurred
Stellate	Trumpet	Tubular
Labiate	Urceolate	Coronate
Rotate	Salver-form	Caryophyllaceous
Rosaceous	Personate	Ligulate
Others (specify)		

6.2. Characteristics							
Classification	Sepal	Petal	Anther	Filament	Ovary	Style	Stigma
Yes/No							
Colour							
Measurement							
Count							
Others (specify)							
Unit of Measurement = (mm/cm)							

7. Leaf Description

7.1. Type (tick)		
Simple	Ternately Compound	Palmately/Digitately Compound
Pinnately Compound	Bipinnately Compound	Tripinnately Compound
Others (specify)		

7.2. Leaf Arrangement (tick)			
Alternate	Alternative Decussate	Opposite Decussate	Bipinnate
Even Pinnate	Fascicled	Odd Pinnate	Perfoliate
Opposite	Rosette	Tripinnate	Peltate
Unifoliate	Trifoliate/Ternate	Whorled	
Others (specify)			

7.3. Shape (tick)					
Acicular	Cordate	Deltoid	Elliptic	Ensiform	Lanceolate
Linear	Lyrate	Obcordate	Oblong	Obovate	Orbicular
Palmate	Pectinate	Pinnatifid	Reniform	Renucinate	Spatulate
Ovate	Others (specify)				

7.4. Surface Features (tick)			
Glabrous	Glaucous	Glaucescent	Resinous
Pubescent	Tomentose	Others (specify)	

7.5. Apex (tick)			
Acuminate	Acute	Apiculate	Aristate
Emarginate	Mucronate	Obtuse	Retuse
Rounded	Tridentate	Truncate	
Others (specify)			

7.6. Margin (tick)			
Ciliate	Crenate	Dentate	Denticulate
Entire	Lobed	Serrate	Sinuate
Serrulate	Spiny	Doubly Serrate	Undulate
Erose	Others (specify)		

7.7. Venation (tick)		
Arcuate	Cross-venulate	Dichotomous
Longitudinal	Palmate	Parallel
Pinnate	Reticulate	Rotate
Others (specify)		

7.8. Leaf Attachment to the Stem (tick)		
Petiolate	Sessile	Clasping
Others (specify)		

7.9. Leaf Base (tick)			
Attenuate	Auriculate	Connate perfoliate	Cordate
Cuneate	Decurrent	Hastate	Oblique
Obtuse	Peltate	Perfoliate	Sagittate
Sheathing	Truncate	Others (Specify)	
Unit of Measurement = (mm/cm)			

8. Stem Description

8.1. Inflorescence Types (tick)		
Spike	Receme	Panicle
Corymb	Umbel	Helicoid Cyme
Head	Others (specify)	

8.2. Above the Ground Stem System (tick)			
Ascendent	Decumbent	Erect and Caulescent	Erect and Acaulescent (Scapose)
Procumbent	Repent	Stolon	Thorn
Others (specify)			

8.3. Underground Stem System (tick)			
Bulb	Corm	Rhizome	Tuber
Others (specify)			

8.4. Stem Surface Features (tick)			
Glabrous	Glarbrate (Glabrescent)	Glaucous	Glaucescent
Resinous	Pubescent	Puberulent	Tomentose
Others (specify)			

8.5. Measurement	
Height of the Plant	
Unit of Measurement = (mm/cm/m)	

9. Seed Description

9.1. Characteristics				
Classification	Epicotyl	Hypocotyl	Cotyledon	Radicle
Yes/No				
Colour				
Measurement				
Others (specify)				
Unit of Measurement = (mm/cm)				

10. Fruits Description

10.1. Characteristics			
Classification	Endocarp	Exocarp	Mesocarp
Yes/No			
Colour			
Measurement			
Others (specify)			
Unit of Measurement = (mm/cm)			

11. Roots Description

11.1. Types (tick)			
Fleshy Roots	Tuberous Roots	Storage Roots	Buttress Roots
Contractile Roots	Haustoria	Prop Roots	Pneumatophores
Aerial Roots	Others (specify)		

11.2. Characteristics			
Classification	Primary	Lateral	Root Hairs
Yes/No			
Colour			
Measurement			
Others (specify)			
Unit of Measurement = (mm/cm)			

12. Soil Description

12.1. Types (tick)			
Loamy	Sandy Loam	Sandy Clay Loam	Clayey Loam
Clay	Silty Clay	Sandy Clay	Sandy
Silty	Peaty	Chalky	
Others (specify)			

12.2. Characteristics	
Soil pH	
Soil Hardness	

13. Life Upan (tick)

13.1. Flower			
Herbaceous	Annual	Biennial	Perennial
Woody	Deciduous	Evergreen	
Others (specify)			

13.2. Leaf			
Herbaceous	Annual	Biennial	Perennial
Woody	Deciduous	Evergreen	
Others (specify)			

13.3. Stem			
Herbaceous	Annual	Biennial	Perennial
Woody (ligneous)	Tree	shrubs	Bushes
Others (specify)			

14. Parts Used (tick)

Flower	Bulb	Stem	Inner Bark
Outer Bark	Tuber	Rhizomes	Leaves
Seeds	Fruits	Resin	Whole Plants
Aerial Part	Others (Specify)		

15. Propagation Method

15.1. Sexual (tick)	
Seed	Wilding
Others (specify)	

15.2. Asexual (tick)		
Cutting (Stem, Root and leaf)	Division	Layering
Tissue Culture	Budding	Grafting
Others (specify)		

16. Conservation Status (tick)

Extinct	Extinct in the wild	Critically endangered
Endangered	Vulnerable	Near-threatened
Conservation-dependent	Least-concern	Data deficient
Not evaluated	Others (specify)	

