CONSERVATION MANAGEMENT PLAN

(January 2022 to December 2031)

Jigme Singye Wangchuck National Park
Department of Forests and Park Services
Ministry of Agriculture and Forests
2021

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JIGME SINGYE WANGCHUCK NATIONAL PARK
Department of Forests and Park Services
Ministry of Agriculture and Forests
Tshangkha, Trongsa, Bhutan.

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ENDORSEMENT AND APPROVAL OF THE ROYAL GOVERNMENT OF BHUTAN

CONSERVATION MANAGEMENT PLAN OF JIGME SINGYE WANGCHUCK NATIONAL PARK (2022-2031)

"In accordance with the provisions of the Forests and Nature Conservation Act of Bhutan, 1995."

Submitted for Approval

Tashi Tobgyel
Chief Forestry Officer
Jigme Singye Wangchuck National Park

Sonam Wangdi
Chief Forestry Officer
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Recommended for Approval

Director
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Approved By:

Hon'ble Secretary
Ministry of Agriculture and Forests

འབྲུག་གྱལ་ཁབ་ཀྱི། ཞིང་རྩམ་དང་ནགས་ཚལ་གྱལ་ཁག།
Royal Government of Bhutan
Ministry of Agriculture and Forests
Tashichho Dzong
Thimphu: Bhutan

SECRETARY

FOREWORD

Jigme Singye Wangchuck National Park is the third largest protected area in Bhutan and plays a vital role in conservation of biodiversity in the central region of the country. It is strategically located in central Bhutan to connect southern and northern conservation landscapes and acts as a crucial corridor for dispersal of wildlife and geneflow among various protected areas. The gazettement of this national park in 1995 was a huge milestone in achieving Royal Government's commitment of maintaining at least 60% of total geographical area under forest cover for all times to come, as mandated by the Constitution of the Kingdom of Bhutan.

With wide altitudinal variations, from as low as 250 masl in the southern sub-tropical region to as high as 4925 masl at the peak of Jowo-Durshing (Black Mountain range) in the alpine region, the national park has a great floral and faunal diversity, complimented by its rich cultural diversity including the aboriginal Monpa community. Based on a sound scientific methodology of extensive surveys, this management plan (2022-2031) is a science-based approach to biodiversity conservation with integration of human communities and their livelihood.

I am optimistic that this management plan will contribute immensely towards conservation of rich biodiversity of central Bhutan and bring in balance between conservation and developmental needs of the human communities within and around Jigme Singye Wangchuck National Park.

I wish Jigme Singye Wangchuck National Park best in fulfillment of this management plan.

Tashi Delek!

Thinley Namgyel

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Royal Government of Bhutan
Ministry of Agriculture and Forests
Department of Forests and Park Services
Thimphu: Bhutan

DIRECTOR

PREFACE

It gives me immense pleasure to present the 4th Conservation Management Plan of Jigme Singye Wangchuck National Park (JSWNP) spanning for ten years from January 2022 to December 2031. JSWNP has made remarkable achievements in terms of conservation of the rich biodiversity in central Bhutan and in enhancement of livelihood of the park residents during the implementation of its previous three management plans in the last 25 years of the park's existence.

It is heartening to notice that this new plan has clear vision, mission, goal with realistic, reckonable, and time-bound objectives that are all geared towards accomplishing the goal of preserving the rich biodiversity and providing the ecosystem services to the nation.

The department also attaches great importance to the continued financial support and assistance bestowed by the Royal Government of Bhutan (RGoB), Bhutan for Life (BFL), GEF LDCF NAPA III project supported by UNDP, other donors and conservation partners for providing financial support to carry out major portions of the plan revision expenses like rapid biodiversity survey, socio-economic survey, local forest management planning, community consultation and drafting of this plan, for which we are immensely grateful.

Lastly, I would like to congratulate and express my appreciation to the management of JSWNP for coordinating and developing this conservation management plan, and Nature Conservation Division for their constant technical guidance in this development. I also commend the hard work and sacrifices made by each and every staff who were engaged in one way or the other in developing this important document.

Tashi Delek!

Lobzang Dorji

ACKNOWLEDGEMENT

Jigme Singye Wangchuck National Park is pleased to present this new Management plan, which is the fourth sequel in the park's conservation history of over 25 years. This conservation management plan will be implemented for ten years (2022 to 2031), during which the plan document will form the main basis of activity implementation in the park. The park management would like to convey sincere acknowlwdgement to the following for the successful completion of this management plan preparation;

The Nature Conservation Section (NCS) of the park led the whole process of the plan preparation, starting from planning and conduct of field surveys, coordination meetings and workshops, and final plan writing. The park management applauds the efforts put in by NCS. I also commend the efforts put by all the colleagues who have been actively involved in various field surveys and rapid assessment works, which are vital steps towards developing this plan.

The Nature Conservation Division (NCD) has been of great support in providing technical support and guidance throughout the plan preparation. Therefore, the park management would like to sincerely thank NCD for their timely support and guidance.

The management planning is a budget-intensive process and the park management is highly grateful to the funding agencies such as RGoB, Bhutan for Life (BFL) and GEF LDCF NAPA-III projects for kind support in terms of finance.

Thank You.

Tashi Tobgyel
Chief Forestry Officer, JSWNP

LIST OF ACRONYMS

$AAC_{Silv.}$	Silvicultural Annual Allowable Cut
$AAC_{Sust.}$	Sustainable Annual Allowable Cut
AM	Adaptive Management
APA	Annual Performance Appraisal
BA	Basal Area
BC	Biological Corridor
BFL	Bhutan For Life
CA|TS	Conservation Assured; Tiger Standards
CF	Community Forest
CFMG	Community Forest Management Group
CFO	Chief Forestry Officer
COVID-19	Corona-Virus Disease- 2019
DBH	Diameter at Breast Height
SES	Socio-Economic Survey
DoFPS	Department of Forests and Park Services
DoL	Department of Livestock
EOO	Extent of Occurrence
FFMG	Forest Fire Management Group
FMD	Foot and Mouth Disease
FNCA	Forest and Nature Conservation Act of Bhutan,1995
FNCRR	Forest and Nature Conservation Rules and Regulations of Bhutan
FO	Forestry Officer
FPES	Forest Protection and Enforcement Section
FR	Forest Ranger
FRMD	Forest Resources Management Division
FRMS	Forest Resources Management Section
FYP	Five Year Plan

GEF	Global Environment Facility
GIS	Geographic Information System
GNH	Gross National Happiness
GPS	Global Positioning System
Ha.	Hectare
HWC	Human-Wildlife Conflict
IAPS	Invasive Alien Plant Species
ICDP	Integrated Conservation and Development
ICIMOD	International Center for Integrated Mountain Development
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
JDNP	Jigme Dorji National Park
JSWNP	Jigme Singye Wangchuck National Park
Km^2	Square Kilometer
LFMA	Local Forest Management Area
LFMP	Local Forest Management Plan
LG	Local Government
Masl.	Meters above sea level
METT+	Management Effectiveness Tracking Tool
MHPA	Mangdechu Hydroelectric Project Authority
MoU	Memorandum of Understanding
NAPA	National Adaptation Program of Action
NBC	National Biodiversity Center
NBSAP	National Biodiversity Strategy and Action Plan
NCD	Nature Conservation Division
NCS	Nature Conservation Section
NTFP	Non-Timber Forest Produce
NWFP	Non-Wood Forest Produce
NWFP-MG	Non-Wood Forest Produce Management Group

PA	Protected Area
PNP	Phrumsengla National Park
PRA	Participatory Rural Appraisal
PWS	Phibsoo Wildlife Sanctuary
RBA	Relative Basal Area
RGoB	Royal Government of Bhutan
RMNP	Royal Manas National Park
RRA	Rapid Rural Appraisal
RSPN	Royal Society for Protection of Nature
SFES	Social Forestry and Extension Section
SMART	Spatial Monitoring and Reporting Tool
TAT	Turn Around Time
THyE	Tangsibji Hydro-Electricity Project
TL	Truck Load
UNDP	United Nations Development Programme
UWICER	Ugyen Wangchuck Institute for Conservation and Environmental Research
VIC	Visitor Information Center
WCNP	Wangchuck Centennial National Park
WCPA	World Commission on Protected Areas
WWF	World Wildlife Fund for Nature

GLOSSARY OF LOCAL TERMS

Cham	Trees (Girth 3' to 3'11")
Chiwog	Lowest administrative unit, formed by group of villages
Chhu	River or Water
Drashing	Trees/ Timber (Girth 4'1" and above)
Dzongkhag	District
Gewog	Block
Gup	Elected head of Gewog
Jowo-Durshing	Local name for Black Mountains
Lhakhang	Temple
Sokshing	Leaf litter Collection areas
Tsamdro	Pastureland
Tsesa	Kitchen Garden
Tsim	Trees (Girth 1' to 2')
Zem	Hand-crafted basket made of cane or bamboo

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EXECUTIVE SUMMARY

Often referred to as the heartbeat of the protected area system of Bhutan, Jigme Singye Wangchuck National Park (JSWNP), erstwhile known as the Black Mountain National Park, was gazetted as a national park in 1995. With an area of 1730 km^2 JSWNP is the third larges protected area in the country after Wangchuck Centennial National Park (WCNP) and Jigme Dorji National Park (JDNP). The Park, as of December 2018 has implemented three conservation plans, and this is the fourth conservation management plan of JSWNP, prepared for ten years, 2022 to 2031.

This management plan is prepared based on findings of a robust biodiversity assessment, Local Forest Management Planning (LFMP), Socio-economic Survey (SES) of the resident communities and zonation exercise. Existing data on human wildlife conflict (HWC), species records, invasive species and other data were also used. In addition, a strategic framework analysis and several Participatory Rural Appraisals (PRA), stakeholder consultation at local, dzongkhag and national level have contributed to formation of this plan to the final shape.

The first chapter of the plan gives a brief background information about JSWNP and its conservation outlook; specifying the vision, mission, objectives and goals of the park. It highlights on the salient features of this plan document and then details out the zonation of the park, describing all zones (core, transition, buffer and multiple-use zones) designated in the park.

The second part comprises of detailed description of the current status of JSWNP under which floral description, faunal description and socio-economics of the park residents are described at length. Owing to presence of different vegetation zones (sub-tropical to alpine) in the park and a robust biodiversity survey, a total of 876 species of plants (including 92 species of orchids), 55 species of mammals, 323 species of birds, 376 species of butterflies, 42 species of herpetofauna and 16 species of fishes have been recorded from the park. Socio-economics wise, the park has a total of 601 households inside its boundary and a total population of 5538 individuals (2937 males and 2601 females), whose primary source of livelihood is agriculture and livestock rearing. The second part also describes the forest resource areas in the park such as community forests (CFs) and local forest management areas (LFMAs), on which the local communities are dependent.

The third part presents the overall review of the past management plan, highlighting on the objectives that have been fulfilled during the plan period, issues and challenges faced during the plan implementation, lessons learnt from the plan implementation and gaps and carry over activities from the previous plan.

The fourth part identifies conservation threats and management challenges in JSWNP. Then each of the conservation threats are ranked. This is followed by fifth part which, based on the threats ranking, proposes management prescriptions under six broad conservation objectives that are further divided into 20 strategies and 85 strategic actions. This is followed by sixth part that details out implementation plan and financial outlay of this plan and the seventh part outlines monitoring an evaluation plan of the plan implementation.

The plan also has a detailed local forest management plan of seven gewogs having human settlements in JSWNP, put together under Appendix 1.

This management plan aims to address conservation threats and management challenges facing JSWNP during the next ten years through proper implementation of the activities prescribed in this plan document.

The financial outlay for this plan has been prepared referring to the financial outlay of BFL project, and RGoB's funding outlay as per the 12th Five Year Plan. The major portion of the funds for the plan implementation would come from the Bhutan for Life (BFL) project during the initial years and would be gradually overtaken by RGoB and other conservation donors over the years.


Great Hornbill (*Buceros bicornis*)

Black Mountain range rising above the clouds

Tigress (BTN-21) from JSWNP

PART 1: BACKGROUND

1.1. History and Significance

Nestled in the Eastern Himalayas and sandwiched between the two giant nations, India to the South and China to the north, Bhutan is a small mountainous country with a total geographic area of 38,394.00 km^2. The country, owing to its strategic location at the ecotone of two major biogeographic realms, the northern Palearctic and the southern Indo-Malayan realms, Bhutan has a rich natural resources and diverse flora and fauna. Under the visionary leadership of our kings, environmental conservation in Bhutan has always been given the foremost priority. Environmental conservation is one of the four pillars of Gross national Happiness (GNH), Bhutan's developmental philosophy that seeks to promote human development and manage environmental conservation within a sustainable strategy guided by Buddhist ethics. As such, today Bhutan has over 71% of the country under forest cover and the Royal Government of Bhutan (RGoB) has conserved overwhelming 51.44% of the country's total landmass under Protected Areas network, which comprises of five National Parks, four Wildlife Sanctuaries, one Strict Nature Reserve, one Botanical Garden and eight Biological Corridors (DoFPS, 2015).

Often referred to as the heartbeat of the protected area (PA) system of Bhutan, Jigme Singye Wangchuck National Park (JSWNP) is strategically located in the central region of Bhutan to connect the conservation landscapes in all four directions. It shares boundary with Royal Manas National Park (RMNP) in the south, connects to Wangchuck Centennial national Park and Jigme Dorji National Park in the north via BC 8, and to Phibsoo Wildlife Sanctuary (PWS) in South-West and Phrumsingla National Park (PNP) in the East via BC 3 and BC 4 respectively. It is the third largest protected area in the country, with an area of 1730 km^2. It was notified as a National Park in 1993 and operationalized in 1995. The national park was formally known as Black Mountain National Park, attributing to the Black Mountain ranges, which forms the core of the national park; however, it was renamed as Jigme Singye Wangchuck National Park in 2001 to honor the commitment made by His Majesty the fourth Druk Gyalpo towards environmental protection and conservation (JSWNP, 2014).

Due to the prevalence of wide altitudinal variation, from as low as 250 masl in the south to 4925 masl at the peak of *Jowo Durshing,* the national park has a good representation of varied vegetation types ranging from sub-tropical to alpine landscapes enabling different habitat types and great species diversity. Over 55 species of mammals, 323 species of birds, 376 species of butterflies 16 species of fishes and more than 42 species of herpeto-fauna have been recorded in the national park. Many of these species are globally threatened and of great conservation significance. Some of these species are the Bengal tiger *(Panthera tigris tigris),* musk deer *(Moschus chrysogastor),* red panda *(Ailurus fulgens),* golden langur

(Trachypithecus geei), Himalayan black bear *(Ursus thibetanus),* gaur *(Bos gaurus),* the critically endangered White-bellied heron *(Ardea insignis),* and Rufous-necked hornbill *(Aceros nipalensis)* to name a few.

The national park is also very significant in providing structural and functional linkages between between different protected areas of the country due to its strategic location, at the centre (Letro, 2018). It functions as a crucial linkage between the southern and the northern conservation landscapes by enabling smooth movement of wildlife, especially the tiger and migratory bird species between these landscapes. The high mountains in the central regions of the national park are important water sources that drain into the Mangdechhu river in the east and Punatshangchhu river in the west. The Nikachhu joins the Mangdechhu from the north. All of these rivers are important in terms of hydro-electricity production.

At the local level the national park is significant as the park has a diversity of communities living inside, which includes two of Bhutan's first settlers, the *Monpa* communities in Jangbi, Wangling and Phrumzur villages of Langthel gewog under Trongsa dzongkhag and Reeti village under Jigmechholing gewog of Sarpang dzongkhag, and *Olep* community in Rukha village in Athang gewog of Wangdue Phodrang dzongkhag. These communities are very important both culturally and historically. However, their cultural and linguistic practices are at the verge of extinction and JSWNP plays important role in their conservation (Letro and Wangchuk, 2016).

1.2. Vision, mission and goals

Vision

"A conservation landscape with natural biodiversity thriving in coexistence with values and aspirations of local community and enabling a vital connectivity between southern and northern conservation landscapes of Bhutan."

Mission

"The biodiversity is valued, conserved and sustainably utilized for environmental and social welbeings, through an integrated management approach."

Goals

1. The conservation and protection of key species and its habitat are strengthened in the park.
2. The park's natural resources are sustainably managed under scientific management plans.
3. Unique landscapes and ecosystems are managed and improved.
4. The livelihood and wellbeing of park residents are enhanced.

Objectives

1. To strengthen protection of wildlife and forest resources
2. To strengthen wildlife monitoring and research
3. To manage and improve wildlife habitats
4. To ensure sustainable management of natural resources
5. To ensure harmonious coexistence of local communities and national park
6. To strengthen national park institutional and technical capacity

1.3. Salient features

This plan is developed following scientific methods and guidelines, particularly Voume IV of the Forest and Nature Conservation Code of Best Management Practices of Bhutan (DoFPS, 2021). The data on which this plan is based were collected through biodiversity survey (mammal, birds, vegetation), socio-economic survey and Local Forest Management Planning (LFMP). Existing data on insects, fishes, herpeto-fauna, orchids and invasive plant species were also used for the planning.

A team of technical experts were invited from the Nature Conservation Division (NCD) for interpretation of these data, and based on the findings from the data analysis, the management prescriptions for the next ten years were derived.

The plan is based on the features of Adaptive Management. Adaptive management is simply learning from past management actions to improve future planning and management. It comprises of five steps forming a cycle: 1. Conceptualise the management regime, 2. Plan the actions and strategies, 3. Implement the planned activities, 4. Analyse the impact of interventions, communicate the outcome and adapt to emerging needs, and 5. Capture the lessons learnt and incorporate them into next plan (Fig. 1). This management plan comes at the time of COVID-19 pandemic when activities implementation is not guaranteed due to many associated restrictions. Therefore, the plan is highly adaptive in nature, which allows flexibility in implementation, both in modality and timeline, with regular review of the progress and building on the experiences of past year's progress. Every year, the management team of the park will review the outcomes of this plan implementation and adapt to the emerging needs, given the current unpredictable situations.

One of the key salient features of this management plan is its prerequisite to develop an annual operational plan (OP) and implement the prescribed activities based on the OP. The OP will be prepared annually, after thorough review of this management plan (which will act as the master plan for 10 years), reviewed and approved by the department and implemented by the national park.

Figure 1: Adaptive Management Cycle

1.4. National Park Zonation

Unlike most protected areas (PAs) around the world, Bhutan has local communities living inside the protected areas who enjoy traditional user rights over natural resources. This demands for an integrated approach in maintaining the ecological integrity of the PAs and meeting developmental needs of the park residents. The National Forest Policy of Bhutan, 2011 requires our PAs to be managed based on functional zones to accommodate integrated conservation and development through a variety of appropriate management regimes, which is further translated as a requirement in the Forest and Nature Conservation Rules and Regulations (FNCRR, 2017).

Therefore, based on such needs, JSWNP carried out the zonation of the park in 2021 as per the Zonation Guideline of Bhutan, 2020 (NCD, 2020); with the fundamental aim to classify the park into different zones for conservation of species and their habitats, and to support resource use and other social needs for its residents. The zonation exercise was completed using scientific concepts, methods and tools applied globally such as Maxent, Zonation and GIS. To achieve a realistic, data-based zonation output, certain species of wildlife were prioritized, especially those species that are threatened as per IUCN nomenclature. Major

focus was given to tiger, other cat species such as common leopard *(Panthera pardus),* Asiatic golden cat *(Catopuma temminckii)* and clouded leopard *(Neofelis nebulosa),* wild dog *(Cuon alpinus),* Himalayan black bear, musk deer, golden langur, red panda and bird species such as White-bellied heron, Hornbills, Himalayan monal *(Lophophorus impejanus),* Blood pheasant *(Ithaginis cruentus)* and Satyr tragopan *(Tragopan satyra)*. The data on these species was fed to zonation software, and the output from the software was further refined using GIS software and field truthing exercises. Community consultation was carried out at two levels; firstly, before the zonation exercise all the communities of the park were consulted during data collection, and second round of consultation was done after the first draft of management plan was produced. Peoples' feedback, suggestions and complaints were compiled and incorporated into the final copy of the conservation management plan.

Apart from identifying areas important for biodiversity conservation, habitat preservation and protection for long-term persistence of biodiversity and ecosystem, the park zonation will benefit in better management of ecosystem services to park residents, down-stream users and visitors alike.

The zonation exercise designated the following four zones in JSWNP, in line with the zonation guideline of Bhutan, 2020:

1.4.1. Core Zone

The core zone is a non-negotiable zone where any kind of anthropogenic activities are strictly prohibited except for conservation activities such as patrolling and regulated scientific studies that effect conservation.

A total of 953.1 km2 which equals to 55% of the total PA area has been identified and designated as the core zone. The zone is separated into two parts by a transition zone that connects Nabji side to Reeti side through Dungkola. The core zone is formed of areas with high conservation values that provide critical services for the persistence of flora and fauna of international, national or local importance including resident or migratory fauna. Core habitats of focal species such as tiger, musk deer, red panda, and the endemic *Primula chasmophila* are all covered in the core zone. The least explored Black Mountain range, which is unique in multiple ways, is more or less covered under this zone.

1.4.2. Transition Zone

Transition zones are areas of interdependence between wildlife and communities wherein, traditional and legal rights for sustainable use of natural resources is permitted for a certain period of time. The protection status of this zone shall become equivalent to that of the core zone except during the traditional/legal use-right season or for a fixed time use.

An area of 42.3 km2 which is equal to 2% of total PA area has been designated as transition zone. The zone has two parts; one connecting Nabji side to Reeti side through Dungkola

which is areas where cattle grazing has been practiced by few herders of Bumthang since the time immemorial, and the other one encompassing the seasonal grazing areas in the Simkharka area.

1.4.3. Buffer Zone

The buffer zone is classified mainly to provide cushioning function to the core or transition zone when these zones are located in the immediate vicinity of anthropogenic disturbances both from within and outside of the PAs.

An area of 123.2 km^2 which is equal to 7% of the total PA area has been designated as buffer zone. This is mainly formed of 500m buffer between core and multiple-use zones plus a separate buffer designated to cushion the anthropogenic activities by people of Simkharka though no multiple-use zone is designated in the area for there is no human settlement inside the park area. However, since the human settlement is located right outside of the park area, a buffer stretch was felt necessary.

1.4.4. Multiple-Use Zone

The multiple use zone may include settlements, built-up areas, private registered lands and resource allocation areas for the PA residents. This zone is also termed as 'zone of cooperation' underscoring the role of cooperation between the park management and its residents. This is a zone where stakeholders agree to work together to manage and use the area in a sustainable manner to benefit both people and wildlife. This zone encompasses all the LFMP areas of all the communities.

Overall, an area of 611.4 km^2 which is equal to 35% of total PA area has been designated as the multiple-use zone. This zone is formed by five parts as follows;

Reeti community has an area of 41.6 km^2 as multiple-use zone, which comprises of all the LFMP area plus additional areas where human activities such as cattle herding and Non-timber Forest Products (NTFP) collection are prominent.

Chendebji village has 12.1 km^2 as its multiple-use zone, which is the area around the agricultural fields of the village and a small stretch of area adjacent to Chendebji to Nyala Dangla where some level of human activities such as NTFP collection and firewood collection are in practice.

Phobji gewog has 71.3 km^2 of multiple-use zone despite the gewog not having any human settlement in the park area. This zone has been designated due to the fact that the areas such as Khebethang, Wangjela, Maniting, Jari-Busa, Yakchu, Khephu, Bruksana and Dungshingtshang under Phobji gewog have been used as transitional cattle, yak and sheep herding ground by the people of the gewog for centuries and the practice is still active. The people use the area for more than 8 months every year; therefore, it was necessary to demarcate the area as multiple-use zone given their traditional rights.

Adha-Rukha has an area of 129.4 km^2 as multiple-use zone to cater to the resource needs of the people of Athang gewog inside the park. The zone covers villages in the Adha region, extends towards Taksha through Nangshina and encompasses the communities towards Rukha side.

Langthel, Korphu and Trong gewogs altogether have 357.0 km^2 as multiple-use zone. This covers areas to cater to the resource needs of all communities of these three gewogs inside the park jurisdiction. All three gewogs have LFMPs, the areas of which are covered within the multiple-use zone. The following table summarizes the park zoning details of JSWNP;

Zonation Area Details					
Sl. No.	***Zones***	***Locality***	***Coverage (Km2)***	***Total (Km2)***	***% of PA area***
1	Core Zone	-	953.0	953.1	55.1
2	Buffer Zone	-	123.0	123.2	7.1
3	Transition Zone	Simkharka	17.6	42.3	2.5
		Nabji-Reeti	24.7		
4	Mutiple Use Zone	Reeti	41.6	611.4	35.3
		Chendebji	12.1		
		Phobji	71.3		
		Adha-Rukha	129.4		
		Langthel-Korphu-Trong	357.0		
			TOTAL	**1730.0**	**100.0**

Table 1: Zonation area details of JSWNP

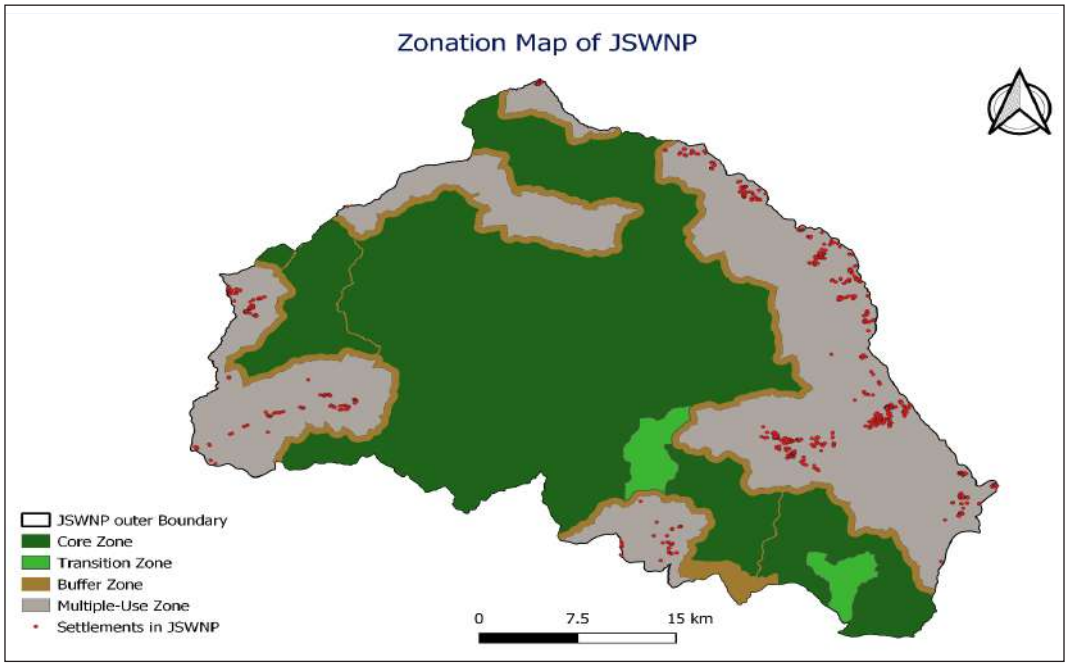

Figure 2: Zonation Map of JSWNP, 2021.

PART 2: CURRENT STATUS

2.1. Landscape Characteristics

2.1.1. Location and Extent

JSWNP is located between the latitudes of 27° 1' 20.64" to 27° 29' 13.92" North and longitudes of 90° 4' 5.52" to 90° 41' 19.32" East, covering an area of 1730 Km^2. JSWNP covers 10 gewogs, wholly or partly, from within the political boundaries of five Dzongkhags (districts) of Trongsa, Sarpang, Tsirang, Wangdue Phodrang and Zhemgang. From Trongsa, Korphu gewog entirely falls inside the park and Langthel and Tangsibji gewogs fall partly inside the park. From Sarpang, about half of Jigmechholing Gewogfalls inside the park and Chhudzom (Dovan) Gewogjust touches the park at one point. From Tsirang, Sergithang and Phuntenchhu gewogs have small parts of them falling inside the park. From Wangdue Phodrang, around half of Athang and Phobji gewogs fall inside the park and from Zhemgang, part of Trong gewog falls inside JSWNP.

The boundaries of the park are as follows:

East: Starting from the confluence of Nikachhu and Mangdechhu the boundary follows the latter towards the south until its confluence with Yangdigangchhu at 27° 8' 52.691" N 90° 41' 17.805" E which is demarcated with boundary pillar (Feno peg, No. 80187) in Tingtibi.

South: The southern boundary of the park follows Yangdigangchhu up to its junction with the ridge from Tamala at GPS coordinate 90° 40'27" E and 70° 06'36" N. It follows the ridge up to Tamala peak at 2193 masl. The boundary then descends and follows the Kuilegangchhu up to the junction of Hartikhola and end of the ridge at 27° 1' 22.50" N; 90° 37' 21.40" E, where boundary pillar No. 0065511 is fixed at the junction. From here, the boundary follows the ridge above Samkhar where two boundary pegs are fixed, and runs till it meets with Ruthalgang chhu at 90°33'22" E and 27°1' 32.85" N. It then follows upstream along Ruthalgangchhu at 27° 2' 6.300" N; 90° 34' 21.400" E and peg No. 0065513 is fixed at the Rakshadung from where the boundary follows the ridge up to Ranzipong above Chungshing village at 27° 2' 3.400" N 90° 34' 11.600" E, demarcated with peg no. 0065512. The boundary then follows the ridge till the peak (2335m) and then descends to join Galechhu at 90° 29'30" E and 27° 3'30" N. From here the boundary follows the main stream of Galechhu till its western tributary at 90° 29'30" E and 27° 2'30" N, and then follows the tributary up to the peak at 2057 m; it then descends to join Gongkhola at 90° 26'45" E and 27° 3' 45" N. It then follows Gongkhola upstream and then the western ridge till Mangarling dara (27° 4' 43.300" N 90° 25' 8.300" E) where Peg No. 0065517 is fixed. It then follows north of Mangarling dara ridge until GPS 27° 5' 12.400" N 90° 25' 2.600" E, which is demarcated with Peg No. 0065518. Then it descends along Morgangling dara to join Kharkhola at 27° 5' 31.000" N90° 23' 53.600" E, demarcated with boundary peg No.65515. The boundary then

follows upstream of kharkhola till Norbugang Ney at GPS coordinate 27° 6' 37.400" N,90° 23' 46.900" E, demarcated with boundary peg no. 0065514 and then follows western ridge till Malingdrangra at Tsunithang village at 27° 6' 4.200" N 90° 21' 54.900" E, demarcated with peg No. 0065516. It then follows the north-western ridge to meet a peak of 3068 m and descends to join Burichhu at 90°19'30" E and 27° 9'00" N; follows Burichhu up to 90° 16'15" E and 27° 7'45" N (2345 masl) and then follows its western tributary to meet a peak of 3445masl. It then descends along the ridge just below the confluence of Punatsangchhu and Harachhu.

West: From below the confluence of Harachhu and Punatshangchhu at 90° 4'11.15"E 27°10'44.72"N the boundary follows Punatshangchhu up to its confluence with Kisonachhu; it then follows Kisonachhu up to its confluence with Marachhu and Kangkhachhu at 27°7'39" N; 90° 6' 7.3" E (Peg No. 0065519); it then follows Kangkhachhu towards North till it reaches Khiphu at the end of ridge with Kangakhachhu, at 27° 19' 30.60" N 90° 5' 29.40" E (Peg No. 0065521) and follows along ridge towards northeast and drops at Tarana with Marachhu at 27° 20' 39.60" N90° 9' 0.80" E (Peg No. 0065520). Then the boundary follows Marachhu till the north of Khebeythang; and then follows the ridge up to Selela to join northern boundary.

North: The northern boundary starts from Selela and ascends along the ridge going northeast to meet a peak of 4136 masl., and joins with the tributary of Lamchela/Khebechhu; follows the tributary to join the main stream of Lamchelachhu at 90° 20'15" E and 27° 29' N. The boundary then follows, Lamchelachhu up to its confluence with Nikkachhu or Chendebjichhu and then follows Nikachhu up to its confluence with Mangde chhu.

2.1.2. Climate and Topography

JSWNP is one of the few protected areas that represents great altitudinal variation. The wide elevation range and mountainous terrain create complex climatic conditions; however, the park can be broadly categorized into four climatic zones; wet-subtropical, temperate, sub-alpine and alpine zones. The wet-subtropical climatic conditions prevail along the southern regions of the national park with altitude as low as 150 masl. The temperate conditions prevail along the mid-altitude areas all around the national park, and the sub alpine and alpine conditions occur mainly in the north-central part of the park where the Black Mountain range rises to form permanent ice cap. The south-west monsoon contributes most of the annual rainfall from June to September. The rain shadows imposed by the high mountain ranges result in localized rainfall gradients during this period.

Topographically, the north-central part of the national park has rugged landforms, with peaks rising to almost 5000 masl at the highest point, while the southern parts are relatively less steep and rugged.

Geologically, the mountains are recent and steep-sided, consisting largely of Pre-Cambrian and early Paleozoic quartzite and gneiss, with some areas with sedimentary limestone, dolomite, sandstone and shales. The soils are generally clay loam, with good permeability and moderate moisture retention.

2.1.3. Hydrology and Drainage

The national park is surrounded by three major rivers: The Mangdechu defines the eastern boundary starting from its confluence with Nikka Chhu below Tangsibji in Trongsa to Tingtibi, Nikachu drains the Chendebji valley in the northern part of the park till its confluence with Mangdechu, whereas Punatshangchu touches the mid-western part of the park in Taksha. There are many glacial lakes in the Black Mountain region. The most distinct ones are the Jeadhha Tsho, Mendey Tsho, Buxa Tsho, Tsho Zhao, Yue Tsho and Ser Tsho.

Numerous streams originate from these snow-fed alpine lakes which form smaller rivers like the Hara-chu, Nabji-chu, Berti-chu, Phrumzur-chu, and the Waichhen-chu. This network of small perennial and annual tributaries flow down the steep slopes, often as waterfalls and along valleys to become tributaries of the larger rivers. The distinct rainy and dry seasons results into a wide seasonal variation in the river flows, with large volumes of sediment-laden water flowing during the monsoon and low volume during the dry, winter season. The local communities also rely on the water from these rivers for domestic consumption and for irrigation.

2.2. Floral description

2.2.1. Vegetation zones, land-use and habitat types

The national park has three major eco-floristic zones with different vegetation types and they are: 1. Sub-tropical zone, 2. Temperate zone, and 3. Alpine zone. Due to the wide-range of altitude and variation in climatic conditions, the park supports a wide range of forest types and habitat types within the different land-use types. Forest constitutes the dominant ecosystem with 95% per cent under forest cover and 17 land-use types classified inside the park (LCMP, 2016). The presence of 11 forest types including meadow, wetland, rocky outcrop, cave, limestone formation etc., signifies the presence of diverse habitat types for successful conservation of fauna and flora inside the park.

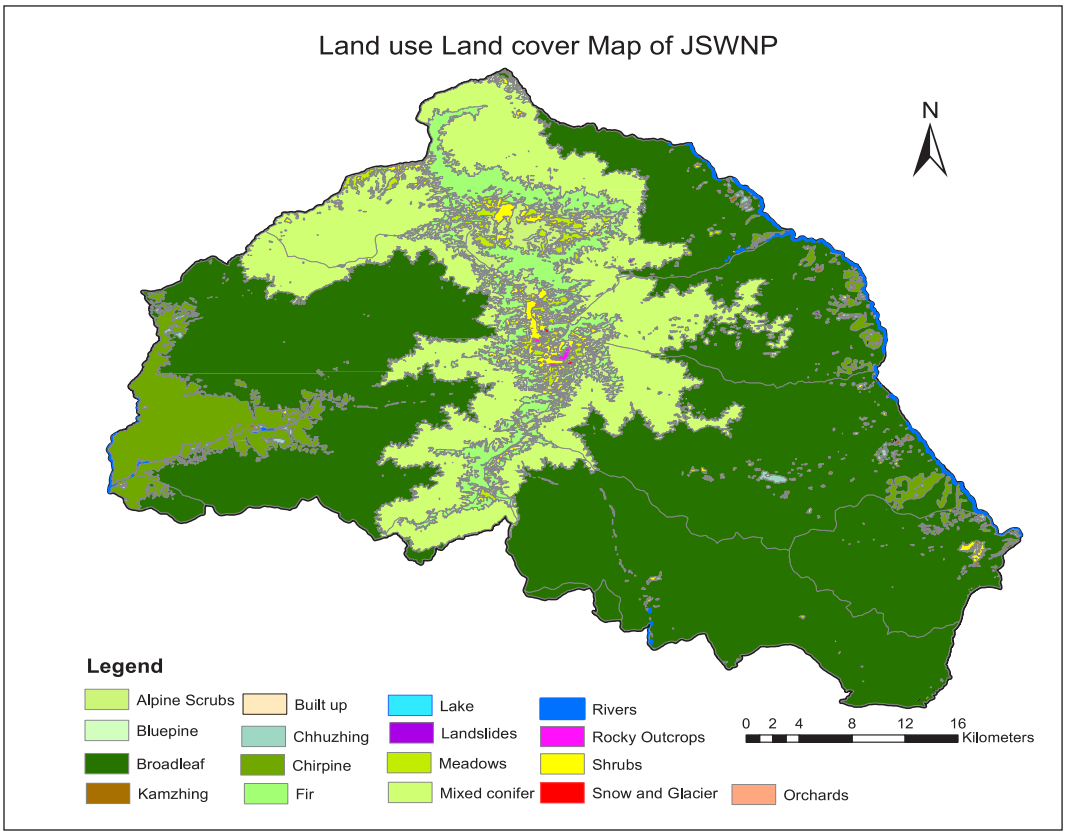

Figure 3: Land-use map showing 17 land-use types classified inside the park

2.2.2. Threatened floral species

The Park is home to so many species of threatened flora and the conservation of those species will be of utmost importance for achievement of overall conservation goals and also in providing ecosystems goods and services to the communities residing inside the park. The Species *Paphiopedilum fairrieanum* was recorded under Taksha range and the assessment on population status, habitat characteristics and threat level to the species was fairly understood for management. However other threatened floral species recorded inside the park were: *Cypripedium himalaicum, Gastrochilus calceolaris, Primula chasmophila, Nardostachys jatamansi, Paris polyphylla, Panax pseudo-genseng, Taxus baccata etc.* require further assessment for sustainable management. The direct and indirect threat observed were mainly illegal collections, forest fires, human disturbance, browsing and climate change.

Figure 4: Paphiopedilum fairrieanum in its natural habitat at Rukha, Athang, Wangdue Phodrang

2.2.3. Floristic Composition of the major lifeform distribution under each range & Forest Types

A. Floristic Composition

Recent surveys recorded 876 species of plants inside the 77 vegetation plots and they are154 evergreen trees, nine conifer trees, 69 deciduous trees, 99 evergreen shrubs, 93 deciduous shrubs, 19 evergreen palms, 123 woody and non-woody climbers, 25 grasses and bamboos, 173 perennial herbs, 95 annual herbs and 92 epiphyte and terrestrial orchids inside the park *(Appendix 1)*. Based on the analysis, seven cluster solution with 11 forest types were classified as depicted in Figure 5 below;

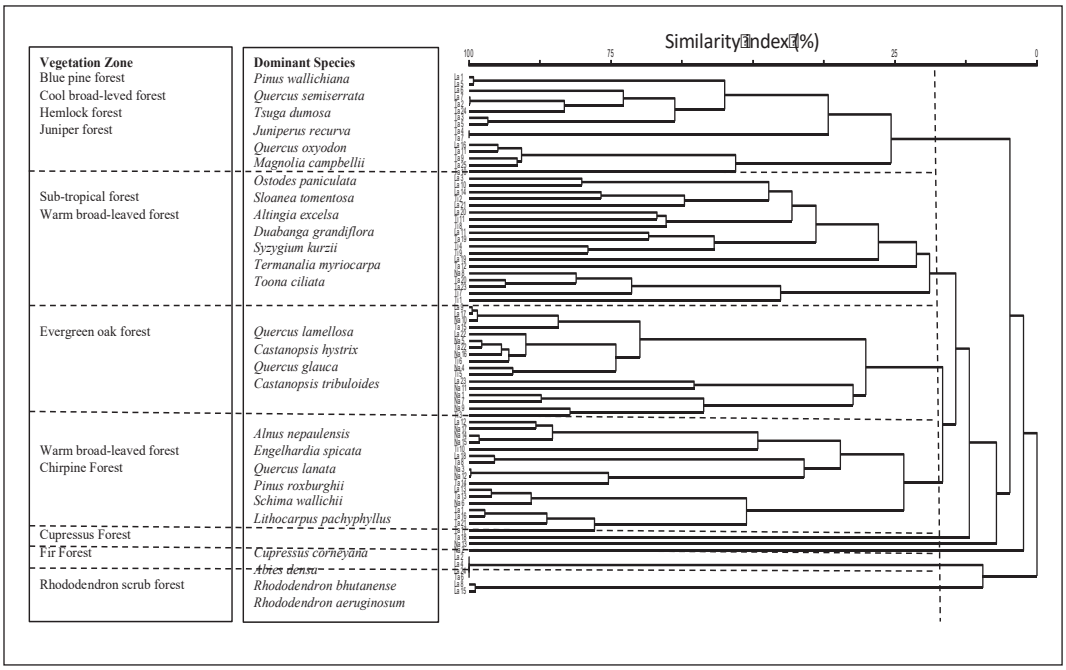

Figure 5: Cluster dendrogram showing sequential clustering of trees and shrubs using Relative Basal Area in % (RBA) data occurring inside 77 plots and the similarity index scale (%) arbitrarily marked at 17 % portraying 7 cluster solution with dotted lines. The cluster analysis was performed using distance measure of relative Sorensen (Bray-Curtis) and group average as linkage method.

