



In Search of Sacred

GIANTS

An Assessment of Tsenden Forests in Bhutan



UGYEN WANGCHUCK INSTITUTE
FOR
CONSERVATION AND ENVIRONMENT



SOCIAL FORESTRY & EXTENSION DIVISION,
DEPARTMENT OF FORESTS & PARK SERVICES





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Foreword

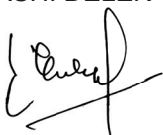
Despite the Tsenden's cultural significance and deep roots in Bhutan's mythical and historical past, very little is known about this celebrated tree's ecology and natural history in terms of scientific forestry. Thus it was felt highly important to document the Tsenden's morphology, values and uses, silvicultural behaviour, occurrence and distribution throughout the country. This report is a technical exposition of the nationwide Tsenden mapping project depicted in the documentary film *In Search of Sacred Giants* released in 2011, produced by the Ugyen Wangchuck Institute for Conservation and Environment (UWICE) and the Information and Communication Services (ICS) of the Ministry of Agriculture and Forests, with financial support from the Bhutan Trust Fund for Environmental Conservation (BT FEC).

The nationwide survey and mapping of native Tsenden was initiated by the Ugyen Wangchuck Institute for Conservation and Environment and the Social Forestry and Extension Division (SFED) to generate baseline information critical for present and future management of Tsenden. The main objective of this exercise was to create a greater avenue to protect, conserve, and manage existing natural Tsenden forests by enhancing natural regeneration. The outcome of this survey and mapping report places emphasis on conservation of important native Tsenden forests through the establishment of a gene-bank and continued promotion of plantation programmes at the national level.

This project also undertook documentation of the historical and cultural significance of outstanding Tsenden trees throughout the country. These significant lone standing trees attest to the value and care given them by their surrounding communities, and that traditional beliefs and concerns of local people need to be considered for the effective conservation, protection and sustainable management of this valuable species.

I would like to congratulate and extend my warm appreciation to the SFED and to UWICE, and particularly to those individuals who were involved in the field exercise, for producing this informative report on the native Tsenden or *Cupressus comeyana*, the national tree of Bhutan. I urge all stakeholders to make use of this information in managing our Tsenden resources rationally and wisely.

TASHI DELEK



Director General

Department of Forest and Park Services



Abstract

This nationwide survey and inventory indicates that Bhutan's native Tsenden (*Cupressus corneyana*) occurs within an altitudinal range of 1,800 to 2,600 meters above sea level (masl). Native Tsenden are found on steep rocky precipices in the most remote parts of Punakha, Wangdue Phodrang, Lhuntse and Trashigang Dzongkhags. The distribution of both plantation and significant lone Tsenden is much wider than that of natural Tsenden forests: these have been recorded as low as 300 masl and can be seen even in Phuntsholing. Most of the significant lone Tsenden trees¹ recorded in this survey are found around important historical monuments and sacred places of religious and cultural significance, and are believed to have grown from the walking sticks of Guru² Rinpoche, Zhabdrung³ and Phajo Drujom Zhigpo⁴. Tsenden trees found in and around villages in different regions throughout Bhutan are also believed to be the sacred abodes of local guardian deities. Bhutanese pay deep respect to these trees.

Ecologically, the Tsenden forest is an indicator of intact and untouched forest ecosystems, where there has been very little or no human disturbance. The typical structure of Tsenden forests is that Tsenden always occupies the top canopy compared to other associate species. The Tsenden associates are invariably cool broadleaved and conifers species and its density varies with altitude and humidity of the particular location.

Tsenden extraction for the construction and renovation of dzongs and important monuments in Bhutan over the centuries is one of the major threats that have restricted the occurrence of native Tsenden forests to remote and difficult to reach areas. The die-back of mature Tsenden is another observed natural phenomenon that may be endangering the existence of Bhutan's natural Tsenden forests. Forest fire and grazing may also be endangering factors that need to be understood for better management of viable Tsenden populations in the wild.

Strict control on the logging of Tsenden forests is necessary until the regeneration ecology and growth dynamics of Tsenden forests are understood comprehensively. Study on the impact of forest fire and browsing on Tsenden regeneration, on the drought tolerance of seedlings and on soil preferences and competition for light are some of the urgent actions that will foster the sustainable utilization and conservation of Bhutan's remaining Tsenden forests. Establishment of nurseries and gene bank are some of the additional crucial actions needed for the promotion and conservation of native Tsenden in Bhutan.

-
- 1 Tsenden trees occurred singly around important monuments and sacred sites are considered *significant lone Tsenden*
 - 2 An emanation of the Buddha Amitaba, a great yogi who brought Buddhism to Tibet and Bhutan in 8th century
 - 3 A Tibetan saint from drukpa lineage who visited Bhutan in 16th century and unifier of Bhutan as a nation state
 - 4 A Tibetan saint who first introduced Drukpa Kagyud Buddhist traditions in Bhutan



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In Search of Sacred Giants: An Assessment of Tsenden Forests in Bhutan, is the product of the concerted efforts of many individuals and Institutions. Without their immense support and guidance, the report would not have materialised. We are hopeful that the information generated and presented in this report will be of significant benefit to readers and natural resource managers and will contribute towards the conservation of the Tsenden (*Cupressus corneyana*), the national tree of Bhutan.

We would like to offer our sincere gratitude to the Honourable Minister, Lyonpo Dr. Pema Gyamtsho, for his visionary leadership, guidance and continuous support. Indeed it was Lyonpo's personal initiative and support that made it possible to undertake this very crucial study with financial support from the Bhutan Trust Fund for Environmental Conservation. Our deep appreciation and most sincere thanks to Dasho Sherub Gyeltshen, Honourable Secretary, Ministry of Agriculture and Forests, and to Mr. Karma Drukpa, Director General, Department of Forests and Park Services, for their unwavering support. We are very grateful to Mr. Sherub, Chief, Research and Education, UWICE, for his skilful guidance and invaluable advice throughout this study.

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Introduction

1





1. Introduction

1.1. Background

Cupressus is one of three plant genera in the *Cupressaceae* family. The other two plant genera in this family are *Thuja* and *Juniperus*. Within the *Cupressus* genera, there are three species (*C. corneyana*, *C. torulosa* and *C. cashmeriana*). *Cupressus corneyana*, locally known as Tsenden, is the national tree of Bhutan and considered to be endemic to Bhutan. Ecologically, *C. corneyana* is a light-demanding pioneer species, initiating primary forest succession and secondary succession after the destruction of the broadleaved understory due to episodic fires (Miehe & Gurung, 1999). It requires rugged terrain with well-drained subsoil and a cool, moist and temperate atmosphere.

Timber from the Tsenden is very durable and good for making cabinetry and furniture and resistant to rot fungi and borer insects. Its unequalled qualities of strength, durability and uniform length make it the finest and most sought after construction material for dzongs and monasteries. The sacredness of the Tsenden means that every part of the tree is treasured and used, for example in incenses and medicines. Despite its significance as Bhutan's national tree and a plethora of historical and cultural values attached to it, there is very limited information on Tsenden forests in Bhutan. A short study conducted by the Bhutan-German Sustainable RNR Development Project in 1999 in the Wangdue and Punakha areas indicated that the altitudinal range of natural Tsenden distribution in Bhutan is at least as wide as that of Blue Pine, from 1600 masl to 3100 masl (Miehe & Gurung, 1999). The natural distribution of Tsenden in Bhutan remains unknown and very little understanding on its ecological requirements and growth dynamics exists.

There is a high risk that Bhutan's native Tsenden forests might disappear before their extent is assessed, their biology and dynamics understood and their gene pool conserved. A nationwide Tsenden survey and mapping project was therefore carried out to collect preliminary data on Tsenden forests and outstanding individual trees nationwide. The project was implemented by a team of researchers from the Ugyen Wangchuck Institute for Conservation and Environment in collaboration with the Social Forestry Division of the Ministry of Agriculture and Forests, with financial support from Bhutan Trust Fund for Environmental Conservation.



1.2. Objectives of the Mapping and Survey

Though Tsenden trees are well-known and eye-catching throughout Bhutan, knowledge concerning the natural occurrence of Tsenden is still rudimentary as no systematic inventory has been done to date. Consequently, nationwide Tsenden survey and mapping was carried out to strengthen the understanding of their distribution, biology, ecological needs and growth dynamics in relation to varying climatic and edaphic factors. The main objectives of the nationwide mapping and survey of Tsenden were to:

- Understand the present distribution of Tsenden forests in Bhutan.
- Generate information on the structure and species composition of Tsenden forests in the wild and in plantation areas.
- Identify threats and conservation issues and understand regeneration dynamics through observation of regeneration in harvested Tsenden forests in the wild.
- Produce Tsenden forest distribution maps to aid identification of natural seed sources for promoting endemic Tsenden forests in Bhutan through plantation.
- Collect socio-historical information on significant lone Tsenden trees.

1.3. Methodology

In order to generate reliable information on the extent of *C. corneyana* (both plantation and natural stands), the survey and mapping was carried out based on the preliminary survey report by the Social Forestry and Extension Division, Department of Forests and Park Services. We also relied on the Bhutan-German Sustainable RNR Development Project report of 1999 and other available information on the distribution of *C. corneyana* reported in the past. Additionally, oral histories on the existence of Tsenden forests in different locations were sought from elderly people in different communities.

Based on the information drawn from the above sources, the survey and mapping team visited and enumerated all the significant lone Tsenden trees around important monuments and all the accessible natural stands in the wild. Coordinates for each lone Tsenden tree, plantation and natural stand were collected and recorded using eTrex Garmin GPS units. Ecological parameters (height, diameter, canopy density, slope, aspect, and soil) were enumerated and recorded for natural stands as well as plantation forests within circular plots of 12.62 meters radius. Associate tree species, herbs, shrubs and evident regeneration of Tsenden and other associate tree species



were recorded. Short semi-structured interviews were also carried out with elderly people in some of the villages to gain an understanding of the variety of uses for Tsenden and local legends and stories concerning the Tsenden.



**General Distribution of
Tsenden Forests**

2





2. Results

2.1. Spectral Extent of Tsenden Forests in Bhutan

The nationwide survey and inventory indicated that natural Tsenden forest occurs within the altitudinal range of 1800 to 2800 masl, most often on steep rocky slopes and in the remotest parts of Punakha, Wangdue Phodrang, Lhuntse and Trashigang (Figure 1). The distribution for the plantation Tsenden is wider than for natural Tsenden forests and is recorded as low as 300 masl in Phuntsholing (though this is most probably the Indian cultivar *C. cashmeriana* and not *C. corneyana*). Most significant lone Tsenden trees are found around important historical monuments and sacred places of religious and cultural significance.

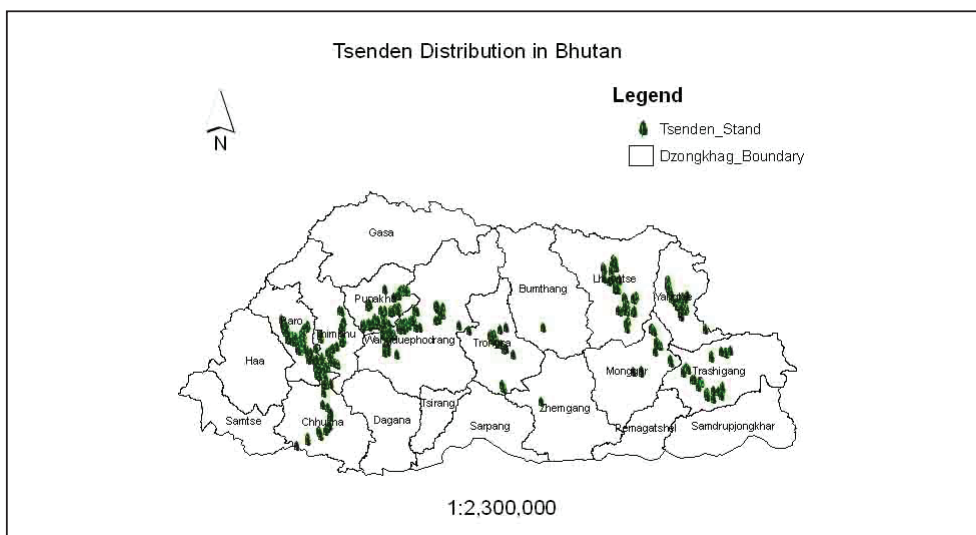


Figure 1: General Distribution of Tsenden in Bhutan

2.2. Natural Tsenden Forests

Natural Tsenden forests occur in steep rugged terrain and extremely harsh climatic conditions in the valleys of Punakha, Wangdue Phodrang, Lhuntse and Trashigang within the altitudinal range of 1800 to 2800 masl.

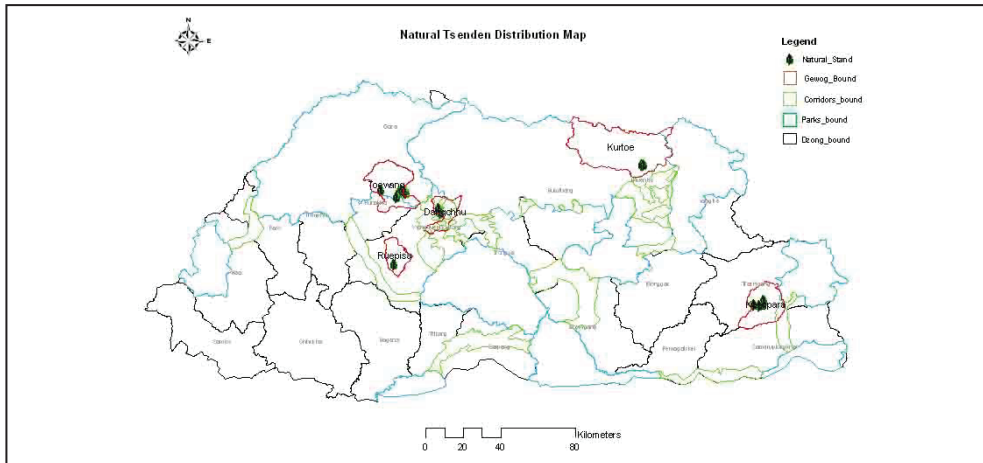


Figure 2: Distribution of Natural Tsenden Forests in Bhutan

In Punakha, the natural Tsenden population occurs in the upper Pho Chhu valley in two locations: a) Tsenden Nang Na and b) on the rides of Si Chhu valley. In both locations, the Tsenden forests occur on very steep rugged and rocky terrain devoid of human habitation. Accessing these Tsenden forests is extremely difficult as they are located on exceptionally steep ridges and valleys surrounded by huge gorges and steep mountains. The ridges of Tsenden Nang Na and Si Chhu valley are at equal height facing each other, separated by the Ngoe Chhu by a distance of 1 kilometre (crow flight distance). Tsenden Nang Na is a full day's gruelling walk from Tamidamchoe, one of the last permanent settlements before reaching the natural Tsenden forest. Similarly, access to the natural scattered Tsenden forest above the Si Chhu valley is from Jibjokha (Samdinkha) along the north bank of the Pho Chhu to Kewa Nang village (6 hours' walk). From Kewa Nang it takes another two days to reach the periphery of the natural Tsenden stand. This wild and turbulent tributary river is a natural barrier that prevents access to the upper reaches of the Pho Chhu for most of the year. There is no suspension bridge and the river can only be crossed during winter (from late November until early April). This valley has a greater extent of Tsenden distribution than does the Ngoe Chhu valley (Tsenden Nang Na), with more scattered distribution and stronger competition from *Quercus* and rhododendrons in rocky sites. The lower Si Chhu appeared to be less humid than the Ngoe Chhu but Blue Pine was not observed in the upper valley: it seemed to be restricted to the frequently burnt vicinity of Gangi Nang. The upper reaches of the Si Chhu showed traces of past fire incidences, which caused a patchy distribution of different regeneration stages.