17. Enumerators Detail

Assessment Date (dd/mm/yyyy)	
Name and Designation	
Mobile no	
Work Station	
Other Remarks	

ANNEXURE-IV-Survey and Mapping FORM-III

FORM-C

1. Respondent Detail

Name	
Age	
Gender	
Village	
Gewog	
Dzongkhag	
Office and Position	

2. Naming

Sorig	
Botanical	
Local/Common	
Synonym	

3. Parts Used and Collection Period

Collection Period	J	F	M	A	M	J	J	A	S	O	N	D
Aerial Parts												
Whole Plant												
Underground Part												
Other (specify)												
A-Bulb B-Stem C-Bark (outer/inner) D-Tuber E-Rhizomes F-Leaves G-Seeds H-Fruits I-Flower J-Resin												
Others (Specify)												

4. Collection Methods

5. Propagation and Cultivation Methods

5.1. Sexual (tick)	
Seed	Wilding

5.2. Asexual (tick)		
Cutting (Stem, Root and leaf)	Division	Layering
Tissue Culture	Budding	Grafting
Others (specify)		

6. Health Benefits

Disease/Ailment	

7. Value (Nu. Per Kg)

Wet	
Dry	

8. Annual Requirement (Kg)

Name of the Company	Quantity

9. Annual Collection

Name of the Company	Year	Quantity

10. Formulation (TM - Drugs)

Name of the Drugs/Herbal Products	Vital	Essential	Non-Essential
Others (specify)			

11. Formulation (Commercial Products)

Name of the Product	Value (Nu)	Annual Production (Kgs)

12. Enumerators Detail

Assessment Date (dd/mm/yyyy)	
Name and Designation	
Mobile no	
Work Station	
Other Remarks	

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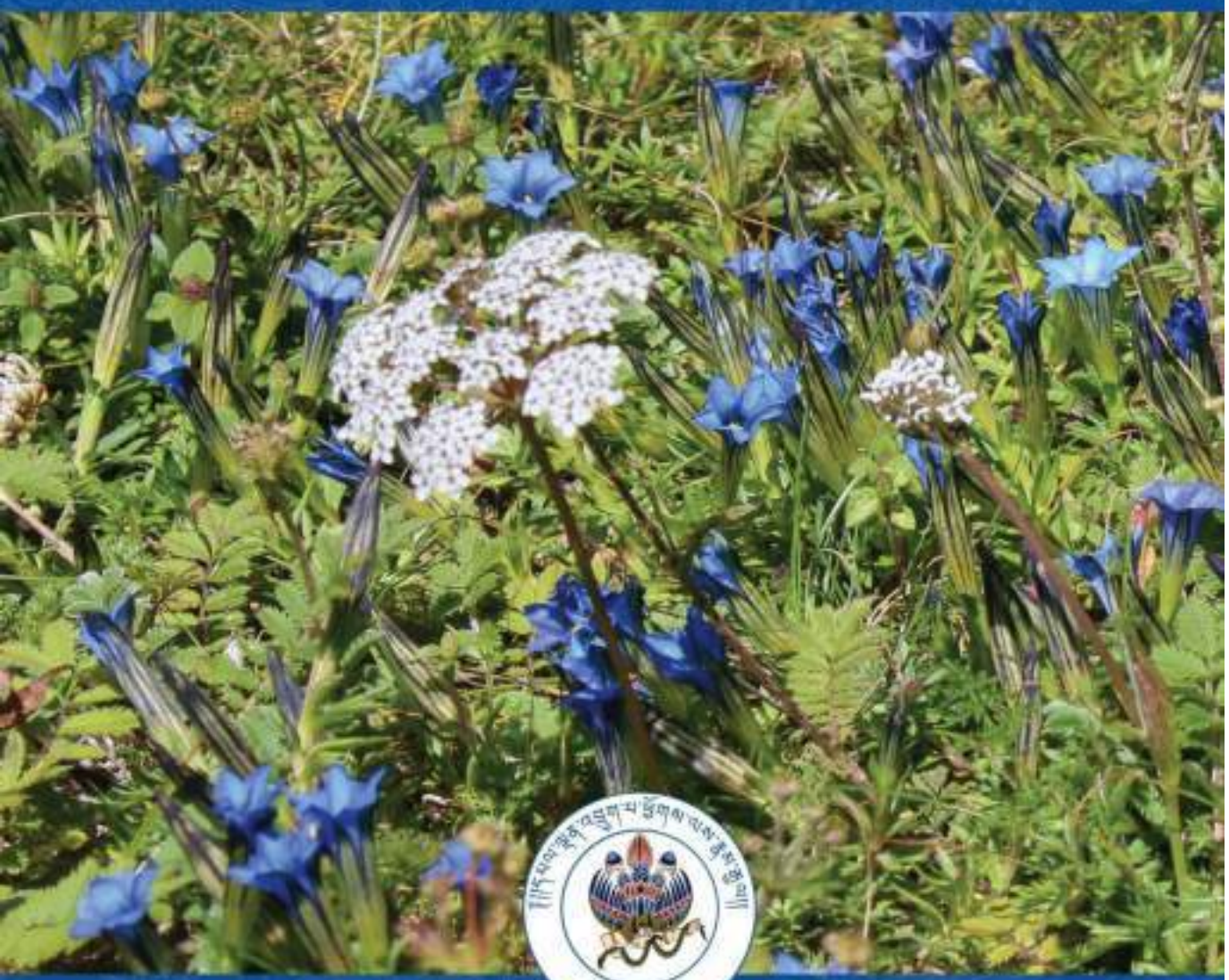
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Department of Traditional Medicine Services
Ministry of Health, Thimphu
Royal Government of Bhutan
PABX: +975-2-338834, Fax No. 338837
PO Box: 297
www.health.gov.bt