B. Forest types

i. Blue pine forest, Cool broad-leaved forest, Hemlock forest and Juniper forest

These forest types are spread within the jurisdiction of Lanthel and Taksha Range and the dominant species recorded are Pi*nus wallichiana, Quercus semiserrata, Tsuga dumosa, Quercus oxyodon, Magnolia campbellii* and *Juniperus recurve.*

ii. Sub-tropical forest and Warm broad-leaved forest

Such forest types are found mostly in Tingtibi and Taksha range; however, they are also found in Langthel and Nabji range. The dominant species recorded are *Ostodes paniculata, Sloanea tomentosa, Altingia excels, Duabanga grandiflora, Syzygium kurzii, Termanalia myriocarpa* and *Toona ciliate.*

iii. Evergreen oak forest

These forests are a very characteristic feature of some parts of central Bhutan; they are prominently spread in all of the four ranges. The dominant species recorded are *Quercus lamellose, Castanopsis hystrix, Quercus glauca* and *Castanopsis tribuloides.*

iv. Warm broad-leaved forest and Chirpine forest

These types of forest are found in all of the four ranges. The dominant species recorded are *Alnus nepaulensis, Engelhardia spicata, Quercus lanata, Schima wallichii, Lithocarpus pachyphyllus* and *Pinus roxburghii.*

v. Cypress forest

This type of forest is found in upper catchment of Harachhu and Poekachhu under Taksha range and the dominant species is *Cupressus corneyana.*

vi. Fir Forest

This type of forest is found under Langthel and Taksha range and the dominant species is *Abies densa.*

vii. Rhododendron scrub forest

This type of forest is found under Langthel and Taksha range and the dominant species are *Rhododendron bhutanense* and *Rhododendron aeruginosum.*

2.2.4. Range wise life-form composition of trees & shrubs, ground vegetation

A. Trees & shrubs

The overall life-form composition has a considerable proportion of evergreen trees at 65% followed by conifer trees at 14%, deciduous trees 15%, evergreen shrub at 3%, deciduous shrub at 1.3%, climber at 0.25%, evergreen palm at 0.46%, and grasses and bamboos at 0.19% (Fig. 6).

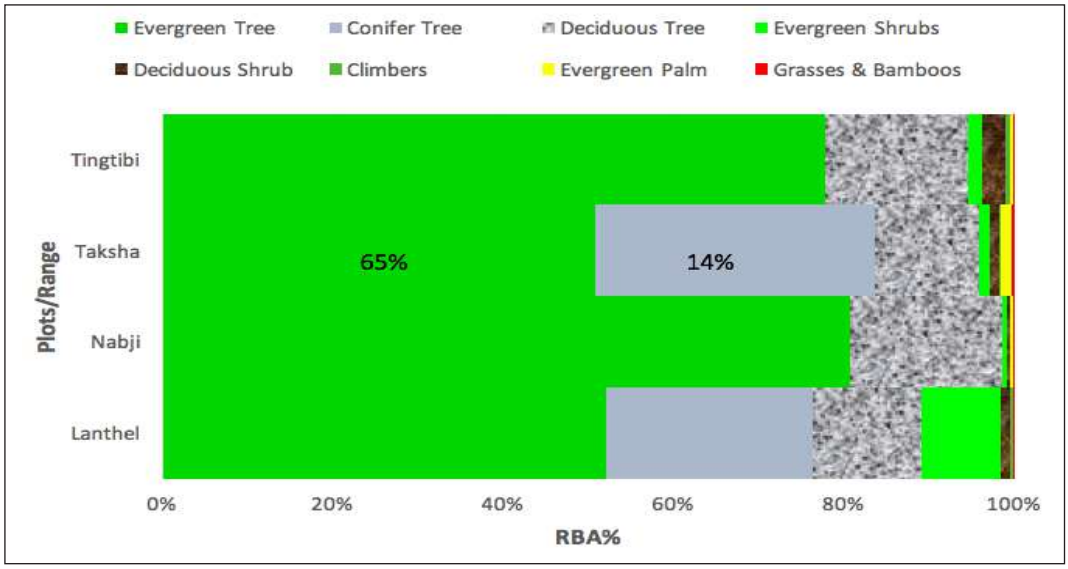

Figure 6: Range wise cover % distribution pattern of eight lifeform group of trees and shrubs.

B. Ground vegetation

The life-form composition of the ground vegetation has a considerable proportion of perennial herb with 51% followed by annual herb at 11%, evergreen shrub 10%, climbers 10%, grasses and bamboos 9 %, deciduous herb 6%, orchids 2% and evergreen palm 1% cover in all four ranges (Fig. 7).

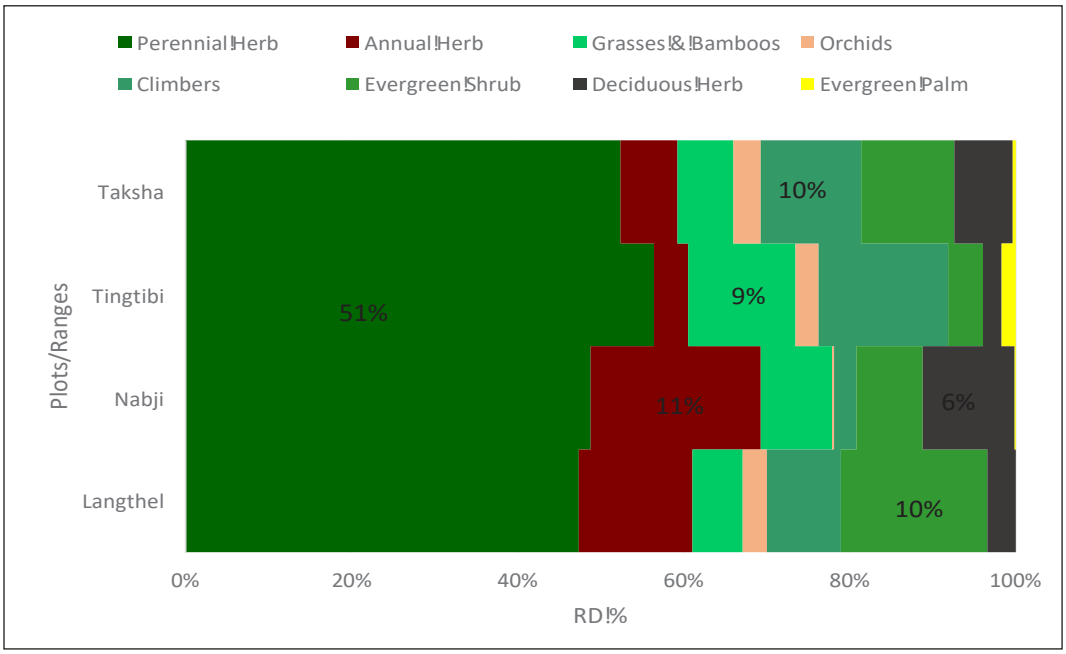

Figure 7: Range wise cover % distribution pattern of eight lifeform group of ground vegetation

A. Epiphytic orchids

Orchids fall under the largest family of flowering plants in the world, Orchidaceae. The epiphytic orchid community recorded inside the park is classified into the following tribes: Arethuseae at 45% followed by Dendrobieae at 37%, Podochileae at 9%, Vandeae at 6%, Malaxideae at 3%, and Cymbidieae and Epidendreae at 1% each (Fig. 8).

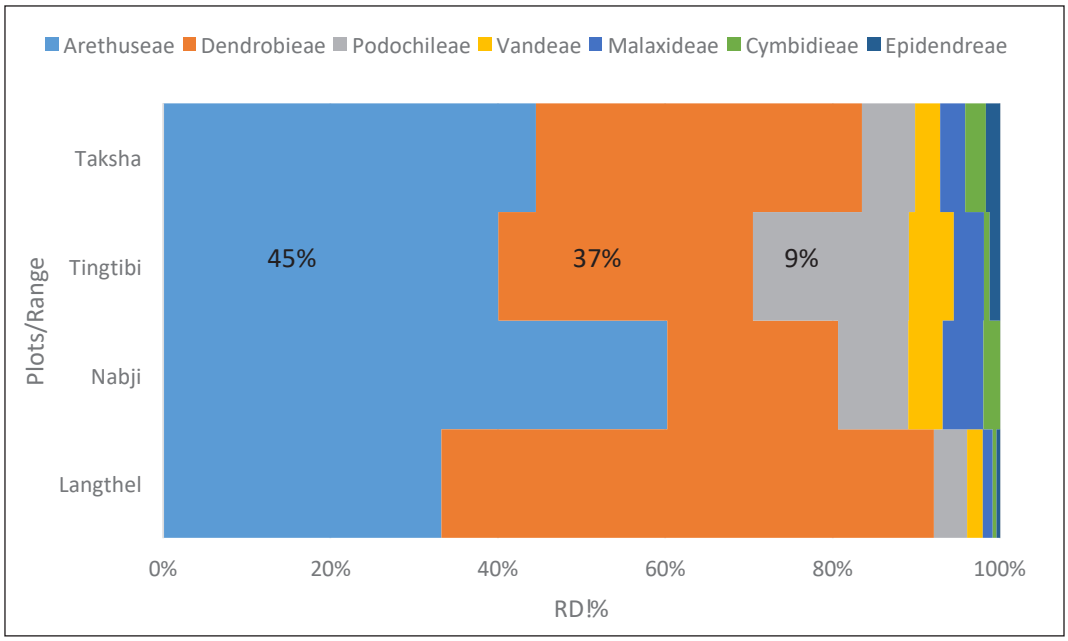

Figure 8: Range wise cover % distribution pattern of epiphyte orchids classified into 7 tribes

B. Forest structural features under each range

A total of seven forest structural features namely: maximum DBH, maximum height, stem density, basal area, species richness, DBH class distribution and Height class distribution was determined as follows:

Ranges	Langthel	Nabji	Taksha	Tingtibi
No. of plots	24	17	25	11
Tree plot size (m^2)	400	400	400	400
Ground veg. plot size (m^2)	4	4	4	4
Max. DBH (cm)	140	260	156	170
Max. Ht (m)	48	42	50	50
Stem density (no)	618	245	446	363
Basel area (m^2)/ha	78.43	72.83	56.17	66.68
Tree Richness (H') highest	2.45	2.08	2.28	2.37

Table 2: Summary of the plots surveyed under each range with mention of plot size and forest structural features

i. DBH class

The forest stand structural features of the park is illustrated by DBH class distribution arranged at an interval of 20 cm with 11 classes as shown below:

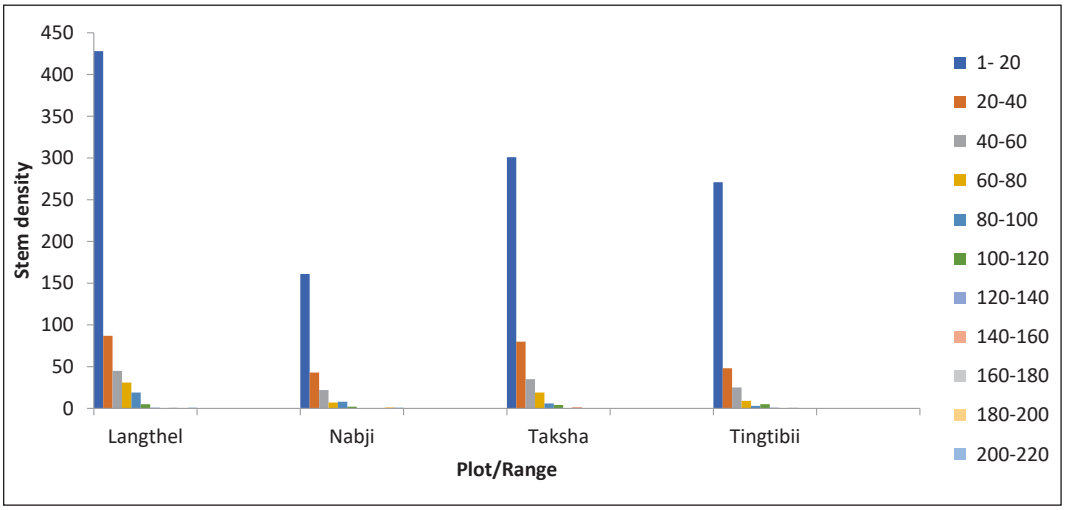

Figure 9: DBH class distribution of trees and shrubs under each range illustrating forest structural features of the park.

ii. Height class

The forest stand structural features of the park is also illustrated by height class distribution arranged at an interval of 5 cm with 8 classes as shown below.

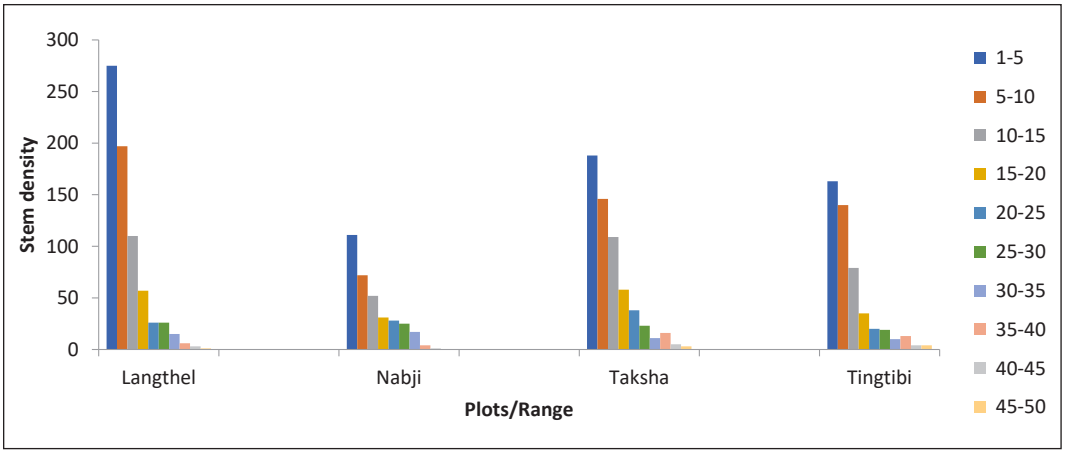

Figure 10: Height class distribution of trees and shrubs under each range illustrating forest structural features of the park.

iii. Species area curve

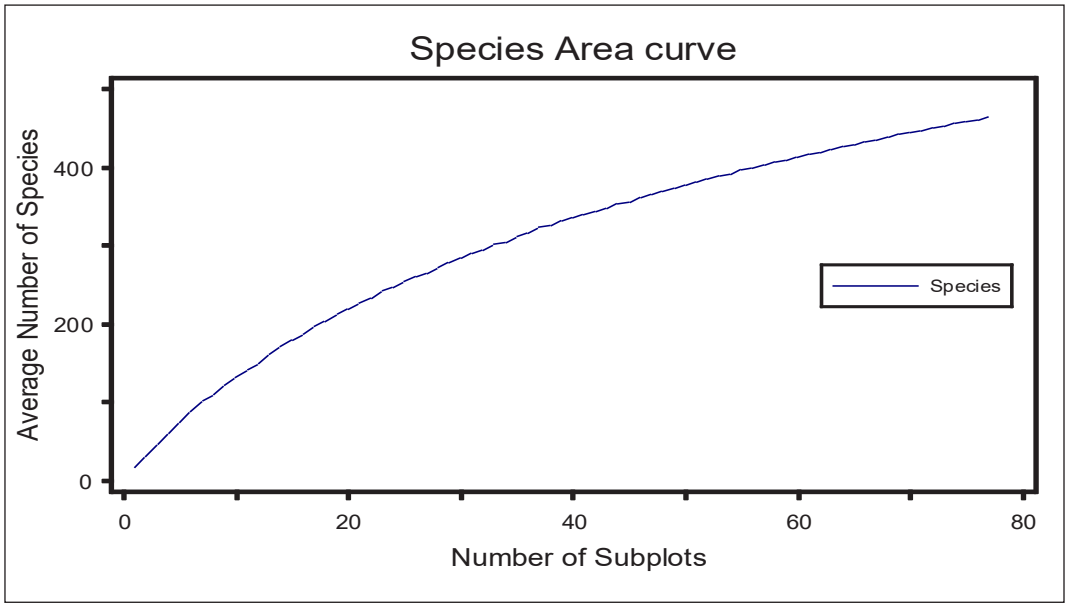

Figure 11: Species area curve of the trees and shrub

Number of species increases upon increasing the sample size. Therefore, the slope of the species area curve graph below showing gentle slope indicate sample size was good enough for recorded number of species diversity in general.

iv. Species dominance curve

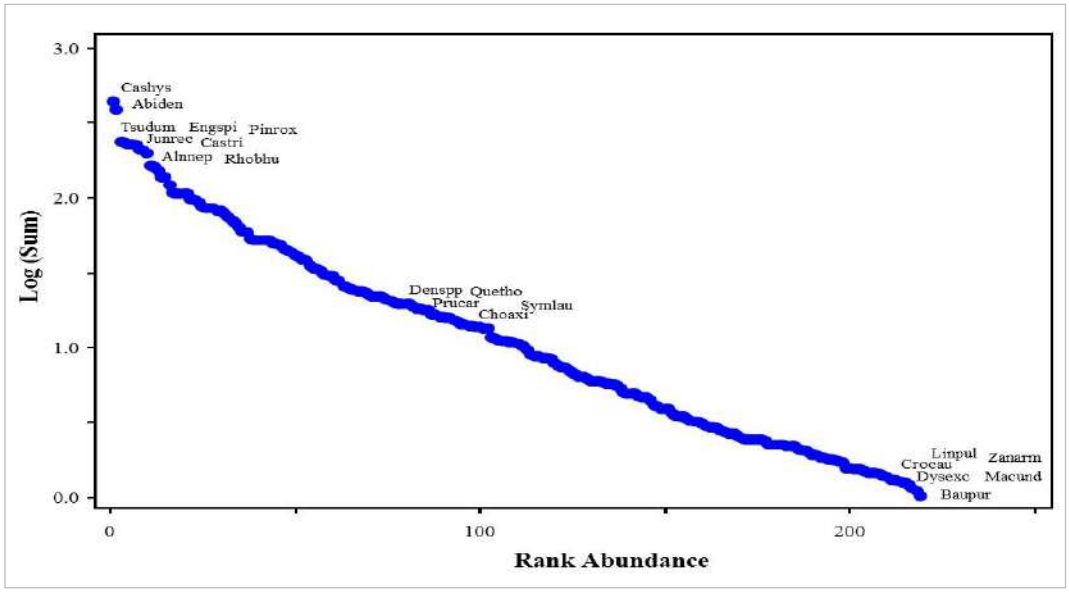

Figure 12: Species dominance curve of trees and shrubs.

The dominance curve showing the pattern of trees and shrubs ranked by abundance based on RBA% from highest to lowest in Jigme Singye Wangchuck National Park and they are *Castanopsis hystrix, Tsuga dumosa, Abies densa, Engelhardia spicata, and Pinus roxburghii.*

Several species are used in traditional medicines, cottage industries, and collected by villagers as food, fodder, fertilizer, and for other livelihoods and commercial purposes.

2.3. Faunal description

Owing to the great altitudinal variation and diverse habitat types, JSWNP holds a wide array of wild faunal diversity. Since the gazettement of national park in 1993, the record of faunal diversity has increased manifolds. For instance, the first conservation management plan for the erstwhile Black Mountain National Park recorded only 19 species of mammals and 154 species of birds in the national park. The second conservation management plan published in 2003 enlisted 22 mammals and 167 birds (JSWNP, 2003). Owing to limited survey of other taxa, the list of many lesser-known taxa was non-existent then. The conservation management plan 2014 recorded 35 species of mammals and 171 species of birds inside the national park. For the first time, the national park also enlisted butterflies recorded inside the national park. Over the last six years, the national park embarked on the inventory of other lesser studied taxa such as herpetofauna, fishes, and small mammals, and conducted the annual monitoring of species such as tiger, which has helped record many other rare and cryptic species which were not recorded in the past. Rapid biodiversity assessment was again conducted in 2019-2020 for the mammals and birds to assess the status of distribution of animals of conservation significances and identify conservation needs for the purpose of conservation management planning. While the record of mammals, birds, herpetofauna, fishes, and butterflies are remarkable, there is still limited information on the diversity of insects and freshwater macroinvertebrates, which also plays a vital role in the ecological processes.

2.3.1. Mammalian Diversity

The rapid biodiversity assessment for mammals in JSWNP was conducted in 40 randomly sampled biodiversity monitoring grids of 4x4 km, spread across the national park. The randomly sampled grids which are representative of the different habitat types across different elevation gradients covered over 640 km^2, which is about 40% of the total area. A remotely triggered camera trap was installed in the sampled grid cell for photographic record of mammals and trail transect survey was conducted to record the wildlife signs, evidences, and direct sightings, besides recording the conservation threats. A total of 39 camera traps were deployed in the sampled grids in a phase wise manner since 2017-2020, with a shift from low altitude regions of Nabji, Tingtibi, Taksha and Langthel Range during the winters to high altitude regions of Black Mountains during the summers. The camera traps were left in the field from 60-90 days and it yielded a cumulative trap days of 2617 days

and captured as many as 2270 independent captures, thus yielding a photo capture success rate of 0.86 images per trap day. The images were considered independent at the single site when it was photographed after 60 minutes. A total of 22 mammal species were photo captured by the camera traps including seven species of wild felid including the charismatic tiger, thus affirming JSWNP as a hotspot for wild felids. Snow leopard *(Panthera uncia)* was photo captured from the Black Mountain regions for the first time in the national park in 2017. Prey species of the top carnivores recorded in the national park include barking deer *(Muntiacus muntjac),* wild pig *(Sus scrofa),* sambar *(Cervus unicolor),* gaur, Himalayan serow *(Capricornis thar),* Himalayan goral *(Naemorhedus goral)* and musk deer. Other species of conservation concern recorded in the camera traps are red panda, binturong *(Arctictis binturong),* wild dog and Himalayan black bear.

Similarly, mammal evidence survey was conducted along the trail in the sampled grids and a total of 235 transects were laid in 42 sampled grids, covering 117 kms. Each transect was at least 500 meters long and between 5-8 transects were laid in each sampled grid. A total of 306 signs and wildlife evidences belonging to 20 mammal species were recorded along the transects, yielding a sign encounter rate of 2.61 evidences per km. The transect survey revealed that mammal diversity is highest in warm broadleaved forests, followed by cool broadleaved forests, conifers, and finally the alpine habitats *(Table 3)*. Of the nine different wildlife evidences including acoustics and direct sightings that were recorded during the survey, and wildlife dropping was the most commonly encountered evidence at 41.6%, followed by tracks and direct sightings. Remains of the body parts accounted the least number of evidences *(Fig.13)*. Direct sighting was mostly for primates and squirrels.

Habitat Types	No of species	No of evidences observed	Shannon Diversity Indices H'	Evenness J
Alpine	3	6	0.87	0.79
Conifer	13	45	2.15	0.84
Cool broadleaved forests	20	123	2.31	0.77
Warm broadleaved forests	20	129	2.55	0.85

Table 3: Species diversity indices in different habitats as observed through sign survey

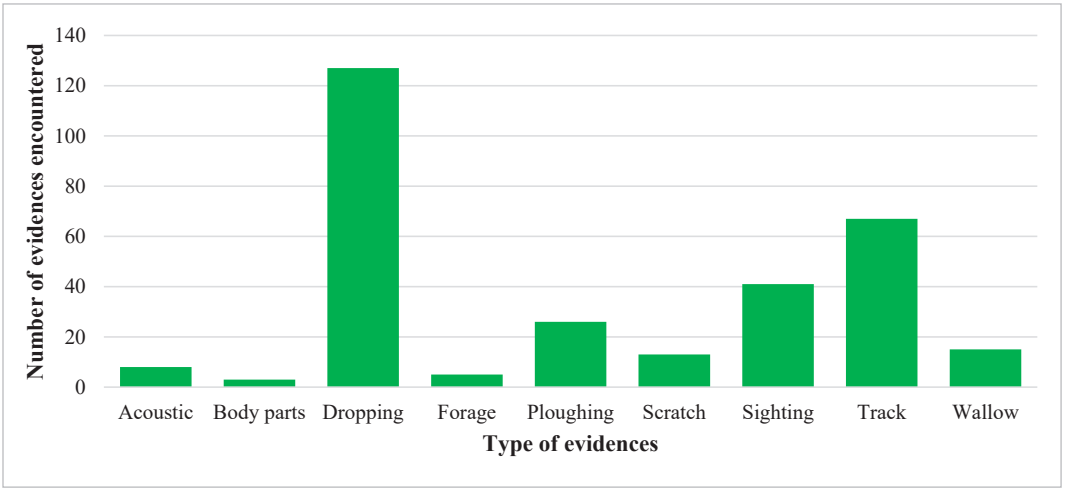

Figure 13: Different wildlife evidences encountered during the transect survey.

The assessment of mammals recorded in the national park affirmed the presence of 55 mammal species (Appendix 2.1), which is an increase by 54% from the 2014 baseline. The checklist is inclusive of 13 species of rodents recorded during the small mammal inventory conducted in 2017 (Dorji, 2017) and the diversity of mammal is spread across seven orders and 23 families. Felidae under the order Carnivora has the highest number of species with eight species followed by Rodentia family of Muridae and Sciuridae with six species each *(Fig. 14)*. Fourteen mammal species recorded inside the national park are threatened species falling under the Vulnerable (8 species), Endangered (5 species) and Critically Endangered (1 species) category of the IUCN Red List of Threatened Species and thirteen of them are strictly protected under schedule I species list of the Forests and Nature Conservation Act 1995 *(Table 4)*. Except for few opportunistic records, the national park still lacks a proper inventory of bats.

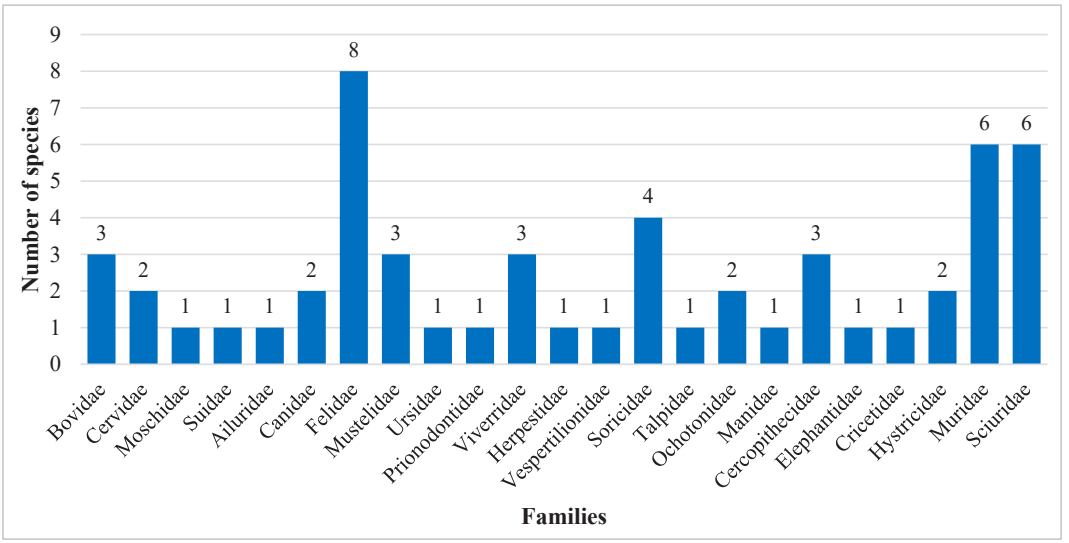

Figure 14: Mammalian species diversity across different families.

SL. No.	Common Name	Family	Scientific Name	IUCN Status*	FNCA 1995 Status
1	Red panda	Ailuridae	*Ailurus fulgens*	VU	Schedule I
2	Gaur	Bovidae	*Bos gaurus*	VU	Schedule I
3	Serow	Bovidae	*Capricornis thar*	NT	Schedule I
4	Dhole	Canidae	*Cuon alpinus*	EN	NA
5	Golden langur	Cercopithecidae	*Trachypithecus geei*	EN	Schedule I
6	Sambar	Cervidae	*Cervus unicolor*	VU	NA
7	Asian elephant	Elephantidae	*Elephas maximus*	EN	Schedule I
8	Clouded leopard	Felidae	*Neofelis nebulosa*	VU	Schedule I
9	Common leopard	Felidae	*Panthera pardus*	VU	Schedule I
10	Tiger	Felidae	*Panthera tigris*	EN	Schedule I
11	Snow leopard	Felidae	*Panthera uncia*	VU	Schedule I
12	Leopard cat	Felidae	*Prionailurus bengalensis*	LC	Schedule I
13	Chinese pangolin	Manidae	*Manis pentadactyla*	CR	Schedule I
14	Musk deer	Moschidae	*Moschus leucogaster*	EN	Schedule I
15	Himalayan black bear	Ursidae	*Ursus thibetanus*	VU	Schedule I
16	Binturong/Asian bearcat	Viverridae	*Arctictis biturong*	VU	NA

Table 4: Species of conservation significance found in JSWNP, being listed under Threatened Category of the IUCN Red List and Schedule I of the FNCA 1995.

**LC= Least Concern, NT= Near Threatened, VU= Vulnerable, EN=Endangered, CR= Critically Endangered, NA= Not Applicable*

Since the National Tiger Survey of 2015 wherein JSWNP was identified as one of the protected areas rich with tiger density, annual monitoring of tiger was conducted in the national park using remote camera traps. During the monitoring session from 2016-2018, the national park identified eight individual tigers and predicted site use by tigers in JSWNP was 43% with more favorable habitats predicted in low altitude regions of Tingtibi and Nabji Park Range. Among the prey species co-occurring with tiger, wild boar had the highest occupancy of 59% followed by barking deer (56%); serow (55%), gaur (44%); and sambar (43%) (Letro et al. 2019). The predicted habitat use potential of various ungulates along the altitudinal gradient suggests that there is more favourable habitat for tigers as tiger abundance is determined prey availability.

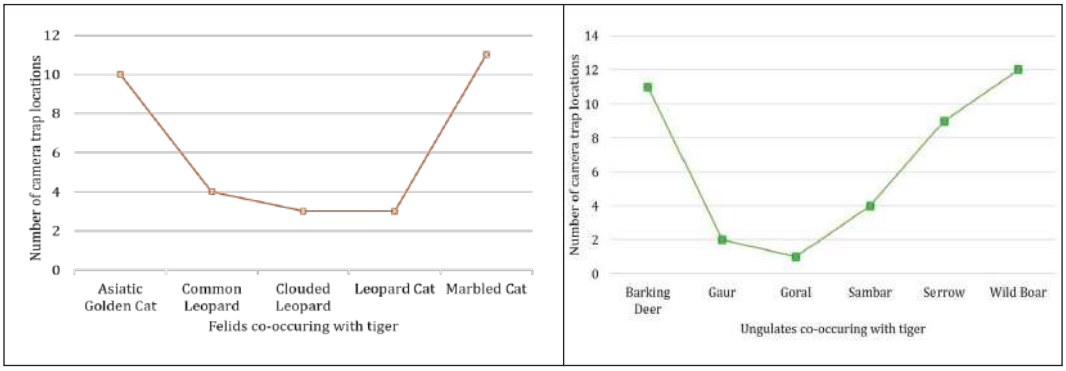

Figure 15: Tiger and co-occurring felids and ungulates as ascertained from camera trap survey.

Threats of concern in the major wildlife habitats include grazing by livestock, harvesting of timber and other non-wood forest produces, infrastructure development, risk of forests fire. Poaching poses direct threat to the species survival *(Fig. 16)*. Camera trap images also revealed that there is higher degree of disturbances by humans and livestock with naïve occupancy of humans accounting 0.78 and cattle and stray dogs accounting 0.428 and 0.103 respectively of the 39 camera trap stations.

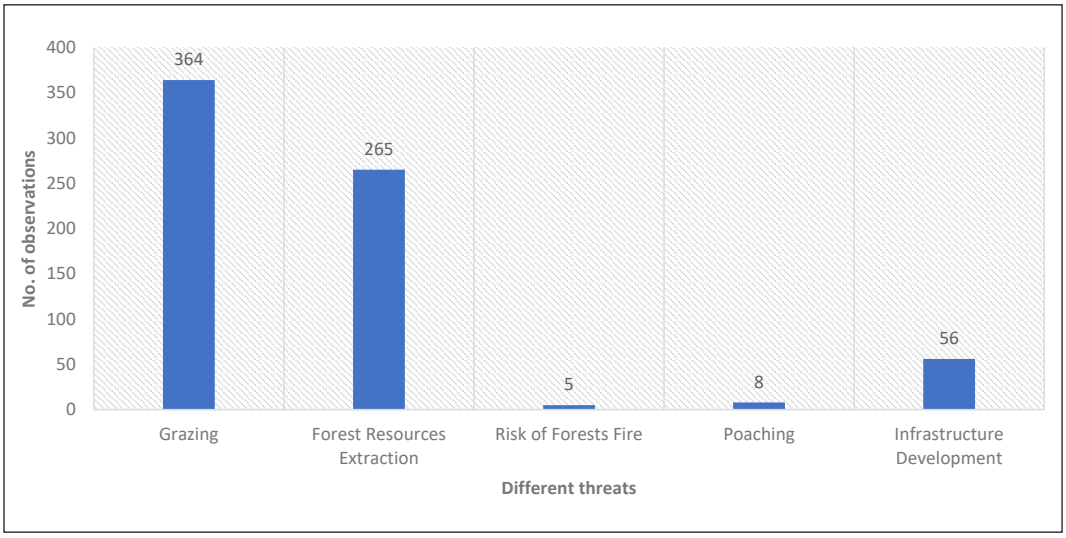

Figure 16: Different intensity of threats as observed during the trail transect survey.

2.3.2. Birds

Birds play a vital role in maintaining the health of ecosystem as they are found occupying different trophic levels in the environment. They play a vital role in controlling pests, acting as pollinators, and dispersal of seeds. Birds being one of the indicator species makes it easier and suitable for the conservationist and climate scientists to investigate the degree of environmental change due to climate change. In its last conservation management plan (2014-2018), JSWNP has recorded only 174 species of birds, many of which were altitudinal migrants.

Rapid assessment of birds in JSWNP was conducted in 45 biodiversity monitoring grids of 4x4 km grid cells using MacKinnon Listing Technique. Different listing technique was followed for different habitats. In most forested habitats, a 20 species list was used while in the alpine and wetlands 10 species list was adopted. A total of 67 species lists were completed with the maximum listing being completed for warm broadleaved forests with 24 lists compiled from 15 biodiversity monitoring grids. Only one grid with wetland as major habitat was covered and three list was completed. As such, a total of 243 species was recorded from the 995 observations made from the entire surveyed area. The survey found that warm broadleaved forests and cool broadleaved forests have the highest species richness and diversity indices, while it was lowest for wetlands and habitats near the settlements *(Table 5)*.

Habitat Type	No of species detected	No of detections	Species Diversity H'	Evenness J'
Farmland and settlement	21	83	2.82	0.92
Cool broadleaved forest	146	1157	4.24	0.87
Conifer	20	56	2.63	0.88
Warm broadleaved forest	158	1582	4.39	0.86
Chirpine forest	72	528	3.73	0.88
Wetland	14	28	2.24	0.89
Subalpine	34	190	3.13	0.89

Table 5: Avi-faunal diversity as obtained from the rapid assessment following Mackinnon Listing Technique.

A cumulative listing of birds recorded in JSWNP was conducted building on the earlier baselines and opportunistic records. A total of 324 birds belonging to 72 families have been positively recorded in JSWNP *(Appendix 2.2)* of which nine species falls under the threatened category of the IUCN Red List of Threatened Species *(Table 6)*. The critically endangered White-bellied Heron is found inhabiting the river banks of Punatsangchu, Harachu and Kisonachu under jurisdiction of Taksha Park Range office and Mangdechu and Bertichu under Tingtibi Park range office. The White-bellied Heron census 2021 counted 22 birds of which three birds were recorded between Taksha and Kamechhu and another three along the Berti chhu inside JSWNP (RSPN, 2021).

SL. No.	Family	Scientific Name	Common Name	IUCN
1	Accipitridae	*Haliaeetus leucoryphus*	Palla's Fish Eagle	EN
2	Aroleidae	*Ardea insignis*	White-bellied Heron	CR
3	Bucerotidae	*Buceros bicornis*	Great Hornbill	VU
4		*Aceros undulatus*	Wreathed Hornbill	VU
5		*Aceros nipalensis*	Rufous-necked Hornbill	VU
6	Cisticolidae	*Prinia cinereocapilla*	Grey-crowned Prinia	VU
7	Emberizidae	*Emberiza rustica*	Rustic Bunting	VU
8	Phasianidae	*Arborophila mandellii*	Chestnut-breasted Partridge	VU
9	Sittidae	*Sitta formosa*	Beautiful Nuthatch	VU

Table 6: List of threatened species in JSWNP

The national park also harbors three of the four hornbill species found in the country, Great Hornbill (Buceros bicornis), Wreathed hornbill *(Aceros undulatus)*, and Rufous-necked Hornbill, all of which are vulnerable in the IUCN Red List of Threatened Species and inhabiting the subtropical and warm broad-leaved forests of the national park.

The rich diversity of the avian fauna is attributed to the presence of diverse ecological zones ranging from the vary sub-tropical forest to the alpine vegetation in the Black Mountain. The different forest types and microclimate provides multiple habitats for the bird species thereby fostering the adaptability and dispersal.

2.3.3. Herpetofauna

JSWNP is also a rich repository of herpetofauna diversity. A survey conducted in 2016-17 recorded the presence of 42 herpetofauna species *(Appendix 2.3)*, belonging to 30 genera and 12 families *(Figure 17)*. Of these, 32 species belonging to 24 genera and eight families were reptiles and nine species from six genera and four families were amphibians (Tshewang and Letro, 2019).

i. Snakes

Twenty-four species of snakes from 18 genera belonging to four families were recorded in the national park. The family Colubridae was the most diverse with 16 species belonging to 12 genera, whereas Pythonidae appeared to be the least diverse with only one species.

ii. Lizards

Eight species of lizards belonging to three families were recorded in the national park and the family Scincidae was the most diverse with three species and two genera. In the families Gekkonidae and Agamidae, we recorded two species each.

iii. Anurans

A total of nine frog species belonging to six genera and four families were recorded in the national park, of which, Rhacophoridae was the most diverse with three species, followed by Bufonidae, Dicroglossidae, and Ranidae with two species each.

A lone turtle species recorded in the national park, Cuora mouhoti belonging to Geometridae family is listed as endangered in IUCN Red List of Threatened Species. Other threatened species includes the Burmese python *(Python bivitatus)*, and the king cobra *(Ophiophagus Hannah)* both of which are categorized as Vulnerable in the IUCN Red List.

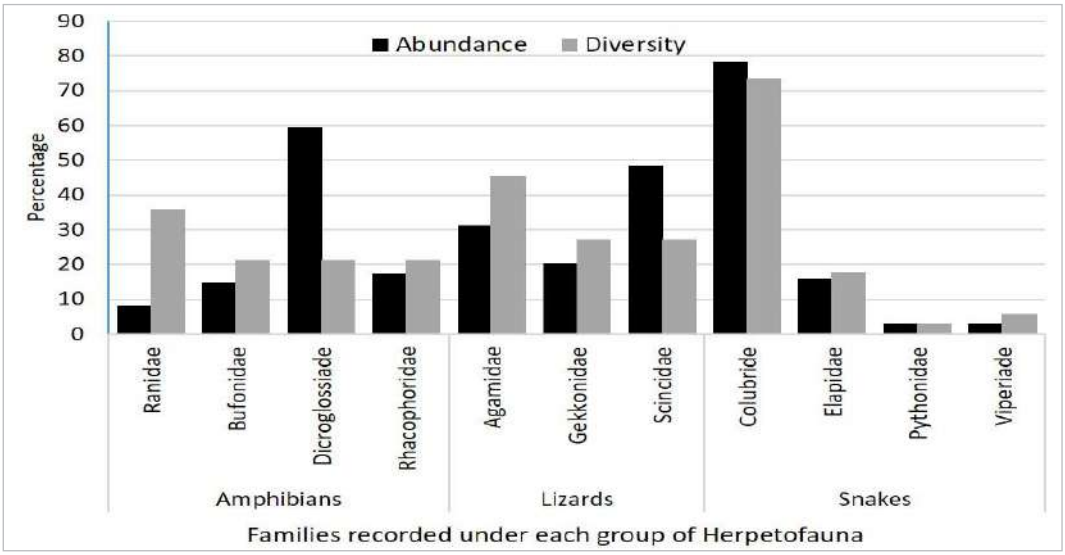

Figure 17: Diversity of Herpetofauna recorded in JSWNP.