Plate 1: Mixed Tsenden-Oak-Hemlock forest on the Ngoe Chhu ridge, Punakha (April 2011)



Plate 2: Tsenden stand on the upper ridges of the Si Chhu along the north bank of the Pho Chhu, Punakha (April 2011)



Plate 3: View of Tsenden stand at Si Chhu and Ngoe Chhu ridges from Tamidamchoe, the last settlement before the Tsenden Nang Tsenden forests (April 2011)

In Wangdue Phodrang, natural stands of Tsenden can be seen in two different locations, viz. in the Nobding-Dang Chhu area (Nyichhu Phug) and in Chuselumba. The upper Dang Chhu (Nyichhu Phug) catchment probably had extensive areas of Tsenden forests in the past as one can find numerous Tsenden stumps and dead Tsenden logs in the area but relics now survive far from settlements. A few scattered trees in small groups can be seen above and below the road some kilometres west of Nobding in the Jambaychu catchment area. All the mature Tsenden trees that were observed by Long in 1982 and 1984 along the road have since been cut down for renovation of Taktsang monastery and Punakha dzong (Miehe & Gurung 1999). Opposite Nobding, some small populations of Tsenden occur on the rocky steep flanks of a small tributary valley west of Si Chhu, draining the southern flanks of the Sebjigang range. These were also observed by earlier travellers (Long 1980, Miehe & Gurung 1999). Some scattered natural regeneration of Tsenden can be observed in exposed soils and in steep areas along the cooler valley and under the canopy of big trees such as *Alnus*, *Betula*, *Juglans* and *Pinus wallichiana*.

The most extensive surviving natural Tsenden populations in this area are along the northwest tributary of the upper Dangchhu locally known as Nyichhu Phug (altitude 2500 masl). Roughly 1500 hectares of natural Tsenden occur along the left and



right banks of the Nyichhu Phug with a mix of cool broadleaved tree species and hemlock. The trees in the lower valley seem to have been extracted in the past as there is an old tractor road at the valley bottom that might have been used for timber transportation. Remnants of dead Tsenden logs along the old tractor trail (see plate 4) and Tsenden stumps can be found in the area.



Plate 4: Old tractor trail before entering the Nyi Chhu Phug natural Tsenden stand (Photo, March 2012)

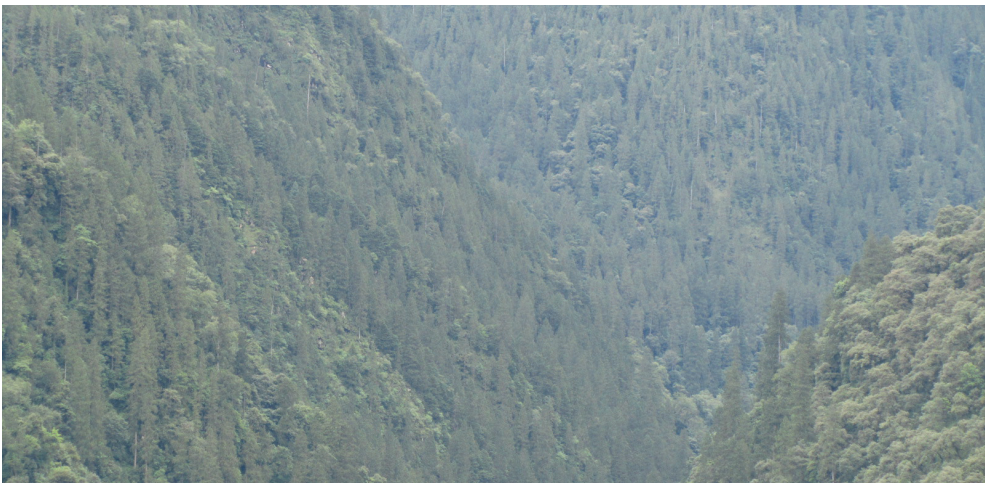


Plate 5: Natural Tsenden stand on the rocky flanks of Nyi Chhu Phug, Wangdue Phodrang (2300 masl)



Plate 6: Nyi Chhu Phug natural Tsenden stand (altitude 2550 masl)

In Chuselumba, a natural Tsenden forest occurs on the steep upper flanks of an eastern tributary valley of the Punatsang Chhu about 15 kilometres south of Wangdue Phodrang. Access to this particular Tsenden stand is from Hisithangkha via Bjaphu, the last village before entering the relic Tsenden forest. There is a farm road until Bjaphu and it takes another 10 walking hours (with porters) to reach the centre of the Tsenden forest near the upper limit of the logging area (2640 masl, 27°24'10"N/89°56'22"E). The lowest relic Tsenden was found on the logging track at 2350 masl and the actual lower margin of the Tsenden dominated forest is traced at 2550 masl. The extent of the Tsenden-dominated forest was estimated in the field at about 500 ha (Gurung 1999). The upper limit of the Tsenden forest is inaccessible due to very steep terrain and rock precipices.

Nearly all exploitable Tsenden trees which were accessible have been harvested for renovation of Punakha Dzong and Taktsang Monastery (Ura and Dompnier, 1999). Tsenden trees adapted to lower altitudes/drier climatic conditions seem to have disappeared from this area and remaining Tsenden trees are largely adapted to rocky sites at higher altitudes and inaccessible rocky precipices. The genetic variety of the Chuselumba Tsenden forest seems to have been impoverished. Strict protection of the relics is strongly solicited as recommended by the BG-SRDP/GTZ project report (Miehe & Gurung 1999).



A small stand of mature Tsenden (approximately 60 trees) of roughly uniform age with diameters ranging from 80m to 130m can be seen immediately above Jalla village. Compared to other natural sites, the slope is very gentle with dark-coloured, deep soil. A soil sample from this area may supplement our understanding of Tsenden dynamics and ecology.



Plate 7: Natural Tsenden stand at Chuselumba, Wangdue Phodrang (April 2012)

In Lhuentse, natural Tsenden stands occur in three different locations—Serzhong, Urgang and Khangphulung. In these locations Tsenden occur in scattered groups with cool broadleaved species such as *Oak*, *Castanopsis*, *Acer*, *Tetracentron*, etc., on very steep terrain and rocky precipices, making it extremely difficult to enter the area. Most of these Tsenden stands are inaccessible either due to the terrain or extremely thick understory layers of *Laurophyllous*, *Daphne*, and *Eurya* species. In these areas, the traditional practice of Ladam and Ridam (restriction of entry into high altitude area) must be taken into consideration when conducting field research, as it may affect access to certain sites. Usually, Ladam and Ridam commences from May until October every year, with some regional variation in dates.



Approximately 10 hectares of natural Tsenden forest occurs above Serzhong village ($27^{\circ}50'02.2''\text{N}/91^{\circ}07'47''\text{E}$) in Kurtoe Gewog. It takes 7-8 hours to walk towards the northwest of Dungkhar valley via Serzhong village. The nearest entry point into the Serzhong Tsenden stand is from Serzhong village, which is located 2 hours (by foot) south of the stand.



Plate 8: Scattered natural Tsenden mixed cool broadleaved species above Serzhong village, Lhuntse at an altitude of 2580 masl (Sept. 2011)

Roughly 20 hectares of natural Tsenden forest occur in Urgang valley, which is west of Nga Lhakhang ($27^{\circ}49'53.3''\text{N}/91^{\circ}04'07.1''\text{E}$). The area is completely inaccessible due to steep terrain, rocky precipices, and a thick understory of shrubs, herbs and bamboos. However, one can get a very clear view from Tergang ($27^{\circ}49'31.5''\text{N}/91^{\circ}04'30.9''\text{E}$), approximately 3 hours' walk east of the Urgang Tsenden stand. Khangphulung is the furthest natural Tsenden stand (approximately 200 hectares) that can be found in Lhuntse Dzongkhag in the corridor between Gangzor and Kurtoe gewogs (administrative blocks). This area is completely inaccessible for exploration as it is full of cliffs and steep terrain with very dense understory vegetation. By foot, it is a day journey southwest of Nga Lhakhang, which is the last settlement before reaching the Tsenden stand.



Plate 9: Natural Tsenden stand at Urgang, Lhuntse at an elevation of 2800 masl (Sept. 2011)



Plate 10: Natural Tsenden stand at Khangphuglung, Lhuntse at an elevation of 2790 masl (Sept. 2011)



Natural Tsenden stands occur in Merdha, Jurni, Momlumchhu and Drongderejur in Kangpara gewog under Trashigang Dzongkhag. Approximately 50 hectares of Tsenden forest can be found north of Merdha village at an elevation of 2455 masl on steep terrain and rocky precipices. Access is possible only upto the base of the Tsenden forest ($27^{\circ}10'01.5''\text{N}/91^{\circ}42'48.9''\text{E}$) with further access into the interior is denied by steep rocky cliffs. A history of fire is apparent, with remnants of burnt Tsenden trees abundant in the area. Though inaccessible, the Tsenden stand is included as part of the Merdha community forest. It takes approximately 2 hours to reach the stand from Merdha village.



Plate 11: Natural Tsenden stand at Merdha, Kangpara, Trashigang at an elevation of 2455 masl (Sept. 2011)

On the right flank of Nera Ama Chhu in Jurni valley, approximately 100 hectares of Tsenden occur within a cool broadleaved forest comprising *Quercus*, *Symplocus*, and *Rhododendron* species with a thick understory of shrubs and herbs. Access is from Jurni ($27^{\circ}10'32''\text{N}/91^{\circ}43'08.2''\text{E}$, altitude 2300 masl), a valley formerly used by the nomads of Merak and Sakteng as a winter Tsamdrol (grazing ground) but long



since abandoned. It is possible to enter from Jurmi only upto the base of the Tsenden stand as it is located on very steep rocky terrain. It takes roughly an hour to reach the base of the Tsenden forest from Jurmi.

The Momlum Chhu Tsenden forest ($27^{\circ}09'42.2''\text{N}/91^{\circ}40'20.7''\text{E}$) is scattered over an area of approximately 100 hectares. It takes 1.5 hours walk to get to this stand. Nearly another 100 hectares of natural Tsenden occurs in Thronderejur valley ($27^{\circ}10'26.5''\text{N}/91^{\circ}43'12.1''\text{E}$) northwest of Merdha village. It takes 3 hours to walk from Merdha village via the Merdha natural stand. As with the Merdha stand, entry is possible only upto the base of the Tsenden forest and interior access is not possible due to sharp rocky precipices.



Plate 12: Natural Tsenden stand at Jurmi, Kangpara, Trashigang at an elevation of 2400 masl (Sept. 2011)



2.3. Spectral Distribution of Tsenden Stands in Relation to Existing Land Use Practice

In order to get the sense of Tsenden forests occurring within the protected area network, the shape file generated for the Tsenden distribution was superimposed on the protected area network map of Bhutan. While superimposing, it was observed that only few Tsenden stands are falling within the national parks and wildlife sanctuaries. Of about 11 natural Tsenden stands recorded through the survey only two stands (one within Jigme Dorji National Park and other within the Wangchuck Centennial Park) are under the protected area network and rest are outside the protected areas as indicated in the map below.

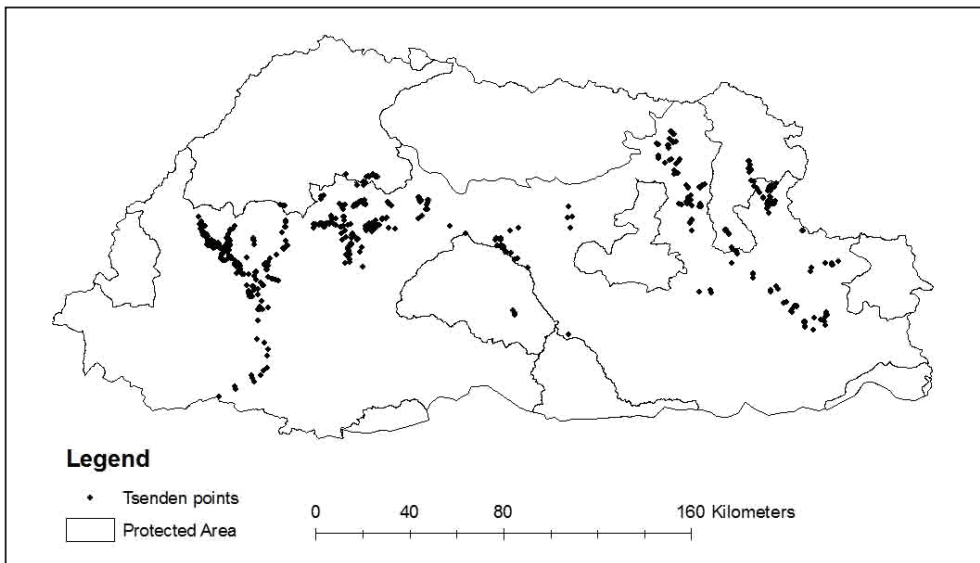


Figure 3: Spectral Distribution of Tsenden Stands within the Protected Areas of Bhutan

2.4. Distribution of Plantation and Lone Tsenden

The survey and mapping team enumerated plantation and lone Tsenden trees existing in and around important monuments (gompas, lhakhangs, dzongs), schools, army cantonments and villages. These include all Tsenden trees that were planted and tended by Department of Forests and Park Services (DoFPS) personnel, monastic communities, private land owners, army personnel and village communities in different regions.



2.4.1. Plantation Tsenden

To simplify recording and future analysis, Tsenden trees planted in groups numbering over 20 individuals are categorized as plantation. This includes all Tsenden plantations by the DoFPS in Government Reserved Forests as well as plantations by schools, army personnel, monastic communities and local communities. Survey and mapping results indicate that Trashigang Dzongkhag has the greatest number of Tsenden plantations, followed by Thimphu Dzongkhag. District-wise Tsenden plantation information is shown in the table below, including the approximate number of Tsenden or area covered by Tsenden in each location.

Table 1: Tsenden plantation in Thimphu Dzongkhag

Sl. No.	Approx no. of trees/area	Location/Place Name	Remarks
1	150	Dechencholing Royal Body Guard cantonment	Government Land
2	50	Chubachu, in front of Royal Monetary Authority Office	Government Land
3	20 hectares	Lumitsawa area	Govt. Reserve Forests
4	5 hectares	Lamperi	Govt. Reserve Forests

Table 2: Tsenden plantation in Paro Dzongkhag

Sl. No.	Approx no. of trees/area	Location/Place Name	Remarks
1	350	Shaba Army Cantonment	Government Land
2	50	Shaba MSS	Government Land
3	50	Paro Hospital Compound	Government Land
4	29	Lhabu Gompa	Private Land
5	38	Tomcheyna	Private Land
6	90	Zuri Dzong	Private Land
7	133	Drugyel Dzong	Government Land
8	31	Rinpung Dzong compound	Government Land
9	3-5 hectares	Old Drugyel Dzong compound	Government land
10	3 trees	Ta Dzong compound	Government land



Table 3: Tsenden plantation in Chukha Dzongkhag

Sl. No.	Approx no. of trees/area	Location/Place Name	Remarks
1	1 hectare	Gedu	Govt. Reserve Forests

Table 4: Tsenden Plantation in Phunakha Dzongkhag

Sl. No.	Approx no. of trees	Location/Place Name	Remarks
1	23	Tsosa	Community Forest
2	22	Garakha	Private Land
3	120	Yusakha	Private Land
4	1000	Punakha Dzong compound	Government Land
5	200	above Mochu bridge	Govt. Reserve Forests
6	50	Zomlingthang	Private Land
7	100	Punakha HS school compound	School Compound
8	24	Pangkarpo Gompa	Private Land
9	40	Jangsa Gompa	Private Land
10	40	Jangsa Gompa	Private Land

Table 5: Tsenden Plantation in Wangdue Phodrang Dzongkhag

Sl. No.	Approx no. of trees	Location/Place Name	Remarks
1	25	Dorangtha	Private Land
2	200	Gaselo HS School	School compound
3	31	Pangkha	Government Land
4	60	Samtegang LS School	School compound
5	110	Tapchikha	Government Land
6	30	Tsho Wom Gup office	Private Land
7	300	Chuzomsa forest gate	Govt. Reserve Forests
8	50	Latagang	Private Land



Sl. No.	Approx no. of trees	Location/Place Name	Remarks
9	22	Chamjo	Private Land
10	29	Thokha	Private Land
11	30	Mari Pokto	Private Land
12	1200	Army Training Centre	Government Land
13	3000	Nobding area	Govt. Reserve Forests
14	>70	Radha Lhakhang compound	Government land

Table 6: Tsenden plantation in Trongsa Dzongkhag

Sl. No.	Approx no. of trees	Location/Place Name	Remarks
1	200	Tshangkha LS school compound	Government land
2	15	Trongsa Dzong compound	Government land

Table 7: Tsenden plantation in Mongar Dzongkhag

Sl. No.	Approx no. of trees	Location/Place Name	Remarks
1	21	Thilling/Serzhong	Private Land
2	4	Dremitshe Dzong compound	Private Land

Table 8: Tsenden plantation in Lhuntse Dzongkhag

Sl. No.	Approx no. of trees	Location/Place Name	Remarks
1	170	Goempa Karpo	Private Land
2	23	Lekpogang and Lhuntse Dzong compound	Government land



Table 9: Tsenden plantation in Trashigang Dzongkhag

Sl. No.	Approx no. of trees	Location/Place Name	Remarks
1	60	Rongthung	Private Land
2	200	Kanglung	College compound
3	23	Khangma	RNR compound
4	200	Youngphula	Govt. Reserve Forests
5	50	Barshong	Private Land
6	100	Khaling Gompa	Private Land
7	100	Khaling HSS	Khaling PS compound
8	200	Khaling	School compound
9	5000	Above Khaling town	Community forests
10	30	Khaling Handloom Centre	Private Land
12	120	Manangkholo	Govt. Reserve Forests
13	35	Thrimshing LSS	School compound
14	1000	Zordung/Kangpara	Private Land
15	2000	Merdha	Private Land

Table 10: Tsenden plantation in Trashigang Dzongkhag

Sl. No	Approx. no of trees	Location/Place Name	Remarks
1	15	Old Dzong compound	Government land

2.4.2. Lone Tsenden

A detailed enumeration of lone Tsenden trees was carried out as a subset of the nationwide Tsenden survey and mapping project. The survey team recorded the GPS coordinates of every Tsenden tree encountered singly or in a group of < 20 Tsenden trees in any particular location. In addition, ecological parameters such as forest strata, elevation, slope, aspect, diameter and height were recorded for every lone Tsenden tree encountered.

Survey and mapping results indicate that Paro Dzongkhag has the greatest number



**Structure and Species
Composition of
Tsenden Forests**

3





3. Structure and Composition of Tsenden Forests

Ecologically, Tsenden forests are indicators of forest ecosystems facing minimal human disturbance. As such, they may serve as habitat for iconic wildlife species. The typical Tsenden forest is comprised of broadleaved and conifer forests with wide variation in species composition based on the altitude and humidity of the particular location. Most native Tsenden forests constitute the following species: *Quercas*, *Castanopsis*, *Rhododendron*, *Betula*, *Alnus*, *Acer*, *Benthamedia*, *Sorbus*, *Rhus*, *Ilex*, *Symplocus*, and *Tsuga* with *Laurophyllous* understory, and overtopped by an open stratum of *Pinus wallichiana* and *Quercus semicarpifolia*. This type of forest is quite common in the moderately dry areas of central Bhutan. The Tsenden storey is superimposed, forming an open canopy upto 15 meters above the upper limit of the oak and pine crowns. Depending on slope angle and degree of disturbance, the Tsenden canopy can be closed or very sparse. The number of vascular plant species occurring with Tsenden forests varies widely according to moisture content of the site (hygric/humid and driest habitat). A fairly dry stand was recorded on the southwest facing rocky spur in Chuselumba, where Tsenden trees grow in open *Pinus wallichiana-Quercus semicarpifolia* forest with a sparse *Laurophyllous* understory and grass-dominated ground layer. On the wet side of the hygric range on the north facing slope of Nyechhu Phug (2650 masl) in Wangdue, Tsenden occurs in mixed Hemlock forests with *Acer sikkimense*, *Betula utilis*, *Quercas lameso* and *Quercas semicarpifolia* in the main canopy and a fern and tall-forb-dominated herb layer on mossy ground. At Si Chu/Pho (2030 masl), which has northern exposure, Tsenden accompanies warm broadleaved forests with *Castanopsis tribuloides*, *Schima wallichii*, *Michelia* sp. With *Quercus lanata* occurring in the upper limit of the Tsenden forest.

Eco-physiologically, the Tsenden prefers the humid end of the hygric range of *Pinus wallichiana* for faster growth and better establishment. The structure of Tsenden forests seems highly diverse. There is no characteristic indicator species accompanying the Tsenden in all communities. Tsenden appears to be an accidental addition to floristically quite different forest communities, comparable to the Blue Pine (BG-SRDP report, 1999).

3.1. Structure of Natural Tsenden Forests

In order to gain modest understanding of structural dynamics of the natural Tsenden stands, the team has measured the diameter and height of Tsenden as well as associates tree species in three natural stands out of eleven natural Tsenden stands



identified through survey in four districts. A total of 12 circular plots (4 plots per natural stands) with 12.62 meters radius were laid randomly in three different natural stands (viz. Chuselumba, Nychhu Phug and Kangpara). With the diameter class data obtained from 12 plots, a diameter distribution graph was prepared taking diameter along x-axis and number of trees along y-axis. It was observed that there is more number of Tsenden as well as associates tree species in lower diameter classes and fewer trees in higher diameter classes but this result is not conclusive as the n-value is very small.

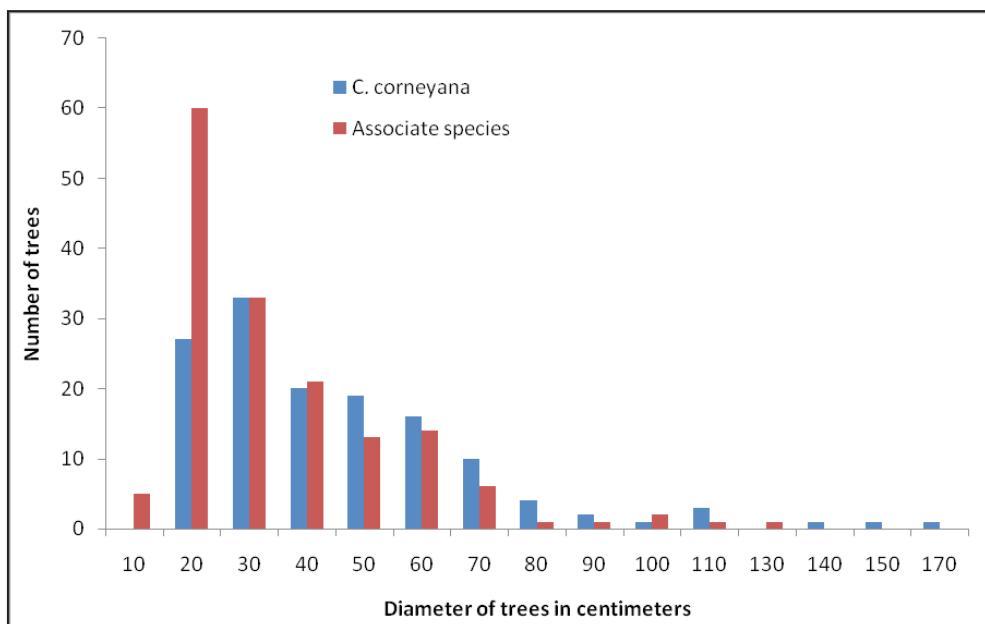


Figure 5: Structure of Natural Tsenden Forests in Bhutan

3.2. Structure of Plantation Tsenden Forest

The graph below represents the structural dynamics of plantation Tsenden forests and it portrays similar trend in diameter class distribution with natural stands. It indicates that the plantation Tsenden has lot of young individuals which are in the rapidly growing phase and really fewer numbers of mature trees. This graph provides only the glimpse of plantation Tsenden forests structure in Bhutan and not the exhaustive structural pattern as it is based on minuscule data set (n=191¹).

1 Number of trees measured at breast height diameter within the plots

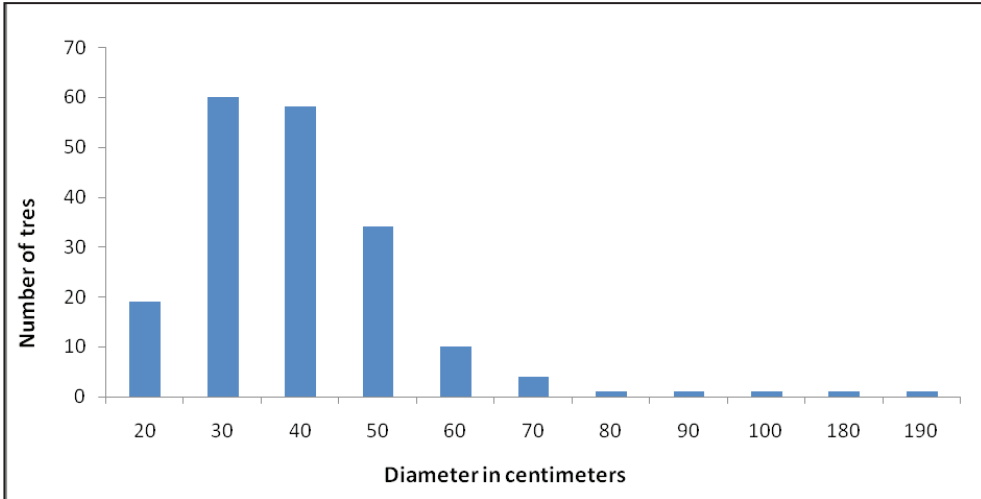


Figure 6: Structure of Plantation Tsenden Forests

3.3. Structure of Lone Tsenden Trees

The lone Tsenden structural graph was prepared using the diameter data collected from the field (n=912). It illustrates the normal distribution curve pattern with more number of trees within 60-180 centimetres diameters at breast height and less number of trees on the two extremes.