Periodic monitoring of these recorded species is vital for its conservation and survey of sites which were not surveyed before are expected to add new record of herpetofauna in the national park. While the national park has many intact habitats, the coming up of numerous developmental activities like hydropower construction, road construction, installation of high-tension electric lines, and the use of fertilizers and pesticides by the park residents are likely to threaten the habitats of herpetofauna. Herpetofauna, especially the snakes face considerable threat from killing by local people on the pretext of local and traditional belief that snakes are fated to be killed.

2.3.4. Fishes

Until recently, the studies related to aquatic biodiversity has been scarcely investigated when compared to the terrestrial biodiversity in Bhutan. Now with the ecological significance of the aquatic biodiversity understood, many conservationists are diving into the field of aquatic science and in particular Ichthyology (study of fishes). Numerous rivers, rivulets and streams flows through the jurisdiction of JSWNP the major rivers being the Mangdechhu flowing from Trongsa to Tingtibi in eastern Park boundary; Punatsangchhu in western part; and Nikachu in the northern part. A total of 16 species of fishes were recorded during the fresh water diversity survey conducted in year 2016 (Dorji, 2016) *(Appendix 2.4)*.

Only two species amidst the aforementioned 16 species were found to be threatened as per IUCN Red List. The endangered golden masheer (Tor putitora) also listed in Schedule I species of FNCA was found distributed in Mangdechhu, Bertichu and Harachu confluence. The common carp *(Cyprinus carpio)* which is Vulnerable in the IUCN Red List is found in Adha Lake and Berti Fishery ponds. These 16 species of fishes is little to comprehend the total probable species that can be discovered from the national park as the previous study only covered some of the prominent fishing spots form major rivers; thereby leaving many small streams and rivulets unexplored. As the developmental activities increases with coming years and particularly with hydropower construction, it has become very crucial and imperative to document the proper checklist of fishes and conduct ecological associated studies.

2.3.5. Butterflies

Butterflies are the subject of fascination for conservationists and one of the intensively studied insect groups. Butterflies along with moth falls under same order of Lepidoptera. Asides the beauty, butterflies play a vital role in ecosystem by being central pollinators to many agricultural crops and ecologically functions as a food source to many predators like birds, spiders and lizards. Butterflies are sensitive and responds instantly to trivial changes in the environment thus it is used as indicator species for studying the impacts of habitat and climate change.

JSWNP with presence of numerous habitat types and microclimate conditions, in addition with dedication and passion of foresters has significantly contributed in proving the Park to be one of the prominent and diverse sites in terms of butterfly diversity. Currently, JSWNP holds a total record of 376 species belonging to four families *(Appendix 2.5)*. Over the period of seven years (Earlier management plan period: 2014-2018), 237 species were added over the previous list of 139 species. Despite this splendid current list of butterflies, many areas of the park need intensive exploration in order to have a comprehensive checklist.

*2.3.6. Dragonflies and Damselflie*s

A recent survey of Dragonflies and Damselflies in the park recorded 27 species of Dragonflies from 5 families and 15 species of Damselflies from 7 families *(Appendix 2.6)*. The survey was a rapid one given less time and resources; therefore, the list would be much longer and the park aims to add to the list during this plan period.

Nabji village in jswnp, surrounded by paddy fields

2.4. People and livelihood

For this management plan revision, an extensive socio-economic survey (SES) was conducted in all communities of the park from November to December, 2019. Data was collected through Participatory Rapid Appraisal (PRA), Rapid Rural Appraisal (RRA) and Questionnaire survey. The interview was conducted for both village and sampled households through structured interview using a set of developed questionnaires, consisting of both closed and open-ended questions. A sufficient sample size was surveyed to ensure that the survey result is statistically relevant. Random sampling was used to ensure that the sample is representative of the survey area to avoid bias in the result and ensure that all elements of the population have an equal chance of being interviewed. The Yamane's (1967) method was used to determine the sample size while random sampling using whisky social gathering tool was used to determine which households are to be selected for interview primarily to sidestep biasness. Overall, a total of 470 respondents (203 Male and 267 Female) were sampled to be part of the survey.

2.4.1. Demography and social structure

Of the ten gewogs falling inside JSWNP, seven gewogs have communities residing inside the park's jurisdiction. Three gewogs i.e., Phobji, Chudzom (Dovan) and Phuntenchu have no communities inside the park. Although Phobji gewog does not have permanent settler inside the national park, there are at least eight households who lead semi-nomadic lifestyle, migrating with their yak, cattle and sheep herds along the Black Mountain trails of JSWNP, with their transit huts located in Wangjela, Jari Busa, Yakchu, Khephu, Kilam, Jeddah tsho, Gubjila and Broksa.

Overall, there are 601 households and a total population of 5538 (2601 female and 2937 male) inside Jigme Singye Wangchuck National Park. Sergithang gewog under Tsirang has only seven households falling inside the park's jurisdiction. Gewog wise households and population distribution of the park are summarized in the figures below:

HH & Population information of JSWNP					
Dzongkhag	Gewog	Total HH	Population		
			Male	Female	Total
Zhemgang	Trong	73	461	397	858
Trongsa	Korphu	192	863	804	1667
	Langthel	105	401	324	725
	Tangsibji	85	486	368	854
Wangdue phodrang	Athang	112	519	574	1093
Sarpang	Jigmecholing	27	196	123	319
Tsirang	Sergithang	7	11	11	22
	Total	**601**	***2937***	***2601***	**5538**

Table 7: Gewog wise households and population distribution of the park

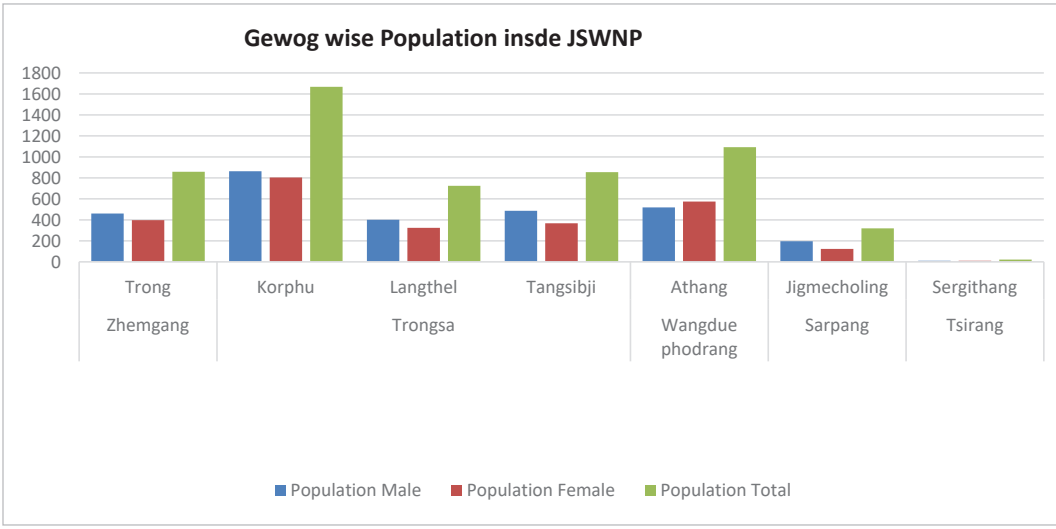

Figure 18: Gewog wise population status in JSWNP obtained from respective Gewog office.

The survey found that overall, 50% of the population inside the park live in their respective communities while the remaining 50% live out of the communities (working in urban areas or studying in schools outside the village). The gewog wise status of population living in and out of communities is as follows;

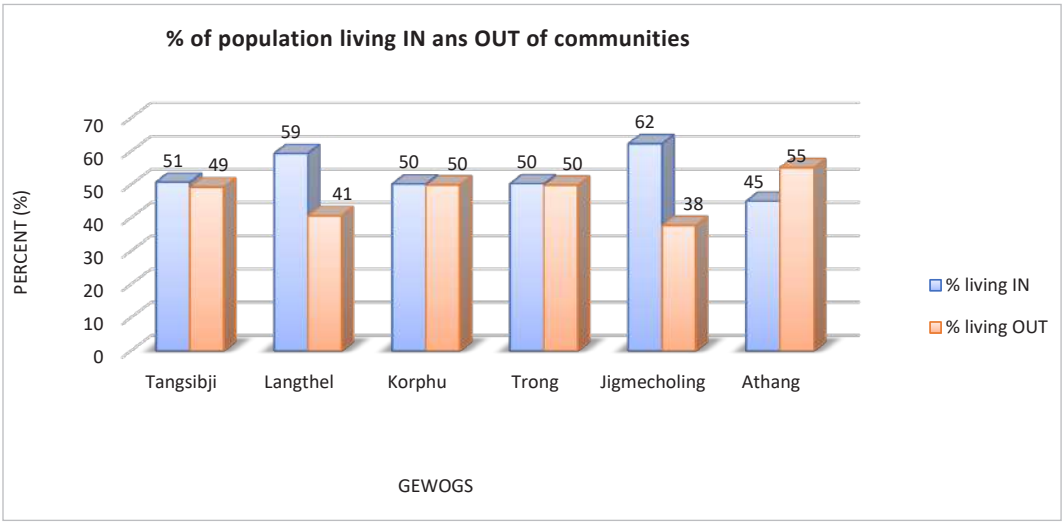

Figure 19: Proportion of population living IN and OUT of the Park

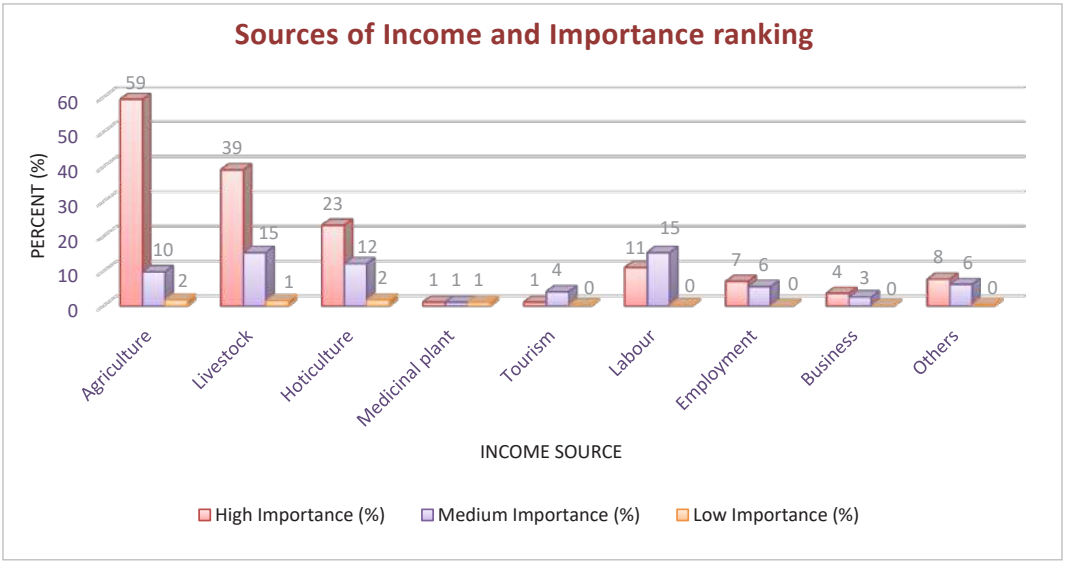

Figure 20: Sources of income and their Importance ranking (total should be 100%).

2.4.3. Agriculture

Agriculture is the main source of livelihood for the people living in JSWNP. Most of the agricultural lands are in lower elevation areas of the park. The most common types of land holding are Chhuzhing (wetlands), Kamzhing (dry-lands), Orchard and Tsesa (vegetable garden). The overall average land holding in the park stands to be 0.99 acre of wetland per household, 1.422 acres of dryland per household, 0.12 acres of Tsesa per household and 0.32 acres of orchard per household. The distribution of each land type under different gewogs is summarized in the table below;

Land Holding in JSWNP				
Gewog	***Chuzhing (Acre)***	***Kamzhing (Acre)***	***Tsesa (Acre)***	***Orchard (Acre)***
Tangsibji	110.3	142.4	18.9	5.1
Langthel	42.5	26.9	6.5	26.5
Korphu	106.8	174.0	19.0	100.9
Trong	76.0	218.0	14.4	29.1
Jigmecholing	11.29	83.18	1.89	26.6
Athang	250.2	210.3	20.7	4.9
TOTAL	**597.1**	**854.8**	**81.5**	**193.1**

Table 8: Gewog wise land holding in JSWNP (obtained from respective gewog records)

People grow various cereals, vegetables, fruits and cash crops. Common cereals grown are paddy, wheat, barley, maize, buckwheat and millet. Mustard is grown as a source of oil in certain parts such as Chendebji village, Samthang and Rukha communities. In hotter areas such as Athang, Langthel and Trong gewogs people grow some fruits such as mandarin, mango, jack fruit, plum, peach and walnut as source of income. Cardamom is cultivated by most of the communities as cash crop. Chendebji village also grows potatoes as a cash crop.

The challenges facing farming are many. Despite the park's effort to mitigate the challenges, all communities still face one or more of the constraints hindering agricultural productivity. Crop damage by wildlife still stands out to be the biggest constraint to farming in the national park. During the past management plan period, the park has supported various mitigation measures such as electric/ solar fencing, supply of improved varieties of crop and livestock and alternative livelihood options; however, the cases of human-wildlife conflict still stand out. Other constraints to farming are pest and diseases, insufficient irrigation, insufficient land, shortage of labour, poor soil fertility, poor access to market, insufficient funds to invest, erratic climatic conditions, unavailability of quality seeds and soil erosions. The severity of each of these constraints is depicted in the figure below;

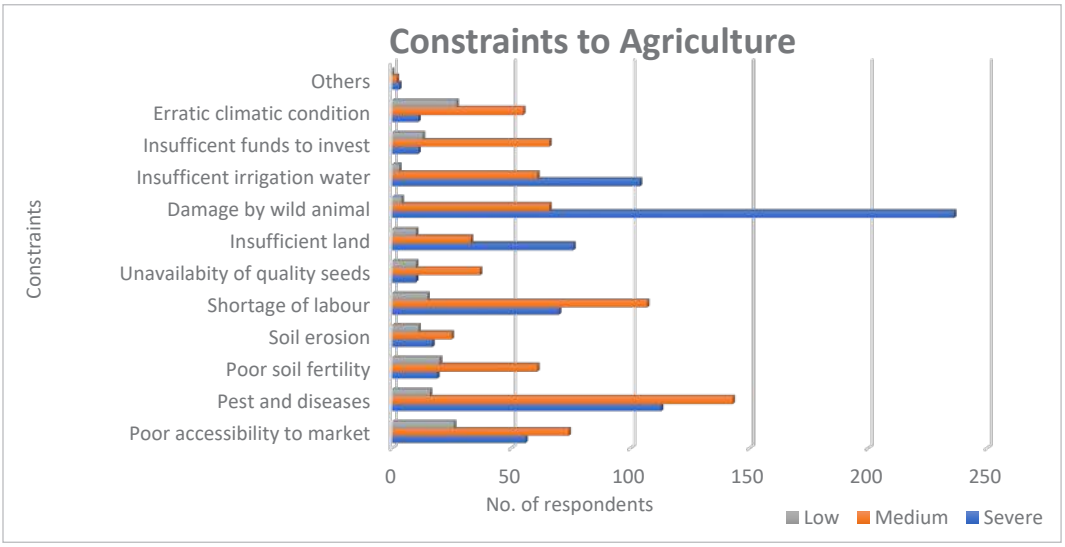

Figure 21: Constraints to agriculture and their severity in JSWNP.

2.4.4. Livestock

Livestock rearing is the second most important income source and livelihood option. Common livestock reared in the park are cattle, yak, horse, poultry, pig, goat and sheep. While cattle are reared across the communities in all gewogs, yak herding is not a common practice among the permanent settlers of the park. Some yak herding families of Phobjikha herd their yaks along the trails leading from Phobjikha valley towards the Black Mountain range. This is an ancient trail used for yak herding since ancient times. The people transit

from one location to another depending upon the season, herding the yaks in the park's area for over 8 months every year. Though most of the communities in the park are connected with farm roads, people still keep horses in communities such as Korphu, Tangsibji, Athang and Langthel. However, the number of horses/ mules has decreased over the past decade and is expected to further decrease in coming years. Poultry is gaining popularity in various communities, reared mainly for egg and meat. Goats are reared in communities of Tangsibji, Korphu, Athang and Reeti and similarly, piggery is common in Tangsibji, Athang and Korphu communities. "Others" category includes other domestic animals such as yak, sheep, cat, and dog. The gewog wise distribution of livestock is depicted in the table below;

Livestock Holding in JSWNP						
Gewog	***Horse***	***Cattle***	***Goat***	***Poultry***	***Pig***	***Others***
Tangsibji	62	1770	22	1781	151	74
Langthel	26	920	1	600	0	38
Korphu	67	2106	22	1958	151	81
Trong	2	129	0	309	0	3
Jigmecholing	16	195	9	159	0	0
Athang	58	1190	21	1237	151	50
TOTAL	**231**	**6310**	**75**	**6044**	**453**	**246**

Table 9: Gewog-wise Livestock population in JSWNP (obtained through SES)

The importance of livestock to the communities are: source of income, source of food, drought power, manure and means of transportation among others. The weightage to each of these varies among the communities as shown in the figure below;

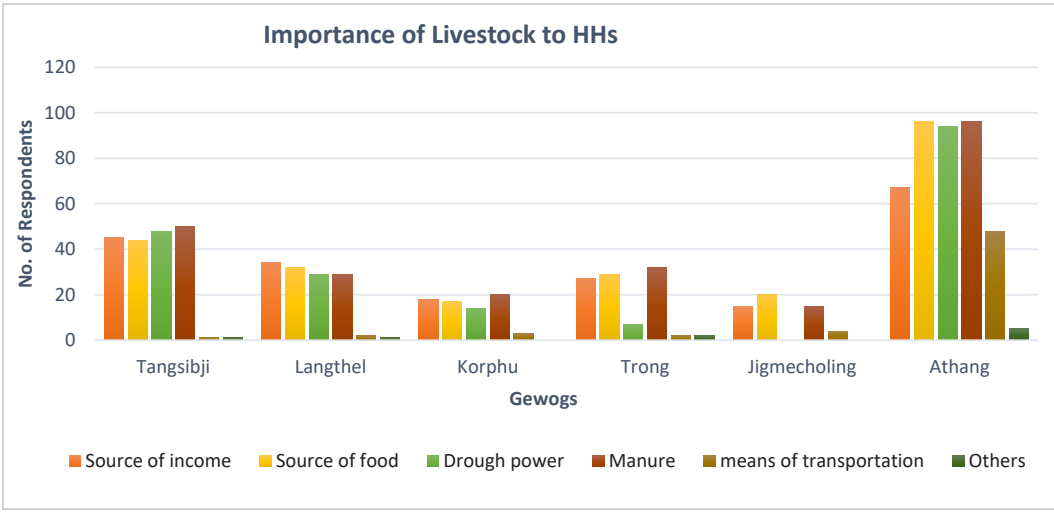

Figure 22: Importance of Livestock

The grazing areas for livestocks are mainly forest and fallow agriculture fields in communities of Athang, Tangsibji, Korphu, Langthel and Jigmechholing gewogs. Tethered and stall feeding is gaining popularity in communities of Tangsibji, Athang, Langthel and Trong gewogs due to an increase in the number of improved breeds of cattle. Some households in Tangsibji, Trong and Athang gewogs also have improved pastures to feed their livestock. The following figure explains the feeding habit of livestock in different gewogs;

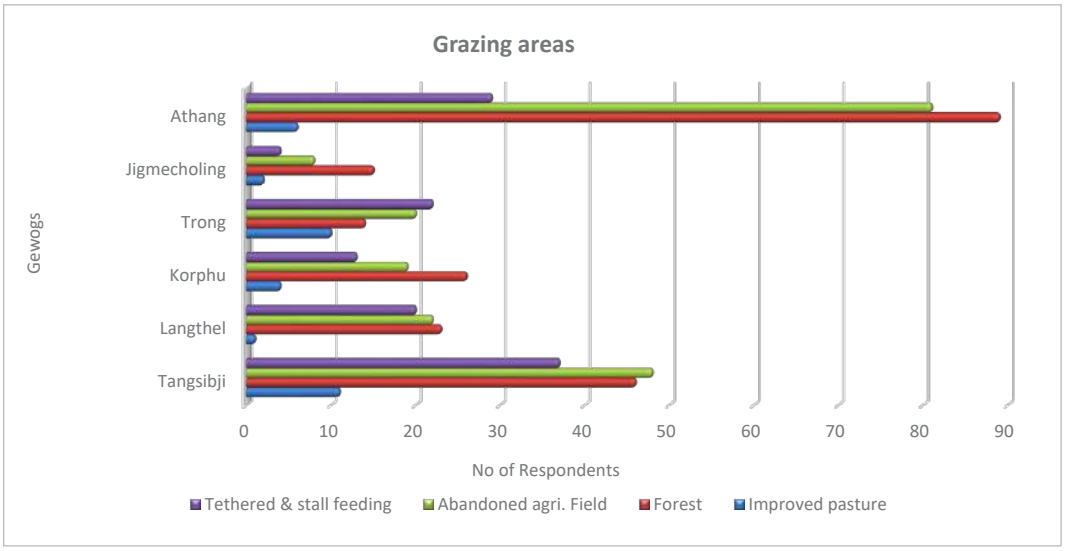

Figure 23: Gewog-wise livestock feeding habits in JSWNP

The survey asked the respondents whether or not they owned pastureland and if they intended to develop new pastureland if given a choice. Their responses are summarized in the figure below;

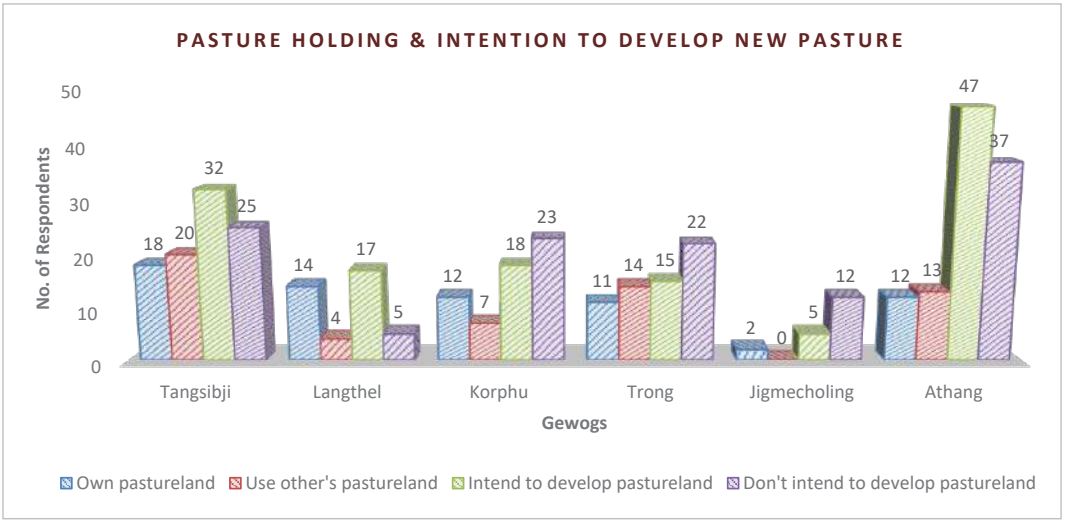

Figure 24: Pasture holding and intention to develop new pastures.

Not so different from farming, the challenges to livestock rearing are many; most of which are common between the two. Like in farming, loss to wildlife is the most severe constraint facing livestock rearing. Livestock depredation and crop damage are the two main facets of human-wildlife conflict in the national park. Other challenges to livestock rearing are insufficient fodder, insufficient grazing land, diseases, poor quality/ local breeds, parasites and poor veterinary & extension services. These are depicted in the figure below;

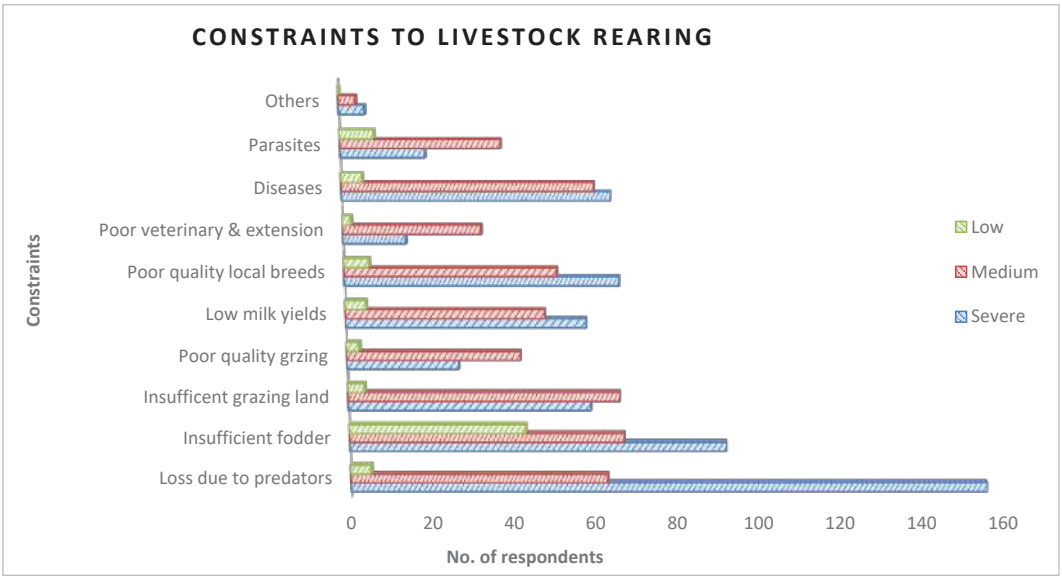

Figure 25: Constraints to Livestock rearing

2.4.5. Human-Wildlife Conflicts (HWC)

The Park has human settlements in the multiple-use zones, who are primarily dependent on agriculture and livestock rearing. Since these settlements are surrounded by forests, constant interaction between wildlife and the human communities become inevitable, leading to various conflicts between human and wildlife. The main types of conflicts faced in the national park are: 1. Crop damage, 2. Livestock depredation and, 3. Human-human conflict due to wildlife (this is another dimension of HWC where two or more group of people clash in the varying interest of wildlife, such as the conflict between conservationists and poachers).

i. Crop damage

Crop damage by wildlife is widespread among all the settlements in the park. Wildlife species responsible for crop raiding are the wild pig, sambar deer, barking deer, monkeys (mainly Assamese macaque and on rare occasions, Golden langurs), Asiatic black bear and porcupine. Tangsibji gewog has a major conflict with monkeys, while other gewogs suffer from damage by wild pigs, sambar deer, barking deer and porcupines.

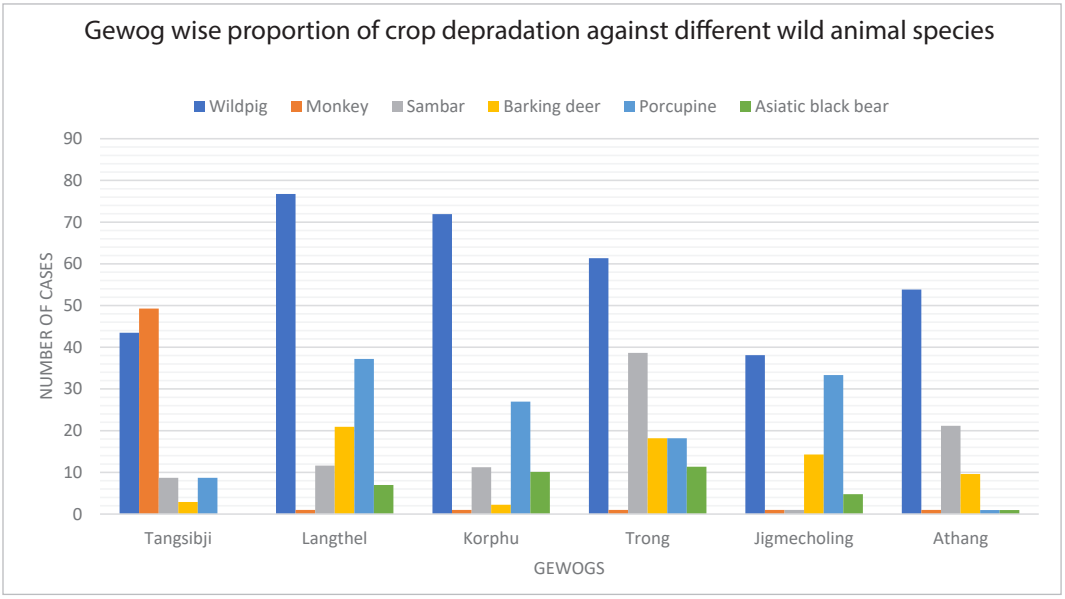

Figure 26: Gewog-wise proportion of crop depredation against different wild animal species.

Species-wise, wild pigs dominate this category of conflict across the gewogs whereby 47% of all conflicts related to crop damage across the settlements in the park is caused by wild pigs; however, in Tangsibji gewog monkey are found to cause the maximum crop damage. Damage by sambar deer, barking deer and porcupine is also widespread across the gewogs. The Asiatic black bear was reported to cause crop damage in Trong, Korphu, Langthel and Jigmechholing gewogs.

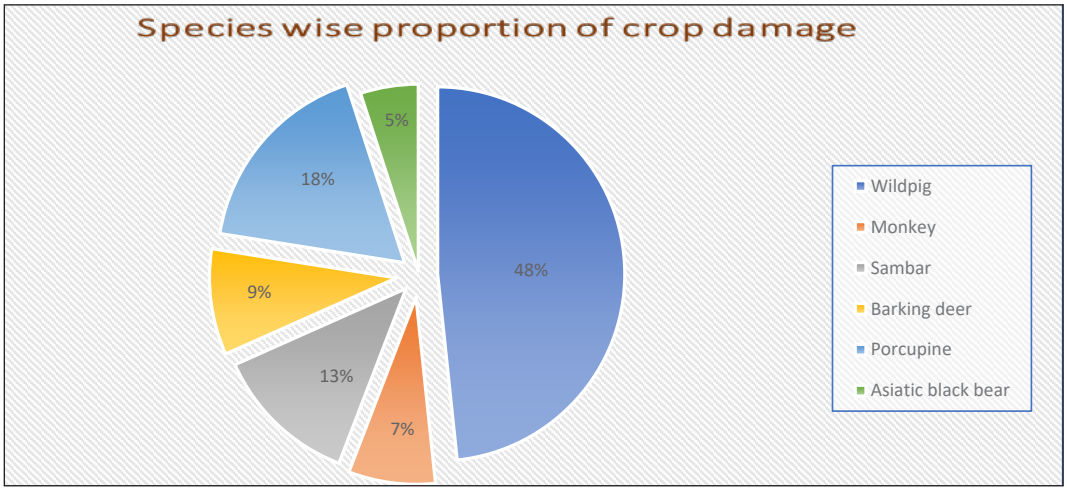

Figure 27: Species-wise proportion of crop damage.

Crop wise, the maximum damage was reported to be done to paddy (45%), followed by barley (34%), cash crops (8%) and wheat (5%). Other crops damaged are sweet buckwheat, bitter buckwheat, vegetables, mustard and millet. The proportions of crop damage in the national park are depicted in the graph below;

ii. Livestock depredation

Livestock depredation by wildlife is also widespread among all the gewogs having human settlements in the national park. The survey found that this form of HWC is most rampant in Langthel gewog where 52% of the respondents holding livestock reported livestock depredation by wildlife followed by Athang (40%), Tangsibji (35%), Trong (33%), Jigmechholing (25%) and Korphu (18%).

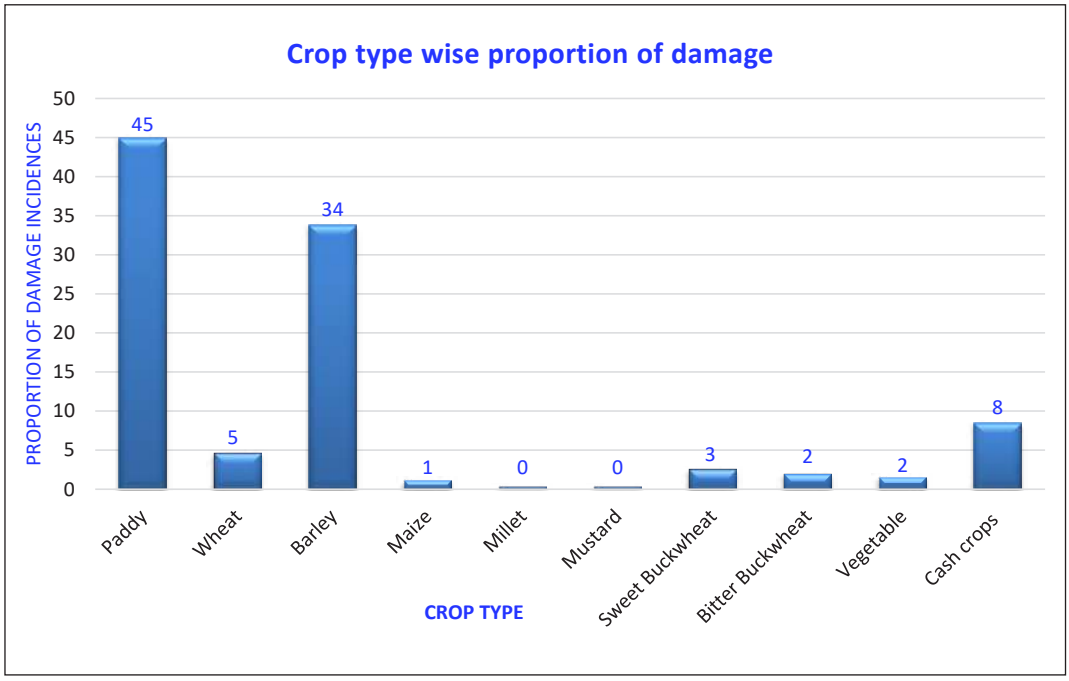

Figure 28: Crop type wise damage proportion

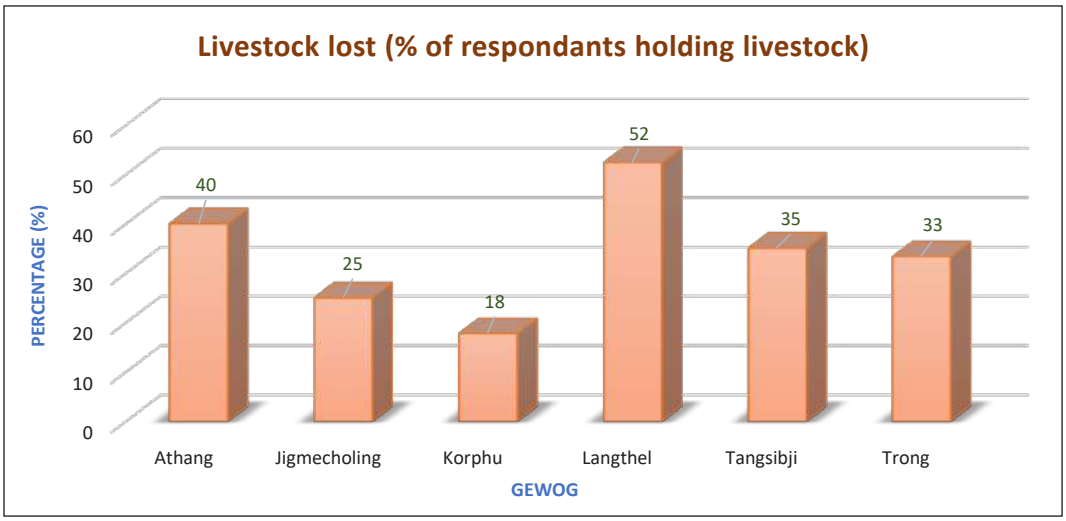

Figure 29: Percentage of respondents who lost livestock to predators

Livestock depredation trend: overall, 37% of the respondents said that livestock depredation is increasing in their communities, while 29% said it has remained the same over the years, 26% said it is decreasing and the remaining 8% of the respondents had no idea about the trend.