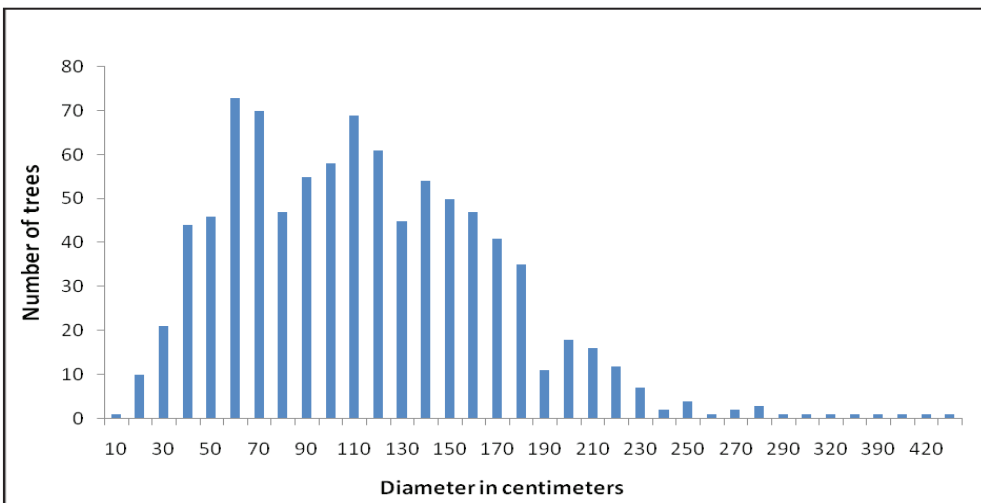



Figure 7: Structure of lone Tsenden Trees in Bhutan



Table 11: Trees, shrubs and herbs species found in the Tsenden forests in the wild and plantation areas


Tree species	Shrub and herb species
1. <i>Quercus semicarpifolia</i>	24. <i>Symplocos glomerata</i>
2. <i>Quercus lanata</i>	25. <i>Euphorbia pulcherrima</i>
3. <i>Quercus graffithii</i>	26. <i>Magnolia campbellii</i>
4. <i>Pinus wallichiana</i>	27. <i>Acer sikkimense</i>
5. <i>Pinus roxburghii</i>	28. <i>Eriobotrya hookeriana</i>
6. <i>Castanopsis hystrix</i>	29. <i>Tetracentron sinen</i>
7. <i>Castanopsis indica</i>	30. <i>Artemisia bulgaries</i>
8. <i>Toona ciliata</i>	31. <i>Pteridium spp.</i>
9. <i>Alnus nepalensis</i>	32. <i>Daphne bholua</i>
10. <i>Rhus chinensis</i>	33. <i>Viburnum erubescens</i>
11. <i>Rhus succedanea</i>	34. <i>Euphorbia himalayansis</i>
12. <i>Juglans regia</i>	35. <i>Rosa sericea</i>
13. <i>Erythrina arborecens</i>	36. <i>Rosa microphylla</i>
14. <i>Persea bootanica</i>	37. <i>Rubia cordifolia</i>
15. <i>Populus ciliate</i>	38. <i>Rubus ellipticus</i>
16. <i>Schima wallichii</i>	39. <i>Elshotzia fruitcosa</i>
17. <i>Salix butaneasis</i>	40. <i>Euphorbia graffithii</i>
18. <i>Nisha japonica</i>	41. <i>Synoglossum spp.</i>
19. <i>Lindera heterophylla</i>	42. <i>Eleagnus parvifolia</i>
20. <i>Eurya cerasifolia</i>	43. <i>Arisaema spp.</i>
21. <i>Rhododendron arboretum</i>	44. <i>Buddleja asiatica</i>
22. <i>Toricellia tilifolia</i>	45. <i>Anaphalis contorta</i>
23. <i>Symplocos lucida</i>	46. <i>Persicaria chinense</i>





Historical, Cultural and
Religious Significance
of Tsenden

4





4. Historical, Cultural and Religious Significance of Tsenden

The Tsenden is firmly rooted in Bhutan's mythical and historical past, and closely associated with religious and cultural life. Historically, Bhutan was known by many names and one such name is 'Lhomon Tsendenjong', the Southern Land of the Cypress, perhaps given by Tibetans in the past. When Bhutan joined the United Nations in 1971, the Tsenden was designated as Bhutan's national tree along with other national symbols.

Tsenden wood is embedded in the fabric of Bhutan's culture. Its unequalled strength, durability and uniform length have made it the finest and most widely sought construction material for dzongs and monasteries throughout the centuries. The sacredness of the Tsenden means that every part of the tree is treasured and used, whether it is as timber for construction or bark and leaves for incense and medicines. Many spectacular and magnificent lone specimens are found near temples and monasteries across the country and most of these are associated with famous Buddhist spiritual masters and scholars. The Tsenden tree is believed to have been first brought to Bhutan by Guru Rinpoche in the form of his walking stick or staff. For example, the huge and ancient Tsenden trees at Kurjey Lhakhang in Bumthang and at Nabji Lhakhang in Trongsa are popularly believed to be the walking sticks of Guru Rinpoche, dating back to his visit to Bhutan in the 8th century. Other Tsenden trees near monasteries and temples are either believed to be the walking sticks of Zhabdrung Namgyel, Lam Drukpa Kuenley, Lam Phajo Drugom Zhigpo or to have been planted by other renowned ancient Buddhist masters, Je Khenpos (chief abbot of monastic body), or heads of the local monasteries in the past.

Many of the significant lone Tsenden trees found in and around villages in different regions are believed to be the sacred abodes of local guardian deities. Bhutanese pay deep respect to such trees. These Tsenden trees are adorned with prayer flags and ribbons. Annually, people of that particular locality will perform elaborate rituals under the designated Tsenden to please the deity for the well-being and prosperity of the village. Failure to perform such rituals is believed to bring ill fortune to the villagers in that particular year. The fear of reaping poor harvests and sickness or loss of lives for both humans and livestock ensures that such festivals and rituals continue to be held.

As part of the Tsenden survey and mapping project, an education and awareness-raising documentary film on Tsenden was made and distributed nationwide and broadcasted on Bhutan public television. The historical, cultural and religious significance of the Tsenden was explored in-depth in this documentary film.



Threats and
Conservation Issues

5





5. Threats and Conservation Concerns

Of numerous threats and conservation concerns that may be affecting the sustainable management of Tsenden Forests in Bhutan, four of them seemed to be exerting paramount pressures to the persistence of Tsenden forests in Bhutan. These threats and conservation concerns are:

- 1. Excessive Logging:** The excessive timber logging for construction and renovation of dzongs and important monuments in the country has been a major threat to the existence of natural Tsenden stands in the past, and pressure for good Tsenden wood for construction continues. Most of the accessible trees have been logged for the reconstruction of dzongs and monasteries, of which there are some 2,002 such sacred structures in Bhutan. Many of these require frequent maintenance and renovation, putting pressure on available Tsenden resources.



Plate 13: Illegally felled and converted Tsenden logs in the interior of Nyi Chhu Phug natural stand at an altitude of 2560 masl (March 2012)

In the past Tsenden was probably preferred for house construction, as long as suitable trees were within reach or a river could be used for transport (BG-SRDP report, 1999). Even today Tsenden shingles are preferred roofing material for anyone who can get them and cannot afford the more environmentally friendly CGI sheets for roofing. Advances in modern transport facilities and cable cranes have facilitated the exploitation of remaining Tsenden forests. There is serious danger of these disappearing in the coming years if necessary precautions are not taken to conserve and safeguard remaining natural-growth Tsenden forest areas. As a result, Bhutan's natural-growth Tsenden trees are endangered in the wild. Today Tsenden can only be found in remote and difficult-to-reach places, or else near well-guarded monasteries.



- II. Forest Fires:** In addition to logging for construction, persistence and future regeneration of Tsenden forests may be threatened by forest fires. At least one century of fire protection is necessary for the production of valuable timber and high biodiversity in Tsenden forests (Miehe et al. 1999).



Plate 14: Remnants of fire-burnt Tsenden trees found in Merdha, Kangpara and Chuselumba, Wangdue Phodrang natural stand (April 2012)

- III. Cattle Grazing:** A third possible threat to Tsenden regeneration may be cattle grazing. Logging and woodcutting trails provide easy access for cattle to reach Tsenden regeneration areas where they may browse on Tsenden saplings as well as trample the young seedlings. In Chuselumba, Tsenden seedlings in logged areas were less resistant to browsing than were Blue Pine seedlings. However, more research needs to be done to determine the effects of browsing by cattle and other wild ungulates on Tsenden.
- IV. Limited Drought Tolerance at Seedling Stage:** Another probable, but little studied, threat to natural Tsenden forests is low seed vitality and limited drought tolerance at the seedling stage. In most natural stands, there is strong competition between Tsenden and Blue Pine during early stages of growth. Tsenden seems not to grow as fast or tall enough to shade out Blue Pine in later stages. The die-back of mature Tsenden could be another worrying phenomenon and potential threat to the existence of natural Tsenden forests in Bhutan that has been observed in almost all the locations where Tsenden naturally occurs (see plate 15).



Plate 15: A die-back of mature Tsenden trees in Nyi Chhu Phug, Wangdue Phodrang at an altitude of 2540 masl (March 2012)

The ecological observations made through this study and previous studies suggest that ***the conservation of natural Tsenden forests in Bhutan will bear real challenge*** because of many difficult ecological questions will need to be answered before appropriate conservation measures can be implemented. The historic distribution of Tsenden is very difficult to assess as few written documents exist and pollen analysis cannot differentiate among various species of the *Cupressaceae* family. Nevertheless, immediate action is necessary to prevent the disappearance of the remaining natural stands.

Regarding conservation threats to significant lone trees, the challenges are those of valuing, documenting and maintaining knowledge concerning the cultural and historical significance of Tsenden trees in order to protect them from development threats, and in providing appropriate care and maintenance for ancient specimens.



Recommendations

6





6. Recommendations

6.1. Protection of Tsenden Forests

Strict protection is needed to safeguard the remaining Tsenden natural stands as majority of the stands are following outside the protected areas of the country. Tsenden should be included as a top conservation priority in Bhutan's national policy, in the same or equivalent category as rare medicinal plants and endangered species. It should be listed as a scheduled species following detailed studies on the impacts and ramifications of such a listing. Immediate actions should include:

- Complete restriction (with the possibility of review on a case-by-case basis) on logging activities in natural Tsenden stands until further research is conducted and ecological dynamics are better understood.
- Restriction of plantation Tsenden logging to the timber quantities needed for the maintenance of historic structures of national importance, until a scientifically founded management plan for the sustainable use of Tsenden forests is available.
- Strict control on the procedures to be followed while conducting the necessary minimum logging activities, including care to be taken that future seed trees are left in the top storey, that any logging is avoided on steep flanks with high risk of erosion, etc.
- Restriction on grazing by cattle in natural Tsenden areas until effects on Tsenden regeneration is studied.
- Logging activities on plantation Tsenden forests should be accompanied by reforestation measures similar to the FMU model. Priority should be given to Tsenden raised from local seed in cooperation with the relevant research institutes. Logging procedures should also optimize on the opportunity to collect mature cones in large quantities from vital trees as the crowns of standing trees are rarely within reach.
- Conservation of genetic variety of indigenous Tsenden through seed banks.

Further, there is an urgent need for documentation, conservation and care of significant lone Tsenden as many of these trees get removed due to developmental activity. A detailed documentation of the historical and cultural significance of outstanding individual trees throughout Bhutan should be conducted with the relevant agencies, including analyses of their current health and potential threats to their continued survival. Traditional beliefs and concerns of the local people should be taken into consideration. Conservation and care should be provided to the relevant institutions for the continued stewardship of these living national treasures.



6.2. Research

Considering the quantity of large-sized timber required for the restoration of important historical monuments, Tsenden should become a focus for basic and applied forestry research in Bhutan. Well-written management plans based on scientific information for the sustainable use and conservation of Tsenden forests are needed urgently. As almost nothing is known about the ecology and regeneration dynamics of the Tsenden, research work should be closely linked to practical forest conservation and management and can primarily be conducted by Bhutanese foresters and scientists/researchers. Essential areas of research that would yield necessary information for the sustainable utilization and conservation of Tsenden forest are:

- I. Impact of forest fire on Tsenden regeneration:** Long intervals of forest fire are likely to favour the initial spread of Tsenden as a pioneer species. On the other hand, the extension of Tsenden-covered areas is limited by too frequent fires, grazing and woodcutting (BG-SRDP report, 1999). There is therefore a need to investigate the frequency of fire and other disturbances necessary to maintaining healthy populations of Tsenden in the wild.
- II. Drought tolerance of Tsenden seedlings:** A few limited studies conducted in the past have indicated that Tsenden seedlings are less drought tolerant when compared with Blue Pine (Miehe et al. 1999). A plenty of Tsenden seedlings observed on the suitable substrate but rarely older saplings by Miehe and his team in 1999 in the harvested area of Chuselumba, Punakaha, is an indication that seedlings die after the first monsoon. A systematic long-term study of micro-habitat preferences and drought resistance of Tsenden and Blue Pine is necessary for scientifically-based sustainable management of native Tsenden plantations in Bhutan.
- III. Soil preference and competition for light:** There is little information on soil types and substratum necessary for vigorous Tsenden germination and better survival in the wild. Furthermore, light is an essential abiotic ecological factor vital for the growth and establishment of conifer saplings but the amount and intensity of light requirement differs from species to species. Therefore, study on these factors will yield extremely useful ecological information for long-term management of the Tsenden forest.
- IV. Impact of browsing:** Systematic counts on permanent observation plots are necessary in order to understand the magnitude of the impact of grazing and



browsing on the survival rate of Tsenden seedlings. It is assumed that both cattle and wild ungulates eat Tsenden seedlings accidentally with other palatable herbs and those other Tsenden seedlings are decimated through trampling.

V. *Assessment of Tsenden Forest Growing Stock and Growth Rate Studies:*

Because the main refuges for Tsenden are steep rocky flanks, common forest inventory methods cannot be applied to Tsenden assessment. Additionally, difficulties in mapping Tsenden forests are increased by the fact that to date, it has not been possible to distinguish the Tsenden from other conifers via satellite images or aerial photography (D.B. Dhital, FRMD). Therefore, any extrapolation with GIS and remote sensing techniques remains unrealistic for the time being.

Although inventory and mapping of natural stands, plantations and significant lone Tsenden in Bhutan has been completed and the extent of its distribution has been mapped through this study, there remains an urgent need to carry out growing stock assessment for both natural and plantation Tsenden forests. This is fundamental for the management and conservation of relict Tsenden forests. Through knowledge of the extent and accessibility of different populations the over-exploitation of small natural stands can be avoided and informed decisions can be made on limited timber extraction where it is ecologically feasible and justified. Growth rate studies on both natural and plantation Tsenden forests will add value to developing robust and dynamic management plans for the sustainable utilization and conservation of Tsenden forests in Bhutan.

VI. *Tsenden Germination Experiments:*

Tsenden seeds from natural stands are collected and distributed every year to various institutions and organizations by Social Forestry and Extension Division of Department of Forests and Park Services for raising seedlings in the nursery, however, there are no documents describing the rate of germination, seed viability and micro-site preferences. There is a need for specific study on Tsenden seed germination rates, seed viability, seed collection season and sites, sowing time and micro-site preferences for promotion of Tsenden forests through plantation.

Seeds can be collected from different relict Tsenden forests and tested in different habitats and altitudes. An establishment of seed provenances (plantations of Tsenden from different areas serving as future seed resources) could be another healthy initiative that can be taken up immediately for conservation and future propagation purposes.



VII. Studies of the Natural Regeneration of Tsenden on Permanent

Observation Plots: These studies are urgently needed for the elaboration of sustainable management strategies for Tsenden forests. It is uncertain whether natural Tsenden regeneration occurs in mature forests where selective logging is undertaken. Preliminary observations made by the survey team of the BG-SRDP project in 1999 suggested that clear-cutting (including the broadleaved undergrowth) and subsequent plantation gives more promising results. It would be beneficial to test these assumptions on permanent observation plots. The main variants to be studied are:

- Undisturbed mature forest: Tsenden regeneration may be hampered during the observation period until the top canopy trees break down or fire occurs in the area. If Tsenden trees germinate, the fate of the seedlings can be monitored.
- Tsenden forests where selective logging was conducted in the past: permanent observation plots should be laid down to examine Tsenden regeneration under the shade of older Tsenden trees with few canopy gaps.
- Tsenden forest with clear cut patches: plots where young Tsenden are already established should be selected and compared to plots where Tsenden have not yet germinated. Where cattle are present, exclusion plots should be included to study the effects of cattle browsing and trampling on Tsenden regeneration.
- Recently burnt areas: suitable sites where recent fires have occurred in the relic Tsenden forests (most probably Si Chu/Pho Chu confluence, where fire-burnt parts of the Tsenden forest are accessible) may be selected to study the successional dynamics of Tsenden forests.

Due to the sparse regeneration of Tsenden in logged areas, the standard size of observation plots used in Bhutan may need to be increased. Some standard measurement parameters may be omitted to augment the feasibility of recording within a realistic timeframe.

VIII. Taxonomic and Genetic Studies: Identification between different species of cypress (especially between *Cupressus corneyana* and *Cupressus cashmeriana*) based on morphological and physiological characteristics are very difficult. Taxonomic differences can only be identified in female cones and leaf branchlets that have been observed minutely or microscopically. The genetic variation of Bhutanese Tsenden (planted holy trees, trees from relict forests) in comparison with Indian cultivars can possibly be accessed through



isogyme analyses and may yield interesting results. Such a study at the genetic level would contribute towards solving the problem of taxonomic identification/differentiation among different species of cypress and the conservation of native Tsenden in the gene bank at the National Biodiversity Centre in Serbithang. These studies should include specimens of the Indian Tsenden cultivar (*Cupressus cashmeriana*) to assess the degree of relationship with the Bhutanese Tsenden (*Cupressus corneyana*).

6.3. Management of Plantation Stands

In promoting healthy endemic Tsenden forests through plantations, the Social Forestry and Extension Division (SFED) should consider the risks and disadvantages of raising monoculture forest. Normally, monoculture forest is vulnerable to a variety of diseases and pest epidemics. In addition, like most conifer species, Tsenden have allelopathic effects on other vegetation, preventing undergrowth. It is therefore very crucial to encourage mixed plantations for better success and viable Tsenden populations.

The SFED should carry out a detail investigation of ecological conditions of identified plantation sites prior to establishment of Tsenden plantations. These plantations must follow well-developed management and monitoring plans for sustained production of Tsenden timber resources to meet the ever increasing demands of construction and renovation of sacred monuments in Bhutan.



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Annexure 1: District/Dzongkhag-wise lone and group Tsenden trees listing through tree to tree enumeration

Lone and group Tsenden trees distribution in Thimphu Dzongkhag

Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
1	Cool Broadleaved Forest	680	216.5	30	S		2890 m	Chari/Thimphu	273545.2	893736
2		570	181.4	35	S			Chari/Thimphu		
3		340	108.2	20	S			Chari/Thimphu	273546	893738
1	Blue Pine Forest	1420	452.0	40	E	0%	2421 m	Pangrizampa	273210.8	893853.3
2		950	302.4	30	E			Pangrizampa		
1	Blue Pine Forest	320	101.9	30				Tashichodzong complex	272920.6	893802.3
2		310	98.7	31				Tashichodzong complex		
3		270	85.9	28				Tashichodzong complex		
4		280	89.1	27				Tashichodzong complex		
5		190	60.5	23				Tashichodzong complex		
1		387	123.2	42	S	0%		Bap Lhakhang	272622.9	893908.1
1		593	188.8	31				Depshi	272538.7	893813.6



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
1		285	90.7	13				Tshalumaphey	272546.6	893835.2
1		355	113.0	37				Termalina	272530.9	893826.6
1		500	159.2	41				Namseling	272409.2	893643.3
1		497	158.2	38				Singay	272320.9	893515.7
1	Blue Pine Forest	690	219.6	23	S	0%		Chiji Gompa	271841.3	893544.5
2		117	37.2	15				Chiji Gompa		
3		236	75.1	25				Chiji Gompa		
4		578	184.0	41				Chiji Gompa		
5		695	221.2	42				Chiji Gompa		
6		700	222.8	42				Chiji Gompa		
7		510	162.3	41				Chiji Gompa		
1		780	248.3	38				Bama	271906.1	893430.9
1		317	100.9	26				Sisina	272045	893430.2
1		330	105.0	23				Kharibji	272201.1	893353.3
2		405	128.9	37				Kharibji	272158.9	893354.3
3		430	136.9	38				Kharibji	272158.7	893355.4
1		356	113.3	37				Langdro	272216.4	893407.8
1		475	151.2	21				Dalukha	272137.7	893450.1
2		185	58.9	22				Dalukha	272156.9	893435.3
1	Blue Pine Forest	580	184.6	37				Belukha	272728	893130.3



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
2		180	57.3	23				Belukha	272725.1	893135.1
3		128	40.7	18				Belukha	272724.8	893135.5
4		188	59.8	20				Belukha		
5		117	37.2	17				Belukha		
6		98	31.2	16				Belukha		
1		468	149.0	42				Jangsakha	272735	893115
1		500	159.2	33				Drugyeling	272801.6	893126.9
1		520	165.5	30				Chimithangkha	272634.6	893126.9
2		433	137.8	18				Chimithangkha		
1		357	113.6	20	NW	0%		Ngyenzergang	272338.7	893542
1		247	78.6	22				Tshaphu	272250	893534.7
1		535	170.3	25	NW			Khasakha	272238.3	893446.6
1	Cool Broadleaved Forest	534	170.0	30	SW		2975	Tango	273533.1	893829.2
2		600	191.0	28				Tango	273535.1	893812.7
3		600	191.0	40				Tango	273534.4	893812.7
4		450	143.2	30				Tango	273533.4	893815.2
5		530	168.7	30				Tango		
6		300	95.5	25				Tango		



Lone and group Tsenden trees distribution in Paro Dzongkhag

Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
1	Blue Pine Forest	645	205.3	33	SW		2327	Peri Lhakhang	272324.3	892614
2		582	185.3	25				Peri Lhakhang		
3		187	59.5	19				Peri Lhakhang		
4		122	38.8	14				Peri Lhakhang		
1	Blue Pine Forest	417	132.7	34	SW			Sirikha	272254.1	892453
1	Blue Pine Forest	604	192.3	34				Tshendentsa	272252.7	892439.1
1	Blue Pine Forest	354	112.7	45				Jephu	272342.9	892353.9
2		110	35.0	21				Jephu		
1	Blue Pine Forest	470	149.6	42	NE	10%		Jewdado	272319.4	892355.7
2		495	157.6	37				Jewdado		
3		540	171.9	37				Jewdado		
4		370	117.8	37				Jewdado		
5		110	35.0	19				Jewdado		
6		130	41.4	19				Jewdado		
1	Blue Pine Forest	407	129.6	35				Zongdrakha	272256.1	892415.5



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
1	Blue Pine Forest	582	185.3	28				Nakha	272352.2	892608.2
1	Blue Pine Forest	346	110.1	31				Gangkha	272402	892544.2
2		185	58.9	26				Gangkha		
3		420	133.7	41				Gangkha		
1	Blue Pine Forest	422	134.3	26	NE	20%		Zachekha	272450.1	892428.8
2		105	33.4	12				Zachekha		
3	Blue Pine Forest	462	147.1	230				Zachekha	272452.4	892431.6
4		400	127.3	26				Zachekha		
5		100	31.8	12				Zachekha		
6		217	69.1	16				Zachekha		
7		83	26.4	10				Zachekha		
8		150	47.7	13				Zachekha		
9		208	66.2	20				Zachekha		
10	Blue Pine Forest	238	75.8	23				Zachekha	272455.7	892437.7
11		90	28.6	6				Zachekha		
12		180	57.3	18				Zachekha		
13		120	38.2	17				Zachekha		
14		295	93.9	23				Zachekha		



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
15		395	125.7	14				Zachekha		
1	Blue Pine Forest	475	151.2	40	SE	5%	2308	Keysa/Shaba	272118.6	892742.3
2		442	140.7	36				Keysa/Shaba		
1	Blue Pine Forest	487	155.0	32				Gongri		
2		72	22.9	13				Gongri		
3		221	70.3	26				Gongri		
4		83	26.4	11				Gongri		
5	Blue Pine Forest	370	117.8	37	E	15%		Gongri	272210	892703.4
6		60	19.1	11				Gongri		
7		40	12.7	7				Gongri		
1	Blue Pine Forest	233	74.2	12	SE	2%	2173	Tamcho Lhakhang	271949.7	893016.4
2		220	70.0	12				Tamcho Lhakhang		
3		320	101.9	12				Tamcho Lhakhang		
4		571	181.8	18				Tamcho Lhakhang		
5		410	130.5	25				Tamcho Lhakhang		
6		410	130.5	25				Tamcho Lhakhang		



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
7		137	43.6	17				Tamcho Lhakhang		
8		140	44.6	17				Tamcho Lhakhang		
9		262	83.4	25				Tamcho Lhakhang		
10		203	64.6	19				Tamcho Lhakhang		
11		305	97.1	23				Tamcho Lhakhang		
12		85	27.1	11				Tamcho Lhakhang		
13		96	30.6	11				Tamcho Lhakhang		
1	Blue Pine Forest	160	50.9	11	NE			Issuna	271946.4	892910.8
2		126	40.1	20				Issuna		
3		175	55.7	20				Issuna		
1	Blue Pine Forest	650	206.9	33	SW			Issuna Gompa	272036.8	8921819
1	Blue Pine Forest	453	144.2	35				Above Shaba HSS	272106.4	892816
1	Blue Pine Forest	458	145.8	28				Samteiling	272140.4	892802.6



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
1	Blue Pine Forest	270	85.9	23				Drakarpo	272143.7	892820.3
1	Blue Pine Forest	230	73.2	21				Yutega	272200.9	892812
2		130	41.4	9				Yutega		
3		712	226.6	18				Yutega		
1	Blue Pine Forest	376	119.7	25				Galakha	272155.8	892747
1		335	106.6	28				Zhingkana	272216.1	893159.4
1		277	88.2	21				Tshephu/Jawaloo	272018.6	893156.6
2		680	216.5	25				Tshephu/Jawaloo		
3		140	44.6	8						
4		148	47.1	12						
5		340	108.2	23						
6		370	117.8	12						
7		226	71.9	21						
8		202	64.3	18						
9		240	76.4	21						
10		263	83.7	22						
12		290	92.3	10						
13		460	146.4	23						



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
14		172	54.7	16						
15		382	121.6	23						
16		130	41.4	15						
17		480	152.8	22						
1		200	63.7	18				Phuchikha/ Dogar	271925.2	892609.8
2		145	46.2	15						
3		335	106.6	21						
4		300	95.5	22						
5		430	136.9	15						
1		425	135.3	12				Doteng	273002.7	892609.8
1		760	241.9	40						
2		370	117.8	28						
1		272	86.6	39						
1		320	101.9	20						
2		352	112.0	18						
3		310	98.7	18						
1		400	127.3	30				Jabjee	272854.5	892350.4
2		120	38.2	11				Luchu	272821.7	892519.4
1		560	178.3	28						
1		210	66.8	12				Rama	272650.8	892406.7
2		200	63.7	15				Dungtshe	272610.8	892511.9
1		180	57.3	13						



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
2		120	38.2	14						
3		125	39.8	13						
1		347	110.5	43	NW	10%	2393	Nemjo	272558.1	892548.2
1		305	97.1	34				Dromja	272546.6	892334.8
1		354	112.7	34				Olathang	272541	892406.7
1	Blue Pine Forest	164	52.2	24	W	5%		Kidiphu	272754.7	892548.2
2		142	45.2	24						
3		124	39.5	22						
4		189	60.2	24						
5		180	57.3	29						
6		160	50.9	24						
7		179	57.0	29						
8		220	70.0	30						
9		210	66.8	22						
10		118	37.6	12						
11		325	103.5	22						
12		488	155.3	24						
13		360	114.6	28						
14		435	138.5	25						
15		240	76.4	16						
16		445	141.6	40						
17		440	140.1	16						



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
1		364	115.9	38				Kemparamda	272705.8	892521.1
1		290	92.3	25				Damji	272639.8	892513.4
1		414	131.8	40				Gona	272704.4	892236.3
1		192	61.1	20				Damena	272645.9	892331.9
1		366	116.5	35				Lango	272655.4	892156.9
1		340	108.2	35				Rimpung Dzong com	272531.4	892525.1
2		444	141.3	35						
3		227	72.3							
4		220	70.0	20						
5		270	85.9	23						
6		500	159.2	40						
7		310	98.7	40						
8		469	149.3	37						
9		454	144.5	38						
10		880	280.1	32						
11		290	92.3	30						
12		384	122.2	28						
13		350	111.4	25						
1	Blue Pine Forest	179	57.0	20		10%		Ta Dzong	272542.9	892534
2		145	46.2	15						
3		174	55.4	16						



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
4		125	39.8	14						
5		75	23.9	12						
6		99	31.5	16						
7		125	39.8	19						
8		105	33.4	13						
9		107	34.1	16						
10		178	56.7	20						
11		146	46.5	19						
1	Blue Pine Forest	360	114.6	26				Shangkha	272603.8	892527.6
2		260	82.8	18						
1		365	116.2	33				Thashikha	272628.8	892558.1
2		375	119.4	21						
3		328	104.4	21						
4		365	116.2	29						
1	Blue Pine Forest	460	146.4	25				Kempa	272725.2	892535.6
2		850	270.6	35					272603.8	
3		354	112.7	20						
1	Blue Pine Forest	500	159.2	18				Chunto	272951.8	892603.3
2		430	136.9	20						
3		152	48.4	20						



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
4		155	49.3	20						
5		680	216.5	20						
2		463	147.4	41						
1	Blue Pine Forest	258	82.1	25	SE	20%		Langmana	272534.7	892419.4
1		323	102.8	20				Gapty	272527.8	892529.2
2		390	124.1	34				Gangtay palace	272528.2	892442.2
1		161	51.2	22				Khangkhu	272453.2	892455.5
1		305	97.1	25				Woochu	272323.4	892533.7
2		550	175.1	22						
3		220	70.0	10						
1		533	169.7	22				Chimakah	272303.8	892546.3
1		540	171.9	35				Above NIE	272457.5	892529.2
2		330	105.0	24				NIE compound		
3		257	81.8	21						
4		182	57.9	14						
5		286	91.0	22						
6		144	45.8	12						
7		70	22.3	8						
8		116	36.9	13						
9		292	92.9	25						
10		340	108.2	35						
11		263	83.7	32						