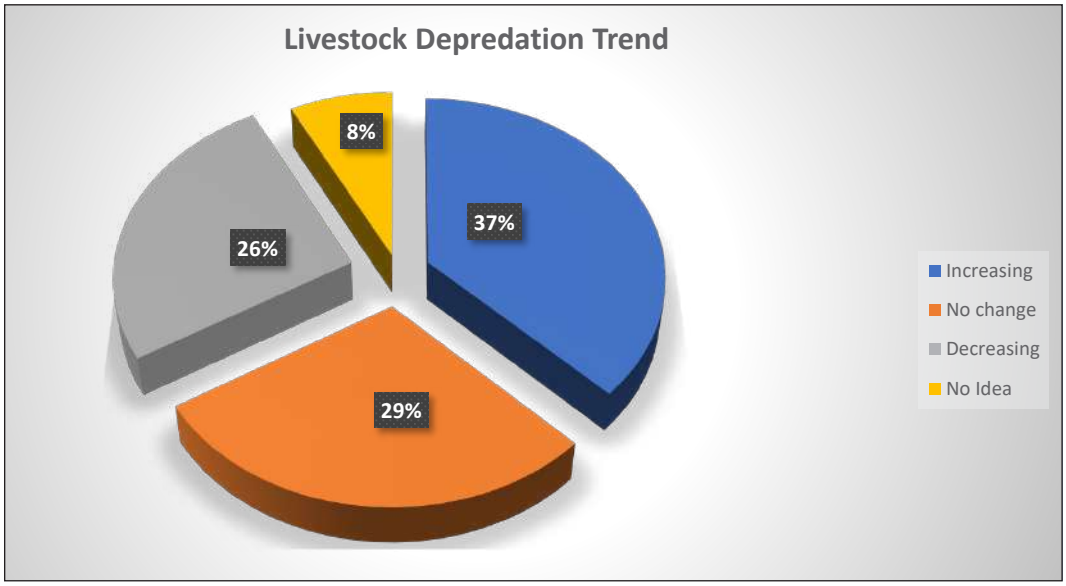

Figure 30: Livestock depredation trend in JSWNP

iii. Human-Tiger conflict

In 2017 a study to assess the human-tiger conflict in the park was conducted. The result showed that the highest risk conflict hotspot was in Nabji Range, followed by Tingtibi Range, Langthel Range, and Taksha Range respectively (Fig. 30). Determined by the distance of kill sites from the nearest settlements (probable risk of 0 to 5 kilometres from the nearest settlements), the results showed that Korphu gewog (villages of Korphu, Nabji and Nimshong) in Nabji Range has the highest conflict risk of 368 hh (50.2%), followed by 120 hh (16.4%) in Tangsibji gewog (Chendebji & Kela) in Chendebji beat, 109 hh (14.9%) in Langthel gewog (Jangbi, Prumzur, Wangling, Beyzam, Ngormay) in Langthel Range, 69 hh (9.4%) in Adha gewog (Rukha, Lawa, Nashina), and 67 hh (9.4%) in Trong gewog (Tama & Berti) in Tingtibi Range. Of the 1,095 households living inside the park, 733 hh (66.9%) falls in the more prone to the conflict zone of 0 to 5 kilometers and 362 hh (33.1%) in low risk of more than 5 kilometers from the kill sites (Dorji, 2017). The following figure shows tiger conflict hotspot areas in the national park;

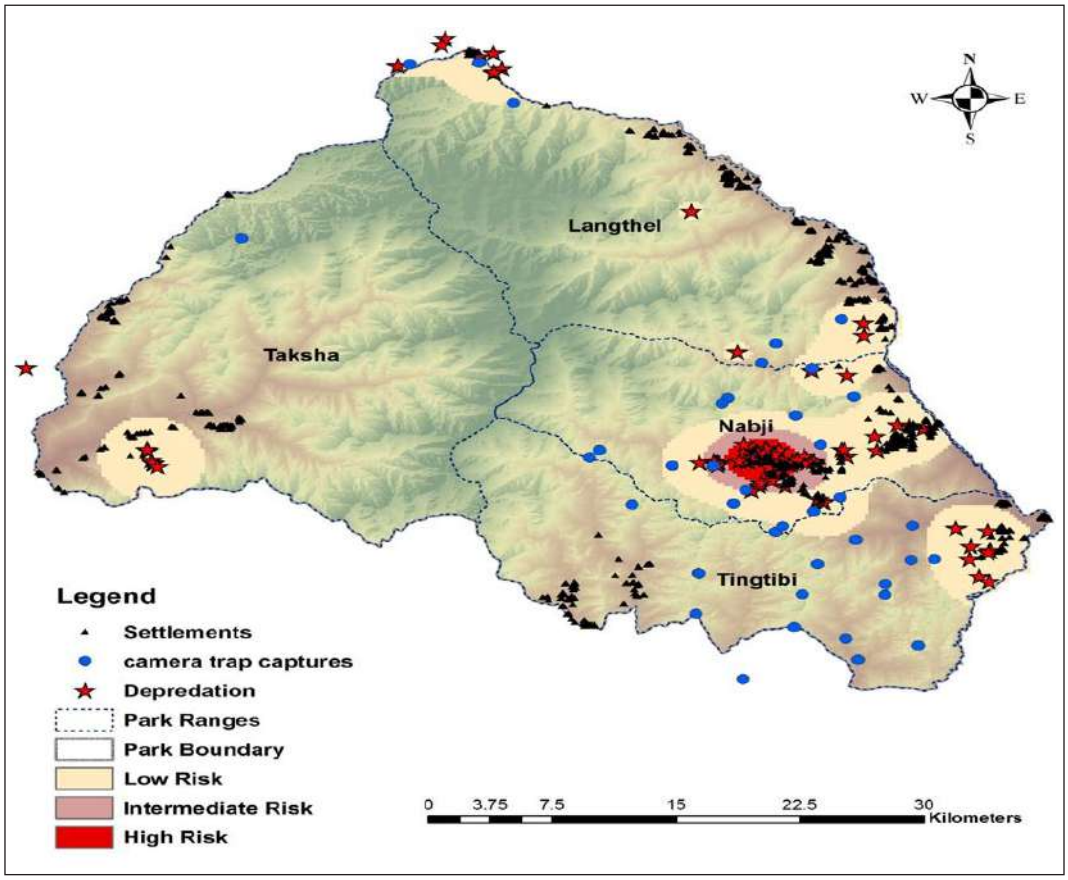

Figure 31: Human-Tiger Conflice Hotspots in JSWNP

iv. HWC Hotspot Mapping

As a part of the nationwide Human Wildlife Hotspot Mapping exercise, a HWC hotspot mapping of the park was carried out in 2021 based on the existing data on livestock depredation, crop raiding and loss of human lives to wildlife for the past eight years (2014 to 2021). The result showed that HWC hotspots lies along the periphery of the park where human settlements are spread. Majority of the communities under all four ranges of the park showed high occurrence of HWC. The overall depiction of HWC hotspots in the park is represented in the figure below;

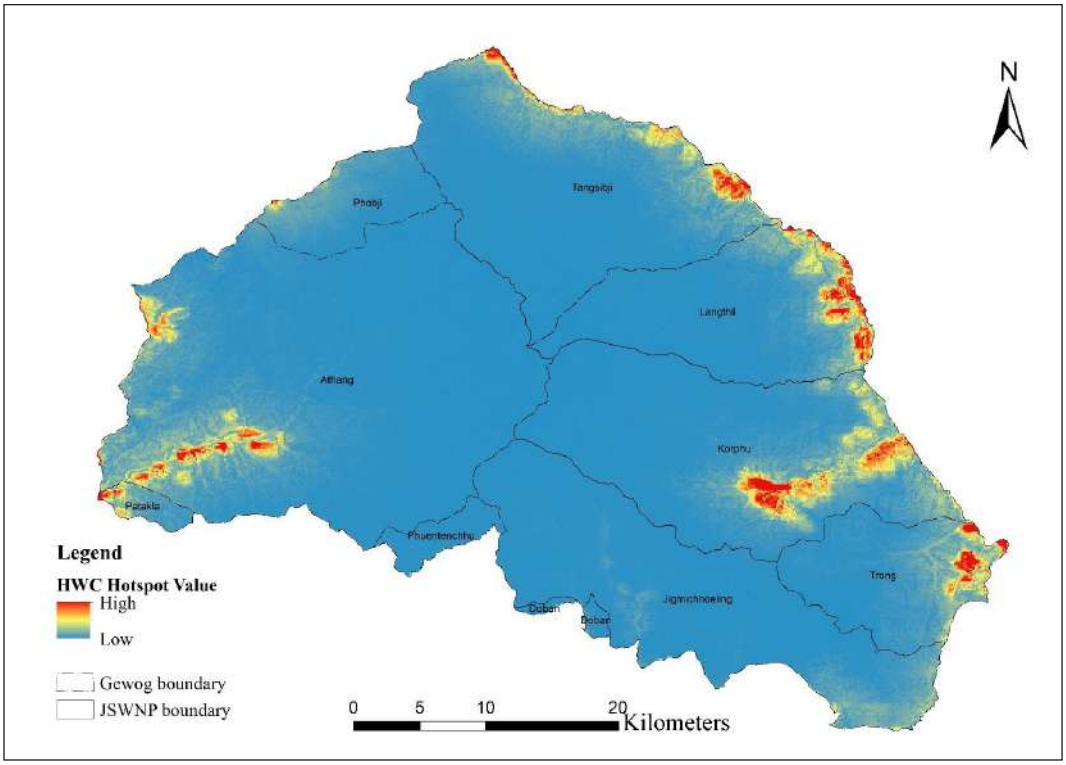

Figure 32: HWC Hotspot map of JSWNP, 2021.

2.5. Forest Resource Area

The Park residents are dependent on natural resources such as timber, firewood, poles and non-timber forest produces (NTFPs) for their day-to-day livelihoods and to supplement income generation besides agriculture and livestock rearing. To meet these requirements, Community Forests have been established in most of the communities; there are eighteen CFs and two NWFP management groups in the park. In the recent times, it was observed that the resources were also allocated from the forests outside management regimes; therefore, LFMPs have been prepared for all gewogs with settlements in the park in order to manage the resources from such forests. The Park has no Forest Management Units (FMUs).

2.5.1. Community Forests (CFs)

The Park has a total of eighteen CFs spread across the communities inside the park. Each of these CFs is managed under management plans and by Community Forest Management Groups (CFMGs). The following table shows list of CFs in the park, location, year of establishment and management plan plan periods.

SL No	Name of CF	Village	Gewog	Dzongkhag	Establishment year	1st Management Plan period	2nd MP Reviewed plan period	MP next review period (FY)
1	Nabji Community Forest	Nabji	Korphu	Trongsa	2009	July 2009-July 2019	July 2019 - June 2029	2028 - 2029
2	Korphu Community Forest	Korphu			2010	August 2010-August 2020	July 2020 - June 2030	2029 - 2030
	Nimshong Community Forest	Nimshong			2017	September 2017-August 2027		2026 - 2027
3	Kella Chithuen Community Forest	Kella	Tangsibji		2013	May 2013 - April 2023	July 2019 - June 2029	2028 - 2029
4	Cherub Community Forest	Malling & Langbro			2013	May 2013 - April 2023	July 2019 - June 2029	2028 -2029
5	Wangling Community Forest	Wangling	Langthel		2015	September 2015 - August 2025		2024 - 2025
6	Jangbee Community Forest	Jangbee			2013	August2013-July 2023		2022 - 2023
7	Beyzam Community Forest	Beyzam			2013	August 2013-July 2023		2022 - 2023
9	Ngormey Community Forest	Ngormey			2017	September 2017 - August 2027		2026 - 2027
10	Monpa Selwai Yoezer Tshogpa	Jangbee			2018	May 2018-April 2028		2027 - 2028

11	Berti, Phendheyling Community Forest	Berti	Trong	Zhemgang	2017	July 2017 - June 2027		2026 - 2027
12	Pema Choeling Community Forest	Tama			2016	July 2016 - June 2026		2025-2026
13	Olep Community Forest	Rukha	Athang	Wangdue	2016	October 2016 - September 2026		2025-2026
14	Yoesum Tashi Community Forest	Lawa			2016	Sept 2016- August 2026		2025-2026
15	Samthang Community Forest	Samthang			2010	June 2010 - May 2020	July 2020 - June 2030	2029-2030
16	Shayuep Community Forest	Lamga			2018	Nov.2017 - October 2027		2026-2027
17	Migtana Pindru Community Forest	Migtana			2018	May 2018-May 2028		2027-2028
18	Rukha Nagtshel Thuenken Tshogpa	Rukha	Adha	Wangdue	2009	July 2017 - June 2020	2021-2022	2026-2027

Table 10: Details of Community Forests in JSWNP.

2.5.2. Non-Wood Forest Produce Management Groups (NWFP-MGs)

The Park has two NWFP-MGs namely Rukha Naktshel Thuenken Tshokpa (RNTT) and Monpa Selwai Yoezer Tshogpa (MSYT). RNTT was established in 2009 and belongs to the villages of Lawa, Lamga, Rukha, Migtana and Samthang village under Athang gewog, Wangdue Phodrang with 70 HH members. Besides cane and bamboo, the group also manages about five different types of NWFPs viz. T*erminalia chebula, Phyllanthus emblica, Plectocomia himalayana, Rubia cordifolia and Piper betleoides* within the designated areas of their communities. Its first management plan was from July 2017 to June 2020 and the second management plan is currently being prepared after thorough resource assessment (plan period of 2022 to 2016).

The MYST was established in 2007 for the Monpa community of Jangbi, Phrumzur and Wangling, benefitting 58 households under Langthel gewog, Trongsa. It was initially established as a NWFP management group, however, in 2018, the same was converted to community forest with same name and same members. Its current management plan has been implemented since May 2018 and will expire in April 2028.

Both of these groups manage cane and bamboo as major NWFP and produce products such as baskets, *Bichha* and other related handicrafts. Trainings on product development and marketing of finished products have been provided to these groups in regular intervals.

2.5.3. Local Forest Management Areas

From 2017 to 2020 seven LFMPs have been prepared for all of the seven gewogs with settlements in the park jurisdiction. The resource availability, demand-supply analysis and allocation modality for next ten years under each of these LFMP areas are compiled in the last chapter of this management plan, which will form the strict basis for resource allocation during the plan period. Although the plans were prepared starting from 2017, all LFMPs will be implemented uniformly from 2022 to 2031, which is the implementation period of this management plan. The following table summarizes all the LFMPs of JSWNP;

Sl No	Gewogs	Dzongkhag	LFMP prepared	AAC (m^3)	Implementation period
1	Trong	Zhemgang	2020	2460	2022-2031
2	Jigmechholing	Sarpang	2019	3538	2022-2031
4	Korphu	Trongsa	2017	2817	2022-2031
5	Langthel	Trongsa	2020	4868	2022-2031
6	Tangsibji	Trongsa	2020	343	2022-2031
7	Athang	Wangdue	2018	3075	2022-2031
8	Sergithang	Tsirang	2019	228	2022-2031

Table 11: Details of LFMPs in JSWNP

2.6. Administration, service delivery and park infrastructure

The Park has its headquarter at Tshangkha, under Tangsibji gewog, Trongsa. It is located below east-west national highway, below the Tshangkha Central School. At the headquarter, besides the park head office, there is a visitor information center (VIC), an Orchidarium, CFO's quarter and staff quarters to accommodate six families. The park heaquarter oversees the overall functioning of the national park and park range offices, and reports to the department headquarter at Thimphu. Chief Forestry Officer (CFO) heads the park and is assisted by Administration and Accounts sections in overseeing the overall functioning of the park. Four functionsal sections under the CFO are Nature Conservation Section (NCS), Social Forestry and Extension Section (SFES), Forest Protection and Enforcement Section (FPES) and Forest Resource Management Section (FRMS), who report to respective functional divisions at the head quarter through the CFO.The field activities are implemented through four range offices and two beat offices as depicted in the park's organogram *(Fig. 33)*.

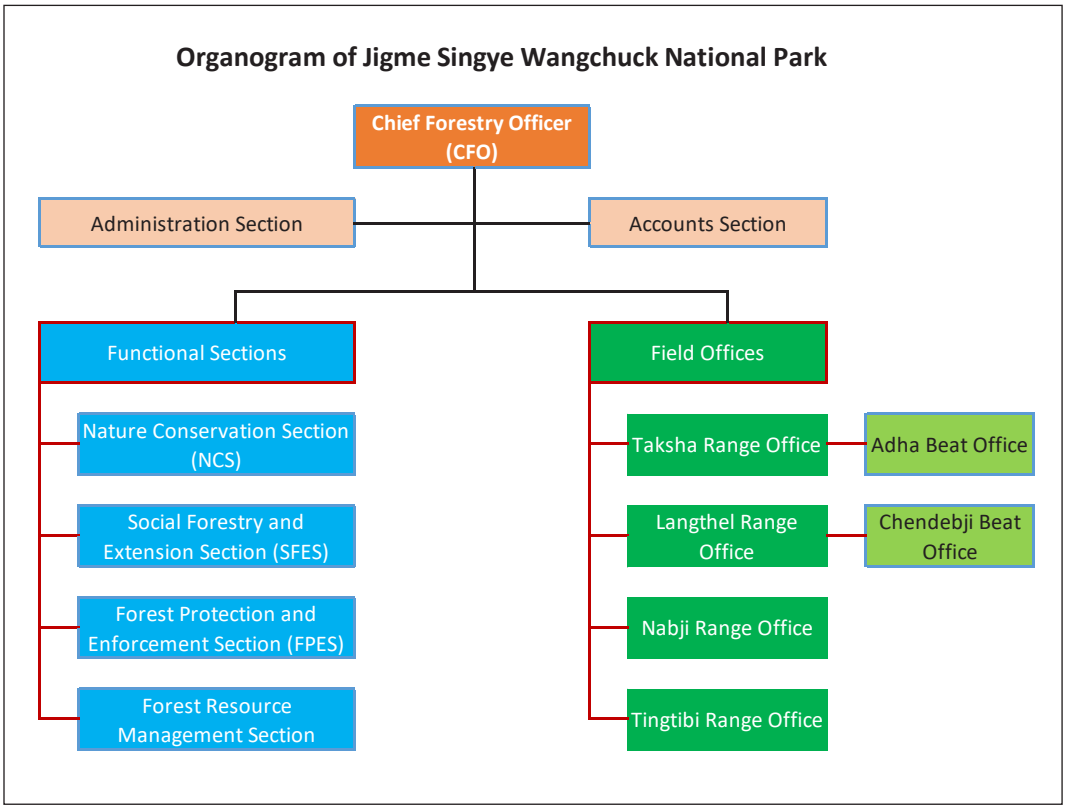

Figure 33: Organogram of JSWNP

Various communities spread across the national park are catered through the park's four administrative ranges, with range offices located at Taksha (Taksha Park Range), Tongtongphey (Langthel Park Range), Tingtibi (Tingtibi Park Range) and Nabji (Nabji Park Range). There are two Beat offices (erstwhile known as Deputy Park range offices) at Adha and Chendebji under Taksha and Langthel range, respectively.

Taksha Range Office oversees the Athang *gewog* of Wandiphodrang dzongkhag. Communities of Adha such as Lopokha, Lhomtshokha, Phaktakha, Gemdro, Bartsa, Kago, Morakha and Gentsawa are catered by the Beat office at Adha while the communities of Rukha, Migtena, Lawa, Lamga, Dayu, Kashacjeko, Samthang, harachu and Satshamla are catered by Taksha range office.

Langthel Range Office oversees Langthel and Tangsibiji *gewogs* of the Trongsa dzongkhag partially. Communities of Langthel gewog, such as Jangbi, Phrummzur, Ngormay, Shenling, Baseling and Nangnang are catered from the range office at Tongtophey while the communities of Tangsibji *gewog* such as Kella, Dimba and Chendebji are caterd through the beat office in Chendebji. As such, the Chendebji village falls outside the park area; however, their agricultural fields fall inside the park area.

Tingtibi Range Office covers the Trong *gewog* under Zhemgang dzongkhag. There are three villages, Berti, Takabe and Tama inside the national park. These communities are catered by the range office located in Tingtibi town. Nabji Range Office covers Korphu *gewog* of Trongsa and Jigmecholing gewog of Sarpang.

Human resource wise, the Park has 31 technical (Forestry) staff and 8 supporting staff. The headquarter has overall strength of 11 staff (1 Chief Forestry Officer, 3 Forestry Officers, 2 Senior Rangers, 1 Administrative Assistant, 1 Accounts Assistant, 1 Driver, 1 Night Guard and 1 Caretaker). Taksha range has 3 Rangers, 1 Forester and 1 Caretaker. Langhtel range has 2 Rangers, 4 Foresters and 1 Caretaker. Tingtibi range has 3 Rangers and 1 Forester. Nabji range has 2 Rangers, 3 Foresters and 1 Caretaker. Adha beat office has only 1 Forester (1 Ranger is on study leave since July 2021). And, Chendebji beat office has 2 Rangers and 2 Foresters.

Snow Leopard captured in Black Mountains, JSWNP in 2017

PART 3: SUMMARY REVIEW OF THE PAST PLAN

3.1. Assessment of previous plan (major outputs from the objectives of previous plan)

During the past management plan period, apart from the regular RGoB financing, the park also implemented conservation projects funded by different donor agencies such as WWF Bhutan and GEF, due to which a lot of conservation outputs were achieved. The major achievements during the period are summarized under the following six headings;

3.1.1. Forest protection and law enforcement

- **SMART patrolling**

JSWNP was the second protected area to start Spatial Monitoring and Reporting Tool (SMART) program in the country after RMNP. After its start, the SMART patrolling has only improved and strengthened in the national park and enhanced the conservation outputs to new heights. During the past management plan period, the areas of the park that was previously not traversed were explored and brought within the purview of SMART coverage. The parks patrolling teams have often apprehended poachers and other offenders, located and destroyed snares and traps set for wildlife including birds and ambushed poacher teams in the national park areas. A patrolling route guide was also developed for exclusive use by park officials which has helped guide the new officials in performing the patrols.

3.1.2. Forest resources management

- **LFMP**

The Local Forest Management Planning (LFMP) was started in the national park in 2017 and completed in 2020. All of the seven gewogs having human settlements in the park have been covered under LFMPs.

- **Community Forests (CF)**

Twelve new Community Forest were established between 2013 and 2018 in different locations in five *gewogs*. Two in Tangsibji *gewog*, three in Langthel *gewog*, one in Korphu *gewog*, two in Trong *gewog* and four in Athang *gewog*. Today, the park has a total of 18 CFs. Two Community Forest management plan were revised during the 12 FYP. The two CFs of Kella were revised in the middle of their earlier management plan due as the previous plan included areas that were far flung and not accessible to the communities, especially the resources such as firewood and poles. During the revision, the areas were revised and made more accessible to the benefitting communities. Awareness meeting, certification and record keeping training to CFMGs of Olep, Yeosum Tashi and Samthang community Forests were conductedduring the past plan period. CF awareness meeting was also

conducted at Migtina from in 2017 for two new CFs: Olep and Yeosum Tashi CF. The Community Forest Management Group (CFMG) of Langthel and Tangsibji gewog under Langthel park range were also trained on various aspect of record keeping pertaining to CF management from in 2018.

- **Non-Wood Forest Product**

The management plan of NWFP group, Rukha Naktshel Thuenken Tshokpa (RNTT) was revised in May 2017 for three years, till May 2020. Hands on training to NRTT members for manufacturing handicraft products *(Zem)* was organized in 2018. The training was organized to enhance the interest of the participants for handicraft production, improve the quality of product, maintain consistency in the quality of product to overcome market competition and sustenance, and to examine the cost analysis for producing *Zem* for ensuring the profit or loss.

- **Initiatives to reduce dependency on Natural Resources**

In order to reduce demand on fuel wood by the park residents the park management supported 8 numbers of new biogas plants construction and repair of 7 units of old biogas in in Athang *gewog* in collaboration with Dzongkhag livestock office, Wangduephodrang in 2016-17 FY. Another 4 units of biogas plant constructed in Reti village in 2017-18 FY.

The park management also supplied 20 numbers of 10-liter electric rice cooker to 8 schools/ institutions, five lakhangs and three Dratsangs/ Shedras during FY 2015-16. Another 30 numbers of 10-litre Rice cookers were supplied to schools and institutions and Lakhangs during FY 2017-18. MoU was signed between the park management and the institutions and community Lakhangs to reduce the use of firewood.

3.1.3. Research and monitoring

- **Research**

During the past plan period, various research activities were carried out, some of the prominent ones are as listed below;

- ✓ Herpeto-fauna survey was conducted in the park, recording the presence of 16 snakes, 3 lizards, 2 geckos, 2 toads and 8 frog species.
- ✓ Habitat study for Satyr tragopan was successfully completed.
- ✓ Himalayan monal habitat and conservation threats assessment was carried out in 2018.
- ✓ Musk deer survey was conducted in the national park. We have now ascertained the preliminary Extent of Occurrence (EOO) of musk deer in the national park with an area of 413.19 sq.km (Dorji, 2013).

- ✓ Survey on butterflies of JSWNP has been completed and 174 species of butterflies in five different families have been recorded while 30 more specimens are to be identified.
- ✓ A study to assess the status, conflict and conservation aspects of Assamese macaque in JSWNP has been completed.
- ✓ HWC hotspots mapping, focusing on Human-Tiger conflict has been carried out in the park, whereby Nabji and Korphu are found to be the most vulnerable areas, prone to conflict with tigers (Dorji, 2017).
- ✓ Assessment of White-bellied heron habitat and conservation threats in Harachu was carried out in 2018.
- ✓ Field works for species listing of small mammals in JSWNP has been carried out and 12 species of small mammals have been recorded in the first phase.
- ✓ A comparative study of nesting and feeding behaviors of rufous-necked hornbill (RNH) and great hornbills was conducted in 2017 (Dorji, 2018).
- ✓ An inventory and assessment of Invasive Alien Plant Species (IAPS) in Jigme Singye Wangchuck National Park was carried out in 2018.
- ✓ An inventory to list the diversity of Orchids in the park was completed in 2016. An orchidarium was also established at the park headquarter, Tshangkha.

- **Tiger monitoring**

In order to monitor the individual tigers recorded during the national tiger survey in 2015, regular tiger monitoring was carried out during the past management plan period with funding supports from WWF-UK. Entire Park area was covered for the monitoring, which was carried out phase wise due to lack of enough camera traps. Apart from tiger images, various other wildlife species area also captured and monitored by the monitoring exercise. Snow leopard was captured for the first time in 2017 in the camera traps set for monitoring tigers (Letro et al. 2021).

3.1.4. Human wildlife conflict management

- **Electric fencings**

In JSWNP, solar fencing was first introduced as an ICDP intervention in the year 2014 at in Jangbi village under Langthel gewog, Trongsa on a trial basis. With 100% crop harvest from the trial area in the following year encouraged solar fencing in other locations. The park management supported electric fencing for 62 kilometers of agriculture fields in all the five gewogs falling under JSWNP from 2014 to till 2018. Most of the places like Adha, Rukha, Jangbi & Chendebji are totally covered by solar fencing supplied from the park. 419.27 acres of agricultural field (Wetland= 233.95Acre, Dryland= 185.31Acre.) in 43 locations of seven Gewogs under JSWNP, viz. Tangsibji, Langthel, Korphu, Trong, Jigmichholing, Phuentengchu & Athang benefitting around 366 households were protected from wildlife damage through electric fencing during past plan period.

- **Improved cattle breeds**

  Twenty-two number of Jersey cows were given to the community of Tama under Trong gewog of Zhemgang, which falls under Tingtibi range of JSWNP. Stall feeding of these cattle was encouraged. The recipients of these improved breeds agreed to give back the first female calf born by the cow to the park so that these could be supplied to other households. The main objective of the initiative is to reduce the number of livestock holding in the community while still yielding sufficient livestock products, and also to reduce grazing pressure in the forests. This also reduces the livestock depredation cases as a smaller number of livestock go to the forests for grazing.

- **Cardamom saplings distribution**

  In order to provide alternative source of income, a total of 94,400 cardamom saplings were supplied to various communities within the park. 35,400 saplings were supplied in 2017 and 59,000 saplings in 2018. The main goal was to reduce pressure on forest by reducing heavy dependency on natural resources for their livelihood. The scheme has benefitted 133 households in total.

3.1.5. Preservation of cultural and religious sites

Considering the great cultural and religious significance in the national park, a number of initiatives were taken to conserve and promote such values. All cultural sites within the national park have been mapped with a brief background on each site *(Fig. 34)*. The indigenous Monpa and Olep communities in Jangbi, Phrumzur, Rukha and Reeti were given major focus to conserve the unique cultural values. The park celebrated the National Day of 2016 in Jangbi to spread awareness about the unique Monpa culture. Similarly, support was given to Singye Namgyel Community Primary School in Monpa community of Rukha and Migtena for Social Forestry Day celebration on 2nd June, 2017. The ancient trail from Reeti to Nabji to Kudra to Jangbi holds great religious value as the trail was traversed by Guru Rinpoche during his visit to Bhutan in 7th century AD. Based on such significance and site evidences, the park promoted the tourism activity along the trail. A statue of Guru Rinpoche was installed in Kudra village and in Reeti Nye during the past plan period. Construction of Chhamkhang in Nabji lhakhang and conservation of monuments at Korphu lhakahng was carried out during the period as well.

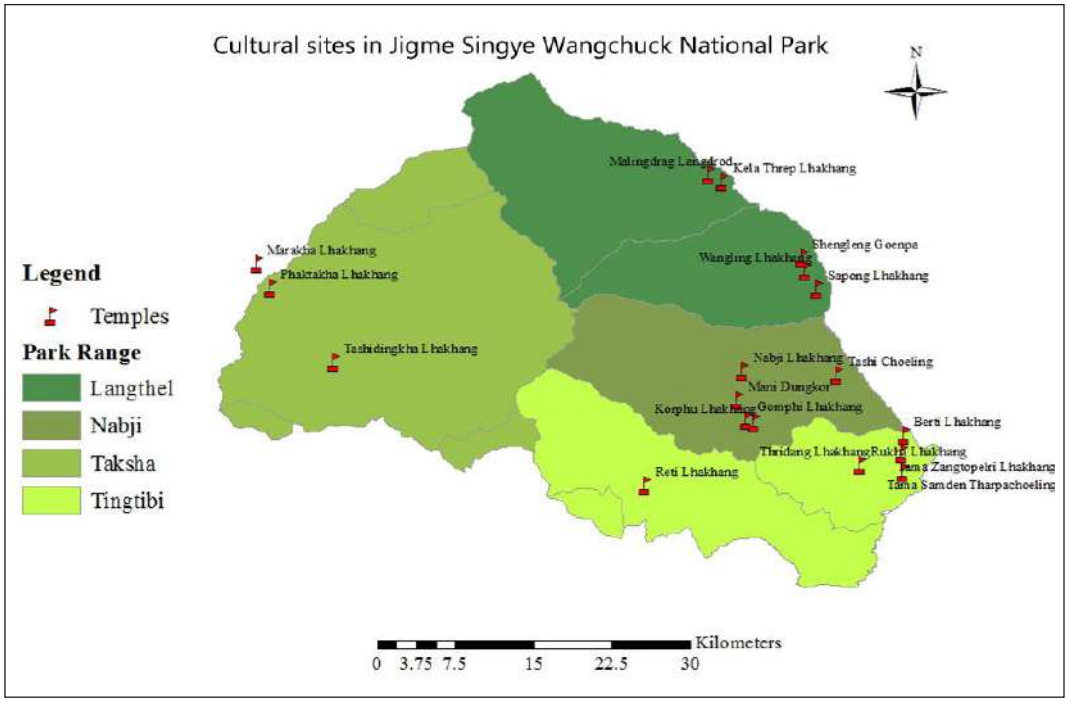

Figure 34: Map showing cultural sites in JSWNP

3.1.6. Strengthening of institutional capacity

- **Infrastructure**

  ✓ A 3-units staff quarter was constructed in Taksha range in 2017.

  ✓ A 2-storey building housing visitor information center (VIC) and guest rooms was constructed at the headquarter in 2018.

- **Human resource development/ Trainings**

Various capacity building trainings, tours and study programs were conducted during the plan period. Some of the prominent ones are as follows;

✓ In 2015, a total of eight staff including the Chief Forestry Officer of JSWNP went for study tour to Bangkok to study the community-based ecotourism programs. Similarly, a total of 7 community leaders were sent to Bangkok to study community-based ecotourism in 2016. Also in Bangkok, short-term wildlife/ protected area management tour was organized for a total of 18 staffs for the duration of 5 days. During the tour our foresters observed and learned various aspects of protected area management, community-based ecotourism development and management in protected areas and also conservation activities undertaken by the Department of National Parks, Thailand.

✓ Advance office and financial management training course in Philippines was attended by the accountant of the park.

- ✓ Training on basics of GIS was delivered to 21 park field staffs through the expertise of GIS Officer, WWF Bhutan Program in 2016. The Park rangers are now applying the GIS knowledge in their day-to-day field activities, in producing relevant maps without having to rely on others.
- ✓ SMART Patrolling Enforcement trainings have beenconducted by the park on yearly basis. The SMART focal of the park attended SMART Connect Workshop in Cambodia from May 29th to June 2nd 2017 to enhance efficiency and transform the SMART Connect program.
- ✓ The In-charge of Research and Monitoring Section of the park attended the Basic Statistical Concepts and Current Method of Designing Data Collection and Analyzing Data Relevant to Wildlife Research training course from 27th December to 10th January 2018 at Biodiversity Conservation Society Sarawak, Malaysia. The program was arranged to build in-house capacity of staff to cater the research needs of the park and also act as a training of trainers to conduct in house training.
- ✓ The In-charge of Research and Monitoring Section attended 7th International Hornbill Conference at Kuching, Malaysia from 16th to 18th May 2016 as guest speaker. The park's research output on hornbills was presented during the conference.
- ✓ The watershed focal of the park attended a two-weeks long springshed management training at ICIMOD in Nepal in 2018.
- ✓ Voluntary Forest Fire Management Groups (FFMG) have been formed under Taksha range, which is the most fire-prone area of the national park.
- ✓ Cane and bamboo management plan has been developed and operationalized for Jangbi and reviewed for Athang. Products development and value addition training was conducted for the people of Lawa and Lamga and the marketing strategy have been developed.

3.1.7. METT+ Assessment

An assessment of the management effectiveness of JSWNP was done in 2015 and 2016 focusing on the past five years using Bhutan METT+. The average score of JSWNP was 57.7% which is above global standard of 53% (as per global average scores around the world was 53% in the analysis of 2010). Similarly, second METT+ assessment of the park was carried out in 2021 in which the park achieved an overall score of 66.0% which is an increase by 8.3%.

3.1.8. CA|TS certification

Conservation Assured; Tiger Standards (CA|TS) is a set of 17 minimum elements with associated standards and criteria for effective management of tiger conservation areas. JSWNP, along with RMNP and JDNP underwent a rigorous process of CA|TS assessment in 2018-19, and achieved certification as a CA|TS Approved site in 2019. Therefore, JSWNP is one of the two CA|TS sites in Bhutan (other one is RMNP).

3.1.9. Water sources mapping

An assessment to map and assess the status of all the water sources in the park was carried out in 2020. 82 water sources were recorded during the survey, out of which 77 are from within the areas of Jigme Singye Wangchuck National Park and remaining five from outside the park area (from the communities of Bartsa, Gemdro and Morakha in Adha that are catered in service by the park despite falling outside the park's jurisdiction).

Maximum number of water sources (n=35) was recorded from Athang gewog, followed by Trong (n=15). Korphu (n=12), Tangsibji (n=11) and Langthel (n=9). The study found that overall, 45% of the water sources in the park were reported to be drying while remaining 55% had no change as compared to past. No dried-up water source was listed in the survey from any gewog.

Gewog wise, Langthel has the biggest ratio of the sources drying up to those with no change (ratio of 7:2). Korphu has ratio of 1:1 and Tangsibji has 7:4. while Trong and Athang have a smaller ratio of water sources drying as compared to those with no change, as represented by ratio of 1:2 and 3:4 respectively.

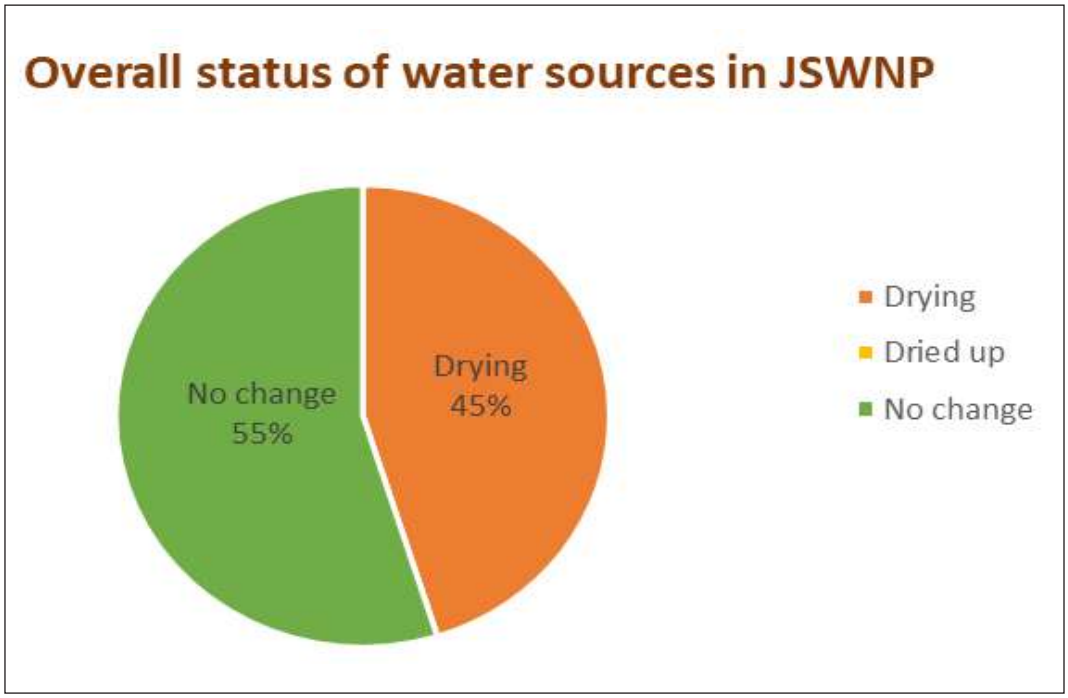

Figure 35: Status of water sources in JSWNP.

3.2. Lessons learnt

Overall, the past management plan implementation was a huge success for the park. Over 90% of the management prescriptions from the previous plan were implemented as per timeline and required standards. The following were some of the contributing factors (the lessons we learnt) for the successessful implementation;

3.2.1. Funding source

With secured funding from RGoB and projects the park achieved much of its budget-intensive conservation milestones such as wildlife surveys, research & monitoring, patrolling, infrastructure development such as staff quarters, visitor information center, livelihood enhancement programs for communities such as biogas, supply of improved breeds and climet-smart farming support, mobility bikes and field gears and equipment.

3.2.2. Partnership & Collaboration

Many of the conservation activities were implemented in partnership with other agencies which not only achieved better implementation but also enhanced the park's working relationship with the collaborating agencies. For example, the park's support in terms of providing improved breeds (Jersey) cattle to 22 households of Tama community was carried out in collaboration with the department of livestock (DoL) for they are more experienced in such activities than the park.

3.2.3. Adaptive management

Strategic Adaptive Management proves promising in an effective and rigorous management of reserves for biodiversity conservation (Kingsford and Biggs, 2012). During the past plan implementation period, the principles of adaptive management was applied to achieve desired targets' some of the best examples are;

- **Effective planning and Implementation**

  The park developed annual work plan at the start of each financial year, aligning the activities with the approved fund. Review meetings were conducted on quarterly basis to incorporate changes that crop up on priority basis. Regular monitoring was carried out to ensure timely completion of the tasks. If a method did not work good for one year, the subsequent plan was modified to make it more realistic and achieveable.

- **Human resource management**

  Human resource allocation was made strategically even if it meant deviation from the prescribed allocation in the actual work plan. We did not stick to the specified section heads to carry out all the tasks; instead, the works were distributed to field staffs based on their capacities, which led to timely completion of field works.

- **Resource allocation**

  Field offices were equipped with necessary equipment to undertake effective field works, monitoring and evaluation. Equipment such as GPS, SMART kits, mobility bikes and field gears were procured and issued to field staff.

  However, the overall success story did not come without any challenge. The Park was faced with multiple issues and challenges during the plan implementation period, some of the prominent of which are;

- **Lack of Technical Expertise**

  The park lacked technical expertise in certain fields and had to hire one such from other agencies for carrying out field works in some cases. For instance, the national park had to hire an expert from UWICER for small mammals' survey and site engineers for drawing, designing, estimation and work supervision of all construction work.

- **Outside collaborators**

  Some works was carried out in collaboration with the outside agencies. And in some of such cases there have been issues regarding coordination, monitoring and reporting. For instance, Biogas initiative in Adha-Rukha was implemented in collaboration with Wangdue dzongkhag administration and the activity implementation got delayed due to lack of coordination and monitoring.

- **Delay in budget release**

  The system of quarterly budget release from the funding agency hampered the work implementation in many cases. This is because various works are scheduled in different months but when it comes to implementation, we had to wait until the time the budget was released, which was mostly delayed, leading to delayed completion of the activities.

3.3. Gaps and carry over actions from previous plan

The conservation activities prescribed in the past management plan were mostly implemented within the plan period; however, some important tasks had to be carried over to the next plan, some of which are as follows;

3.3.1. Lesser-known taxa

Although baseline data for most of higher taxa of fauna has been established, the survey and listing of lesser-known taxa such as micro-invertebrates, beetles, dragonflies & damselflies, moths, bees & wasps and mushrooms is pending.

3.3.2. Eco-tourism with sustainable business models

Although JSWNP was the first protected area in the country to start eco-tourism program with Nabji-Korphu eco-trail, not much success could be achieved due to lack of proper business model for such programs. Today, the existing infrastructure along the trail are deteriorating. Also, the park has many other potential tourism sites spread across the park, such as Adha-Rukha trail, ancient black mountain trail from Phobjikha, Tamala lake, and many more. Therefore, reviving or initiating these ecotourism opportunities with good business model would benefit the park residents and the country as a whole.

3.3.3. Climate change

Assessment of climate vulnerability and capacity assessment of park communities, spreading awareness on climate change and implementation of adaptation and readiness programs is a current need of the park in face of increasing climate disaster.

3.3.4. Infrastructure

Although basic infrastructure such as office buildings and staff quarters have been drastically developed during the past plan period, more of such is needed in various field offices. Nabji range is in need of both office building and staff quarter, Langthel range is in need of renovation of both office building and staff quarters, and Taksha range is in need of renovation of existing office building and staff quarter.

A Juniper forest destroyed by forest fire in Maniting, JSWNP

Priimula chesmophila; an endemic species of JSWNP

PART 4: THREAT ANALYSIS

Threat analysis encompasses identification of conservation threats and their assessment in conservation planning and management. It forms the integral part of conservation planning and management. Once the threat has been identified, threat ranking is necessary to prioritize interventions.

4.1. Conservation threats in JSWNP

4.1.1. Poaching

The Black Mountain landscape is an important habitat for many threatened wildlife species that are highly valued for their parts and products such as tiger, musk deer, Himalayan black bear and red panda among others. The landscape is surrounded by human settlements and is approachable from all four directions. From the northern side, an ancient trail leads towards the peak of the Black Mountain range; the trail is still used by nomadic yak herders for seasonal migration of yaks. The existence of such trails provides easy access to people of all kinds. Therefore, poaching is one of the major threats facing wildlife conservation in JSWNP. In the past years, the park's patrolling teams have located and dismantled large numbers of traps and snares set for wildlife poaching. In 2021 alone a total of 39 musk deer traps were located and removed by our patrolling teams from the Black Mountain region. In certain occasions, poachers are caught and apprehended on site inside the park's areas.

The main species targeted by poachers are musk deer, Himalayan black bear and tiger in rare cases. Other species such as barking deer, sambar deer and wild pigs are hunted for bush meat in some parts of the park. In some parts, such as along the ancient trail from Phobjikha, bird species such as monal pheasant, kalij pheasant and blood pheasant are poached as evident from the snares and traps seen during patrolling and survey transacts.

Illegal fishing is another form of poaching caught quite frequently inside the park or along its boundary. The Park is crisscrossed by multiple rivers and tributaries which harbors good population of freshwater fish species and is targeted by poachers for illegal fishing. Illegal fishing is frequently reported from areas of all range jurisdiction.

Illegal collection of hornet and honey is another form of poaching reported from some parts of the park, especially under Taksha range.

4.1.2. Illegal extraction of timber and NWFPs/ stone and boulder/ surface collection

Most of the park residents depend heavily on timber for house construction, to which each household is eligible for timber to construct a new house every 25 years as per FNCRR. When a family divides within the 25 years period, the new house construction does not stand eligible unless the census registration is separated. Therefore, in such a case people tend to harvest timber illegally to construct new houses. Some people also harvest timber illegally for economic gain through sale of such timber. In the last four years (2016 to 2020), a total of 27 cases of illegal timber extraction were caught as per the official record *(Table 12)*.