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
12		251	79.9	24						
13		156	49.7	18						
14		330	105.0	22						
1	Blue Pine Forest	380	121.0	38				Shomchey	272935.8	892140.9
2		640	203.7	40						
3		305	97.1	23						
4		400	127.3	39						
5		455	144.8	41						
6		330	105.0	39						
7		170	54.1	22						
1	Blue Pine Forest	470	149.6	33				Honju	272623.2	892140.9
2		304	96.8	25						
1		468	149.0	25				Koba	272528.7	892210.6
1	Blue Pine Forest	93	29.6	12				Kuengacholing	272658.7	892312.5
2		273	86.9	32						
3		100	31.8	15						
4		228	72.6	32						
5		216	68.8	32						
6		205	65.3	30						
7		207	65.9	31						



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
8		235	74.8	32						
9		210	66.8	30						
10		184	58.6	30						
11		150	47.7	28						
12		198	63.0	31						
13		205	65.3	26						
14		162	51.6	23						
15		210	66.8	23						
16		219	69.7	30						
17		210	66.8	31						
18		225	71.6	20						
19		199	63.3	31						
20		202	64.3	28						
1		256	81.5	28				Tsendona	272650.4	892301.9
2		387	123.2	35						
3		309	98.4	31						
4		312	99.3	26						
5		436	138.8	21						
1	Blue Pine Forest	270	85.9	36				Jutsaphug	272858.1	892010.4
2		180	57.3	23						
3		402	128.0	32						
4		425	135.3	41						



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
1	Blue Pine Forest	264	84.0	22				Tsento Shari	272502.2	892041.2
2		340	108.2	29						
1		505	160.7	34				Satsham Chorten	272709	892116.1
1		389	123.8	29				Jagathang	272655.6	892134.3
1		493	156.9	32				Dakaphu	272627.2	892059.1
1		207	65.9	22				Daka Gompa	272632.7	892045.4
2		203	64.6	21						
3	260	82.8	28							
4	237	75.4	25							
5	147	46.8	22							
6	257	81.8	24							
7	358	114.0	26							
1	Blue Pine Forest	385	122.5	40	E	20%		Jili Gompa	272838.1	891956.9
2		360	114.6	32						
3		325	103.5	30						
4		290	92.3	35						
1		280	89.1	36				Tshezhi		
2		35	11.1	6						
3		250	79.6	35						
4		220	70.0	37						



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
5		295	93.9	35						
6		170	54.1	18						
7		375	119.4	36						
8		475	151.2	48						
9		285	90.7	38						
10		450	143.2	42						
1		175	55.7	25				Shari Tsento	2728204	892034.4
2		180	57.3	25						
3		335	106.6	38						
4		220	70.0	32						
5		80	25.5	12						
1	Blue Pine Forest	413	131.5	35	SW	5%		Shari Talu	272827.7	892128.7
1		540	171.9	38				Satsham Chorsten	272741.8	892048.5
1		457	145.5	28				Upper Jagathang	272718.6	892113.2
2		420	133.7	25						
1		390	124.1	38				Tsego	272645.3	892140
2		560	178.3	32						
3		557	177.3	26						
4		660	210.1	27						
1	Blue Pine Forest	383	121.9	22				Gangju	272625	892128.7



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
2		150	47.7	18						
3		120	38.2	18						
4		283	90.1	30						
1		510	162.3	38				Ngoba	272555.2	892135.4
1		540	171.9	40			2412	Chutakha	272720.5	892144.2
1		140	44.6	20						
2		70	22.3	12				Kyichu Lhakhang	272628.7	892232.6
1		85	27.1	12						
2		159	50.6	16						
3		615	195.8	209						
4		305	97.1	18				Opposite Rinchenling Resort	272740.4	892135.4
1		480	152.8	35						
1		254	80.9	28						
2		240	76.4	25						
3		50	15.9	16						
4	Blue Pine Forest	368	117.1	21	S	5%	2412	Tsento Mesi	272320.6	893516.7
1		506	161.1	33				Tongzhi	273159.7	891923.3
1		515	163.9	36				Ramche	273136.4	891919.2
1		383	121.9	29				Chhuenje	273120.1	891912.7



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
1		476	151.5	20						
2		441	140.4	34						
3		358	114.0	21						
4		308	98.0	25						
1		450	143.2	39				Phongdo	273010.7	891919.7
1		607	193.2	42						
2		320	101.9	26						
3		117	37.2	23						
1	Blue Pine Forest	385	122.5	28	N			Zamsar	273108.4	891953
2		460	146.4	35						
3		440	140.1	30						
4		268	85.3	25						
5		358	114.0	25						
6		350	111.4	22						
7		330	105.0	20						
8		440	140.1	30						
9		375	119.4	39						
10		675	214.9	40						
11		275	87.5	30						
12		445	141.6	33						
13		555	176.7	45						
14		440	140.1	40						



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
15		458	145.8	19						
16		320	101.9	25						
1	Blue Pine Forest	560	178.3	25		5%		Simjo	273002.1	891929.6
2		250	79.6	15						
3		320	101.9	25						
4		230	73.2	18						
5		275	87.5	20						
1	Blue Pine Forest	442	140.7	27	SW			Dobji Dzong	271605.6	893131.3
2		495	157.6	22						
3		490	156.0	26						
3		565	179.8	35						
1	Blue Pine Forest	565	179.8	30	SE			Dawakha	271625.1	893134.5
1	Blue Pine Forest	620	197.4	34	SE			Silu Gompa	271554.7	893110.5
1		234	74.5	28						
2		340	108.2	29						
3		153	48.7	13						
4		343	109.2	14						
5		345	109.8	28				Tagu/ Dawakha	271438.9	893101.4
1		480	152.8	12				Sali	271434.3	893035.7



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
2		755	240.3	25						
1		430	136.9	20				Zongo	271425.1	893043.4
2		500	159.2	22						
1		284	90.4	22				Khamdra	271544.8	893017.8
2		543	172.8	28						
3		260	82.8	16						
4		429	136.6	25						
5		255	81.2	16						
1		155	49.3	13				Lomekha	271655.9	893117.4
2		187	59.5	18						



Lone and group Tsenden trees distribution in Chukha Dzongkhag

Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/ Place	GPS Coordinates	
									Latitude	Longitude
1	Blue Pine Forest	507	161.4	38	E	10%		Paga Gompa	271720	893339.9
2		503	160.1	35	E			Paga Gompa		
3		520	165.5	30	E			Paga Gompa		
4		450	143.2	35	SW	10%		Paga Gompa	271708.9	893329.8
5		471	149.9	40	SE			Paga Gompa	271728.3	893328.3
6		446	142.0	36	SE			Paga Gompa		
7		365	116.2	23				Paga Gompa	271736.1	893310.3
8		488	155.3	27				Paga Gompa	271746.9	893303.9
9		570	181.4	18				Paga Gompa		



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/ Place	GPS Coordinates	
									Latitude	Longitude
1	Blue Pine Forest	695	221.2	30				Rinchenling Gompa	271616.2	893223.9
1		560	178.3	20				Chapcha Dzong	271146.8	893242.8
1		137	43.6	15				Wangkha Plantation	270226	893442.8
2		140	44.6	14				Wangkha Plantation		
3		150	47.7	15				Wangkha Plantation		
1	Blue Pine Forest	862	274.4	38	SE	5%	2757	Lomji Lhakhang	271202.7	893440
2		980	311.9	42				Lomji Lhakhang		



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/ Place	GPS Coordinates	
									Latitude	Longitude
1		370	117.8	28				Dokhacu Gompa	271217.9	893245.8
2		203	64.6	11				Dokhacu Gompa		
1		720	229.2	18	NW			Shamakha	271332	893310.6
2		610	194.2	17				Shamakha		
1	Blue Pine Forest	365	116.2	16	SW			Tshamdra Gompa	271510.3	893226.4
1	Blue Pine Forest	195	62.1	21	SE	15%		Rimtakha Gompa	271137.3	893250.8
2		150	47.7	19				Rimtakha Gompa		
3		200	63.7	19				Rimtakha Gompa		



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/ Place	GPS Coordinates	
									Latitude	Longitude
4		272	86.6	22				Rimtakha Gompa		
5		371	118.1	33				Rimtakha Gompa	271147.3	893225.5
6		237	75.4	12				Rimtakha Gompa	271146.5	893223.9



Lone and group Tsenden trees distribution in Wangdue Phodrang Dzongkhag

Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
1	Cool Broadleaved Forest	223	71.0	20	NW	5%	2471	Ridha Gompa	273306.2	911007.9
2		224	71.3	20				Ridha Gompa		
3		230	73.2	19				Ridha Gompa		
1	Cool Broadleaved Forest	640	203.7	81	E	10%		Jalla	273232.4	900922.9
2		460	146.4	79				Jalla		
3		490	156.0	78				Jalla		
4		530	168.7	79				Jalla		
5		640	203.7	82				Jalla		
6		540	171.9	82				Jalla		
1	Cool Broadleaved Forest	255	81.2	18	SE	3%		Pangkha	273249.7	890156
2		334	106.3	16				Pangkha		
3		290	92.3	26				Pangkha		
4		527	167.7	38				Pangkha	273237.3	890149.1
1	Cool Broadleaved Forest	310	98.7	16	NW	20%		Kazhi	273205.4	895925.8



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
1	Cool Broadleaved Forest	474	150.9	20	SE	20%		Chura Gangkha	273147.9	895059.9
1	Cool Broadleaved Forest	680	216.5	40	NW	5%		Chungsekha	273136.1	895753.1
2		670	213.3	40				Chungsekha		
1	Cool Broadleaved Forest	650	206.9	36	NW			Chungdi Gompa	273049.5	895709.4
1	Cool Broadleaved Forest	495	157.6	36	NE	15%		Goenkha	273041.4	895720.3
1	Warm Broadleaved Forest	400	127.3	38	NW	50%	2019	Chitokha	273228.9	900105.5
2		568	180.8	36				Chitokha		
3		685	218.0	21				Chitokha		
1	Warm Broadleaved Forest	240	76.4	18				Khaney	273221.6	900052.9
1		543	172.8	20	N			Galeykha	273135.8	895929
2		800	254.6	21				Galeykha		
1		549	174.8	35				Chimtsheing	273113.9	895096.6
1		217	69.1	28				Laykhukha	273110.7	895900



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
1	Warm Broadleaved Forest	549	174.8	22				Samtengang	273104.7	895854.4
1		468	149.0	36				Gangju	273059.7	895953.8
2		532	169.3	22				Gangju		
3		445	141.6	17				Gangju	273055.6	895958.1
4		510	162.3	21				Gangju		
1	Warm Broadleaved Forest	468	149.0	28				Phadikha	273051.8	900143.5
2		380	121.0	23				Phadikha		
3		363	115.5	23				Phadikha		
4		294	93.6	22				Phadikha		
1	Cool Broadleaved Forest	607	193.2	41				Jashiphaka	273048.8	895948.2
2		665	211.7	42				Jashiphaka		
1	Cool Broadleaved Forest	530	168.7	50	N	20%		Chimseing	273120.6	895851
2		720	229.2	55				Chimseing		
3		295	93.9	33				Chimseing		
1		630	200.5	58				Rabana	273025.7	895931.1
1		900	286.5	22	NE			Theymakha	272944.2	895723.4
2		240	76.4	23				Theymakha		



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
3		260	82.8	24				Theymakha		
1		670	213.3	22				Zangtekha	272941.1	895834.7
1		380	121.0	28				Kokokha	272956.6	895908.4
1		460	146.4	55				Wakha	273015.9	900358.5
2		336	107.0	49				Wakha		
1	Cool Broadleaved Forest	328	104.4	23	S			Tapchikha	272314	895336
2		286	91.0	35				Tapchikha		
3		430	136.9	32				Tapchikha		
4		490	156.0	31				Tapchikha		
1	Cool Broadleaved Forest	510	162.3	36	S	10%		Gikha	272230.2	895328.2
1		390	124.1	30	N	5%		Heishokha	272217.1	895225.5
1	Cool Broadleaved Forest	383	121.9	18	SE	5%		Lhashikang	272536.1	895311.3
1	Cool Broadleaved Forest	460	146.4	33	NE	8%		Rubisa	272822.1	895448.5
2		345	109.8	24				Rubisa		
3		238	75.8	18				Rubisa		
1	Cool Broadleaved Forest	433	137.8	27	W	5%		Ngashitaykha	272811	895356.2
2		494	157.2	20				Ngashitaykha		



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
1	Cool Broadleaved Forest	1047	333.3	70				Womina	273533.2	900300
1	Cool Broadleaved Forest	1320	420.2	97.5				Bay Langdra	273557.8	900226
2		404	128.6	41				Bay Langdra	273608.9	900222.5
3		185	58.9	26				Bay Langdra		
4		316	100.6	56				Bay Langdra		
5		310	98.7	55				Bay Langdra		
6		542	172.5	57				Bay Langdra		
7		280	89.1	36				Bay Langdra		
1	Warm Broadleaved Forest	513	163.3	27	SE	15%		Matsheykha	272428.9	895327.3
2		206	65.6	21				Matsheykha		
1		535	170.3	24				Latagang	272355.3	895300.1
2		484	154.1	23				Latagang		
1		505	160.7	30				Shingkey	272406.1	895255.7
1		348	110.8	22				Chamjo	272410.8	895237.2
1		420	133.7	12				Gensab	272519.1	895318.1
2		250	79.6	18				Gensab		
1		456	145.1	20				Phanna	272545.2	895310.2
1		237	75.4	19				Maripokto	272622.2	895342.4



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
2		345	109.8	21				Maripokto		
1		297	94.5	23				Tashi Dingkha/ Gaselo	272642.6	895344.5
1		368	117.1	31				Ari Druba	272641.2	895349.4
2		366	116.5	29				Ari Druba		
1		372	118.4	33				Pangsho	272643.7	895253.3
1		515	163.9	20	NE			Pangsho Gompa	272909.2	895141.9
1		295	93.9	20				Pangsho Gompa		
2		382	121.6	26				Pangsho Gompa		
3		154	49.0	20				Pangsho Gompa		
4		176	56.0	20				Pangsho Gompa		
5		94	29.9	16				Pangsho Gompa		
6		171	54.4	19				Pangsho Gompa		
7		155	49.3	20				Pangsho Gompa		
8		187	59.5	22				Pangsho Gompa		



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
9		167	53.2	24				Pangsho Gompa		
10		380	121.0	28				Pangsho Gompa		
11		150	47.7	25				Pangsho Gompa		
12		170	54.1	8				Pangsho Gompa		
13		152	48.4	23				Pangsho Gompa		
14		161	51.2	18				Pangsho Gompa		
1		380	121.0	25				Habesa	272737.1	895149.7
2		161	51.2	18				Habesa		
1		340	108.2	21				Ngyenzergang Lhakhang	272834.4	895431
1		1209	384.8	19	W			Namgyeling	272755.2	895534.5
1		534	170.0	35				Naygo	272744.5	895519.5
2		220	70.0	18				Naygo		
3		210	66.8	17				Naygo		
4		170	54.1	17				Naygo		
5		110	35.0	16				Naygo		
6		120	38.2	17				Naygo		
7		494	157.2	22				Naygo		



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
1	Chirpine Forest	420	133.7	20	E	5%	1231	VTI Samthang	273107.4	895311.2
1	Warm Broadleaved Forest	555	176.7	30	sw			Bjarigang	273631.2	895559.5
2		85	27.1	20				Bjarigang		
3		150	47.7	20				Bjarigang		
1		220	70.0	29				Dadu Gompa	273655.4	8956655
2		100	31.8	20				Dadu Gompa		
3		105	33.4	20				Dadu Gompa		
4		605	192.6	37				Dadu Gompa		
5		392	124.8	33				Dadu Gompa		
1		534	170.0	33	S			Palu	273640.1	895618.7
1		470	149.6	28	NE			Bjashikha	273625.3	895542.7
1		645	205.3	53	SE	5%		Thomji	273542.8	895702
1		775	246.7	31				Tshechekha	273552.7	895645.8
1		470	149.6	34				Gumina	273602.2	895702.9
2		124	39.5	27				Gumina		
3		110	35.0	17				Gumina		
4		135	43.0	22				Gumina		
5		295	93.9	31				Gumina		
1		282	89.8	24				Thomji	273616	895644.2
2		133	42.3	16				Thomji		



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
1		200	63.7	25				Lamjo	273606.6	895635.4
2		175	55.7	25				Lamjo		
1		410	130.5	31				Shengana Gompa	273543.8	895506.2
1	Cool Broadleaved Forest	435	138.5	33	E	15%		Kishe Gompa	273536.8	895456.8
2		535	170.3	31				Kishe Gompa		
3		90	28.6	20				Kishe Gompa		
4		225	71.6	25				Kishe Gompa		
1	Chirpine Forest	112	35.7	21	E			Japona	273521,0	895421.6
2		350	111.4	27				Japona		
3		105	33.4	21				Japona		
4		350	111.4	27				Japona		
5		320	101.9	28				Japona		
6		110	35.0	18				Japona		
7		100	31.8	19				Japona		
8		94	29.9	17				Japona		
9		76	24.2	14				Japona		
10		75	23.9	18				Japona		
11		86	27.4	19				Japona		
12		55	17.5	12				Japona		
13		67	21.3	14				Japona		
14		72	22.9	17				Japona		



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
15		48	15.3	12				Japona		
16		185	58.9	31				Japona		
17		130	41.4	20				Japona		
18		134	42.7	24				Japona		
19		98	31.2	15				Japona		
1	Mixed Conifer Forest	312	99.3	20	E	5%	2697	Rukubji	273049.9	901637.7



Lone and group Tsenden trees distribution in Punakha Dzongkhag

Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/ Place	GPS Coordinates	
									Latitude	Longitude
1	Warm Broadleaved Forest	159	50.6	28	SW	15%		Tsosa	273558.8	895520.2
1		155	49.3	31				Tsosa		
2		142	45.2	31				Tsosa		
3		125	39.8	28				Tsosa		
4		165	52.5	32				Tsosa		
1	Warm Broadleaved Forest	230	73.2	17				Gubji	273548	895224.2
1		664	211.4	32				Chorten Nyingpo	273738.7	894703.9
2		710	226.0	35	NE			Chorten Nyingpo		
3		165	52.5	12				Chorten Nyingpo		
1		286	91.0	13				Wolakha	273202.6	895209
2		500	159.2	27				Wolakha		
1		120	38.2	20				Chorten Nyingpo	273744.2	894650.9
2		160	50.9	24				Chorten Nyingpo		
3		135	43.0	20				Chorten Nyingpo		
4		110	35.0	19				Chorten Nyingpo		
5	105	33.4	17				Chorten Nyingpo			
1	272	86.6	30				Yusakha	273752.4	894737.5	
1	310	98.7	33				Rangrekha	273703.4	894648.4	
2	190	60.5	29				Rangrekha			



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/ Place	GPS Coordinates	
									Latitude	Longitude
1		368	117.1	16		0%		Khuruthang	273301.3	895156.7
2		293	93.3	10				Khuruthang		
3		203	64.6	10				Khuruthang	273251.1	895206.4
1		346	110.1	38	SW			Dali Gompa	273229.6	894930
2		316	100.6	33				Dali Gompa		
1		356	113.3	38	E			Talo Dzong	273301.3	894920.7
2		556	177.0	38				Talo Dzong		
3		320	101.9	38				Talo Dzong		
4		270	85.9	38				Talo Dzong		
5		467	148.7	38				Talo Dzong		
6		401	127.6	39				Talo Dzong		
1		535	170.3	28				Pangkarpo	273314.1	894910.3
1	Cool Broadleaved Forest	178	56.7	25	E	15%		Menchuna	273058.7	894543.3
2		150	47.7	24				Menchuna		
3		150	47.7	24				Menchuna		
4		160	50.9	26				Menchuna		
5		183	58.3	25				Menchuna		
6		167	53.2	23				Menchuna		
1	Warm Broadleaved Forest	190	60.5	17				Septokha/Lobesa	27304.7	895126.4
2		366	116.5	28				Septokha/Lobesa		



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/ Place	GPS Coordinates	
									Latitude	Longitude
3	Chirpine Forest	157	50.0	25				Septokha/ Lobesa		
4		190	60.5	17				Septokha/ Lobesa		
5		362	115.2	32				Septokha/ Lobesa		
1	WBL	216	68.8	26				Lemjakha	273114.7	894847.8
2	Warm Broadleaved Forest	282	89.8	28				Lemjakha		
1	Warm Broadleaved Forest	330	105.0	43				Tongchekha	273132.4	894835
2		112	35.7	18				Tongchekha		
3		126	40.1	20				Tongchekha		
1		380	121.0	29				Silina	273142.3	894928.3
2		160	50.9	23				Silina		
3		160	50.9	23				Silina		
1	Warm Broadleaved Forest	274	87.2	28				Omli	273058.9	895023.7
2		157	50.0	19				Omli		
3		165	52.5	23				Omli		
4		156	49.7	24				Omli		



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/ Place	GPS Coordinates	
									Latitude	Longitude
5		210	66.8	21				Ormi		
1	Warm Broadleaved Forest	410	130.5	27				Sepjika	273038.3	895135.2
2		230	73.2	25				Sepjika		
1	Warm Broadleaved Forest	161	51.2	30	W	35%	1966	Tsenden-nana	274215.4	895929.4
2		357	113.6	29						
3		221	70.3	32						
1	Warm Broadleaved Forest	221	70.3	29	W	5%	1589	confluence of Sichu and Phochu	274044.6	895705.7
1		287	91.4	26				Shengana Gompa		
2		270	85.9	35				Shengana Gompa		
3		223	71.0	23				Shengana Gompa		
4		310	98.7	32				Shengana Gompa		



Lone and group Tsenden trees distribution in Trongsa Dzongkhag

Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
1		580	184.6	45				Chendebeji	272925.1	902028.9
2		370	117.8	20				Chendebeji		
3		171	54.4	16				Chendebeji		
1	Cool Broadleaved Forest	520	165.5	27				Tangsibji	272626.3	902717.7
1		400	127.3	34				Tshangkha Shedra	272748.5	902743.2
2		312	99.3	28				Tshangkha Lhakhang	272755	902820.2
3		330	105.0	21				Tshangkha	272749.2	902820.9
1	Cool Broadleaved Forest	278	88.5	32				Dabji Gompa	272807.3	902708.5
2		222	70.7	28				Dabji Gompa		
3		315	100.3	21				Dabji Gompa		
4		487	155.0	36				Dabji Gompa		
1	Cool Broadleaved Forest	496	157.9	22				Taju Gompa	272745.9	902818.4
2		468	149.0	30				Taju Gompa		
3		236	75.1	15				Taju Gompa		
1	Chirpine Forest	385	122.5	16				Rephay	272309	903125.9
1		548	174.4	17				Samcholing Lhakhang		



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
1	Cool Broadleaved Forest	220	70.0	23				Chakazur Lhakhang	272444.4	902927.8
1	Cool Broadleaved Forest	330	105.0	15				Bubja	272456.3	903030.8
2		296	94.2	18				Bubja		
1	Cool Broadleaved Forest	217	69.1	15				Taksi Gompa	272615.9	902858.8
2		235	74.8	18				Taksi Gompa		
3		147	46.8	20				Taksi Gompa		
4		188	59.8	16				Taksi Gompa		
5		187	59.5	18				Taksi Gompa		
6		280	89.1	21				Taksi Gompa		
7		250	79.6	24				Taksi Gompa		
1	Cool Broadleaved Forest	506	161.1	51				Tashi Dingkha	272628.4	902814.1
1	Cool Broadleaved Forest	346	110.1	25	SW	10%	2869	Dorji Gompa	273021	903219.6
2		164	52.2	15				Dorji Gompa		
3		174	55.4	20				Dorji Gompa		
1	Cool Broadleaved Forest	530	168.7	30		25%	2138	Trongsa Dzong premises		
2		620	197.4	35						



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
3		630	200.5	32						
4		545	173.5	25						
5		645	205.3	23						
6		540	171.9	33						
7		450	143.2	40						
8		633	201.5	45						
9		350	111.4	25						
10		490	156.0	27						
11		625	198.9	30						
1	Cool Broadleaved Forest	560	178.3	35		15%	1911	Tashiding	2726'19.2	9028'27.4
1	Cool Broadleaved Forest	247	78.6	25		15%	1609	Korphu	2795'21.4	1044'936
1		201	64.0	35						
2		176	56.0	30						
1	Warm Broadleaved Forest	372	118.4	40	SW	15%	1315	Nabje	2794'729	1046'291



Lone and group Tsenden trees distribution in Zhemgang Dzongkhag

Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/ Place	GPS Coordinates	
									Latitude	Longitude
1	Warm Broadleaved Forest	440	140.1	25	SE	10%	1141	Zurphai	270552.4	904342.2

Lone and group Tsenden trees distribution in Bumthang Dzongkhag

Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/ Place	GPS Coordinates	
									Latitude	Longitude
1	Blue Pine Forest	335	106.6	28	S	15%		LamaiGompa	273245.1	904335.7
2		405	128.9	30	S	15%		LamaiGompa		
1	Blue Pine Forest	600	191.0	40	SE	30%		Kurjey	273514.8	904348.8
1		530	168.7	20	W	20%		Jakar Dzong	273256.7	904437.4
2		410	130.5	18	W	20%		Jakar Dzong		
1	Blue Pine Forest	338	107.6	23				Zhungye	273019.8	904414.3



Lone and group Tsenden trees distribution in Mongar Dzongkhag

Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/ Place	GPS Coordinates	
									Latitude	Longitude
1	Cool Broadleaved Forest	610	194.2	36	NW	5%		Yakgang	271546.5	911345.5
1	Cool Broadleaved Forest	310	98.7	25	SW	15%		Wengkhar	271608.4	911624.1
1		345	109.8	28	SW	10%		Tongsing	271533.9	911641.7
2		355	113.0	30				Tongsing		
3		340	108.2	25				Tongsing		
4		335	106.6	26				Tongsing		
1	Cool Broadleaved Forest	326	103.8	27	E	15%		Dremtshi	271858	912615.3
2		244	77.7	24				Dremtshi		
1	Cool Broadleaved Forest	341	108.5	28	SE	20%		Lemi/ Dremtshi	271955	912606.8
1	Cool Broadleaved Forest	264	84.0	34	SE	20%		Yarab/ Serzhong	272530.4	912129.6
2		300	95.5	36						
3		174	55.4	33						
4		220	70.0	35						
1	Cool Broadleaved Forest	300	95.5	55	NE	25%		Aja Ney	272851.3	912041.9



Lone and group Tsenden trees distribution in Lhuntse Dzongkhag

Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
1	Cool Broadleaved Forest	435	138.5	41	W	5%		Tergang Lhakhang	274931.5	910430.9
2		490	156.0	40				Tergang Lhakhang		
3		485	154.4	42				Tergang Lhakhang		
1		830	264.2	47	W	5%		Nga Lhakhang	274953.5	910497.1
1		843	268.3	40	W	15%		Khowchung Lhakhang	274609.5	910732.1
2		540	171.9	38				Khowchung Lhakhang		
3		210	66.8	30				Khowchung Lhakhang		
1	Warm Broadleaved Forest	475	151.2	30				Jang	274012.2	911057.3
1		382	121.6	30				Kilung	274301.8	910859.8
1	Warm Broadleaved Forest	510	162.3	28	W	20%		Lhuntse Dzong premises	273952	911118
2		520	165.5	28				Lhuntse Dzong premises		



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
3		410	130.5	25				Lhuntse Dzong premises		
4		380	121.0	20				Lhuntse Dzong premises		
5		420	133.7	20				Lhuntse Dzong premises		
6		310	98.7	18				Lhuntse Dzong premises		
7		240	76.4	18				Lhuntse Dzong premises		
8		210	66.8	16				Lhuntse Dzong premises		
1		620	197.4	48	W	15%		Lekpogang	273938.9	911115.7
2		580	184.6	70				Lekpogang		
3		410	130.5	40				Lekpogang		
4		420	133.7	51				Lekpogang		
5		385	122.5	29				Lekpogang		
6		286	91.0	25				Lekpogang		
7		288	91.7	24				Lekpogang		
8		275	87.5	22				Lekpogang		
9		280	89.1	25				Lekpogang		
10		205	65.3	20				Lekpogang		
11		355	113.0	27				Lekpogang		
12		201	64.0	20				Lekpogang		