Year	2016	2017	2018	2019	2020	Total
Illegal timber extraction	2	6	10	5	4	**27**

Table 12: Summary of illegal timber extraction cases in JSWNP

NWFPs are collected, consumed and marketed in all the communities in the park. Some of the commonly collected species are fern, mushrooms, bamboos, wild fruits and vegetables. However, there are other economically viable species that are restricted on collection that people tend to collect illegally for economic gains. This includes species such as *Paris polyphylla* (commonly known as Thog-sampa in sharchopkha, *Satua* in lhotshamkha and *Thochu kewa* in Dzongkha) and *Neopicorrhiza sp.* The *P. polyphylla* collection is rampant in areas opposite to Chendebji where both locals and outsiders enter the park area illegally and collect the species in destructive manner. *Picorrhiza sp.* is collected from black mountain areas of the park. Both of these species are used as important ingredients in traditional medicines. Other forms of illegal NWFP collection are harvesting of wood burr for woodcrafts and illegal surface collection of sand and boulders. For instance, two separate cases involving 20 trees, either illegally felled or damaged at Chendebji forest for burr extraction during 2018-2019.

4.1.3. Human wildlife conflict

Due to the presence of human population residing inside the national park who practice agriculture and livestock for their subsistence, human wildlife conflict is a common phenomenon in JSWNP. The findings from the social survey on people's perception of HWC trend in the national park show that HWC incidences are increasing over the years both in terms of crop damage and livestock depredation.

Crop raiding by wild animals occurs across all the gewogs under JSWNP while paddy and barley are the most damaged crop types. The wild animals involved in the crop damage include wild pig, monkey, sambar deer, porcupine, barking deer and Asiatic black bear of which wild pig is the most conflicting species while Himalayan black bear has the least conflicting record.

With many livestock herders from within and outside the national park freely grazing their livestock across different seasons of the year, the livestock often fall prey to the large carnivores like tigers, leopards and wild dogs. The free ranging livestock herding clubbed with minimal guarding practice increases risks of depredation by wild carnivores.

4.1.4. Grazing

The JSWNP is home to grazing grounds for both migratory and resident cattle and most of these grazing areas are under Langthel, Nabji and Tingtibi ranges. The migratory cattle herders are mostly from Chumey gewog in Bumthang and they migrate during the winter

to Langthel and Korphu gewogs in Trongsa, Trong gewog in Zhemgang and Jigmecholing gewog in Sarpang (Letro, 2014). There are over 1500 cattle which graze in the national park during some part of the year. The majority of the cattle still comprise of local breeds which often are low in productivity. The alpine meadows of Black Mountain region under the national park serves as summer grazing grounds for yaks from Phobjikha. There are currently six yak herders owning over 300 yaks.

A study conducted in the national park in 2014 on the impacts of grazing on forests and wildlife found that over grazing leads to trampling of soil, hampers natural regeneration, excessive browsing and lopping which leads to forest degradation (Letro, 2014). The livestock were also found competing with the wild ungulates for the palatable plant species which will impact the wild ungulate population thereby affecting the whole ecosystem. The free grazing also increases the incidences of livestock depredation by the wild predators thereby increasing human wildlife conflict.

4.1.5. Forest fire

Forest fire is a major challenge to conservation especially in Taksha range which is located in south-western part of the park. The vegetation type being dominated by Chirpine, the range faces cases of forest fires on yearly basis, mainly during dry winter months. Other ranges such as Langthel, Nabji and Tingtibi do have some conifer forests; however, forest fires are less frequent in these places.

4.1.6. Invasive species

A recent survey on the invasive species recorded five species of invasive plant species in JSWNP as follows; 1. *Ageratiana adenophora;* 2. *Chromolaena odorata;* 3. *Mikania micrantha;* 4. *Opuntia vulgaris;* and 5. *Parthenium hysterophorus.* Out of the five species, *A. Adenophora* is the most widely distributed species in the national park occurring in all the ranges. The *C. odorata* infested many parts of the national park mainly in the chirpine forests.

Sl No.	Major IAPS	Distribution in JSWNP
1	*Ageratina adenophora*	Nimshong, Nabji, Korphu, Berti, Tongchur, Chungshing, Beyzam, Jangbi, Wangling, Phrumzur, Kudra, Oksengla, Simkharka, Reetey, Gong, GSI camp area, Radhithang, Dayu, Lawa, Lamga, Rukha, Migtena, Samthang, Harachu, Taksha.
2	*Chromolaena odorata*	Along Nimshong-Berti trail, Berti, Kezang-dra, Phrumzur, Jangbi, Wangdigang bridge area, Dayu, Rukha, Lawa, Lamga, Harachu, Samthang, Taksha.
3	*Mikania micrantha*	Nimshong-Berti trail, Berti, Wangdigang bridge area, Chakharthang, Zhilingbe, Tongchur, Dayu, Lawa, Lamga.
4	*Opuntia vulgaris*	Ugyen dra
5	*Parthenium hysterophorus*	Sengling-brag, Rimtigang, Taksha, Rawdung, Wangdigang bridge area, Takabe, Zhilingbe.

Table 13: List of major Invasive plants in JSWNP

4.1.7. Wildlife Disease

Disease to wildlife is another threat to conservation. Given the nature of traditional yak and cattle herding practice in the areas of the parks such as black mountain region, Nabji-Reeti, Simkharka and Langthel, the risk of transmission of diseases like Foot and Mouth Disease (FMD) from domestic to wild ungulates is very high, particularly to musk deer, takin, goral, barking deer and samber deer which comes in close contact with livestock while grazing. Livestock officials has also warned us on the possibility of spread of the disease known as Black Quarter, which is caused by a bacterium *(Clostridium chauvoei)*, from yaks and horses to wild ungulates. Another agent of transmission of diseases like canine distemper and rabies to wildlife would be from the feral dogs. Livestock grazing along with domestic dogs also increases risk of disease transmission between livestock and wildlife.

4.1.8. Habitat degradation (Alpine grassland encroachment; landslides; erosion etc.)

Degradation of alpine habitat, especially encroachment of sub-alpine and alpine grasslands by Juniper and Rhododendron species along the Black Mountain region is a major concern for the park's conservation efforts. This has led to decrease in the grazing grounds for wild ungulates and domestic yaks alike. Since these areas fall in core tiger habitat, it is of great importance to conserve a healthy population of wild ungulates (prey) to support the magnificent cat species. Good habitat in the region would also reduce human-tiger conflict.

Other form of habitat degradation is visible in the form of landslides and soil erosion, especially in Langthel and Tingtibi ranges, mainly associated with construction of transmission lines. A natural landslide above Wangling village under Langthel range has washed away irrigation and drinking water supply to the village, which needs restoration interventions in the form of soil conservation works such as plantation and bioengineering structures.

4.1.9. Drying water sources

A survey to assess and map the water sources of the national park was carried out in 2021, covering entire inhabited areas of the park. The survey found that out of 82 water sources recorded, 45% of the were reported to be drying while remaining 55% had no change as compared to past. No dried-up water source was recorded. Gewog wise, Langthel has the highest ratio of the sources drying up to those with no change (ratio of 7:2). Korphu has ratio of 1:1 and Tangsibji has 7:4. while Trong and Athang have a smaller ratio of water sources drying as compared to those with no change, as represented by ratio of 1:2 and 3:4 respectively (Sinchuri, 2021). The following graph summarizes the status of water sources across different gewogs in the park;

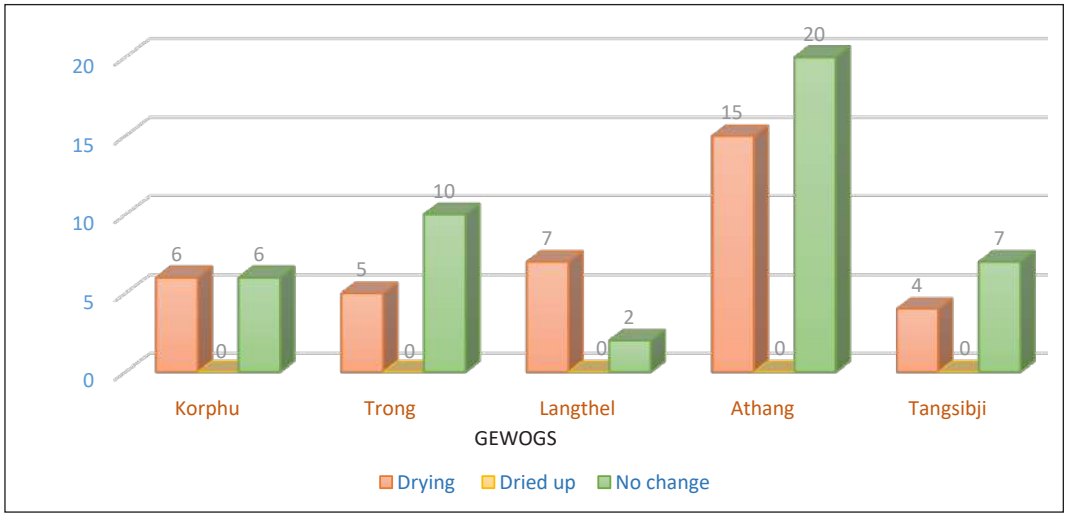

Figure 36: Gewog-wise status of water sources in JSWNP.

4.1.10. Developmental activities

Infrastructure development such as dam construction for hydropower, erection of high voltage transmission lines and road construction causes excessive removal of vegetation and soil excavation, resulting in erosion, river diversion, sedimentation as a result of dumping of rubbles and soil during the construction. JSWNP has in its periphery three major hydropower projects namely Punatsangchu, Mangdechu and Nikachu hydropower projects, and the pressure exerted by these on the park is enormous. Due to the influx of large number of people, both nationals and expatriates, the issues of wildlife offences, encroachment and waste increases, leading to conservation threats. Due to involvement of heavy machineries, noise and dust pollution becomes obvious. In certain parts such as Waichenchhu (opposite Mangdechu powerhouse), collection of riverbed materials for the hydropower project has caused diversion of waterways and degradation of aquatic biodiversity. Moreover, high voltage transmission lines of Mangdechu hydro runs through the park and causes habitat fragmentation and degradation on large scale in the areas of Langthel and Tingtibi ranges.

The network of roads inside the national park has increased drastically during the past decade. Especially, digging of gewog roads and farm roads to connect every village, big or small, in the park has intensified the road network in the park. With its benefit to the rural livelihood comes the threat to biodiversity conservation. Habitat fragmentation and degradation is the major threat posed by road construction.

4.1.11. Waste

The southeast boundary of JSWNP is demarcated by the national highway of Zhemgang-Gelephu whereby the road users carelessly throw plastics and pet bottles along the way. Likewise, the eastern boundary of the park geographically falls along ongoing construction of Nikachhu Hydro project. The waste generated by the project workers are not managed properly. The village settlements are located scattered inside the park. The plastics and pet

bottles generated from food wraps and drinks consumed by road users are thrown carelessly along the footpath. The Park has many places which are considered important from cultural and religious aspects, and attract many visitors. Such visitors also leave behind their wastes.

Many people from Bumthang Dzongkhag also use tsamdro for cattle grazing inside the park, who bring their cattle annually during the winter season and graze inside the forests of JSWNP for about six months, leaving their wastes inside the national park.

4.1.12. Climate Change

The Himalayas stretch over 1600 miles along the northern borders of the Indian subcontinent and the mountainous topography, heterogenic climetic conditions, geology and altitudinal variations in the Himalayas have resulted in distinctive landscapes, ecosystems and biodiversiy. However, the Himalayan ecosystem is rapidly changing under the current global and regional warming, which predicts increase in mean temperature by 0.3-4.8°C by 2100 (IPCC, 2013). Bhutan, located in the eastern Himalaya is no exception to the reality of climate change. By 2050, Bhutan's mean temperature is expected to increase by 2.5°C, with some of the high-altitude region expecting increase by 3.4°C (Parker, et. al., 2017). Climate projections indicate that there could be shifts in vegetation, species extinction and change in ecosystem service delivery with cascading consequences along the ecosystems and human livelihoods and lives (Xu et al., 2009 as cited in Snow Leopard Action Plan for Bhutan, 2018-2023).

Jigme Singye Wangchuck National Park, which represents a typical mountainous landscape characteristics of the Himalayas is vulnerable to all impacts of climate change that the whole Himalayan region is facing. The climate change is expected to impact the park's ecosystem and ecosystem services especially those related to hydrology. Shift in vegetation and phenology is increasingly observed. Due to increased heat stress, different species will shift towards more favourable zones. As a result, habitats are projected to be lost, fragmented or shifted resulting in the changes in the ecological communities. Species that require special habitats, specific food plants or migrate seasonally will be under threat under this scenario (DoFPS, 2015). There are also increasing incidences of pest and disease outbreaks and colonization by invasive species that can have severe implications on the native species and the ecosystem as a whole. As shown by the socio-economic survey, agriculture, livestock rearing and dependency on forest resources were the main livelihood option of the park residents. All of these are directly affected by climate change. Erratic rainfall, hailstorms, crop and livestock diseases, water shortage during cultivation season and many other forms of climate change adversity are already affecting the farmers.

Therefore, it is imperative that the whole process of the management planning is based on Climate-smart approach. Assessment of climate vulnerability of the park communities and their capacity in coping up with effects of climate change is a must in order to achieve climate-smart management interventions. It is also important to understand the ways in which each species and its habitat would be impacted by climate change in near future

and propose management interventions accordingly. This will make this plan more realistic and climate-smart. The adaptive nature of this plan is also a way to keep the management interventions climate-smart as it leaves room for re-designing the intervention approaches based on the emerging needs in the face of climate change. Taking into account the threats of climate change during the manangement plan period, various interventions are prescribed for mitigation of such threats such as climate-smart habitat management for climate-sensitive species, monitoring of disease outbreak in plants and animals, long-term monitoring of alpine and sub-alpine grasslands, enhancement of research on wildlife ecology, studies and control of invasive species, enrichment plantations, forest fire management and improvement of waterholes and saltlicks to name a few.

4.2. Management challenges

4.2.1. Inaccessibility of the areas

The Black Mountain range forms the core part of JSWNP. The range is a chain of rugged topography, mostly inaccessible to human efforts. Motorable roads are available only along the human settlements, along the periphery of the park; therefore, most of the patrollings are carried out on foot, which makes the task extremely challenging due to the inaccessibility of most of the areas.

4.2.2. Developmental pressure

Mangdechu, Nikachu and Punatsangchu form exterior boundary of the national park at different sides. All of these rivers are dammed for hydropower electricity. Therefore, there are four large scale hydro-electric projects (Mangdechu, Nikachu, Punatsangchu-I and Punatsangchu-II projects) under construction right in the periphery of the park. Similarly, construction of high voltage transmission lines through the park areas is rampant along Langthel and Tingtibi range areas. Developmental projects of such scales are sure to bring large number of negative impacts and adversity to conservation in the national park. The Park management has to work in close collaboration with these project authorities, often conflicting on ideas and values.

4.2.3. High dependency on natural resources

The park's communities are settled along mountainous slopes, mostly areas with low soil quality leading to low agricultural productivity. Due to this these communities largely depend upon natural resources such as NTFPs, cardamom cultivation in forest land, fuelwood and timber, which they collect from forest. This puts quite a challenge on the park management to balance between conservation and peoples' livelihood.

4.2.4. Poor conservation awareness

Since the protected areas in Bhutan have people living inside such areas, the local communities are integral part of biodiversity conservation. JSWNP has seven gewogs having human settlements in the park jurisdiction, and in many of these communities, awareness

regarding biodiversity conservation is still limited to few species. Therefore, spreading of awareness related to conservation and rules and regulations related to conservation is necessary.

4.3. Threat Ranking

The conservation threats were ranked using Miradi software, which considers three criteria for threat ranking, 1. Scope, 2. Severity, and 3. Irreversibility. Scope refers to the proportion of the target (area for ecosystems, population for species) that is likely to be affected within 10 years under current circumstances. Severity attempts to categorize the level of damage to the biodiversity target expected within that particular scope and in the specified time frame. Irreversibility is the degree to which the effects of a given threat can be undone and the targets affected by the threat restored, if the threat is stopped.

The nature of threats was determined as follows for all three criteria; 4 = Very High: The threat is likely to be pervasive in its scope, affecting the target across all or most (71-100%) of its occurrence/population; 3 = High: The threat is likely to be widespread in its scope, affecting the target across much (31– 70%) of its occurrence/population; 2 = Medium: The threat is likely to be restricted in its scope, affecting the target across some (11– 30%) of its occurrence/population; 1 = Low: The threat is likely to be very narrow in its scope, affecting the target across a small proportion (1-10%) of its occurrence/population.

In the threats ranking matrix, the three boxes against each threat stand for scope, severity and irreversibility from top to bottom. Color code wise, the dark green represents low, light green represents medium and yellow represents high.

	Threats\Targets	Habitat Management	Species conservation and protection	Community livelihood and welbeing	Sustainable management of Natural Resources	Summary Threat ranking
	Disease		Low			Low
	Drying water sources		Medium	Medium		Medium
	Forest Fire	Medium			Medium	Medium
	Habitat Degradation	Medium				Low
	Human Wildlife Conflict (HWC)		Medium	Medium		Medium
	Illegal extraction of Forest Resources	Low			Medium	Low
	Invasive Species	Medium				Low
	Poaching		Medium			Low
	Waste	Low				Low
	Summary Target Ratings:	Medium	Medium	Medium	Medium	Overall project Ranking: Medium

Figure 37: Threat Ranking of JSWNP using Miradi software

Black Mountain range during winter

PART 5: MANAGEMENT PRESCRIPTION

This section outlines the overall strategic plan prescriptions based on the overall goal of the plan to address threats, issues and challenges described in the previous section. This will be achieved through 85 strategic actions grouped under 20 strategies which are further grouped under 6 conservation objectives. The strategies and actions (management prescriptions) are defined based on the overall conservation goal of the plan to conserve and maintain wildlife habitats, conserve wildlife species and enhance wellbeing and livelihood of the park residents.

The conceptual framework developed using the Miradi software summarizes the management plan's overall goals, objectives, threats, strategies and actions as depicted in the figure below;

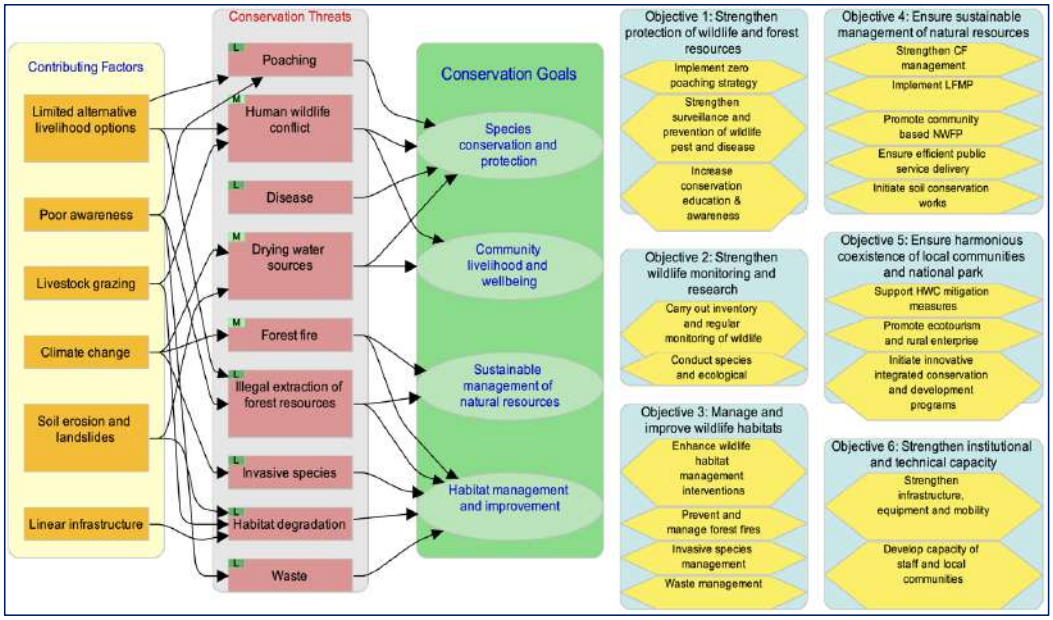

Figure 38: Conceptual Framework of the Management Plan.

Objective 1: To strengthen protection of wildlife and forest resources

1.1. Implement zero poaching strategy

1.1.1. Strengthen and conduct patrolling using Spatial Monitoring and Reporting Tool (SMART).

1.1.2. Carry out hotspot mapping of poaching and other illegal activities in the park.

1.1.3. Form community support groups for resolving poaching of threatened species, and provide timely incentives to such groups to motivate them to support conservation.

1.1.4. Start river rangers programme to patrol river stretches using rafts.

1.2. Strengthen surveillance and prevention of pest and diseases

1.2.1. Carry out regular and opportunistic inspection of pest and disease outbreak.

1.2.2. Collaborate with DoL to carry out regular and opportunistic inspection of disease outbreak in livestock.

1.2.3. Conduct education and awareness campaigns on wildlife pest and diseases.

1.3. Increase conservation education and awareness

1.3.1. Develop and functionalize visitor information center at the park headquarter.

1.3.2. Conduct regular conservation awareness programs in schools and communities in and around the park.

1.3.3. Develop and install conservation messages (sign-boards and posters) at strategic locations in and around the park.

1.3.4. Develop conservation awareness materials (audiovisuals/ signages/ publications).

Objective 2: To strengthen wildlife monitoring and research

2.1. Carry out survey and regular monitoring of wildlife

2.1.1. Conduct periodic tiger survey as part of the National Tiger Survey.

2.1.2. Carry out regular monitoring of tigers in the biodiversity monitoring grids in the national park.

2.1.3. Conduct periodic forest inventory as part of national forest inventory.

2.1.4. Conduct periodic snow leopard survey as part of National Snow Leopard Survey.

2.1.5. Conduct periodic biodiversity monitoring (monitoring of focal species, endangered and endemic species in the park).

2.1.6. Develop Citizen science programmes, provide training and employ them to gather biodiversity data.

2.2. Conduct species and ecological researches

2.2.1. Carry out climate vulnerability and capacity assessment of the park residents.

2.2.2. Conduct study on Red Panda (Population status, density, distribution and conservation threats).

2.2.3. Conduct study on Musk deer (Population status, density, distribution and conservation threats).

2.2.4. Conduct studies on other threatened species (Gaur, Golden langur, Hornbill, White-bellied heron).

2.2.5. Conduct detailed survey of Fish diversity and distribution in the park.

2.2.6. Conductt baseline studies on insects (Bees and wasps; Dragonflies and damselflies; Beetles; Ants) and freshwater macroinvertebrates.

2.2.7. Establish data for Primula, Rhododendrons, Ferns, Mushrooms, Bamboos and Alpine plants).

2.2.8. Conduct long-term monitoring of alpine grasslands, taking climate change as a major parameter.

2.2.9. Conduct studies on important plant species such as Paphiopedilum spp, Cycas pectinata, Cupressus corneyana, Paris polyphylla, Neopicorrhiza sp., etc., taking climate change as a mojor parameter.

Objective 3: To manage and improve wildlife habitats

3.1. Enhance wildlife habitat management interventions

3.1.1. Improve the alpine grasslands in Black Mountain region for wild ungulates and livestock, as an adaptation to climate change adversity.

3.1.2. Improve waterholes and mineral licks as per the Habitat management guidelines of Bhutan.

3.1.3. Conduct enrichment plantations (food and shelter) in the degraded wildlife habitats, as an adaptation to climate change adversity.

3.1.4. Monitor and protect critical wildlife habitats (breeding/nesting/roosting/feeding sites), movement corridors and migratory routes.

3.2. Prevent and manage forest fires

3.2.1. Train staff and communities on forest fire fighting and management.

3.2.2. Equip with forest fire fighting tools and safety equipment.

3.2.3. Create forest fire awareness to the communities residing in fire risk zones.

3.2.4. Create community volunteer groups in forest-fire prone areas, provide training and engage them in forest fire fighting.

3.2.5. Manage fuel load (prescribed burning) to protect the critically threatened plant communities in the fire prone zones.

3.3. Invasive species management

3.3.1. Contain invasive plant species in critical habitat adopting relevant control measures with technical guidance from NBC, as an adaptation to climate change adversity.

3.3.2. Conduct studies on Invasive plant species in collaboration with NBC (IAPS diversity, distribution and habitat prediction modelling of majot IAPs of the park to understand their spreading potential in near future under the current climate change scenario).

3.3.3. Create awareness on impacts of invasive species and engage local communities in its management.

3.4. Waste Management

3.4.1. Organize mass cleaning campaign in collaboration with local communities and other stakeholders.

3.4.2. Initiate community-based waste management programs based on the principles of 4R (Refuse, Reduce, Reuse, Recycle) Monitor and regulate waste disposal within national park.

3.4.3. Initiate innovative waste management based on the principle of 4R (refuse, reduce, reuse and recycle).

Objective 4: To ensure sustainable management of natural resources

4.1. Strengthen Community Forests (CF) management

4.1.1. Review and revise CF management plans.

4.1.2. Provide training on CF record keeping and management.

4.1.3. Encourage growing NWFP inside CF.

4.1.4. Explore market for sale of NWFP and NWFP-products.

4.1.5. Explore and promote ecotourism and recreational activities inside CF.

4.1.6. Conduct regular monitoring of the CF management groups.

4.2. Implement Local Forest Management Plan (LFMP)

4.2.1. Train all field offices on LFMP implementation and record keepin

4.2.2. Allocate rural timber and firewood based on the LFMP prescription.

4.2.3. Carry out plantation in the degraded areas identified in the LFMP.

4.3. Promote community based NWFP management

4.3.1. Strengthen existing NWFP management groups (training on product development and marketing) and institute new groups in potential sites.

4.3.2. Construct collection centers for MYST (NWFP-management group of Jangbi) and renovate the collection center of RNTT (NWFP-management group of Rukha).

4.3.3. Conduct regular monitoring of the NWFP management groups.

4.3.4. Review and revise NWFP management plans.

4.4. Ensure efficient public service delivery

4.4.1. Ensure efficient and timely RNR service delivery.

4.4.2. Inspect, review and issue forestry clearance for developmental activities as per the TAT communicated by the department.

4.4.3. Adopt paper-less office policies and speed up application processing, taking advantage of internet and online services.

4.5. Initiate soil conservation works

4.5.1. Implement bioengineering measures in the landslide and eroded areas (eg. Wangling, Nabji and Korphu).

4.5.2. Implement river bank protection works (eg. Adha, Reeti, Taksha and Nabji).

4.5.3. Carry out landslide stabilization works below staff quarters at the park headquarter.

Objective 5: To ensure harmonious coexistence of local communities and national park

5.1. Support HWC mitigation measures

5.1.1. Upscale effective HWC mitigation measures (eg. electric fencing/ live fencing/ chain-link fencing, barbed wire fencing, stone wall, etc.).

5.1.2. Institute compensation and insurance schemes for livestock loss and crop damage by wild animals.

5.1.3. Explore agriculture intensification and livestock intensification programme to offset crop and livestock loss.

5.1.4. Validate the HWC hotspot areas in the park.

5.1.5. Provide training to deal with HWCs, conflict verification and resolution.

5.2. Promote ecotourism and rural enterprise

5.2.1. Revive Nabji-Korphu eco-trail and functionalize Adha-Rukha eco-trail.

5.2.2. Explore feasibility and establish new eco-trails (Phobjikha-Adha, Nimshong-Berti and Nabji-Reeti).

5.2.3. Develop capacity of eco-tourism management committee (training on hospitality and campsite management).

5.2.4. Promote home stays, local culture and heritage.

5.2.5. Revive Tamala lake and develop the site into a tourism destination, with effective business model.

5.2.6. Develop ecoutorism packages and promotional materials Promote cottage and small industries (handicrafts, furniture, food processing and packaging units such as local pickle and fish drying).

5.3. Initiate other innovative integrated conservation and development interventions

5.3.1. Promote energy efficient appliances to reduce pressure on forest.

5.3.2. Promote and support alternative energy sources (biogas and solar technology) for the park residents.

5.3.3. Support yak herding community of Black Mountain region to curb poaching and other illegal activities in the region.

Objective 6: To strengthen institutional and technical capacity

6.1. Strengthen infrastructure, equipment and mobility

6.1.1. Construct staff quarters at Nabji and Langthel.

6.1.2. Renovate offices at the headquarter and all range offices.

6.1.3. Procure adequate equipment (computers, printers, furniture, patrolling equipment, safety gears, field gears).

6.1.4. Procure pool vehicle for the headquarter and motorbikes for all range offices.

6.2. Develop capacity of staff and local communities

6.2.1. Conduct refresher training (SMART patrolling, uniform, arms handling and drill, FIRMS, G2C Services, wildlife rescue and rehabilitation).

6.2.2. Train staff on species identification and taxonomy.

6.2.3. Train staff on wildlife research (study design, data analysis and reporting).

6.2.4. Train staff on GIS and remote sensing.

6.3. Ensure effectiveness of protected area management

6.3.1. Carry out regular Bhutan METT+ assessment of the park

6.3.2. Carry out timely evaluation of this plan implementation (mid-term evaluation by end of 5th year and final evaluation during the last year of the plan implementation).

6.3.3. Carry out works for the revision of this management plan (RBS, SES and LFMP) in the last year of the plan period.

An alpine scree in Black Mountain


Jeddah Tsho/Getsa Tsho

PART 6: IMPLEMENTATION PLAN AND FINANCIAL OUTLAY

This management plan will be implemented for ten years, from January, 2022 to December, 2031. The implementation plan for the ten years was developed as per the Code of Best Management Practices - Forests and Nature Conservation of Bhutan 2020 (vol. 4) implementation framework, with year-wise implementation plan and cost estimate for each activity. The management plan is highly adaptive in nature and this implementation plan can be re-aligned based on the emerging challenges and opportunities during the plan period. An Annual Operational Work Plan will be prepared and linked with Annual Performance Appraisal (APA) and Monitoring Framework to help achieve this dynamism and evaluate/scored based on APA criteria annually.

Since the Bhutan for Life (BFL) program is the main funding source for this plan implementation, the financial outlay has been primarily based on the BFL's financial model. Similarly, the 12th five-year plan (FYP) outlay of DoFPS has been referred to prepare this financial outlay.

Objectives	Strategies	Actions	Year along with budget (in Million Nu.)										Activity Total
			Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	
Objective 1: To strengthen protection of wildlife and forest resources	1.1. Implement zero poaching strategy	1.1.1. Strengthen and conduct SMART patrolling.	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	**15**
		1.1.2. Carry out hotspot mapping of poaching and other illegal activities in the park.	0	0.3	0.3	0	0	0	0	0	0	0	**0.6**
		1.1.3. Form community conservation groups (Risoops) for threatened species.	0.25	0	0.25	0	0.25	0	0.15	0	0.15	0	**1.05**
		1.1.4. Start river rangers programme to patrol river stretches using rafts.	0	0	0.5	1.5	0.25	0	0	0	0	0	**2.25**
	1.2. Strengthen surveillance and prevention of pest and diseases	1.2.1. Carry out regular and opportunistic inspection of pest and disease outbreak.	0	0.5	0.25	0	0.25	0	0.25	0	0.25	0	**1.5**
		1.2.2. Collaborate with DoL to carry out regular and opportunistic inspection of disease outbreak in livestock.	0.5	0.25	0	0.25	0	0.25	0	0.25	0	0.25	**1.75**
		1.2.3. Conduct education and awareness campaigns on wildlife pest and diseases.	0	0	0.3	0	0.2	0	0.2	0	0.2	0	**0.9**
	1.3. Increase conservation education and awareness	1.3.1. Develop and functionalize visitor information center at the park headquarter.	0.25	0.3	0.3	0	0	0.2	0	0	0.3	0	**1.35**
		1.3.2. Conduct regular conservation awareness programs in schools and communities in and around the park.	0	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0	**1.6**
		1.3.3. Develop and install conservation messages (sign-boards and posters) at strategic locations in and around the park.	0	0.5	0.2	0.2	0.2	0.2	0	0	0.5	0	**1.8**
		1.3.4. Develop conservation awareness materials (audiovisuals/ signages/ publications).	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	**1.5**

Objective 2: To strengthen wildlife monitoring and research	**2.1. Carry out survey and regular monitoring of wildlife**	2.1.1. Conduct periodic tiger survey as part of the national tiger survey.	1	0	0	0	0	1	0	0	0	0	**2**
		2.1.2. Carry out regular monitoring of tigers in the biodiversity monitoring grids in the national park.	0	0.35	0.35	0.35	0.35	0	0.35	0.35	0.35	0.35	**2.8**
		2.1.3. Conduct periodic forest inventory as part of national forest inventory.	1.65	0	0	0	0	0	0	0	0	2	**3.65**
		2.1.4. Conduct periodic snow leopard survey as part of National Snow Leopard Survey.	0.5	0	0	0	0	0.5	0	0	0	0	**1**
		2.1.5. Conduct periodic biodiversity monitoring (monitoring of focal species, endangered and endemic species in the park).	0	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	**1.8**
		2.1.6. Develop Citizen science programmes, provide training and engage them to gather biodiversity data.	0.2	0.4	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	**1.5**
	2.2. Conduct species and ecological research.	2.2.1. Carry out climate vulnerability and capacity assessment of the park residents.	0.2	0	0	0	0.2	0	0	0	0	0.2	**0.6**
		2.2.2. Conduct study on Red Panda (distribution and conservation threats).	0	0	0	0	0	0	0	0.5	0	0	**0.5**
		2.2.3. Conduct study on Musk deer (Population status, density, distribution and conservation threats).	0	0.75	0	0	0	0	0.5	0	0	0	**1.25**
		2.2.4. Conduct studies on other threatened species (Gaur, Golden langur, Hornbill, White-bellied heron, Bear).	0	0	0.3	0.3	0.3	0.3	0.3	0	0	0	**1.5**
		2.2.5. Conduct detailed survey of Fish diversity and distribution in the park.	0	0.35	0	0	0	0	0	0	0	0	**0.35**
		2.2.6. Conduct baseline studies for insects (Bees and wasps; Dragonflies and damselflies; Beetles; Ants) and freshwater macroinvertebrates.	0.1	0.25	0.25	0.25	0.25	0.25	0	0	0	0	**1.35**
		2.2.7. Establish data for Primula, Rhododendrons, Ferns, Mushrooms, Bamboos and Alpine plants).	0	0.3	0.3	0.3	0.2	0.2	0.2	0	0	0	**1.5**
		2.2.8. Conduct long-term monitoring of alpine grasslands.	0.3	0.3	0.3	0.15	0	0	0	0	0	0	**1.05**
		2.2.9. Conduct studies on important plant species such as Paphiopedilum spp, Cycas pectinata, Cupressus corneyana, Paris polyphylla, Neopicorrhiza sp., etc.	0	0	0.35	0.35	0.35	0.35	0.35	0	0	0	**1.75**
Objective 3: To manage and improve wildlife habitats	**3.1. Enhance wildlife habitat management interventions**	3.1.1. Improve the alpine grasslands in Black Mountain region for wild ungulates and livestock.	0.35	0.35	0.35	0	0	0.35	0	0	0.35	0	**1.75**
		3.1.4. Improve mineral licks and waterholes.	0.4	0.4	0.4	0.15	0.15	0.15	0.15	0.15	0.15	0.15	**2.25**
		3.1.5. Carry out enrichment plantations (food and shelter) in the degraded wildlife habitats.	0	0	0	0.5	0.5	0.5	0	0	0	0	**1.5**
		3.1.6. Monitor and protect critical wildlife habitats (breeding/nesting/roosting/feeding sites), movement corridors and migratory routes outside the core zone.	0	0.15	0	0.15	0	0.15	0	0.15	0	0	**0.6**

Objective 3: To manage and improve wildlife habitats	**3.2. Prevent and manage forest fires**	3.2.1. Train staff and communities on forest fire fighting and management.	0	0.2	0.2	0	0.2	0	0.2	0	0.2	0	**1**
		3.2.2. Equip forest fire fighting tools and safety equipment.	0	0	0.5	0.5	0	0	0	0	0	0	**1**
		3.2.3. Create forest fire awareness to the communities residing in fire risk zones.	0.05	0.1	0	0.1	0	0.1	0	0.1	0	0.1	**0.55**
		3.2.4. Create community volunteer groups in forest-fire prone areas, provide training and engage them in forest fire fighting.	0	0	0.2	1	0.2	0	0	0	0	0	**1.4**
		3.2.5. Manage fuel load (prescribed burning) to protect the critically threatened plant communities in the fire prone zones.	0	0	0.5	0	0.5	0	0.5	0	0.5	0	**2**
	3.3. Invasive species management	3.3.1. Contain invasive species in critical habitats.	0	0.5	0.5	0.25	0.25	0.25	0.25	0.25	0.25	0.25	**2.75**
		3.3.2. Conduct studies on Invasive plant species in collaboration with NBC (IAPS diversity, distribution and habitat prediction modelling of majot IAPs of the park to understand their spreading potential in near future under the current climate change scenario).	0	0.35	0.35	0.35	0	0	0	0	0	0	**1.05**
		3.3.3. Create awareness on impacts of invasive species to the local communities	0	0	0	0	0.25	0.25	0	0	0	0	**0.5**
	3.4. Waste Management	3.4.1. Organize mass cleaning campaign in collaboration with local communities and other stakeholders.	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	**1**
		3.4.2. Initiate community-based waste management programs based on the principles of 4R (Refuse, Reduce, Reuse, Recycle).	0	0.25	0.25	0.25	0.25	0.25	0	0	0	0	**1.25**
		3.4.3. Monitor and regulate waste disposal within national park.	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	**0.5**
Objective 4: To ensure sustainable management of natural resources	**4.1. Strengthen Community Forests (CF) management**	4.1.1. Review and revise CF management plans.	0	0.2	0	0.4	0.4	0.4	0.2	0.2	0.6	0.4	**2.8**
		4.1.2. Provide training on CF record keeping and management and product development.	0	0.35	0	0	0.35	0	0	0.35	0	0	**1.05**
		4.1.3. Encourage growing NWFP inside CF.	0	0	0.2	0.2	0	0	0	0	0	0	**0.4**
		4.1.4. Explore market for sale of NWFP and NWFP-products.	0	0.15	0.15	0.15	0	0	0	0	0	0	**0.45**
		4.1.5. Explore and promote ecotourism and recreational activities inside CF.	0	0	0.5	0	0.5	0	0.5	0	0.5	0	**2**
		4.1.6. Conduct regular monitoring of the CF management groups.	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	**1**
	4.2. Implement Local Forest Management Plan (LFMP)	4.2.1. Train all field offices on LFMP implementation and record-keeping	0.2	0	0	0.2	0	0	0	0.2	0	0	**0.6**
		4.2.2. Allocate rural timber and firewood based on the LFMP prescription.	0	0	0	0	0	0	0	0	0	0	**0**
		4.2.3. Carry out plantation in the areas identified in the LFMP.	0	0.25	0	0.25	0	0.25	0	0.25	0	0.25	**1.25**

Objective 4: To ensure sustainable management of natural resources	**4.3. Promote community based NWFP management**	4.3.1. Strengthen existing NWFP management groups (training on product development and marketing) and institute new groups in potential sites.	0.15	0.2	0.15	0.2	0.15	0.2	0.15	0.15	0.15	0.15	**1.65**
		4.3.2. Construct collection centers for MYST (NWFP-management group of Jangbi) and renovate the collection center of RNTT (NW-FP-management group of Rukha).	1.5	0	0	0	0	0	0	0	0	0	**1.5**
		4.3.3. Conduct regular monitoring of the NWFP management groups.	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.4	0.4	0.4	**2.8**
		4.3.4. Review and revise NWFP management plans.	0.15	0	0	0	0.2	0.2	0.2	0	0	0.4	**1.15**
	4.4. Ensure efficient public service delivery	4.4.1. Ensure efficient and timely RNR service delivery.	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	**2**
		4.4.2. Inspect, review and issue forestry clearance for developmental activities as per the turnover time.	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	**1.5**
		4.4.3. Adopt paper-less office policies and speed up application processing, taking advantage of internet and online services.	0	0	0	0	0	0	0	0	0	0	**0**
	4.5. Initiate soil conservation works	4.5.1. Implement bioengineering measures in the landslide and eroded areas (eg. Wangling, Nabji and Korphu).	0	1.5	1.5	0	0	0	0	0	0	0	**3**
		4.5.2. Implement river bank protection works (eg. Adha, Reeti, Taksha and Nabji).	0.8	0.8	0.8	0.8	0.8	0	0	0	0	0	**4**
Objective 5: To ensure harmonious coexistence of local communities and national park	**5.1. Support HWC mitigation measures**	5.1.1. Upscale effective HWC mitigation measures (eg. electric fencing/ live fencing/ chain-link fencing, barbed wire fencing, stone wall, etc.).	0.5	1	1	0	0.5	0	0	0.5	0.5	0	**4**
		5.1.2. Institute compensation and insurance schemes for livestock loss and crop damage by wild animals.	0.7	0.7	0.7	0.7	0.7	0.25	0.25	0.25	0.25	0.25	**4.75**
		5.1.3. Explore agriculture intensification and livestock intensification programme to offset crop and livestock loss.	0	1	0.5	0.5	0.5	0.5	0.5	0.5	1	0	**5**
		5.1.4. Validation HWC hotspot areas in the park.	0	0	0	0	0.2	0	0	0	0	0.2	**0.4**
		5.1.5. Provide training to deal with HWCs, conflict verification and resolution.	0	0.1	0	0.1	0	0.1	0	0.1	0	0.1	**0.5**
	5.2. Promote eco-tourism and rural enterprise	5.2.1. Revive Nabji-Korphu eco-trail and functionalize Adha-Rukha eco-trail.	0	0	0	0.75	1	1	0.75	0	0	0	**3.5**
		5.2.2. Explore feasibility and establish new eco-trails (Phobjikha-Adha, Nimshong-Berti and Nabji-Reeti).	0	0	0	0	0.5	0.5	0.5	0.5	0.5	0.5	**3**
		5.2.3. Develop capacity of eco-tourism management committee (training on hospitality and campsite management).	0	0.2	0.2	0	0.2	0	0.2	0	0.2	0	**1**
		5.2.4. Promote home stays, local culture and heritage.	0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	**0.9**
		5.2.5. Revive Tamala lake and develop the site into a tourism destination, with effective business model.	0.5	1	0.5	0.5	0	0.5	0	0	0	0	**3**
		5.2.6. Promote cottage and small industries (handicrafts, furniture, food processing and packaging units such as local pickle and fish drying).	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	**2.5**

Objective 5: To ensure harmonious coexistence of local communities and national park	**5.3. Initiate other innovative integrated conservation and development interventions.**	5.3.1. Promote energy efficient appliances to reduce pressure on forest	0	0.5	0.5	0.5	0.2	0.2	0.2	0	0	0	**2.1**
		5.3.2. Promote and support alternative energy sources (biogas and solar technology) for the park residents.	0	0	0.5	0.5	0	0	0	0.5	0.5	0.5	**2.5**
		5.3.3. Support yak herding community of Black Mountain to encourage them to check illegal activities in the region by outsiders.	0	0.5	0.5	0.5	0.5	0.5	0.5	0	0	0	**3**
Objective 6: To strengthen institutional and technical capacity	**6.1. Strengthen infrastructure, equipment and mobility**	6.1.1. Construct staff quarters at Nabji and Langthel.	0	0	4.55	0	0	4.55	0	0	0	0	**9.1**
		6.1.2. Renovate offices at the headquarter and all range offices.	0	1.2	0.7	0.7	0.7	0.7	0.5	0.5	0.5	0.5	**6**
		6.1.3. Procure adequate equipment (computers, printers, furniture, patrolling equipment, safety gears, field gears).	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	**5.5**
		6.1.4. Procure pool vehicle for the headquarter and motorbikes for all range offices.	2.38	0	0.28	0	0.49	0.49	0.49	0.49	0.49	0.49	**5.6**
	6.2. Develop capacity of staff and local communities	6.2.1. Conduct refresher training (SMART patrolling, uniform, arms handling and drill, FIRMS, G2C Services, wildlife rescue and rehabilitation).	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	**5**
		6.2.2. Train staff on species identification and taxonomy.	0.35	0.35	0.35	0	0	0	0	0	0	0	**1.05**
		6.2.3. Train staff on wildlife research (study design, data analysis and reporting).	0	0	0	0	0	0.35	0.35	0.35	0.35	0.35	**1.75**
		6.2.4. Train staff on GIS and remote sensing.		0	0	0.35	0.35	0	0	0	0	0	**0.7**
	6.3. Ensure effectiveness of protected area management	6.3.1. Carry out Bhutan METT+ assessment of the park.	0.25	0	0	0	0	0.25	0	0	0	0.25	**0.75**
		6.3.2. Carry out timely evaluation of this plan implementation (mid-term evaluation by end of 5th year and final evaluation during the last year of the plan implementation).	0	0	0	0	0.35	0	0	0	0	0.35	**0.7**
		6.3.3. Carry out works for the revision of this management plan (RBS, SES and LFMP) in the last year of the plan period.	0	0	0	0	0	0	0	0	0	2	**2**
TOTAL			**16.83**	**21.45**	**25.18**	**18.5**	**18.09**	**20.59**	**13.19**	**11.09**	**13.24**	**14.29**	**172.45**

Figure 39: Implementation plan and Financial outlay of the Management Plan

Yuem Tsho, the Emerald lake

PART 7: MONITORING AND EVALUATION

Monitoring of each conservation activities during the time of activity implementation and evaluation after the completion of each activity is the main step towards effective fulfillment of the conservation goals and objectives. A realistic monitoring and evaluation plan for this management plan is prepared as per the Code of Best Management Practices - Forests and Nature Conservation of Bhutan 2020 (Vol. 4) (DoFPS, 2020), highlighting the baseline from which each activity will be picked up from, the output indicators, and year-wise target for each activity. The Park, as the lead implementor of the activities will be responsible for yearly monitoring and evaluation for the implementation of these activities.