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
1	Chirpine Forest	334	106.3	34				Ngalamdung	273947.5	911345.9
1	Cool Broadleaved Forest	311	99.0	40	SW	12%		Tabi/Dungkhar	274851.4	910646.6
1		533	169.7	35				Dungkhar	274922.4	910646.9
2		499	158.8	30				Dungkhar		
3		428	136.2	30				Dungkhar		
4		438	139.4	15				Dungkhar	274919.9	910636.2
1	Cool Broadleaved Forest	414	131.8	30	NE	10%		Drakteng/Khoma	273940.8	911406
2		476	151.5	25				Drakteng/Khoma		
1	Cool Broadleaved Forest	255	81.2	30	NE	40%		Semchabe/ Gangzur	274258.1	910857.3
1		331	105.4	30				Drongtay/Magar	274244.9	910809.1
2		242	77.0	28				Drongtay/Magar		
3		415	132.1	45				Drongtay/Magar		
1	Cool Broadleaved Forest	245	78.0	28	E	39%		Somshing	274316.3	910810.3
2		256	81.5	25				Somshing		
3		121	38.5	19				Somshing		
4		96	30.6	18				Somshing		
1		347	110.5	45				Lingabee	274333.2	910810.3



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
1	Cool Broadleaved Forest	467	148.7	41				Thrimyul	274305.7	910849.3
2		272	86.6	30				Thrimyul		
1		256	81.5	16				Nagtshang		
1		520	165.5	38				Baptong/Khoma	274032	911502.4
2		480	152.8	38				Baptong/Khoma		
3		340	108.2	40				Baptong/Khoma		
1		410	130.5	15				Gompa Karpo	274019,1	911435.3
2		366	116.5	15				Gompa Karpo		
1		275	87.5	22	SW	20%		Wambur	273136.8	911143.1
2		186	59.2	20				Wambur		
1		482	153.4	35	W	15%		Umling	272952.7	911143.1
2		380	121.0	30				Umling		
3		380	121.0	30				Umling		
4		271	86.3	31				Umling		
5		295	93.9	35				Umling		
6		321	102.2	32				Umling		
7		304	96.8	35				Umling		
8		294	93.6	28				Umling		
9		295	93.9	28				Umling		
10		310	98.7	30				Umling		
11		255	81.2	25				Umling		



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
1	Cool Broadleaved Forest	268	85.3	21				Serzhong	275002.2	910747
1		265	84.4	25				Goshupang	275032.8	910722.6
1		210	66.8	20				Goshupang		
2		235	74.8	26				Tshenden Pokpa	275056.1	910708
1		355	113.0	31	SW	5%	50+	Waiwai	275156.5	910803.2
2		371	118.1	38				Waiwai		
3		338	107.6	30				Waiwai		
4		200	63.7	18				Waiwai		
5		171	54.4	15				Waiwai		
1	Cool Broadleaved Forest	515	163.9	40	S	8%		Chusa	275238.1	910723.6
2		272	86.6	36				Chusa		
1	Cool Broadleaved Forest	468	149.0	30	W	5%		Wangshing Lhakhang/Menji	273602.2	911406.4
2		315	100.3	30				Wangshing Lhakhang/Menji		
3		200	63.7	20				Wangshing Lhakhang/Menji		
4		160	50.9	20				Wangshing Lhakhang/Menji		
1		468	149.0	29	W	15%		Jalang	273515.5	911404.3
1		510	162.3	35	W	10%		Dokpabe	273514.5	911416.8



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
1		456	145.1	25	W	20%		Kerog	273525.1	911349.7
2		458	145.8	28				Kerog		
1		316	100.6	28				Budur	273215.8	911207.8
2		214	68.1	22				Budur		
1	Chirpine Forest	658	209.4	30	E	15%		Bapzur	273628.6	911125.5
2		242	77.0	18				Bapzur		
1		421	134.0	37				Kamder	273622.6	911055.3
2		376	119.7	28				Kamder		
1		234	74.5	15				Takila	273555.6	9111059
2		231	73.5	15				Takila		
1		413	131.5	28				Murmur	273754.7	911155.6
1		213	67.8	35				Kamey Gompa	273705.8	911112
1		413	131.5	40				Zarhang Gompa	273722.4	911116.2
2		422	134.3	40				Zarhang Gompa		
3		318	101.2	26				Zarhang Gompa		
1		515	163.9	36				Kisibe	273559.3	910904.1
2		210	66.8	27				Kisibe		
3		200	63.7	27				Kisibe		
1		380	121.0	40				Dangling	273539.8	910941.5
2		410	130.5	35				Dangling		
1		340	108.2	28				Thomjaling	273647.6	911126.3
1		610	194.2	40				Gorgan	273536.1	911204.4



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
1		375	119.4	30				Ngumaling	273653.8	911155.7
1	Cool Broadleaved Forest	422	134.3	33	W	15%		Thrima	274506.2	910825.7
1		315	100.3	28	NW	10%		Shawa	274551.2	910912.2
2		226	71.9	25				Shawa		
3		410	130.5	35				Shawa		
1	Cool Broadleaved Forest	355	113.0	37	W	5%		Zhamling	277660.6	911174.4
1	Cool Broadleaved Forest	322	102.5	28	W	10%		Tsholing	274517.6	910600.5
1		415	132.1	36	W	10%		Ney	274629.5	910430.5
2		371	118.1					Ney	274654.2	910427.5
3		255	81.2	35				Ney		
4		347	110.5	36				Ney		



Lone and group Tsenden trees distribution in Trashigang Dzongkhag

Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
1	Cool Broadleaved Forest	431	137.2	20	W	15%		Lem Phongmey	272215.3	914417
2		511	162.7	18				Lem Phongmey	272216.6	914424
3		585	186.2	28				Lem Phongmey		
1	Cool Broadleaved Forest	495	157.6	22	W	15%		Bumpa Lhakhang/Phongmey	272200.9	914423.4
1	Cool Broadleaved Forest	405	128.9	31	W	10%		Kharsa	272157.1	914430.1
2		400	127.3	30				Kharsa		
3		414	131.8	28				Kharsa		
4		552	175.7	20	S	10%		Kharsa	272151.7	914434.6
1	Cool Broadleaved Forest	446	142.0	24	SW	10%		Shokang	272243.6	914549.3
1	Cool Broadleaved Forest	312	99.3	21	W	20%		Radhi Lhakhang	272224.4	914252.5
2		210	66.8	22				Radhi Lhakhang		
3		112	35.7	22				Radhi Lhakhang		
1	Cool Broadleaved Forest	534	170.0	20	SW	15%		Gothkhar/Shongphu	272027.1	913927.8



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/Place	GPS Coordinates	
									Latitude	Longitude
1	Cool Broadleaved Forest	540	171.9	20	W	30%		Dangrey	272110.7	913941
1	Cool Broadleaved Forest	1259	400.8	35	SW	5%		Khaling Gompa	271231.5	913559.8
1	Cool Broadleaved Forest	297	94.5	26	E	20%		Barshong	271315.7	913309.9



Lone and group Tsenden trees distribution in Trashi Yangtse Dzongkhag

Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/ Place	GPS Coordinates	
									Latitude	Longitude
1	Cool Broadleaved Forest	345	109.8	45	SE	10%	1963	Sharong	274123.6	912541.5
2		320	101.9	40						
1	Cool Broadleaved Forest	480	152.8	40	N	15%	2188	Litchen/ Yangtse	273423.4	912855.7
2		350	111.4	30	SE	5%	1890			
3		630	200.5	35	NE	40%	1963			
4		280	89.1	15	N	15%	1980			
1	Cool Broadleaved Forest	545	173.5	45	SW	30%	2240	Bamdir/ Bumdeling	274006.3	913007.3
2		485	154.4	40						
1	Cool Broadleaved Forest	465	148.0	48	SE	10%		Ngalimang/ Bumdeling	273957	912627.8
1	Cool Broadleaved Forest	390	124.1	50	NW	45%		Drongyul/ Bumdeling	274350	912543.3
2		365	116.2	25						
3		624	198.6	50						
1	Cool Broadleaved Forest	315	100.3	35	SW	55%	2254	Longkhar	274457.3	912534



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/ Place	GPS Coordinates	
									Latitude	Longitude
1	Cool Broadleaved Forest	665	211.7	30	SE	45%	2156	Wangkhar	274306.9	912521.3
1	Cool Broadleaved Forest	356	113.3	28	SE	35%	2141	Tsaling/Dagsa	273720.4	912827
2		545	173.5	40						
1	Cool Broadleaved Forest	536	170.6	30	SW	5%	2211	Khardung Gompa	273725.8	912836
2		210	66.8	20						
3		60	19.1	10						
4		35	11.1	12						
5		38	12.1	12						
6		30	9.5	12						
1	Cool Broadleaved Forest	550	175.1	35	SW	30%	2140	Danagpo	273946.7	913102
2		620	197.4	50						
3		545	173.5	45						
4		650	206.9	60						
5		280	89.1	55						
6		455	144.8	48						
7		484	154.1	45						
1	Cool Broadleaved Forest	615	195.8	45	SW	25%	1600	Old Dzong	273502.8	912935.5



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/ Place	GPS Coordinates	
									Latitude	Longitude
2		195	62.1	20						
3		160	50.9	12						
4		160	50.9	12						
5		170	54.1	15						
6		210	66.8	25						
7		235	74.8	25						
8		380	121.0	45						
1	Cool Broadleaved Forest	525	167.1	60	SW	35%	1946	Bimkhar	273606.2	913025.5
2		515	163.9	55						
3		480	152.8	30	NW	15%	1946	Bimkhar	273603.4	913006.5
4		550	175.1	23	NW	10%	1942		273602.5	913022.3
5		560	178.3	30	NW	5%	1992		273600.4	913036.8
6		465	148.0	32	N	5%	1995		273601.1	913039.3
7		442	140.7	38	NW	20%	2078		273604.2	913102.5
1	Cool Broadleaved Forest	422	134.3	35	NW	20%	1869	New dzong	273654.8	912945.9
1		397	126.4	35	NW	10%	1858			
2		355	113.0	36	NW	5%	1828			
1	Mixed Conifer Forest	485	154.4	45	SW	15%	2108	Namburchan	273646.7	913053.2
1		190	60.5	16	SW	5%	2099	Kelmang	273624.7	913041.8



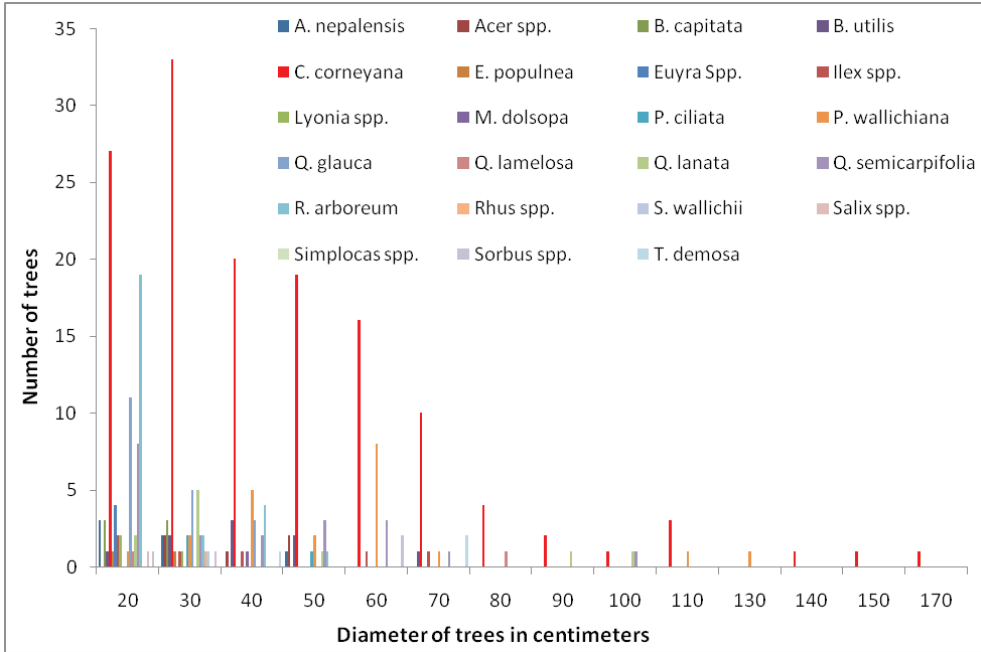
Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/ Place	GPS Coordinates	
									Latitude	Longitude
1	Mixed Conifer Forest	515	163.9	36	SW	25%	2320	Dongna Lhakhang	273634.5	913118.1
1		485	154.4	40	E	30%	2187	Gompadong	273624.8	913107.6
1	Cool Broadleaved Forest	435	138.5	42	SW	0%	1752	Tsharzam	273642.1	912938.1
1	Cool Broadleaved Forest	280	89.1	40	W	40%	2046	Sep	273735.3	912958
1	Cool Broadleaved Forest	150	47.7	28	SE	0%	1711	Cremation ground	273553.9	912926.6
1	Cool Broadleaved Forest	725	230.8	35	SE	15%	2198	Dechen-phodrang	274041.5	913134.8
2		347	110.5	30						
3		200	63.7	29						
4		346	110.1	32						
5		345	109.8	32						
6		190	60.5	28						
7		200	63.7	29						
8		185	58.9	27						
9		210	66.8	30						
10		200	63.7	28						
11		205	65.3	29						



Tree no.	Forest strata	Girth (cm)	Diameter (cm)	Height (m)	Aspect	Slope %	Elevation (m)	Location/ Place	GPS Coordinates	
									Latitude	Longitude
12		200	63.7	29						
13		195	62.1	26						
14		195	62.1	26						
1	Cool Broadleaved Forest	350	111.4	22	SE	25%	1981	Bayling	273722.7	913016.3
1	Cool Broadleaved Forest	343	109.2	50	NW	25%	2076	Rigom	273901.5	913014.2
1	Warm Broadleaved Forest	450	143.2	44	N	35%	2189	Jangphu Lhakhang	272947.7	913750.8
1	Warm Broadleaved Forest	632	201.2	43	SE	25%	2273	Shalamzor	272951	913744.1
1	Warm Broadleaved Forest	768	244.5	55	W	33%	2175	Maniwa	272944	913744.8
1	Cool Broadleaved Forest	343	109.2	45	W	25%	2282	Drataling/ Longkhar	274546	912524.2



Annexure 2: General Structure of Natural Tsenden Forests in Bhutan



Annexure 3: Structure of Natural Tsenden Stand in Nychhu Phug, Wangdue Phodrang