Objectives	Action	Output Indicators	Baseline	Unit	Yearly Target										Remarks
					Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	
Objective 1: To strengthen protection of wildlife and forest resources	1.1. Implement zero poaching strategy														
	1.1.1. Strengthen and conduct SMART patrolling.	Patrolling effort increased	6800	KM	7000	8000	9000	10000	10000	10000	10000	10000	10000	10000	Regular SMART patrolling
	1.1.2. Carry out hotspot mapping of poaching and other illegal activities in the park.	Wildlife offence hotspots identified and mapped.	Nil	% of work completion	0	100			Revalidation						
	1.1.3. Form community conservation groups (Risoops) for threatened species.	Community patrolling groups formed	1	Nos. (cumulative)	1		2		3		4		5		Zizi, Ramachen, Langthel, Nabji, Tingtibi, Taksha
	1.1.4. Start river rangers programme to patrol river stretches using rafts.	No. of ranges implementing the program	0	No (Ranges)			1	2							Tingtibi
	1.2. Strengthen surveillance and prevention of pest and diseases														
	1.2.1. Carry out regular and opportunistic inspection of pest and disease outbreak.	Forest pest and diseases prevented	Nil	Nos of inspections		2	1		1		1		1		
	1.2.2. Collaborate with DoL to carry out regular and opportunistic inspection of disease outbreak in livestock.	Livestock pest and diseases kept under control	Nil	Nos of inspections	2	1		1		1		1		1	
	1.2.3. Conduct education and awareness campaigns on wildlife pest and diseases.	Awareness on wildlife pest and diseases spread	Nil	Nos.			1		2		3		4		

Objective 1: To strengthen protection of wildlife and forest resources	1.3. Increase conservation education and awareness														
	1.3.1. Develop and functionalize visitor information center at the park headquarter.	VICfunctional and cater to visitors	Nil	Year			Functionalize								Functionalizein Yr. 3 and upgrade if necessary.
	1.3.2. Conduct regular conservation awareness programs in schools and communities in and around the park.	Students and communities aware of conservation importance	2	Nos. of programs		2	2	2	2	2	2	2	2		
	1.3.3. Develop and install conservation messages (sign-boards and posters) at strategic locations in and around the park.	Sign boards and posters installed in all strategic locations	Nil	Nos of locations		5	2	2	2	2			7 (renovate)		
	1.3.4. Develop conservation awareness materials (audiovisuals/ signages/ publications).	Conservation materials developed and publicized	1	Nos.	5	2	2	2	2	2	2	2	2	2	
Objective 2: To strengthen wildlife monitoring and research	2.1. Carry out survey and regular monitoring of wildlife														
	2.1.1. Conduct periodic tiger survey as part of the national tiger survey.	NTS completed successfully in the park	65	Nos. of grids	57					65				65	08 grids completed within 2021.
	2.1.2. Carry out regular monitoring of tigers in the biodiversity monitoring grids in the national park.	Regular tiger monitoring carried out	45	Nos. of grids		20	20	20	20		20	20	20		5 grids in each range
	2.1.3. Conduct periodic forest inventory as part of national forest inventory.	NFI completed successfully in the park	108	Nos. of grids	54									108	54 completed within 2021.
	2.1.4. Conduct periodic snow leopard survey as part of National Snow Leopard Survey.	Periodic NSLS conducted in the park	Nil	No of survey	1					1					
	2.1.5. Conduct periodic biodiversity monitoring (monitoring of focal species, endangered and endemic species in the park).	Biodiversity monitoring conducted in Biodicersity Monitoring Grids (BMG)	45	No of BMG		6	6	6	6	6	6	6	6		1 grid in each range
	2.1.6. Develop Citizen science programmes, provide training and engage them to gather biodiversity data.	Community scientist groups formed in different parts of the park	1 (Reeti)	No of groups formed	1	2	1								1 in each range
	2.2. Conduct species and ecological researches														
	2.2.1. Carry out climate vulnerability and capacity assessment of the park residents.	CVCA carried out every 5 years	0	Nos.	1				1					1	
	2.2.2. Conduct study on Red Panda (distribution and conservation threats).	The study conducted and published	1	No of studies			1					1			
	2.2.3. Conduct study on Musk deer (Population status, density, distribution and conservation threats).	The study conducted and published	1	No of studies		1					1				

Objective 2: To strengthen wildlife monitoring and research	2.2.4. Conduct studies on other threatened species (Gaur, Golden langur, Hornbill, White-bellied heron, Bear).	The study conducted and published	2	No of species			1	1	1	1	1				
	2.2.5. Conduct detailed survey of Fish diversity and distribution in the park.	The study conducted and published	0	No of studies		1									
	2.2.6. Conduct baseline studies for insects (Bees and wasps; Dragon-flies and damselflies; Beetles; Ants) and freshwater macroinvertebrates.	The study conducted and published	1	No of species	1	1	1	1	1	1					
	2.2.7. Establish data for Primula, Rhododendrons, Ferns, Mushrooms, Bamboos and Alpine plants).	The baseline data compiled	0	No of species		1	1	1	1	1	1				This can be compiled from RBS data
	2.2.8. Conduct long-term monitoring of alpine grasslands.	By 4th year, complete the study and publish the reports	0	% of work comple-tion	25	50	75	100							
	2.2.9. Conduct studies on important plant species such as Paphiopedi-lum spp, Cycas pectinata, Cupres-sus corneyana, Paris polyphylla, Neopicorrhiza sp., etc.	Research studies on important plant species completed	0	No of species			1	1	1	1	1				
Objective 3: To manage and improve wildlife habitats	3.1. Enhance wildlife habitat management interventions														
	3.1.1. Improve the alpine grasslands in Black Mountain region for wild ungulates and livestock.	Alpine grasslands improved	18	Hectares	12	15	15	15		15			15		Yakchu, Jari-Busa, Maniting
	3.1.2. Improve mineral licks and waterholes.	Waterholes improved for wildlife	8	Nos.	10	10	10	5	5	5	5	5	5	5	
	3.1.3. Carry out enrichment plantations (food and shelter) in the degraded wildlife habitats.	Plantations carried out in degraded wildlife habitats	0	Hectares				5	5	5	5	5	5	5	
	3.1.4. Monitor and protect critical wildlife habitats (breeding/nesting/ roosting/feeding sites), movement corridors and migratory routes.	Critical habitats identi-fied and protected	0	Nos of sites		1		1		1		1			
	3.2. Prevent and manage forest fires														
	3.2.1. Train staff and communities on forest fire fighting and manage-ment.	Staff and fire-prone communities trained	1	No of trainings		1	1	1	1	1	1	1	1	1	YTaksha and Langthel
	3.2.2. Equip forest fire fighting tools and safety equipment.	Necessary tools and equipment supplied	Nil	Timeline				2025							

Objective 3: To manage and improve wildlife habitats	3.2.3. Create forest fire awareness to the communities residing in fire risk zones.	Awareness on forest fire spread to communities	1	No of awareness programs	2	2		2		2		22		7	
	3.2.4. Create community volunteer groups in forest-fire prone areas, provide training and engage them in forest fire fighting.	Community volunter groups created in Taksha and Langthel	1	No of groups			1	1	1						
	3.2.5. Manage fuel load (prescribed burning) to protect the critically threatened plant communities in the fire prone zones.	Fuel loads in hazard-prone areas managed	Nil	No of sites			2		2		2		2		
	3.3. Invasive species management														
	3.3.1. Contain invasive species in critical habitats.	Invasive species removal carried out in infested areas	Nil	Hectares	10	10	5	5	5	5	5	5	5	5	
	3.3.2. Conduct studies on Invasive plant species in collaboration with NBC (IAPS diversity, distribution and habitat prediction modelling of majot IAPs of the park to understand their spreading potential in near future under the current climate change scenario).	Studies completed and published	1	Nos of studies		1	1	1							
	3.3.3. Create awareness on impacts of invasive species to the local communities	Awareness on Invasive species spread	0	No of Programs					5	5					
	3.4. Waste Management														
	3.4.1. Organize mass cleaning campaign in collaboration with local communities and other stakeholders.	Cleaning campaigns conducted involving all stakeholders	3	No of campaigns	1	1	1	1	1	1	1	1	1	1	
	3.4.2. Initiate community-based waste management programs based on the principles of 4R (Refuse, Reduce, Reuse, Recycle).	Waste management programs initiated in communities	0	No of Communities		1	1	1	1	1					Product development using waste; recycling and Reuse.
	3.4.3. Monitor and regulate waste disposal within national park.	waste disposal monitored and regulated	0	No of Monitoring	5	5	5	5	5	5	5	5	5	5	

Objective 4: To ensure sustainable management of natural resources	4.1. Strengthen Community Forests (CF) management														
	4.1.1. Review and revise CF management plans.	CFMPs reviewed and revised on time	17	Nos.		1		2	2	2	1	1	3	2	As per SFES record.
	4.1.2. Provide training on CF record keeping and management and product development.	CF record keeping trainings provided to the CF member	1	Nos. of CF groups trained		5		5		5		5			As per SFES record and need assessment.
	4.1.3. Encourage growing NWFP inside CF.	Growing of NWFP in CFs initiated	Nil	Nos of CFMGs covered				3	3						
	4.1.4. Explore market for sale of NWFP and NWFP-products.	Maarket for timber and NWFP export linked	1 (Samthang)	No of market linked		1	1	1							
	4.1.5. Explore and promote eco-tourism and recreational activities inside CF.	Eco-tourism activities initiated in CFs	Nil	No of CF covered			1		1		1		1		
	4.1.6. Conduct regular monitoring of the CF management groups.	All CFMGs monitored once every year	17	No of CFs covered	17	17	17	17	17	17	17	17	17	17	Yearly monitoring
	4.2. Implement Local Forest Management Plan (LFMP)														
	4.2.1. Train all field offices on LFMP implementation and record-keeping	Field staff trained on LFMP implementation	Nil	No of field offices	6			6 (refresher)				6 (refresher)			
	4.2.2. Allocate rural timber and firewood based on the LFMP prescription.	Rural allocations made strictly based on LFMP	Nil	No of gewogs covered	7	7	7	7	7	7	7	7	7	7	
	4.2.3. Carry out plantation in the areas identified in the LFMP.	Plantations carried out in identified areas	Nil	Hectares		5		5		5		5		5	
	4.3. Promote community based NWFP management														
	4.3.1. Strengthen existing NWFP management groups (training on product development and marketing) and institute new groups in potential sites.	NWFP management groups strengthened	2	No of NWFP grpups (cumulative)	Train existing groups	3 (create 1 new)	Train existing groups	4 (create 1 new)	Train existing groups	5 (create 1 new)	Train existing groups	Train existing groups	Train existing groups	Train existing groups	
	4.3.2. Construct collection centers for MYST (NWFP-management group of Jangbi) and renovate the collection center of RNTT (NWFP-management group of Rukha).	NWFP collection centers established	1	No s	1 new; 1 renovation										
	4.3.3. Conduct regular monitoring of the NWFP management groups.	NWFP management groups monitored annually	2	No of groups monitored.	2	2	3	3	4	4	5	5	5	5	

Objective 4: To ensure sustainable management of natural resources	4.3.4. Review and revise NWFP management plans.	NWFP plans revised on time	2	Number revised	1				1	1	1			2	
	4.4. Ensure efficient public service delivery														
	4.4.1. Ensure efficient and timely RNR service delivery.	Efficient public service delivered	2 weeks	TAT (No. of weeks)	1	1	1	1	1	1	1	1	1	1	
	4.4.2. Inspect, review and issue forestry clearance for developmental activities as per the turnover time.	Efficient public service delivered	1 weeks	TAT (No. of weeks)	1	1	1	1	1	1	1	1	1	1	
	4.4.3. Adopt paper-less office policies and speed up application processing, taking advantage of internet and online services.	Paper-less office policies adopted	40 rims	No of paper rims	35	30	25	20	15	10	5	5	5	5	in 2021 40 rims were uuse by JSWNP.
	4.5. Initiate soil conservation works														
	4.5.1. Implement bioengineering measures in the landslide and eroded areas (eg. Wangling, Nabji and Korphu).	Degraded watershed areas mitigation measures adopted	Nil	No of sites		1	2								
	4.5.2. Implement river bank protection works (eg. Adha, Reeti, Taksha and Nabji).	Riverbank protection works adopted in erosion prone areas	1 (Adha)	No of sites	1	1	1	1	1						Reeti, Chendebji, Athang, Taksha
Objective 5: To ensure harmonious coexistence of local communities and national park	5.1. Support HWC mitigation measures														
	5.1.1. Upscale effective HWC mitigation measures (eg. electric fencing/ live fencing/ chain-link fencing, barbed wire fencing, stone wall, etc.).	Communities supported with HWC mitigation measures	5	No of communities	5	5	2	2	2	2	2	2	2	2	
	5.1.2. Institute compensation and insurance schemes for livestock loss and crop damage by wild animals.	Livestock and crop compensation schemes adopted	Nil	No of communities		1	1	1	1	1					Led by BTC
	5.1.3. Explore agriculture intensification and livestock intensification programme to offset crop and livestock loss.	Agriculture and livestock intensification programs adopted in collaboration with DoA and DoL.	3	No of communities		4	2	2	2	2	2	2	4	2	
	5.1.4. Reassessment of HWC hotspot areas in the park.	HWC hotspots in the park validated at regular intervals.	1	No. of validations				1					1		
	5.1.5. Provide training to deal with HWCs, conflict verification and resolution.	All field offices trained on HWC management	Nil	No of field offices		6		6		6		6		6	

Objective 5: To ensure harmonious coexistence of local communities and national park	5.2. Promote ecotourism and rural enterprise													
	5.2.1. Revive Nabji-Korphu eco-trail and functionalize Adha-Rukha eco-trail.	The trail revived and functionalized	Nil	No. of facilities developed				3	4	4	3				
	5.2.2. Explore feasibility and establish new eco-trails (Phobjikha-Adha, Nimshong-Berti and Nabji-Reeti).	The ancient trails opened for eco-tourism	1 (nabji-korphu)	No of eco-trails identified					1	1	1	1	1	1	Through assessment of previous failure to be conducted; New activity to focus on developing sites instead of creating infrastructure.
	5.2.3. Develop capacity of eco-tourism management committee (training on hospitality and campsite management).	The eco-tourism management committees trained	1 (cook's training, Jangbi)	No of trainings		1	1	1	1	1	1	1	1	1	
	5.2.4. Promote home stays, local culture and heritage.	home-stays and local culture promoted	Nil	No of home-stays		2	2	2	2	2	2	2	2	2	
	5.2.5. Revive Tamala lake and develop the site into a tourism destination, with effective business model.	Tamala lake developed into tourism destination	Nil.	% of development works	25	50	75	85	95	100					
	5.2.6. Promote cottage and small industries (handicrafts, furniture, food processing and packaging units such as local pickle and fish drying).	CSI promoted through eco-tourism activities and marketing	2 (Lawa-Lamga and Jangbi handicraft)	No of goods promoted		2	2	2	2	2	2	2	2	2	
	5.3. Initiate other innovative integrated conservation and development interventions													
	5.3.1. Promote energy efficient appliances to reduce pressure on forest	Energy efficient appliances adopted	3	No of communities		2	2	2	1	1	1	1	1	1	
	5.3.2. Promote and support alternative energy sources (biogas and solar technology) for the park residents.	Biogas and solar technologies adopted by remote and needy communities	8 (Rukha)	No of communities			1	1				2	2	2	
	5.3.3. Support yak herding community of Black Mountain to encourage them to check illegal activities in the region by outsiders.	Support of roofing materials and access to drinking water given in all yak herding areas.	1 (Jari-Busa)	No (locations)		1	1	1	1	1	1				

Objective 6: To strengthen institutional and technical capacity	6.1. Strengthen infrastructure, equipment and mobility														
	6.1.1. Construct staff quarters at Nabji and Langthel.	Staff quarters constructed	2 (Taksha & Tingtibi)	No of quarters			1 (Nabji)			1 (Langthel)					As per BFL's plan outlay.
	6.1.2. Renovate offices at the headquarter and all range offices.	Old infrastructure renovated on time	1 (Langthel)	No of structures		2	1	1	1	1	1	1	1	1	
	6.1.3. Procure adequate equipment (computers, printers, furniture, patrolling equipment, safety gears, field gears).	Office equipment and field gears adequately procured and utilized	over 50% coverage (2021)	% of coverage	65	90	95	100	100	100	100	100	100	100	
	6.1.4. Procure pool vehicle for the headquarter and motorbikes for all range offices.	Pool Hilux and bikes procured and used in field	Nil	Nos.	1 (Hilux)		1 (Bike)		2 (Bikes)	2 (Bikes)	2 (Bikes)	2 (Bikes)	2 (Bikes)	2 (Bikes)	As per BFL's plan outlay.
	6.2. Develop capacity of staff and local communities														
	6.2.1. Conduct refresher training (SMART patrolling, uniform, arms handling and drill, FIRMS, G2C Services, wildlife rescue and rehabilitation).	Yearly refreshers courses conducted	1	No of courses	3	4	4	4	4	4	4	4	4	4	
	6.2.2. Train staff on species identification and taxonomy.	Training on basic taxinomy provided	Nil	No of participants	10	10	10								
	6.2.3. Train staff on wildlife research (study design, data analysis and reporting).	Training on basic research methodologies provided	1	No of participants						10	10	10	10	10	
	6.2.4. Train staff on GIS and remote sensing.	Training on basics of RS/GIS provided	Nil	No of participants				15	15						
	6.3. Ensure effectiveness of protected area management														
	6.3.1. Carry out Bhutan METT+ assessment of the park.	METT+ assessments carried out regularly	1	No of Assessments	1					1				1	
	6.3.2. Carry out timely evaluation of this plan implementation (mid-term evaluation by end of 5th year and final evaluation during the last year of the plan implementation).	Management plan implementation progress evaluated (Final)	Nil	Nos of evaluation					1					1	
	6.3.3. Carry out works for the revision of this management plan (RBS, SES and LFMP) in the last year of the plan period.	Management Plan revised	1	Nos										1	Revision works to be done in final year, to avoid gaps between plans.

Figure 40: Monitoring plan template with yearly target for the Management Plan

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Lumaked Tsho in JSWNP

The begining of vast alpine grassland of Broksa

APPENDIX

Appendix 1: Local Forest Management Planning

Background

The Forest and Nature Conservation Act of Bhutan, 1995 and Forest and Nature Conservation Rules and Regulation, 2017 states that Bhutan's State Reserve Forest must be managed with proper management plan. However, sustainable management of forests using scientific principles has been confined to FMUs and CFs, despite the unmanaged forests outside these regimes are under tremendous pressure as major portion of the annual timber supply are met from these areas. Accordingly, Department of Forest and Park Services has come up with guidelines for establishment of Local Forest Management Plan (LFMP) and has directed all field Divisions and Parks to come up with LFMPs for sustainable management of such unmanaged forests. Therefore, in line with Conservation Acts and Rules, and instructions from the Department, JSWNP initiated the process of Local Forest management planning in 2017. Although LFMP forms a separate plan document for areas in territorial divisions, for protected areas, the LFMPs are clubbed together with the overall Management Plan of the protected area; compiled as a separate chapter. The LFMPs are prepared following a standard guideline issued by FRMD, taking each gewog as the unit of LFMP. For JSWNP, out of the ten gewogs falling in the park, only seven have human settlements falling inside the park; therefore, this chapter is comprised of compilation of LFMPs of these seven gewogs.

For each of the LFMPs, the respective area was mapped, whereby the park's core zone falling inside the gewog was clipped away, areas with existing management plan such as CFs were clipped off and only those remaining areas were put under the Local Forest Management Area (LFMA). Further, from the LFMA, the far flung, remote and inaccessible areas were kept as future management areas and no survey was conducted in such areas. Only the areas from where resources were extracted in the past and have potential for extraction in next ten years were considered for the LFMP. The final LFMP area was surveyed as per the guideline; and based on the data, designated into three circles; Bulit-up areas, protection circle and production circle. Built-up area is formed by human settlements, agricultural lands and other private lands, protection circle is formed of the areas with slopes greater than 45-degree (100%), water bodies buffer, road buffer, and important sites (cultural, religious and historical sites) buffer and the Production circle is the actual area from where resources will be extracted on sustainable basis in next ten years.

1. The forest management areas

1.1. The Area

JSWNP has seven gewogs with human settlements inside the park's jurisdiction and all of these are covered with LFMP; the three gewogs; Phobji, Phuntenchu and Dovan do not have human settlements in the park area and no LFMP is required.

Sl No.	Gewogs	Dzongkhag	Total Gewog area (Ha)	Gewog area inside the park (Ha.)	% of gewog area falling in the Park	Settlement in the Park area	LFMP prepared/ not
1	Trong	Zhemgang	35913.0	10797.2	30.1		
2	Jigmechholing	Sarpang	50130.4	26060.0	52.0		
3	Dovan (Dragchhu)	Sarpang	22227.0	634.6	2.9	X	X
4	Korphu	Trongsa	29022.7	29022.7	100.0		
5	Langthel	Trongsa	50821.4	16875.1	33.2		
6	Tangsibji	Trongsa	37218.0	27049.1	72.7		
7	Phobji	Wangdue	15125.0	5825.1	38.5	X	X
8	Athang	Wangdue	77841.7	53420.3	68.6		
9	Sergithang	Tsirang	13644.8	1270.3	9.3		
10	Phuntenchu	Tsirang	13644.6	2061.5	15.1	X	X

Table 14: Gewogs and settlements details in JSWNP.

Trong gewog is located in the south-eastern part of the park and consists of three communities; Tama, Takabi and Berti inside the park jurisdiction. There are 858 people living in these three communities, who are largely dependent on forest resources such as timber, firewood and NTFPs and such resources are supplied from the nearby forests. Though Tama and Berti have community forests, resources are extracted from the forests outside of these CFs as well. The Local Forest Management Area (LFMA) of Trong gewog is formed of four compartments; Berti compartment, Tama-1 compartment, Tama-2 compartment, and Tama-3 compartment, forming total area of 1879.59 Hectares. The LFMA is designated into Built-up, Protection and Production circles with areas of 247.41 hectares, 538.5 hectares and 1105.37 hectares respectively.

Jigmechholing gewog spreads from south eastern corner, forming the southern border of the park until the central region, with a small intrusion of Chhudzom (Doban) gewog at the south-central border. Though a large portion (52%) of this gewog falls in the park, only one community, Reeti, falls inside JSWNP. There are 319 people living in Reeti community and due to its remote location, people are heavily dependent upon forest resources. The village has no community forest and the resources are extracted from unmanaged forests around the village. The LFMA of Jigmechholing gewog is formed to two compartments; Compartment 1 towards the east and compartment 2 towards the west, separated by the Reeti river. The total LFMP area is 1127.88 hectares, exclusive of the future management areas. The area is designated into 66.2 hectares of Built-up areas, 110.32 hectares of protection circle and 961.54 hectares of production circle.

Korphu is the only gewog that falls completely inside JSWNP. It is located towards the eastern side of the park and extending towards the Black Mountain peak in the central region. There are three main communities; Nabji, Korphu and Nimshong in the gewog and total population of 1667. All three communities depend on forest resources for livelihood and despite all of them having a community forest each, resources are still extracted from other nearby forests. The LFMA of Korphu gewog is formed of three compartments; Nabji, Korphu and Nimshong compartments, and total LFMP area of 3890.49 hectares.

Langthel gewog, extending from mid-eastern boundary of JSWNP towards its central region, has 33.2% of its area falling inside the park. There are multiple communities such as Phrumzur, Jangbi, Wangling, Ngormay, Shengling, Baseling and Nangnang scattered in the areas of this gewog in the park jurisdiction. The people are mainly tribal Monpa communities who depend heavily on forest resources for livelihood. There are 725 people living in these communities. The LFMA of Langthel gewog has four compartments which forms a total area of 2483.89 hectares. This area is designated into 244.65 hectares of built-up area, 804.21 hectares of protection circle and 1907.82 hectares of production circle.

Tangsibji gewog has 72.7% of its total area falling inside JSWNP, located in the northern side of the park. Two villages of Kella and Dimba are located in the park, though the latter has no people living in the village currently. Chendebji village is located right outside the park's boundary and their agricultural fields are located in the park area. In total, there are854 people living in the park area of Tangsibji gewog and they depend on forest resources for livelihood. The LFMA of Tangsibji gewog is formed of two compartments; Kella compartment and Dima compartment. No area was mapped for Chendebji village as all of their resource demand is met from areas outside the park. The total LFMA is 1168.22 hectares which are designated into 671.33 hectares of built-up areas, 342.16 hectares of protection circle and 771.03 hectares of production circle.

Athang gewog forms the western boundary of the park and extends inward until the central Black Mountain range. Over 68.6% of the gewog's area is located inside the park jurisdiction and the communities of Lopokha, Lhomtshokha, Phaktakha, Gemdro, Bartsa, Kago, Morakha and Gentsawa towards Adha side and communities of Rukha, Migtena, Lawa, Lamga, Dayu, Kashacjeko, Samthang, harachu and Satshamla towards Rukha side are all located inside the park area. A total of 1093 people live in these villages and are depend on forest resources for livelihood. The LFMA of Athang gewog is formed by five compartments; Lhomtshokha, Lopokha, Lawa-Dayu, Rukha-Lamga and Samthang compartments.

Sergithang gewog has a very small part (9.3% of the gewog area) falling inside the park, located in south-western corner of the park. The LFMP for this gewog was carried out by Tsirang Division and data for the areas in the park was shared with JSWNP. This small area has 22 individuals living in the park area. The LFMA of this small community is made of only one compartment with area of 401.23 hectares, which is further designated into 23.78 hectares of built-up areas, 234.94 hectares of protection circle and 142.51 hectares of production circle.

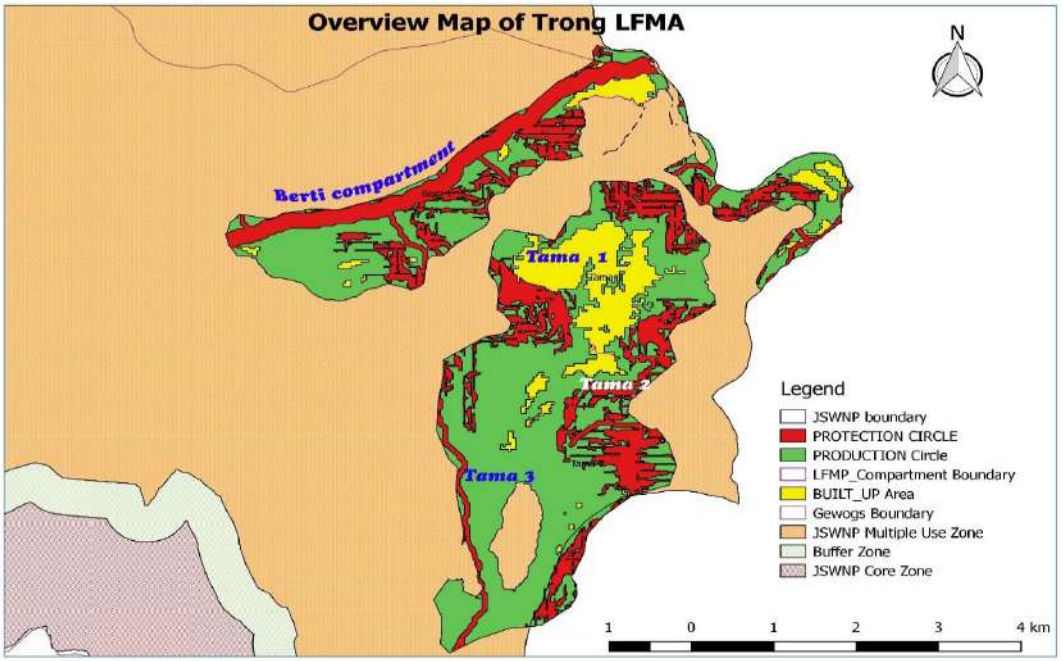

Figure 41: Overview map of Trong LFMA

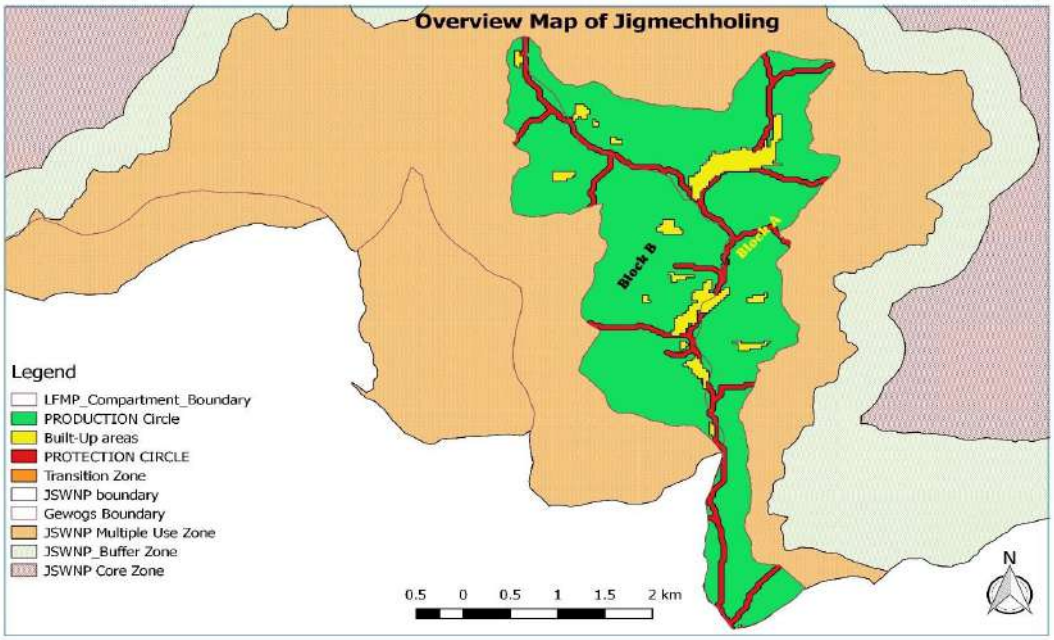

Figure 42: Overview map of Jigmechholing LFMA

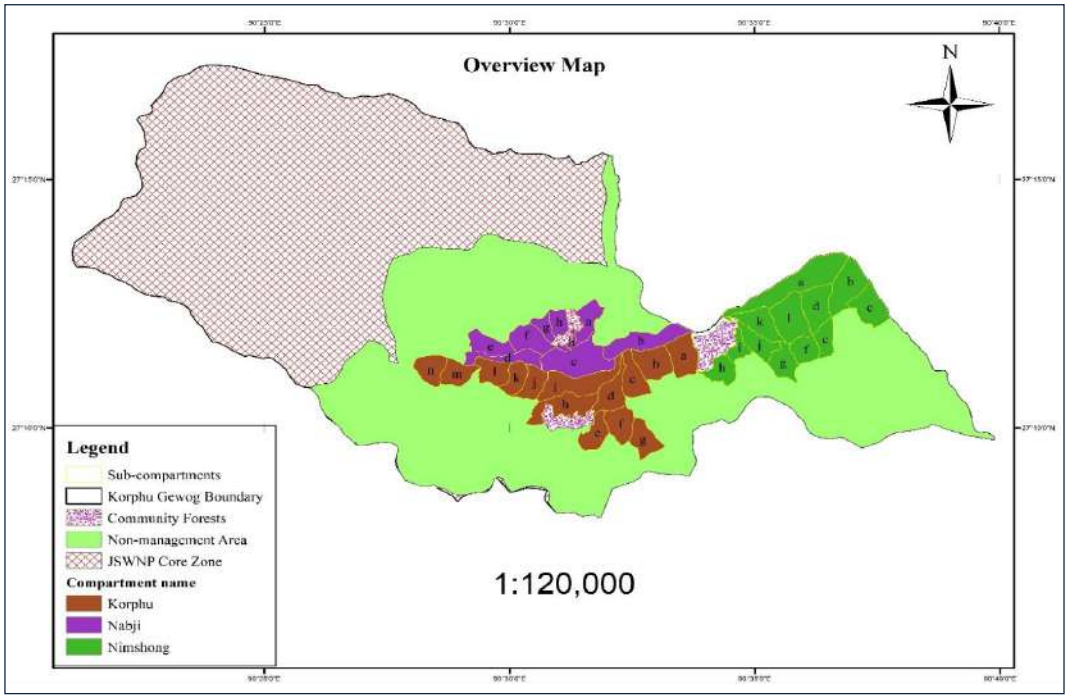

Figure 43: Overview Map of Korphu LFMA

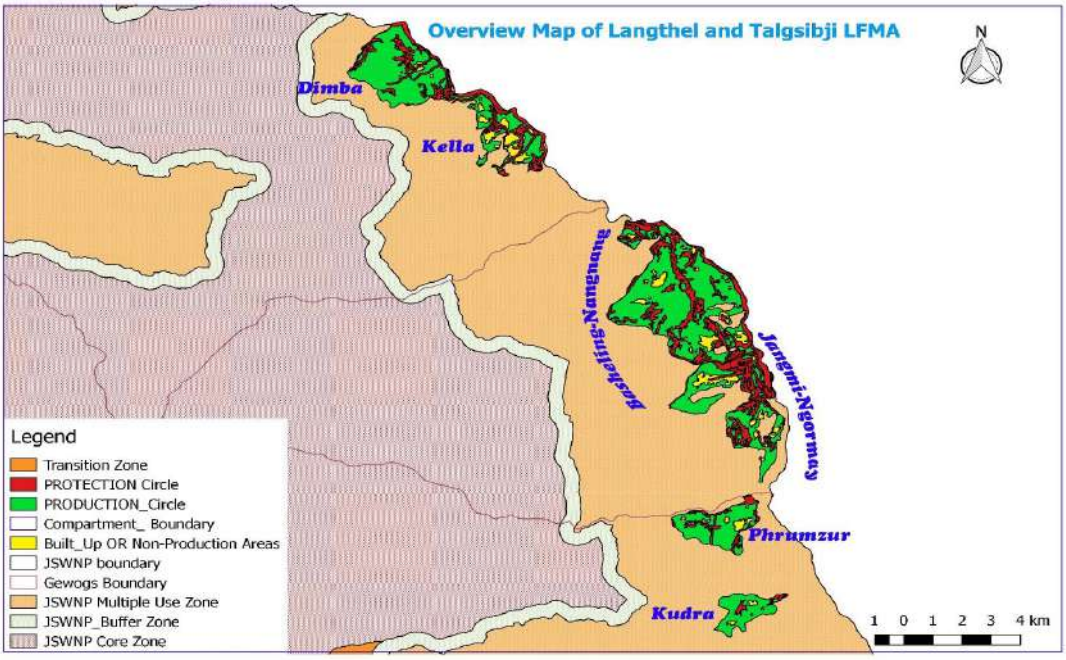

Figure 44: Overview Map of Langthel & Tangsibji LFMA

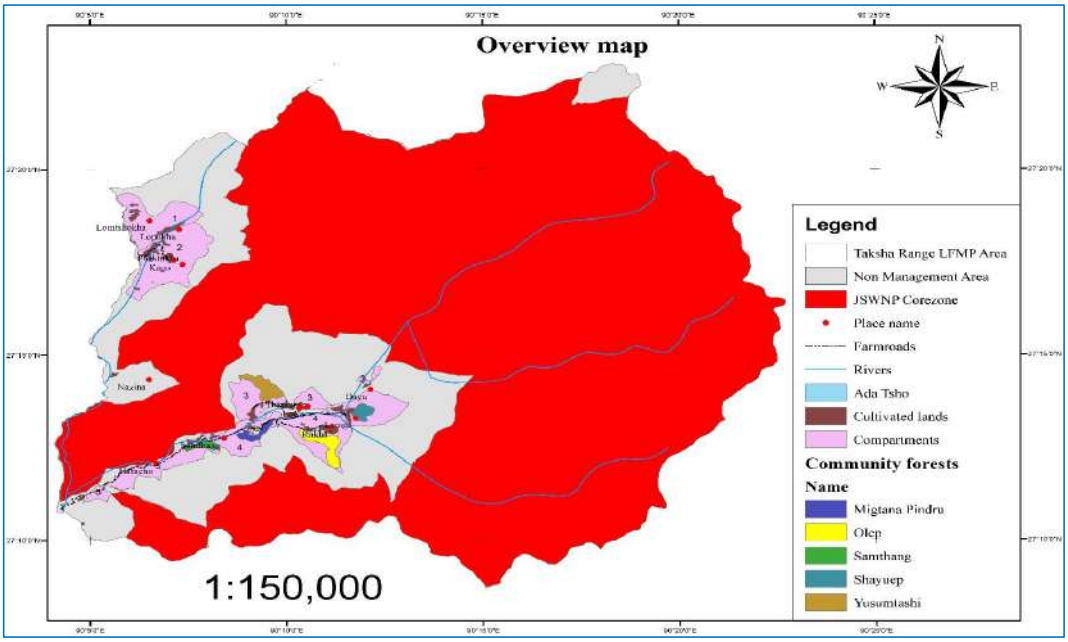

Figure 45: Overview map of Athang LFMA

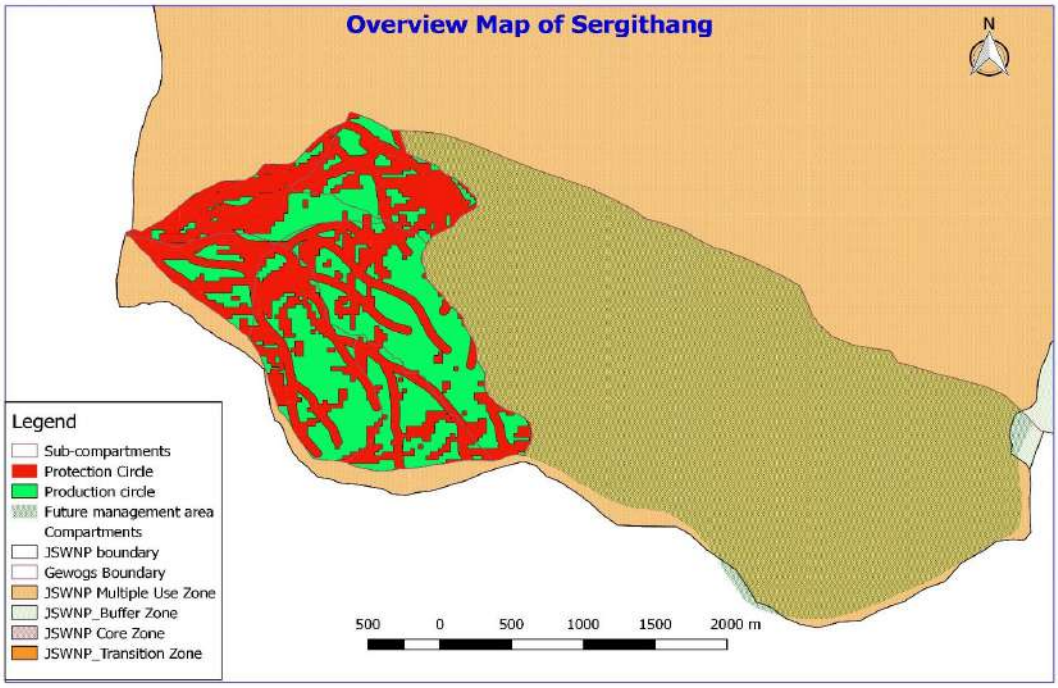

Figure 46: Overview Map of Sergithang LFMA

1.2. Forest Types and Condition

Forest type wise, Jigmechholing, Korphu and Tangsibji LFMAs have total dominance of hardwood forests. Trong and Langthel have major portion of hardwood forests at 84% and 78 % respectively, and the remaining portion in Trong is formed by mixed hardwood-conifer (16%) and that in Langthel is formed of 20% mixed hardwood-conifer and 2% chirpine. Athang has 47% hardwood, 35% chirpine and 18% mixed hardwood-conifer. Sergithang has 72% chirpine, 13% mixed hardwood-conifer and 6% hardwood. The area wise forest type is summarized in the table below;

LFMA wise Forest types Distribution (%)										
Sl. No.	**Gewog**	**Hem-lock**	**Fir**	**Spruce**	**Mixed Conifer**	**Blue-pine**	**Chirp-ine**	**Hard-wood**	**Mixed HC**	**Total**
1	Trong	0	0	0	0	0	0	84	16	**100**
2	Jigmechhol-ing	0	0	0	0	0	0	100	0	**100**
3	Korphu	0	0	0	0	0	0	100	0	**100**
4	Langthel	0	0	0	0	0	2	78	20	**100**
5	Tangsibji	0	0	0	0	0	0	100	0	**100**
6	Athang	0	0	0	0	0	35	47	18	**100**
7	Sergithang	0	0	0	9	0	72	6	13	**100**

Table 15: LFMA-wise Forest Type Distribution.

Age class wise, Trong, Jigmechholing, Korphu, Tangsibji, Athang and Sergithang have over 50% of matured stands while Langthel has the same below 50 (47%). Langthel has the maximum over-matured stand at 5% while all other except Athang and Sergithang have 1% of over-matured stands. Immature stands are more or less uniformly distributed among all the LFMAs, between 18% to 38%. Young stands are mostly found in Langthel and Tangsibji (17% each), Jigmechholing (13%), Trong and Korphu (10% each) and minimum at Sergithang (3%).

Stand type wise, all LFMAs have 100% natural stands except Trong (99% natural and 1% plantation) and Langthel (97% natural and 3% plantation).

Canopy closure wise, dense forests are found in Trong and Langthel (13% each) and Jigmechholing (21%). Korphu and Tangsibji have less dense forest and Sergithang has no dense forest at all. Closed canopy is found in most LFMAs with over 50% canopy closure in all except Jigmechholing (42%) and Langthel (46%). Open forests are uniformly distributed among all LFMAs; between 27% to 38% distribution. Unstocked areas were mostly found in Tangsibji, Langthel and Jigmechholing with around 10% unstocked areas.

Stand condition wise, most areas were found to have good or average conditions. Poor forest condition was mostly observed in Tangsibji (23%), Trong (14%), Langthel (13%) and Jigmechholing and Korphu at 12% each. The details of age distribution, stand types, canopy closure and stand condition are presented in the table below;

Sl. No.	Gewog	Age Distribution (%)					Stand Type Distribution (%)			
		Young	*Immature*	*Mature*	*Overmature*	*Total*	*Plantaion*	*Natural*	*Coppice*	*Total*
1	Trong	10	22	67	1	**100**	1	99	0	**100**
2	Jigmechholing	13	31	55	1	**100**	0	100	0	**100**
3	Korphu	10	38	51	1	**100**	0	100	0	**100**
4	Langthel	17	31	47	5	**100**	2	97	1	**100**
5	Tangsibji	17	18	64	1	**100**	0	100	0	**100**
6	Athang	6	32	62	0	**100**	0	100	0	**100**
7	Sergithang	3	19	78	0	**100**	0	100	0	**100**

Sl. No.	Gewog	Canopy Closure (%)					Condition (%)			
		Dense	*Closed*	*Open*	*Unstocked*	*Total*	*Good*	*Average*	*Poor*	*Total*
1	Trong	13	56	27	5	**100**	45	41	14	**100**
2	Jigmechholing	21	42	28	10	**100**	44	44	12	**100**
3	Korphu	6	55	31	8	**100**	57	31	12	**100**
4	Langthel	13	46	30	11	**100**	44	42	13	**99**
5	Tangsibji	5	52	32	12	**101**	33	44	23	**100**
6	Athang	11	52	36	2	**100**	70	28	2	**100**
7	Sergithang	0	66	34	0	**100**	34	66	0	**100**

Table 16: LFMA-wise Age and Stand Type distribution, Canopy Closure and Stand Condition.

Slope wise, majority of the areas falls under gentle and moderate slopes; however, Korphu, jigmechholing, Trong and Athang have over 20% of the area under steep slopes. Erosiveness was found to be stable to moderate in most of the areas with gentle and moderate slopes. Unstable aeras were mainly those falling along steep slopes. Similarly, soil cover was found to be high to moderate in the areas with gentle to moderate slope and stable areas. The details of slope, erosiveness and soil cover are laid in the table below;

LFMA wise Site Conditions (% of area)										
Sl. No.	Gewogs	Slope			Erosiveness			Soil Cover		
		Gentle	*Moder-ate*	*Steep*	*Stable*	*moder-ate*	*Unsta-ble*	*High*	*Mod-erate*	*low*
1	Trong	40	37	24	54	36	11	30	55	14
2	Jigmechhol-ing	38	39	23	43	37	19	32	54	13
3	Korphu	24	45	30	54	40	6	36	54	10
4	Langthel	28	55	17	53	37	10	35	50	15
5	Tangsibji	47	41	12	45	49	6	36	59	5
6	Athang	30	48	22	76	19	5	55	39	6
7	Sergithang	9	78	13	31	69	0	6	88	6

Table 17: LFMA-wise Site Condition description.

1.3. Forest Use

Various forest use identified under LFMP are grazing, sokshing and lopping at tow intensities, intensive and extensive. The LFMA wise forest use is summarized in the table below;

LFMA wise FOREST USE (% of area)							
Sl. No.	Gewog	Intensive Side Use			Extensive Side Use		
		Grazing	*Sokshing*	*lopping*	*Grazing*	*Sokshing*	*lopping*
1	Trong	35	1	8	16	2	9
2	Jigmechholing	41	5	39	16	2	6
3	Korphu	48	0	19	15	0	3
4	Langthel	52	6	32	22	0	22
5	Tangsibji	14	3	14	32	0	8
6	Athang	36	3	12	9	1	1
7	Sergithang	13	0	0	59	0	0

Table 18: LFMA-wise Forest Use.

1.4. NWFP and Firewood

Firewood here means the fallen trees and branches found lying on forest floor. It was found abundantly in 53% of Trong LFMA, 41% of Langthel, 38% in Jigmechholing, 31% in Korphu, 30% in Tangsibji and 25% in Athang. Sergithang had abundant firewood in only 3% of its LFMA. Sparse distribution of firewood was found in all LFMAs, anywhere between 12 to 37 percent of the areas. Bamboo was abundant in some areas and sparse in other areas in all of the LFMAs except Sergithang (0%). Cane was found in Jigmechholing, Trong, Athang and Korphu. Similarly, Daphne was more or less found in areas of all LFMP. The availability of these NTFPs in each LFMA is summarized in the table below;

LFMA wise NWFP occurrence and Firewood (% of area)									
Sl. No.	Gewog	NWFP abundant				NWFP sparse			
		Firewood	*Bamboo*	*Cane*	*Daphne*	*Firewood*	*Bamboo*	*Cane*	*Daphne*
1	Trong	53	15	5	0	21	15	19	7
2	Jigmechholing	38	12	10	1	37	18	18	1
3	Korphu	31	9	3	0	33	18	9	10
4	Langthel	41	8	0	2	19	13	4	13
5	Tangsibji	30	12	0	2	12	11	0	12
6	Athang	25	13	4	1	16	10	2	14
7	Sergithang	3	0	0	0	53	0	0	3

Table 19: LFMA-wise NWFP and Firewood availability

2. Future Management

2.1. Silviculture Measures and Management Options

Different types of forest management options as per the LFMP are Plantation, Thinning, Felling for timber, Felling for firewood and no disturbance (No activity). These are identified in the units of area (in hectare) and percentage; however, two or more of these management options could overlap in any given area.

For Trong LFMA, the dominant management option is No Activity (52% of the area), followed by felling for firewood (20%), Thinning (15%), felling for timber (8%) and plantation (7%). Since the communities of Tama and Berti already have CFs, the relatively smaller area for timber and firewood harvest is not seen as any issue. Compartment wise, Tama-1 compartment falls mostly near the settlement areas where majority of trees are in the diameter class of 10 to 20; therefore, mostly thinning is required in such areas. Other areas (around 40% of the compartment) are located in rugged terrain and no management operation is feasible. Such areas (256.5 hectares) are left out as No Activity zone. Open areas near the settlements require plantation for which an area of 47.3 hectares has been identified. This leaves only 6.8 hectares for timber production and 114.8 hectares for firewood production. For Tama-2 compartment, majority of the areas are inaccessible and too rugged for timber extraction; therefore, major part of the compartment (126.3 hectares) is left as No Activity area. 21 hectare is available for timber production, 73.7 hectares for firewood harvest, 84.2 hectares for thinning and 52.6 hectares for plantation. Tama-3 compartment has relatively more productive areas where 73.8 hectare is available for timber production, 44.3 hectare for firewood production, 88.6 hectares for thinning and 125.5 hectares is left as No Activity zone. Berti compartment is largely accessible; however, since the compartment encompasses the Berti river, some areas need to be protected as these forms riparian zone and river buffer has to be maintained. Overall, the compartment has 45.8 hectares for timber production, 129.9 hectares for firewood production, 30.6 hectares for thinning, another 30.6 hectares for plantation and 435.4 hectare is left as No Activity zone.

For Jigmechholing LFMA, the dominant management option is felling for firewood felling (51%) followed by timber felling (48%), Plantation (31%) and No activity in 26% of the area. The community of Reeti does not have any CF; however, the timber and firewood demand could be met from the large areas available for timber and firewood production. Compartment wise, the compartment 1 (A-block) has natural stands of matured hardwood species in good condition and the area is mostly feasible for future management interventions. An area of 166.1 hectare is available for timber production and 170.3 hectare for firewood production. Plantation is required in 128.7 hectares and thinning in 99.7 hectares. Only 78.9 hectares is left as No Activity zone. Compartment 2 (B-block), not different to first compartment, has an area of 140.7 hectares for timber production, 160.8 hectares for firewood production, 68.3 hectares for thinning, another 68.3 hectares for plantation and 56.3 hectares as No Activity zone.

For Korphu LFMA, felling for timber dominates the future management option with 43%, closely followed by 42% for thinning, felling for firewood (27%), and plantation (15%). Compartment wise, Nabji compartment has 81.2 hectares for felling (timber and firewood combined), 75.2 hectares for thinning and 8.8 hectares for plantation. Korphu compartment has 233 hectares for felling, 249.4 hectares for thinning and 26.4 hectares for plantation. Nimshong compartment has 176.2 hectares for felling, 174.2 hectares for thinning and 62.8 hectares for plantation.

For Langthel LFMA, Majority of area (51%) is for no activity. 17% of the area is to be managed for firewood production, 15% for timber production, 10% for plantation and 7% for thinning. Compartment wise, Kudra compartment has mostly matured to over matured stand of hardwood species such as Toona sp., Castanopsis sp., and Schima wallichii located along moderate slope, making it easier to harvest. The compartment has 43 hectares each for timber and firewood production, 14.3 hectares for thinning and 100.3 hectares is to be left as No Activity zone. Phrumzur compartment has 100 hectares for timber production, 71.4 hectares for firewood production, 28.6 hectares each for thinning and plantation and 128.5 hectares is to be left as No Activity zone. Both Kudra and Phrumzur compartments are not accessible by road and electricity due to which more firewood is used. Once the road is connected, these compartments have potential to meet timber and firewood demands of nearby localities. Jangbi compartment, which covers Jangbi and Wangling villages has 79.7 hectares each for timber production, firewood production and thinning, 95.6 hectares for plantation and 430.1 hectares is to be left as No Activity zone. Ngormay compartment which covers Ngormay, Bashaling, Shengling and Nangnag villages has 316.9 hectares for timber production, 316.9 hectares for firewood production, 83.4 hectares for thinning, 166.8 hectares for plantation and 850.6 hectares is to be left as No Activity zone.

For Tangsibji LFMA, Majority (73%) is to be left with no intervention, 14% to be managed for firewood production, 9% for plantation and 5% for timber harvest. The large portion for no activity is due to the fact that the LFMA has only two villages falling inside it and one of them (Dimba) has no people living in the village. Compartment wise, the only compartment, Kella-Dimba, has 22.4 hectares for timber production, 67.2 hectares for firewood production, 44.8 hectares for plantation and 358.3 hectares is to be left as No Activity zone.

For Athang LFMA, 36% of the area is to be managed for timber production, 34% for firewood production, 32% for thinning, and 13% for plantation. Compartment wise, Lhomtshokha-Kago compartment has 57.6 hectares for felling (timber and firewood combined), 32.8 hectares for thinning and 48.5 hectares for plantation. Lopokha-Phaktakha compartment has 53.6 hectares for felling, 69.9 hectares for thinning and 22.3 hectares for plantation. Lawa-Dayu-Kashacheko compartment has 26 hectares for felling, 30 hectares for thinning and 21.7 hectares for plantation. Rukha-Lamga-Migtena compartment has 168.5 hectares for felling, 187.5 hectares for thinning and 2.4 hectares for plantation. Samthang- Harachu compartment has 109.1 hectares for felling and 19.2 hectares for thinning.

For Sergithang LFMA, 41% (42.1 hectares) of the area is to be managed for timber harvest, 34% (35.6 hectares) for thinning, and 6% (6.5 hectares) for plantation. Refer Table 19 for details:

LFMA wise Silvicultural Measures (area in Ha. and %)							
Sl. No.	**Gewog**	**Unit**	**Planting**	**Thinning**	**Felling (firewood)**	**Felling (timber)**	**No activity**
1	Trong	Ha.	126.5	270.9	362.7	147.7	943.7
		%	7	15	20	8	52
2	Jigmechholing	Ha.	197	168	331.1	306.8	135.2
		%	31	26	51	48	21
3	Korphu	Ha.	337.5	947.3	*600.4*	954.2	0
		%	15	42	27	43	0
4	Langthel	Ha.	291	206	511	439	1509.5
		%	10	7	17	15	51
5	Tangsibji	Ha.	44.8	0	67.2	22.4	358.3
		%	9	0	14	5	73
6	Athang	Ha.	257	607.9	649.9	684.5	0
		%	13	32	34	36	0
7	Sergithang	Ha.	6.2	35.2	0	42.5	0
		%	6	34	0	41	0

Table 20: LFMA-wise Silvicultural Measures

2.2. Tree Marking and Silviculture

Tree marking is done in accordance with the "Tree Marking Guidelines" and the "Silvicultural Guidelines" prescribed by the Department of Forests and Park Services.

The silvicultural system applied is single tree selection system. The principle of negative selection is applied in all tending and thinning operations. Marking of mature trees for felling is permitted only when the immediate vicinity is sufficiently regenerated and the regeneration can grow up (low grazing pressure).

Grazing shall be controlled in all over-mature forests which are in the stage of natural regeneration.

Un-stocked and sparsely stocked parts shall be re-planted with principal local species (species selection according to prevalent forest type).

3. Yield Regulation

The principle of sustainability is to be ensured during LFMP implementation period; which means that resource extraction from the LFMA does not exceed the Annual Allowable Cut (AAC). AAC is the sustainable amount of timber that can be extracted from the area every year.

The sustainable annual allowable cut AACsust. for the management area is calculated as follows:

$AAC_{sust.}$ = Total standing volume / average rotation period.

3.1. Yield Regulation for Trong LFMA

$AAC_{sust.}$ = total standing volume / average rotation period. = 2460 m^3/year

Taking into account the forest type distribution the average production period for the forest management area is 89 years. The total standing volume is 220148 m^3.

The overall production potential as determined by the forest resources assessment is 220148 m^3. Dividing the overall production potential by the planning period of 10 years gives the silvicultural AAC:

$AAC_{silv.}$ = 220148/10 years = 22014.8 m^3/year

As the $AAC_{sust.}$ is lower than the $AAC_{silv.}$ the AAC is fixed at the level of the $AAC_{sust.}$

Therefore, the Annual Allowable Cut for the Trong LFMA is fixed at 2460 m^3.

The AAC per ha is 2.4 m^3.

Taking into account the fixed AAC of 2460 m3 then the total production potential of the forest management area will be used in a period of about 220148/2460 = 89 years. As this period is considerably longer than the planning period of 10 years, there will be no shortage in the availability of wood during the planning period.

3.2. Yield regulation for Jigmechholing LFMA

$AAC_{sust.}$ = total standing volume / average rotation period. = 3538 m^3/year

Taking into account the forest type distribution the average production period for the forest management area is 94 years. The total standing volume is 331840 m^3.

The overall production potential as determined by the forest resources assessment is 331840 m^3. Dividing the overall production potential by the planning period of 10 years gives the silvicultural AAC:

$AAC_{silv.}$ = 331840 / 10 years = 33184 m^3/year

As the $AA_{Csust.}$ is lower than the $AAC_{silv.}$ the AAC is fixed at the level of the $AAC_{sust.}$

Therefore, the Annual Allowable Cut for the Jigmechholing LFMA is fixed at 3538 m^3.

The AAC per ha is 4.0 m^3.

Taking into account the fixed AAC of 3538 m^3 then the total production potential of the forest management area will be used in a period of about 331840/3538 = 94 years. As this period is considerably longer than the planning period of 10 years, there will be no shortage in the availability of wood during the planning period.

3.3. Yield Regulation for Korphu LFMA

$AAC_{sust.}$ = total standing volume / average rotation period. = 2817 m^3/year

Taking into account the forest type distribution the average production period for the forest management area is 105 years. The total standing volume is 296226 m^3.

The overall production potential as determined by the forest resources assessment is 296226 m^3. Dividing the overall production potential by the planning period of 10 years gives the silvicultural AAC:

$AAC_{silv.}$ = 296226 / 10 years = 29622.6 m^3/year

As the AAC_{sust}. is lower than the $AAC_{silv.}$ the AAC is fixed at the level of the $AAC_{sust.}$

Therefore, the Annual Allowable Cut for the Korphu LFMA is fixed at 2817 m^3.

The AAC per ha is 1.3 m^3.

Taking into account the fixed AAC of 2817 m3 then the total production potential of the forest management area will be used in a period of about 296226/2817 = 105 years. As this period is considerably longer than the planning period of 10 years, there will be no shortage in the availability of wood during the planning period.

3.4. Yield regulation for Langthel LFMA

$AAC_{sust.}$ = total standing volume / average rotation period. = 4868 m^3/year

Taking into account the forest type distribution the average production period for the forest management area is 104 years. The total standing volume is 507080 m^3.

The overall production potential as determined by the forest resources assessment is 507080 m^3. Dividing the overall production potential by the planning period of 10 years gives the silvicultural AAC:

$AAC_{silv.}$ = 507080 / 10 years = 50708 m^3/year

As the $AAC_{sust.}$ is lower than the $AAC_{silv.}$ the AAC is fixed at the level of the $AAC_{sust.}$

Therefore, the Annual Allowable Cut for the Langthel LFMA is fixed at 4868 m^3.

The AAC per ha is 2.6 m^3.

Taking into account the fixed AAC of 4868 m^3 then the total production potential of the forest management area will be used in a period of about 507080/4868 = 104 years. As this period is considerably longer than the planning period of 10 years, there will be no shortage in the availability of wood during the planning period.

3.5. Yield regulation for Tangsibji LFMA

$AAC_{sust.}$ = total standing volume / average rotation period. = 343 m^3/year

Taking into account the forest type distribution the average production period for the forest management area is 101 years. The total standing volume is 34733 m^3.

The overall production potential as determined by the forest resources assessment is 34733 m^3. Dividing the overall production potential by the planning period of 10 years gives the silvicultural AAC:

$AAC_{silv.}$ = 34733 / 10 years = 3473.3 m^3/year

As the $AAC_{sust.}$ is lower than the $AAC_{silv.}$ the AAC is fixed at the level of the $AA_{Csust.}$

Therefore, the Annual Allowable Cut for the Tangsibji LFMA is fixed at 343 m^3.

The AAC per ha is 1.6 m^3.

Taking into account the fixed AAC of 343 m^3 then the total production potential of the forest management area will be used in a period of about 34733/343 = 101 years. As this period is considerably longer than the planning period of 10 years, there will be no shortage in the availability of wood during the planning period.

3.6. Yield regulation for Athang LFMA

$AAC_{sust.}$ = total standing volume / average rotation period. = 3075 m^3/year

Taking into account the forest type distribution the average production period for the forest management area is 68 years. The total standing volume is 209760 m^3.

The overall production potential as determined by the forest resources assessment is 209760 m^3. Dividing the overall production potential by the planning period of 10 years gives the silvicultural AAC:

$AAC_{silv.}$ = 209760 / 10 years = 20976 m^3/year

As the $AAC_{sust.}$ is lower than the $AAC_{silv.}$ the AAC is fixed at the level of the $AAC_{sust.}$

Therefore, the Annual Allowable Cut for the Athang LFMA is fixed at 3075 m^3.

The AAC per ha is 1.6 m^3.

Taking into account the fixed AAC of 3075 m^3 then the total production potential of the forest management area will be used in a period of about 209760/3075 = 68 years. As this period is considerably longer than the planning period of 10 years, there will be no shortage in the availability of wood during the planning period.

3.7. Yield regulation for Sergithang LFMA

$AAC_{sust.}$ = total standing volume / average rotation period. = 228 m^3/year

Taking into account the forest type distribution the average production period for the forest management area is 99 years. The total standing volume is 22586 m^3.

The overall production potential as determined by the forest resources assessment is 22586 m^3. Dividing the overall production potential by the planning period of 10 years gives the silvicultural AAC:

$AAC_{silv.}$ = 22586 / 10 years = 2258.6 m^3/year

As the $AAC_{sust.}$ is lower than the $AAC_{silv.}$ the AAC is fixed at the level of the $AAC_{sust.}$

Therefore, the Annual Allowable Cut for the Sergithang LFMA is fixed at 228 m^3.

The AAC per ha is 2.2 m^3.

Taking into account the fixed AAC of 228 m^3 then the total production potential of the forest management area will be used in a period of about 22586/228 = 99 years. As this period is considerably longer than the planning period of 10 years, there will be no shortage in the availability of wood during the planning period.

4. Demand-Supply Assessment

4.1. Demand-Supply Assessment of Rural Timber

The rural wood demand for each LFMA (excluding the extraordinary supply for example Dzong renovation, etc.) has been calculated as the average of the actual wood allotment for past 5 years. The data for each was derived from respective field offices where the allotment data is recorded. The annual timber supply potential is calculated by dividing the total production potential (in number of trees) by the number of years it will take to use up the production potential with the fixed AAC.

4.1.1. Timber Demand-Supply assessment of Trong LFMA

Rural timber allotment data from FY 2016-7 to 2020-21 was used to assess demand from the area. The derived from the allotment register maintained at Tingtibi range of the park.

Demand Supply Assessment of Trong LFMA				
Year	Forest product types (Qty. in number)			
	Drashing	Cham	Tsim	Poles/Flag poles
2016-17	2	0	60	30
2017-18	5	0	0	90
2018-19	18	0	0	140
2019-20	100	0	0	0
2020-21	1	0	0	0
Total	**126**	**0**	**60**	**260**
Average/ Year	25.2	0	12	52

Product	Total Production Potential (Ntot)	Silvicult. Annual Potential	Sustainable Annual Supply Potential*	Annual Demand	Demand -Supply
Drashing/ shingleps	17356	1735.6	195.0	25.2	169.8
Chams	7130	713	80.1	0	80.1
Tsims	3276	327.6	36.8	12	24.8
Poles	5197	519.7	58.4	52	6.4

**Remark: the total production potential divided by 89 years.*

Table 21: Demand-Supply Assessment (Timber) of Trong LFMA

Poles are in highest demand followed by Drashing and Tsims. No demand for cham was recorded. The sustainable supply potential of the LFMA is higher than the annual demand, which would be sufficient to meet the demand during the plan period.

4.1.2. Timber Demand-Supply assessment of Jigmechholing LFMA

Rural timber allotment data from FY 2014-5 to 2019-20 was used to assess demand from the area. The data was derived from the allotment register maintained at Jigmechholing range office of Sarpang Division.

Demand Supply Assessment of Jigmechholing LFMA					
Year	**Forest product types (Qty. in number)**				
	Drashing	**Cham**	**Tsim**	**Poles/ Flag poles**	
2014-15	3	-	-	-	
2015-16	2	-	-	-	
2016-17	1	-	-	-	
2016-17	1	-	-	-	
2019-20	-	70	-	-	
Total	**7**	**70**	**-**	**-**	
Average/Year	1.75	14	-	-	
Product	**Total Production Potential (Ntot)**	**Silvicult. Annual Potential**	**Sustainable Annual Supply Potential***	**Annual Demand**	**Demand -Supply**
Drashing/ shingleps	28002	2800.2	297.9	1.75	+296.1
Chams	4795	479.5	51.0	14	+37.0
Tsims	2317	231.7	24.6	-	+24.6
Poles	1082	108.2	11.5	-	+11.5
**Remark: the total production potential divided by 94 years.*					

Table 22: Demand-Supply Assessment (Timber) of Jigmechholing LFMA.

No record was available for the allotment of Tsim and poles. The demand for drashing and cham could also be higher than that in record, because due to remote location of Reeti community, no strict compliance to tree marking was followed in the past. However, the sustainable supply potential of the LFMA is much higher than the demand, which would be sufficient to cater to increasing demand for next ten years.

4.1.3. Timber Demand-Supply assessment of Korphu LFMA

Rural timber allotment data from 2013 to 2017 was used to assess demand from the area. The data was derived from the allotment register maintained at Nabji Range Office of the park.

Demand Supply Assessment of Korphu LFMA				
Year	**Forest product types (Qty. in number)**			
	Drashing	**Cham**	**Tsim**	**Poles/Flag poles**
2013	45	0	0	265
2014	15	0	0	192
2015	36	0	0	235
2016	121	14	0	449
2017	70	252	160	607
Total	**287**	**266**	**160**	**1748**
Average/ Year	57.4	53.2	32	349.6

Product	**Total Production Potential (Ntot)**	**Silvicult. Annual Potential**	**Sustainable Annual Supply Potential***	**Annual Demand**	**Demand -Supply**
Drashing/ shingleps	24605	2460.5	234	57.4	+176.6
Chams	22479	2247.9	214	53.2	+160.8
Tsims	42622	4262.2	406	32	+374
Poles	103996	10399.6	990	349.6	+640.4

**Remark: the total production potential divided by 105 years.*

Table 23: Demand-Supply Assessment (Timber) of Korphu LFMA

Poles (fencing and flag) are on highest demand followed by Drashing and chams. Demand for Tsim is the lowest. For all of these the sustainable annual supply potential is much higher than the annual demand; therefore, the woods can be sustainably supplied from the LFMA during the plan period.

4.1.4. Timber Demand-Supply assessment of Langthel LFMA

Rural timber allotment data from FY 2016 to 2020 was used to assess demand from the area. The data was derived from the allotment register maintained at the Langthel range of the park.

Demand Supply Assessment of Langthel LFMA				
Year	**Forest product types (Qty. in number)**			
	Drashing	**Cham**	**Tsim**	**Poles/Flag poles**
2016	30	0	0	42
2017	9	0	0	43
2018	10	0	0	280
2019	15	0	0	160
2020	8	0	0	268
Total	**72**	**0**	**0**	**793**
Average/ Year	14.4	0	0	158.6

Product	**Total Production Potential (Ntot)**	**Silvicult. Annual Potential**	**Sustainable Annual Supply Potential***	**Annual Demand**	**Demand -Supply**
Drashing/ shingleps	35865	3586.5	344.9	14.4	+330.5
Chams	12509	1250.9	120.3	0	+120.3
Tsims	5965	596.5	57.4	0	+57.4
Poles	9510	951	91.4	158.6	-67.2

**Remark: the total production potential divided by 104 years.*

Table 24: Demand-Supply Assessment (Timber) of Langthel LFMA

Poles are at the highest demand, which is much higher than the sustainable supply potential. Therefore, it is advised that much of the demand for poles should be met from the existing CFs for all three communities of Tama, Takabi and Berti. Other resources such as Drashing, Cham and Tsims can be sustainably met from the LFMA.

4.1.5. Timber Demand-Supply assessment of Tangsibji LFMA

Rural timber allotment data from FY 2016 to 2020 was used to assess demand from the area. The data was derived from the allotment register maintained at the Langthel range of the park.

Demand Supply Assessment of Tangsibji LFMA				
Year	**Forest product types (Qty. in number)**			
	Drashing	**Cham**	**Tsim**	**Poles/Flag poles**
2013	9	0	24	0
2014	2	0	8	0
2015	4	0	0	192
2016	6	0	6	50
2017	1	0	0	140
Total	**22**	**0**	**38**	**382**
Average/ Year	4.4	0	7.6	76.4

Product	**Total Production Potential (Ntot)**	**Silvicult. Annual Potential**	**Sustainable Annual Supply Potential***	**Annual Demand**	**Demand -Supply**
Drashing/ shingleps	2451	245.1	24.3	4.4	+19.9
Chams	781	78.1	7.7	0	+7.7
Tsims	4681	468.1	46.4	7.6	+38.8
Poles	8916	891.6	88.3	76.4	+11.9

**Remark: the total production potential divided by 101 years.*

Table 25: Demand-Supply Assessment (Timber) of Tangsibji LFMA

The sustainable supply potential is much higher than the annual demand; therefore, the resources can be sustainable met from the LFMA during the plan period.

4.1.6. Timber Demand-Supply assessment of Athang LFMA

Rural timber allotment data from 2013 to 2017 was used to assess demand from the area. The data was derived from the allotment register maintained at Taksha Range Office and Adha dy. Range office of the park.

Demand Supply Assessment of Athang LFMA				
Year	**Forest product types (Qty. in number)**			
	Drashing	**Cham**	**Tsim**	**Poles/ Flag poles**
2013	-	-	-	418
2014	67	172	178	1295
2015	123	154	240	703
2016	12	30	45	977
2017	35	-	-	1170
Total	**237**	**356**	**463**	**4563**
Average/ Year	47	71	93	913

Product	**Total Production Potential (Ntot)**	**Silvicult. Annual Potential**	**Sustainable Annual Supply Potential***	**Annual Demand**	**Demand -Supply**
Drashing/ shingleps	18388	1838.8	270	47	+223
Chams	46549	4654.9	685	71	+614
Tsims	14731	1473.1	217	93	+124
Poles	16554	1655.4	243	913	+670

**Remark: the total production potential divided by 68 years.*

Table 26: Demand-Supply Assessment (Timber) of Athang LFMA

Poles (fencing and flag) are on highest demand followed by Tshims and chams. Demand for Drashing is the lowest. For all of these the sustainable annual supply potential is much higher than the annual demand; therefore, the resources can be sustainably supplied from the LFMA during the plan period.

4.1.7. Timber Demand-Supply assessment of Sergithang LFMA

Rural timber allotment data from 2015 to 2019 was used to assess demand from the area. The data was fetched by Tsirang Forest Division.

Demand Supply Assessment of Sergithang LFMA				
Year	**Forest product types (Qty. in number)**			
	Drashing	**Cham**	**Tsim**	**Poles/Flag poles**
2015	0	0	0	0
2016	0	40	0	0
2017	15	0	0	50
2018	25	0	135	0
2019	55	0	0	50
Total	**95.0**	**40.0**	**135.0**	**100.0**
Average/ Year	19	8	27	20

Product	**Total Production Potential (Ntot)**	**Silvicult. Annual Potential**	**Sustainable Annual Supply Potential***	**Annual Demand**	**Demand -Supply**
Drashing/ shingleps	2476	247.6	25.0	19.0	+6.0
Chams	3146	314.6	31.8	8.0	+23.8
Tsims	4091	409.1	41.3	27.0	+14.3
Poles	8798	879.8	88.9	20.0	+68.9

**Remark: the total production potential divided by 99 years.*

Table 27: Demand-Supply Assessment (Timber) of Sergithang LFMA.

The sustainable supply potential of the LFMA is higher than the demand, which would be sufficient to cater to the demand of small community for next ten years.

4.2. Demand-Supply Assessment of Firewood

Firewood demand is calculated in truckloads. To compare it with the supply potential it has to be converted into standing volume equivalent. The conversion factor applied is:

1 truckload is equivalent to 8 m3 standing volume.

Similar to the rural timber demand, the demand for firewood was calculated using the allotment data for same past five years in each LFMA.

4.2.1. Firewood Demand-Supply assessment of Trong LFMA

Demand Supply Assessment of Firewood of Trong LFMA							
Year	**2016-17**	**2017-18**	**2018-19**	**2019-20**	**2020-21**	**Total**	**Average**
Firewood demand in TL (Truck Load)	0	40	0	8	3	**51**	**10.2**
Firewood demand in Standing volume (*)	0	320	0	64	24	**408**	**81.6**

Total Production Potential	**Annual Supply Potential****	**Annual Demand**	**Demand -Supply**	*Firewood demand in TL multiplied by 8.
($Volume_{tot}$)				**The total production potential divided by 89 years
136461	1533.3	81.6	1451.7	

Table 28: Firewood Demand-Supply assessment of Trong LFMA.

As shown in table the sustainable annual supply potential of Trong LFMA is considerably higher (excess of 1451.7 m^3/year) than the annual demand; therefore, firewood can be sustainably met from the LFMA during the plan period.

4.2.2. *Firewood Demand-Supply assessment of Jigmechholing LFMA*

Demand Supply Assessment of Firewood of Jigmechholing LFMA							
Year	**2016**	**2017**	**2018**	**2019**	**2020**	**Total**	**Average**
Firewood demand in TL (Truck Load)	0	0	0	3	8	**11**	**2.2**
Firewood demand in Standing volume (*)	0	0	0	24	64	88	**17.6**

Total Production Potential (Volume$_{tot}$)	**Annual Supply Potential****	**Annual Demand**	**Demand -Supply**	*Firewood demand in TL multiplied by 8. **The total production potential divided by 94 years
64116	682.1	17.6	664.5	

Table 29: Firewood Demand-Supply assessment of Jigmechholing LFMA

As shown in table the sustainable annual supply potential of Jigmechholing LFMA is considerably higher (excess of 664.5 m^3/year) than the annual demand; therefore, firewood can be sustainably met from the LFMA during the plan period.

4.2.3. *Firewood Demand-Supply assessment of Korphu LFMA*

Demand Supply Assessment of Firewood of Korphu LFMA							
Year	**2013**	**2014**	**2015**	**2016**	**2017**	**Total**	**Average**
Firewood demand in TL (Truck Load)	15	16	17	28	59	**135**	**27**
Firewood demand in Standing volume (*)	120	128	136	224	472	**1080**	**216**

Total Production Potential (Volume$_{tot}$)	**Annual Supply Potential****	**Annual Demand**	**Demand -Supply**	*Firewood demand in TL multiplied by 8. **The total production potential divided by 105 years
107628	1025	216	+809	

Table 30: Firewood Demand-Supply assessment of Korphu LFMA

As shown in table the sustainable annual supply potential of Korphu LFMA is considerably higher than the annual demand; therefore, firewood can be sustainably met from the LFMA during the plan period.

4.2.4. *Firewood Demand-Supply assessment of Langthel LFMA*

Demand Supply Assessment of Firewood of Langthel LFMA							
Year	**2016**	**2017**	**2018**	**2019**	**2020**	**Total**	**Average**
Firewood demand in TL (Truck Load)	2	20	0	22	0	**44**	**8.8**
Firewood demand in Standing volume (*)	16	160	0	176	0	**352**	**70.4**

Total Production Potential ($Volume_{tot}$)	**Annual Supply Potential****	**Annual Demand**	**Demand -Supply**	*Firewood demand in TL multiplied by 8. **The total production potential divided by 104 years
233930	2249.3	70.4	2178.9	

Table 31: Firewood Demand-Supply assessment of Langthel LFMA.

As shown in table the sustainable annual supply potential of Langthel LFMA is considerably higher (excess of 2178.9 m^3/year) than the annual demand; therefore, firewood can be sustainably met from the LFMA during the plan period.

4.2.5. *Firewood Demand-Supply assessment of Tangsibji LFMA*

Demand Supply Assessment of Firewood of Tangsibji LFMA							
Year	**2016**	**2017**	**2018**	**2019**	**2020**	**Total**	**Average**
Firewood demand in TL (Truck Load)	0	5	0	8	6	**19**	**3.8**
Firewood demand in Standing volume (*)	0	40	0	64	48	**152**	**30.4**

Total Production Potential ($Volume_{tot}$)	**Annual Supply Potential****	**Annual Demand**	**Demand -Supply**	*Firewood demand in TL multiplied by 8. **The total production potential divided by 101 years
17369	172.0	30.4	141.6	

Table 32: Firewood Demand-Supply assessment of Tangsibji LFMA.

As shown in table the sustainable annual supply potential of Tangsibji LFMA is considerably higher (excess of 141.6 m^3/year) than the annual demand; therefore, firewood can be sustainably met from the LFMA during the plan period.

4.2.6. *Firewood Demand-Supply assessment of Athang LFMA*

Demand Supply Assessment of Firewood of Athang LFMA							
Year	**2013**	**2014**	**2015**	**2016**	**2017**	**Total**	**Average**
Firewood demand in TL (Truck Load)	49	85	93	75	52	**354**	**70.8**
Firewood demand in Standing volume (*)	392	680	744	600	416	**2832**	**566.4**
Total Production Potential (Volume$_{tot}$)	**Annual Supply Potential****	**Annual Demand**	**Demand -Supply**	*Firewood demand in TL multiplied by 8.			
98112	1442.8	566.4	+876.4	**The total production potential divided by 68 years			

Table 33: Firewood Demand-Supply assessment of Athang LFMA.

As shown in table the sustainable annual supply potential of Athang LFMA is considerably higher (excess of 876.4 m^3/year) than the annual demand; therefore, firewood can be sustainably met from the LFMA during the plan period.

4.2.7. *Firewood Demand-Supply assessment of Sergithang LFMA*

Demand Supply Assessment of Firewood of Sergithang LFMA							
Year	**2015**	**2016**	**2017**	**2018**	**2019**	**Total**	**Average**
Firewood demand in TL (Truck Load)	0	0	0	6	5	**11**	**2.2**
Firewood demand in Standing volume (*)	0	0	0	48	40	**88**	**17.6**
Total Production Potential (Volume$_{tot}$)	**Annual Supply Potential****	**Annual Demand**	**Demand -Supply**	*Firewood demand in TL multiplied by 8.			
4082	41.2	17.6	23.6	**The total production potential divided by 99 years			

Table 34: Firewood Demand-Supply assessment of Sergithang LFMA.

As shown in table the sustainable annual supply potential of Sergithang LFMA is considerably higher (excess of 23.6 m^3/year) than the annual demand; therefore, firewood can be sustainably met from the LFMA during the plan period.

5. Monitoring

Monitoring is important for the control of the AAC. Each tree, which is marked for felling must be recorded in the tree marking book. The tree marking book and allotment registers for all type of allotment (rural construction, renovation, and other purposes will be maintained at the range or beat office looking after each LFMA. All such allotments will be recorded in the register and yearly reports will be generated which will keep track of total demand, allotment and balance stock in each compartment.

The LFMP focal, who is also the head of FRMS (Forest Resources Management Section) at the headquarter will perform annual monitoring of the records.

It is also important to:

- ✓ Ensure utilization of subsidized timber for the genuine purposes for rural house building only.
- ✓ Plan rural marking activity consistently as per the schedule duly approved by DYT, which spells rural marking activity to be carried out annually.
- ✓ Conduct rural timber utilization monitoring regularly as per the Forest and Nature conservation Rules and Regulations (FNCRR), 2017.
- ✓ Maintain comprehensive data so as to facilitate monitoring efficiently.

Appendix 2. Floristic composition of JSWNP

Species No.	Species Name	Family	Langthel Range	Nabji Range	Taksha Range	Tingtibi Range
			RBA%	RBA%	RBA%	RBA%
	Evergreen Tree					
1	*Castanopsis hystrix*	Fagaceae	114.31	160.54	68.55	95.35
2	*Quercus lamellosa*	Fagaceae	81.85	69.97	46.72	
3	*Quercus oxyodon*	Fagaceae	77.71		128.06	4.40
4	*Dodecadenia grandiflora*	Lauraceae	74.17			
5	*Quercus lanata*	Fagaceae	66.31		38.89	
6	*Ostodes paniculata*	Euphorbiaceae	63.49	1.97	17.14	25.67
7	*Sloanea tomentosa*	Elaeocarpaceae	63.18	17.92		26.66
8	*Michelia kisopa*	Magnoliaceae	52.54			
9	*Altingia excelsa*	Hamamelidaceae	42.97	32.98		60.89
10	*Bischofia javanica*	Bischofiaceae	42.35		1.71	
11	*Rhododendron grande*	Ericaceae	40.78		4.20	
12	*Sloanea dasycarpa*	Elaeocarpaceae	40.29			
13	*Drimycarpus racemosus*	Anacardiaceae	36.12			1.72
14	*Quercus semiserrata*	Fagaceae	34.58		18.35	0.17
15	*Castanopsis tribuloides*	Fagaceae	29.26	194.30	0.01	0.06
16	*Beilschmiedia assamica*	Lauraceae	27.63		1.29	23.25
17	*Toona ciliata*	Meliaceae	24.37		43.07	40.40
18	*Garcinia xanthochymus*	Guttiferae	21.43		0.50	4.44
19	*Quercus acutissima*	Fagaceae	18.01			
20	*Persea clarkeana*	Lauraceae	16.57	5.44	75.51	
21	*Neocinnamomum caudatum*	Lauraceae	15.47	0.02	1.26	
22	*Engelhardia spicata*	Juglandaceae	15.18	164.35	49.19	0.42
23	*Phoebe lanceolata*	Lauraceae	14.62		0.32	7.24
24	*Quercus glauca*	Fagaceae	13.58	35.03	38.28	0.87
25	*Aglaia perviridis*	Meliaceae	13.47			
26	*Talauma hodgsonii*	Magnoliaceae	13.27		9.83	
27	*Phoebe cathia*	Lauraceae	12.75	1.37	0.72	0.04
28	*Rapanea capitellata*	Myrsinaceae	10.79	1.65	0.76	5.19
29	*Glochidion nubigenum*	Euphorbiaceae	10.64			
30	*Ficus virens*	Moraceae	10.44		22.52	
31	*Wendlandia wallichii*	Rubiaceae	10.34	0.10		1.18
32	*Symplocos ramosissima*	Symplocaceae	9.59	0.74	7.99	0.10
33	*Macropanax dispermus*	Araliaceae	9.53		9.98	0.07
34	*Rhododendron arboreum*	Ericaceae	8.59		62.35	0.00
35	*Schima wallichii*	Theaceae	8.50	27.13	39.47	11.63
36	*Aphanamixis polystachya*	Meliaceae	8.17	1.53	3.44	3.60
37	*Meliosma simplicifolia*	Sabiaceae	7.82			0.50

38	*Aglaia lawii*	Meliaceae	7.72			8.21
39	*Syzygium cumini*	Myrtaceae	7.55	5.92	14.06	26.84
40	*Syzygium kurzii*	Myrtaceae	7.44	7.02		35.41
41	*Lithocarpus elegans*	Fagaceae	7.37	28.09	0.95	60.32
42	*Bridelia retusa*	Euphorbiaceae	4.94		9.90	0.39
43	*Acer oblongum*	Aceraceae	4.71			
44	*Symplocos glomerata*	Symplocaceae	4.15	0.80	25.56	1.54
45	*Daphniphyllum chartaceum*	Daphniphyllaceae	3.46			0.00
46	*Schefflera elata*	Araliaceae	2.92	2.71		0.74
47	*Castanopsis indica*	Fagaceae	2.70			1.25
48	*Gironniera cuspidata*	Ulmaceae	2.51			
49	*Styrax grandiflorus*	Styracaceae	2.38	0.02		0.01
50	*Eriobotrya hookeriana*	Rosaceae	2.32		9.40	0.22
51	*Ficus nervosa*	Moraceae	2.23			
52	*Daphniphyllum himalense*	Daphniphyllaceae	2.15		31.26	
53	*Persea minutiflora*	Lauraceae	1.93			
54	*Styrax serrulatus*	Styracaceae	1.89	0.09		0.04
55	*Eurya acuminata*	Theaceae	1.83	17.80	5.91	0.47
56	*Terminalia myriocarpa*	Combretaceae	1.78	60.64	68.56	19.27
57	*Ilex dipyrena*	Aquifoliaceae	1.65		0.15	
58	*Lithocarpus pachyphyllus*	Fagaceae	1.64			50.90
59	*Quercus semecarpifolia*	Fagaceae	1.55			
60	*Helicia nilagirica*	Proteaceae	1.53	16.22		4.07
61	*Lithocarpus fenestratus*	Fagaceae	1.33		0.70	
62	*Symplocos lucida*	Symplocaceae	1.05		1.18	
63	*Pandanus furcatus*	Pandanaceae	0.97			2.43
64	*Tetradium ruticarpum*	Rutaceae	0.93			
65	*Mangifera sylvatica*	Anacardiaceae	0.70	0.02	29.50	12.10
66	*Ficus cyrtophylla*	Moraceae	0.65			0.06
67	*Skimmia arborescens*	Rutaceae	0.56		0.87	
68	*Kydia calycina*	Malvaceae	0.55			
69	*Rhododendron hodgsonii*	Ericaceae	0.50			
70	*Neolitsea cuipala*	Lauraceae	0.44	7.42		1.87
71	*Schefflera impressa*	Araliaceae	0.39		4.65	10.12
72	*Cinnamomum bejolghota*	Lauraceae	0.37	3.02	26.03	7.94
73	*Ficus heteropleura*	Moraceae	0.33		0.27	0.19
74	*Phoebe attenuata*	Lauraceae	0.32	0.09	11.66	70.56
75	*Ilex kingiana*	Aquifoliaceae	0.30	0.01		
76	*Trevesia palmata*	Araliaceae	0.26			
77	*Ficus oligodon*	Moraceae	0.26		0.32	0.02
78	*Cordia grandis*	Boraginaceae	0.25			
79	*Dysoxylum excelsul*	Meliaceae	0.23		1.10	
80	*Ficus submulata*	Moraceae	0.18			

81	*Cinnadenia paniculata*	Lauraceae	0.14			
82	*Ficus subincisa*	Moraceae	0.11		0.96	0.06
83	*Macaranga peltata*	Euphorbiaceae	0.10		10.75	
84	*Actinodaphne obovata*	Lauraceae	0.05			
85	*Dobinea vulgaris*	Anacardiaceae	0.04			
86	*Cinnamomum impressinervium*	Lauraceae	0.03	0.11	3.19	6.42
87	*Gordonia excelsa*	Theaceae	0.03	9.67		1.39
88	*Bridelia tomentosa*	Euphorbiaceae	0.03			
89	*Macaranga pustulata*	Euphorbiaceae	0.01	19.83		
90	*Cryptocarya amygdalina*	Lauraceae	0.01	0.02		3.89
91	*Schima khasiana*	Theaceae		130.48		6.05
92	*Persea bootanica*	Lauraceae		115.70		6.03
93	*Beilschmiedia gammieana*	Lauraceae		81.09		11.62
94	*Cryptocarya bhutanica*	Lauraceae		31.54		3.05
95	*Exbucklandia populnea*	Hamamelidaceae		29.79	2.51	26.71
96	*Ailanthus integrifolia*	Simaroubaceae		20.52		
97	*Picrasma quassioides*	Simaroubaceae		14.90		
98	*Eriobotrya dubia*	Rosaceae		11.75	2.54	
99	*Litsea albescens*	Lauraceae		10.50		
100	*Myrica esculenta*	Myricaceae		8.88	2.83	
101	*Michelia doltsopa*	Magnoliaceae		5.76	0.45	
102	*Cinnamomum pauciflorum*	Lauraceae		5.53		
103	*Alcimandra cathcartii*	Magnoliaceae		3.25		0.14
104	*Persea duthiei*	Lauraceae		3.21		0.08
105	*Symplocos dryophila*	Symplocaceae		2.59	21.08	
106	*Michelia punduana*	Magnoliaceae		1.85		3.04
107	*Neolitsea foliosa*	Lauraceae		0.46	8.65	
108	*Persea odoratissima*	Lauraceae		0.21	0.02	18.61
109	*Carthium glabrum*	Betulaceae		0.20		
110	*Beilschmiedia dalzellii*	Lauraceae		0.01		6.79
111	*Callicarpa longifolia*	Verbenaceae		0.01		0.01
112	*Rhododendron arboreum*	Ericaceae			107.48	
113	*Syzygium claviflorum*	Myrtaceae			52.56	0.07
114	*Duabanga grandiflora*	Sonneratiaceae			36.58	31.22
115	*Quercus thomsoniana*	Fagaceae			19.49	
116	*Symplocos cochinchinensis*	Symplocaceae			15.71	
117	*Diploknema butyracea*	Sapotaceae			8.81	
118	*Cinnamomum glaucescens*	Lauraceae			7.49	
119	*Rhododendron kesangiae*	Ericaceae			7.04	
120	*Macaranga denticulata*	Euphorbiaceae			6.67	
121	*Terminalia chebula*	Combretaceae			6.35	
122	*Callicarpa arborea*	Verbenaceae			6.24	
123	*Mallotus philippensis*	Euphorbiaceae			3.68	2.54

124	*Cinnamomum tamala*	Lauraceae			2.11	
125	*Wendlandia grandis*	Rubiaceae			1.41	
126	*Baccaurea ramiflora*	Euphorbiaceae			0.91	0.69
127	*Saurauja nepaulensis*	Actinidiaceae			0.78	
128	*Rhododendron arboreum subsp. delavyi*	Ericaceae			0.65	
129	*Syzygium venosum*	Myrtaceae			0.39	2.76
130	*Pterospermum acerifolium*	Sterculiaceae			0.31	11.03
131	*Quercus oxyodon*	Fagaceae			0.27	
132	*Litsea glutinosa*	Lauraceae			0.21	7.24
133	*Brassaiopsis glomerulata*	Araliaceae			0.19	0.35
134	*Ficus semicordata*	Moraceae			0.13	1.46
135	*Polyalthia simiarum*	Annonaceae			0.09	0.54
136	*Dysoxylum grande*	Meliaceae			0.08	
137	*Castanopsis lanceifolia*	Fagaceae				38.52
138	*Pterospermum javanicum*	Sterculiaceae				8.89
139	*Knema tenuinervia*	Myristicacea				7.67
140	*Toona sureni*	Meliaceae				5.33
141	*Artocarpus chama*	Moraceae				2.71
142	*Gynocardia odorata*	Flacourtiaceae				2.67
143	*Heteropanax fragrans*	Araliaceae				2.22
144	*Mallotus nepalensis*	Euphorbiaceae				1.22
145	*Cleidion spiciflorum*	Euphorbiaceae				1.18
146	*Heliciopsis terminalis*	Proteaceae				1.00
147	*Litsea cubeba*	Lauraceae				0.26
148	*Lithocarpus dealbatus*	Fagaceae				0.24
149	*Artocarpus lacucha*	Moraceae				0.17
150	*Litsea elongata*	Lauraceae				0.04
151	*Symplocos untia*	Symplocaceae				0.02
152	*Tarennoidea wallichii*	Rubiaceae				0.01
153	*Beilschmiedia roxburghiana*	Lauraceae				0.01
154	*Ficus benjamina*	Moraceae				0.01
155	*Alstonia scholaris*	Apocynaceae				
156	*Bridelia pubescens*	Euphorbiaceae				
157	*Elaeocarpus sikkimensis*	Elaeocarpaceae				
158	*Elaeocarpus varunua*	Elaeocarpaceae				
159	*Macaranga indica*	Euphorbiaceae				
160	*Michelia velutina*	Magnoliaceae				
161	*Persea fructifera*	Lauraceae				
162	*Stereospermum colais*	Bignoniaceae				
163	*Wendlandia coriacea*	Compositae				
	Sub-total		**1250.15**	**1372.79**	**1270.76**	**852.81**

	Conifer Tree					
164	*Abies densa*	Pinaceae	289.94		95.33	
165	*Pinus wallichiana*	Pinaceae	196.97		34.50	
166	*Tsuga dumosa*	Pinaceae	78.20		160.84	
167	*Pinus roxburghii*	Pinaceae	14.70		193.54	
168	*Taxus baccata*	Taxaceae	0.34		1.69	
169	*Juniperus recurva*	Cupressaceae	0.19		230.11	
170	*Cupressus corneyana*	Cupressaceae			86.03	
171	*Pinus bhutanica*	Pinaceae			14.21	
172	*Podocarpus neriifolius*	Podocarpaceae			2.67	
173	*Picea spinulosa*	Pinaceae				
	Sub-total		**580.34**		**818.93**	
	Deciduous Tree					
174	*Alnus nepalensis*	Betulaceae	40.16	80.16	39.92	
175	*Hovenia acerba*	Rhamnaceae	34.91			48.07
176	*Juglans regia*	Juglandaceae	30.33			
177	*Erythrina stricta*	Leguminosae	30.14			
178	*Acer campbellii*	Aceraceae	25.74	59.00	2.45	0.32
179	*Casearia glomerata*	Flacourtiaceae	23.88	2.82		0.08
180	*Symplocos paniculata*	Symplocaceae	17.77			
181	*Quercus griffithii*	Fagaceae	16.12		44.57	3.34
182	*Albizia chinensis*	Leguminosae	15.77			0.01
183	*Dalbergia sericea*	Leguminosae	10.59			11.62
184	*Lyonia ovalifolia*	Ericaceae	7.81	11.38	6.81	0.40
185	*Tetracentron sinense*	Tetracentraceae	5.94			
186	*Erythrina arborescens*	Leguminosae	5.87			
187	*Fraxinus floribunda*	Oleaceae	4.82	29.90	6.50	6.16
188	*Magnolia campbellii*	Magnoliaceae	4.52		55.41	
189	*Parasassafras confertiflora*	Lauraceae	3.49			
190	*Corylus ferox*	Betulaceae	2.95			
191	*Brassaiopsis hainla*	Araliaceae	2.93			
192	*Lindera neesiana*	Lauraceae	2.55		0.01	
193	*Chukrasia tabularis*	Meliaceae	2.42			
194	*Tetradium fraxinifolium*	Rutaceae	2.19			
195	*Alangium chinense*	Alangiaceae	1.85			
196	*Sterculia villosa*	Sterculiaceae	1.58		5.99	20.00
197	*Gamblea ciliata*	Araliaceae	1.54			
198	*Brassaiopsis mitis*	Araliaceae	1.38			
199	*Macropanax undulatus*	Araliaceae	1.14			
200	*Lyonia villosa*	Ericaceae	1.09		2.36	
201	*Bauhinia purpurea*	Leguminosae	1.01			
202	*Pentapanax racemosus*	Araliaceae	0.91			
203	*Malus baccata*	Rosaceae	0.83			

204	*Vitex quinata*	Verbenaceae	0.77			1.45
205	*Nayariophyton zizyphifolium*	Malvaceae	0.62		0.76	
206	*Casearia zeylanica*	Flacourtiaceae	0.49			0.93
207	*Celtis tetrandra*	Ulmaceae	0.43		5.04	0.01
208	*Salix myrtillacea*	Salicaceae	0.32			
209	*Wrightia arborea*	Apocynaceae	0.29			4.91
210	*Prunus napaulensis*	Rosaceae	0.29			
211	*Nathopodytes foetida*	Valerianaceae	0.26			
212	*Lindera pulcherrima*	Lauraceae	0.21		1.17	1.28
213	*Acer hookeri*	Aceraceae	0.19		3.88	
214	*Premna barbata*	Verbenaceae	0.11		0.65	
215	*Radermachera sinica*	Bignoniaceae	0.07	1.06		1.46
216	*Sorbus arachnoidea*	Rosaceae	0.07			
217	*Morus macroura*	Moraceae		75.59	3.41	
218	*Carpinus viminea*	Betulaceae		23.95		
219	*Betula alnoides*	Betulaceae		20.29	4.40	23.58
220	*Acrocarpus fraxinifolius*	Leguminosae			52.57	
221	*Betula utilis*	Betulaceae			21.79	
222	*Prunus carmesina*	Rosaceae			18.79	0.05
223	*Choerospondias axillaris*	Anacardiaceae			7.77	7.43
224	*Fraxinus paxiana*	Oleaceae			7.59	
225	*Rhus succedanea*	Anacardiaceae			4.77	
226	*Albizia procera*	Leguminosae			4.07	
227	*Bombax ceiba*	Bombacaceae			3.01	
228	*Lannea coromandelica*	Anacardiaceae			2.98	
229	*Prunus cornuta*	Rosaceae			0.34	
230	*Oroxylum indicum*	Bignoniaceae			0.27	
231	*Phyllanthus emblica*	Euphorbiaceae			0.20	3.90
232	*Lindera assamica*	Lauraceae			0.20	
233	*Alangium alpinum*	Alangiaceae			0.12	
234	*Ficus racemosa*	Moraceae				22.12
235	*Dendrocnide sp*	Urticaceae				19.48
236	*Elaeocarpus lanceifolius*	Elaeocarpaceae				4.66
237	*Albizia gamblei*	Leguminosae				1.83
238	*Heynea trijuga*	Meliaceae				0.96
239	*Aralia foliolosa*	Araliaceae				0.37
240	*Spondias pinnata*	Anacardiaceae				0.31
241	*Acer thomsonii*	Aceraceae				0.18
242	*Bauhinia variegata*	Leguminosae				0.02
243	*Elaeocarpus aristatus*	Elaeocarpaceae				0.02
244	*Acer sikkimense*	*Aceraceae*				
245	*Alangium chinensis*	*Alangiaceae*				
246	*Albizia lebbeck*	*Leguminosae*				

247	*Chisocheton cumingianus*	*Meliaceae*				
248	*Docynia indica*	*Rosaceae*				
249	*Enkianthus deflexus*	*Ericaceae*				
250	*Litsea sericea*	*Lauraceae*				
251	*Phyllanthus reticulatus*	*Verbenaceae*				
252	*Phyllanthus reticulatus*	*Euphorbiaceae*				
253	*Picrasma javanica*	*Simaroubaceae*				
254	*Prunus cerasoides*	*Rosaceae*				
255	*Prunus persica*	*Rosaceae*				
256	*Pyrus communis*	*Rosaceae*				
257	*Salix sikkimensis*	*Salicaceae*				
258	*Sorbus wallichii*	*Rosaceae*				
259	*Wightia speciosissima*	*Rubiaceae*				
	Sub-total		**306.37**	**304.16**	**307.78**	**184.94**
	Evergreen Shrub					
260	*Rhododendron bhutanense*	Ericaceae	162.92			
261	*Rhododendron aeruginosum*	Ericaceae	28.24			
262	*Rhododendron fulgens*	Ericaceae	8.64		0.14	
263	*Myrsine semiserrata*	Myrsinaceae	4.94	0.45	2.89	0.31
264	*Rhododendron campylocarpum*	Ericaceae	2.68			
265	*Rhododendron campanulatum*	Ericaceae	2.61		1.55	
266	*Cocculus laurifolius*	Menispermaceae	2.37			
267	*Rhododendron lanatum*	Ericaceae	1.56			
268	*Oreocnide rubescens*	Urticaceae	1.43			0.51
269	*Glochidion khasicum*	Euphorbiaceae	0.99		0.79	0.03
270	*Mitrephora harai*	Annonaceae	0.95		2.07	
271	*Rhododendron wallichii*	Ericaceae	0.83			
272	*Symplocos pyrifolia*	Symplocaceae	0.73			
273	*Microcos paniculata*	Gramineae	0.73			
274	*Euonymus grandiflorus*	Celastraceae	0.71			
275	*Viburnum cylindricum*	Caprifoliaceae	0.62		11.26	
276	*Glochidion acuminatum*	Euphorbiaceae	0.59			0.74
277	*Maesa indica*	Myrsinaceae	0.56		0.33	
278	*Flueggea virosa*	Euphorbiaceae	0.38			0.06
279	*Lasiococca symphylllifolia*	Boraginaceae	0.36			
280	*Maytenus hookeri*	Celastraceae	0.30	0.61		0.04
281	*Trema tomentosa*	Ulmaceae	0.25			
282	*Eurya cerasifolia*	Theaceae	0.23		0.15	0.25
283	*Randia Spinusa*	Bignoniaceae	0.23			
284	*Boehmeria glomerulifera*	Urticaceae	0.23			
285	*Strobilanthes himalayana*	Acanthaceae	0.21		0.22	0.01
286	*Tabernaemontana divaricata*	Apocynaceae	0.18			0.14
287	*Grewia sepiaria*	Tiliaceae	0.18			

288	*Boehmeria macrophylla*	Urticaceae	0.17		0.72	0.11
289	*Microtropis discolor*	Celastraceae	0.16	1.90		12.47
290	*Capparis acutifolia*	Capparaceae	0.13	0.01		
291	*Glochidion velutinum*	Euphorbiaceae	0.11		2.14	
292	*Maesa chisia*	Myrsinaceae	0.09	0.21		0.01
293	*Dichroa febrifuga*	Hydrangeaceae	0.08			
294	*Ligustrum confusum*	Oleaceae	0.08			
295	*Maytenus kurzii*	Celastraceae	0.07	0.13	0.01	
296	*Maytenus rufa*	Celastraceae	0.07			
297	*Bridelia sikkimensis*	Euphorbiaceae	0.04			
298	*Strobilanthes cusia*	Acanthaceae	0.03	0.05		
299	*Strobilanthes helicta*	Acanthaceae	0.02		0.01	
300	*Scurrula elata*	Loranthaceae	0.01			
301	*Cotoneaster bacillaris*	Rosaceae	0.01			
302	*Pilea hookeriana*	Urticaceae	0.01			
303	*Vaccinium subdissitifolium*	Ericaceae	0.01			
304	*Ardisia macrocarpa*	Myrsinaceae	0.01	0.44		
305	*Leptoboea multiflora*	Gesneriaceae	0.01			
306	*Luculia gratissima*	Rubiaceae	0.01		0.02	
307	*Piper pedicellatum*	Piperaceae	0.01	0.03		
308	*Smilax myrtillus*	Smilacaceae	0.00			
309	*Salacia oblonga*	Alismataceae	0.00			
310	*Agapetes serpens*	Ericaceae	0.00			
311	*Periploca calophylla*	Asclepiadaceae	0.00			
312	*Elatostema integrifolium*	Urticaceae	0.00			
313	*Agapetes smithiana*	Ericaceae	0.00			
314	*Vaccinium retusum*	Ericaceae	0.00			
315	*Strobilanthes capiata*	Acanthaceae	0.00			
316	*Strobilanthes divaricata*	Acanthaceae	0.00			
317	*Camellia kissii*	Theaceae		2.26		
318	*Photinia integrifolia*	Rosaceae		0.60		
319	*Strobilanthes claviculata*	Acanthaceae		0.39		
320	*Phlogacanthus pubinervius*	Acanthaceae		0.29	0.05	
321	*Nostolachma khasiana*	Rubiaceae		0.16		
322	*Dendrocnide sinuata*	Urticaceae		0.16		0.02
323	*Solanum pseudocapsicum*	Solanaceae		0.15		
324	*Croton caudatus*	Euphorbiaceae		0.02		1.25
325	*Citrus medica*	Rutaceae		0.01		
326	*Rhododendron thomsonii*	Ericaceae			2.41	
327	*Rhus paniculata*	Anacardiaceae			1.52	
328	*Pieris formosa*	Ericaceae			0.92	
329	*Glycosmis pentaphylla*	Rutaceae			0.79	
330	*Alstonia sebusi*	Apocynaceae			0.35	

331	*Micromelum integerrimum*	Rutaceae			0.34	
332	*Gaultheria griffithiana*	Ericaceae			0.29	
333	*Metrephora harai*	Araliaceae			0.28	
334	*Rhododendron keysii*	Ericaceae			0.20	
335	*Rhododendron barbatum*	Ericaceae			0.17	
336	*Oxyspora paniculata*	Melastomataceae			0.15	
337	*Woodfordia fruticosa*	Lythraceae			0.07	
338	*Rubus ellipticus*	Rosaceae			0.04	
339	*Randia spinosa*	Bignoniaceae			0.04	0.02
340	*Mahonia nepaulensis*	Berberidaceae			0.03	
341	*Boehmeria ternifolia*	Urticaceae			0.03	
342	*Sarcococca wallichii*	Buxaceae			0.03	
343	*Spermadictyon suaveolens*	Rubiaceae			0.03	
344	*Vernonia volkameriifolia*	Compositae			0.03	
345	*Cotoneaster microphyllus*	Rosaceae			0.03	
346	*Colebrookea oppositifolia*	Labiatae			0.02	
347	*Osyris lanceolata*	Santalaceae			0.02	
348	*Rhododendron maddenii*	Ericaceae			0.01	
349	*Gaultheria fragrantissima*	Ericaceae			0.00	
350	*Justicia adhatoda*	Acanthaceae				0.56
351	*Lasianthus biermannii*	Rubiaceae				0.44
352	*Skimmia laureola*	Rutaceae				0.37
353	*Baliospermum densiflorum*	Euphorbiaceae				0.24
354	*Floscopa scandens*	Commelinaceae				0.07
355	*Ficus squamosa*	Moraceae				0.02
356	*Debregeasia wallichiana*	Urticaceae				0.02
357	*Phlogacanthus thyrsiformis*	Acanthaceae				0.01
358	*Ardisia bhotanica*	Myrsinaceae				0.01
359	*Glochidion lanceolarium*	Euphorbiaceae				0.00
360	*Agapetes auriculata*	*Ericaceae*				
361	*Agapetes saligna*	*Ericaceae*				
362	*Agapetes variegata*	*Ericaceae*				
363	*Brugmansia suaveolens*	*Solanaceae*				
364	*Citrus limon*	*Rutaceae*				
365	*Debregeasia longifolia*	*Urticaceae*				
366	*Ficus hederacea*	*Moraceae*				
367	*Miliusa roxburghiana*	*Annonaceae*				
368	*Poikilospermum suavolens*	*Urticaceae*				
369	*Psychotria calocarpa*	*Rubiaceae*				
370	*Psychotria denticulata*	*Rubiaceae*				
371	*Reissantia arborea*	*Hippocrateaceae*				
372	*Rhynchotechum vestitum*	*Gesneriaceae*				
373	*Schefflera tenuis*	*Araliaceae*				

374	*Smilax rigida*	*Smilacaceae*				
375	*Vaccinium vaccinaceum*	*Ericaceae*				
376	*Crotalaria cytisoides*	*Leguminosae*				
377	*Desmodium motorium*	*Leguminosae*				
378	*Gynura bicolor*	*Compositae*				
379	*Gynura nepalensis*	*Compositae*				
380	*Hibiscus lobatus*	*Malvaceae*				
381	*Lindernia ruellioides*	*Scrophulariaceae*				
382	*Periploca callophylla*	*Labiatae*				
383	*Phyllanthus urinaria*	*Euphorbiaceae*				
384	*Podophyllum hexandrum*	*Podophyllaceae*				
	Sub-total		**225.82**	**7.88**	**30.15**	**17.71**
	Deciduous Shrub					
385	*Drypetes indica*	Euphorbiaceae	12.54	0.58		7.39
386	*Viburnum erubescens*	Caprifoliaceae	2.29	0.40	0.39	
387	*Vitex negundo*	Verbenaceae	2.19			
388	*Prunus rufa*	Rosaceae	1.79			
389	*Hydrangea heteromalla*	Hydrangeaceae	1.55		0.44	
390	*Viburnum nervosum*	Caprifoliaceae	1.52			
391	*Rosa sericea*	Rosaceae	1.38		4.54	
392	*Murraya koenigii*	Rutaceae	0.93		1.01	2.50
393	*Indigera dosua*	Bignoniaceae	0.34		0.33	
	Daphne bholua	Thymelaeaceae	0.28	0.02	1.47	
394	*Sambucus nigra*	Caprifoliaceae	0.24			
395	*Prunus undulata*	Rosaceae	0.15			
396	*Solanum erianthum*	Solanaceae	0.13			
397	*Edgeworthia gardneri*	Thymelaeaceae	0.10			
398	*Hydrangea stylosa*	Hydrangeaceae	0.10			
399	*Potentilla arbuscula*	Rosaceae	0.10			
400	*Philadelphus tomentosus*	Philadelphaceae	0.10			
401	*Daphne involucrata*	Thymelaeaceae	0.07	0.08		
402	*Lepisanthes senegalensis*	Sapindaceae	0.07			
403	*Sorbus microphylla*	Rosaceae	0.06		2.71	
404	*Elaeagnus conferta*	Elaeagnaceae	0.06		0.38	
405	*Sterculia hamiltonii*	Sterculiaceae	0.06		0.50	0.01
406	*Buddleja paniculata*	Buddlejaceae	0.05		0.01	
407	*Sophora wightii*	Leguminosae	0.05			
408	*Elaeagnus parvifolia*	Elaeagnaceae	0.04			
409	*Solanum spirale*	Solanaceae	0.04		0.00	
410	*Zanthoxylum armatum*	Rutaceae	0.03		1.30	
411	*Hibiscus fragrans*	Meliaceae	0.03			
412	*Hydrangea aspera*	Hydrangeaceae	0.02			0.06
413	*Berberis asiatica*	Berberidaceae	0.02		0.01	

414	*Buddleja asiatica*	Buddlejaceae	0.02			
415	*Berberis aristata*	Berberidaceae	0.02			
416	*Ribes griffithii*	Grossulariaceae	0.02			
417	*Hypericum choisianum*	Hypericaceae	0.02			
418	*Morus australis*	Moraceae	0.02			
419	*Lonicera quinquelocularis*	Caprifoliaceae	0.01			
420	*Rubus pentagonus*	Rosaceae	0.01			
421	*Rubus thomsonii*	Rosaceae	0.01			
422	*Rhus chinensis*	Anacardiaceae		4.37	1.57	
423	*Psilanthus bengalensis*	Rubiaceae		0.15		0.11
424	*Clerodendrum colebrookeanum*	Verbenaceae		0.05		
425	*Cannabis sativa*	Cannabceae		0.02		
426	*Aconogonon molle*	Polygonaceae		0.01		
427	*Euphorbia royleana*	Euphorbiaceae			8.51	
428	*Grewia eriocarpa*	Tiliaceae			3.54	6.78
429	*Coriaria napalensis*	Coriariaceae			0.69	
430	*Desmodium elegans*	Leguminosae			0.64	2.89
431	*Casearia graveolens*	Flacourtiaceae			0.52	
432	*Elaeagnus pyriformis*	Elaeagnaceae			0.43	
433	*Berberis hookeri*	Berberidaceae			0.10	
434	*Piptanthus nepalensis*	Leguminosae			0.07	
435	*Leea asiatica*	Leeaceae			0.07	
436	*Clerodendrum japonicum*	Verbenaceae			0.03	
437	*Leptodermis stapfiana*	Rubiaceae			0.02	
438	*Phyllanthus clarkei*	Euphorbiaceae			0.01	
439	*Maddenia himalaica*	Rosaceae			0.01	
440	*Ficus hispida*	Moraceae			0.01	
441	*Brandisia hancei*	Compositae			0.00	
442	*Elaeagnus infundibularis*	Elaeagnaceae			0.00	
443	*Croton joufra*	Euphorbiaceae				6.37
444	*Pterygota alata*	Sterculiaceae				3.47
445	*Grewia sapida*	Tiliaceae				1.76
446	*Sophora velutina*	Leguminosae				0.16
447	*Mackaya indica*	Acanthaceae				0.02
448	*Desmodium caudatum*	Leguminosae				0.02
449	*Chromolaena odoratum*	Compositae				0.00
450	*Rubus lineatus*	Rosaceae				0.00
451	*Ficus hirta*	Moraceae				0.00
452	*Aconogonon polystachyum*	*Polygonaceae*				
453	*Berberis cooperi*	*Cornaceae*				
454	*Berberis griffithiana*	*Berberidaceae*				
455	*Berberis praecipua*	*Berberidaceae*				
456	*Clerodendron serratum*	*Capparaceae*				

457	*Clerodendrum hastatum*	*Verbenaceae*				
458	*Clerodendrum viscosum*	*Verbenaceae*				
459	*Clerodrendrum colebrookeanum*	*Verbenaceae*				
460	*Corylopsis himalayana*	*Hamamelidaceae*				
461	*Crotalaria cytisoides*	*Araliaceae*				
462	*Daphne sureil*	*Thymelaeaceae*				
463	*Desmodium gangeticum*	*Leguminosae*				
464	*Desmodium mortonii*	*Leguminosae*				
465	*Desmodium oblongum*	*Leguminosae*				
466	*Desmodium triquetrum*	*Leguminosae*				
467	*Gaultheria nummularioides*	*Ericaceae*				
468	*Gaultheria semi-infera*	*Ericaceae*				
469	*Gaultheria trichophylla*	*Ericaceae*				
470	*Hypericum gramineum*	*Hypericaceae*				
471	*Hypericum hookerianum*	*Hypericaceae*				
472	*Indegofera decora*	*Bignoniaceae*				
473	*Indigofera autopuperea*	*Leguminosae*				
474	*Indigofera dosua*	*Leguminosae*				
475	*Leea guineensis*	*Leeaceae*				
476	*Leptodermis stafiana*	*Rubiaceae*				
477	*Ligustrum compactum*	*Oleaceae*				
478	*Melastoma normale*	*Melastomataceae*				
479	*Meyna spinosa*	*Rubiaceae*				
480	*Neillia thyrsiflora*	*Rosaceae*				
481	*Osbeckia nepalensis*	*Melastomataceae*				
482	*Pavetta indica*	*Passifloraceae*				
483	*Polygayla arillata*	*Polygalaceae*				
484	*Rhododendron virgatum*	*Ericaceae*				
485	*Ribes glaciale*	*Grossulariaceae*				
486	*Ribes himalense*	*Grossulariaceae*				
487	*Ricinus communis*	*Euphorbiaceae*				
488	*Rubus alexeterius*	*Rosaceae*				
489	*Rubus indotibetanus*	*Rosaceae*				
490	*Rubus pectinariodes*	*Rosaceae*				
491	*Sambucus javanica*	*Caprifoliaceae*				
492	*Sambucus nigra*	*Caprifoliaceae*				
493	*Scurrula pulverulenta*	*Loranthaceae*				
494	*Solanum villosum*	*Solanaceae*				
495	*Spiraea bella*	*Rosaceae*				
496	*Viburnum continifolium*	*Caprifoliaceae*				
497	*Viburnum mullaha*	*Caprifoliaceae*				
498	*Zanthoxylum oxyphyllum*	*Rutaceae*				
499	*Actaea acuminata*	*Ranunculaceae*				

	Sub-total		26.45	5.68	29.34	31.54
	Climbers					
500	*Euonymus vagans*	Celastraceae	2.42			
501	*Gnetum montanum*	Gnetaceae	0.61		0.75	
502	*Hedera nepalensis*	Araliaceae	0.51			
503	*Rhamnus virgatus*	Rhamnaceae	0.51			
504	*Bauhinia scandens*	Leguminosae	0.41			
505	*Beaumontia grandiflora*	Apocynaceae	0.41		0.02	0.00
506	*Tetrastigma serrulatum*	Vitaceae	0.32		0.23	0.45
507	*Tetrastigma leucostaphylum*	Vitaceae	0.31			3.12
508	*Tetrastigma corymbosum*	Vitaceae	0.29			0.62
509	*Caesalpinia cucullata*	Leguminosae	0.26			
510	*Trichosanthes lepiniana*	Cucurbitaceae	0.24			0.06
511	*Dalbergia pinnata*	Leguminosae	0.18			0.01
512	*Toddalia asiatica*	Rutaceae	0.18		0.04	
513	*Acacia pennata*	Leguminosae	0.18			
514	*Piper mullesua*	Piperaceae	0.13			0.13
515	*Rhaphidophora decursiva*	Araceae	0.12	0.00		0.05
516	*Piper longum*	Piperaceae	0.09	0.06		0.04
517	*Paramignya monophylla*	Rutaceae	0.09			
518	*Piper betleoides*	Piperaceae	0.07		0.01	
519	*Ficus sarmentosa*	Moraceae	0.07			
520	*Gongronema ventricosum*	Asclepiadaceae	0.05			
521	*Smilax elegans*	Smilacaceae	0.05			
522	*Schefflera roxburghii*	Araliaceae	0.04			
523	*Combretum flagrocarpum*	Combretaceae	0.04			0.00
524	*Pterolobum macropterum*	Leguminosae	0.03			
525	*Tetrastigma aplinianum*	Vitaceae	0.02			
526	*Cryptolepis buchanani*	Asclepiadaceae	0.02			0.01
527	*Piper suipigua*	Piperaceae	0.01			
528	*Derris polystachya*	Leguminosae	0.01			
529	*Poikilospermum lanceolatum*	Urticaceae	0.01			
530	*Clematis montana*	Ranunculaceae	0.01			
531	*Rubus efferatus*	Rosaceae	0.01			
532	*Aristolochia griffithii*	Aristolochiaceae	0.01			
533	*Rubia wallichiana*	Rubiaceae	0.01		0.00	
534	*Clematis acutangula*	Ranunculaceae	0.01			
535	*Stilbanthus scandens*	Amaranthaceae	0.01			
536	*Rubia manjith*	Rubiaceae	0.00			
537	*Toxocarpus aurantiacus*	Asclepiadaceae	0.00		2.19	0.16
538	*Dioscorea belophylla*	Dioscoreaceae	0.00			
539	*Clematis smilacifolia*	Ranunculaceae	0.00			
540	*Clematis buchananiana*	Ranunculaceae	0.00			

541	*Clematis acuminata*	Ranunculaceae	0.00		0.01	
542	*Aristolochia platanifolia*	Aristolochiaceae	0.00			
543	*Aeschynanthus superbus*	Gesneriaceae	0.00			
544	*Celastrus monospermus*	Celastraceae	0.00			
545	*Cyclea bicristata*	Menispermaceae	0.00			
546	*Jasminum dispermum*	Oleaceae	0.00			
547	*Schefflera bengalensis*	Araliaceae		0.06		
548	*Actinidia callosa*	Actinidiaceae			0.94	
549	*Holboellia augustifolia*	Apocynaceae			0.35	
550	*Berchemia floribunda*	Rhamnaceae			0.16	
551	*Tetrastigma objectum*	Vitaceae			0.14	
552	*Uncaria scandens*	Rubiaceae			0.09	
553	*Ficus heterophylla*	Moraceae			0.05	
554	*Paederia foetida*	Rubiaceae			0.02	
555	*Smilax menispermoidea*	Smilacaceae			0.01	
556	*Schisandra grandiflora*	Schisandraceae			0.01	
557	*Rhaphidophora hookeri*	Araceae			0.01	
558	*Rubus paniculatus*	Rosaceae			0.00	
559	*Dioscorea pubera*	Dioscoreaceae			0.00	
560	*Tetrastigma planicaule*	Vitaceae				0.82
561	*Rhamnus napalensis*	Rhamnaceae				0.03
562	*Chonemorpha fragrans*	Apocynaceae				0.02
563	*Tetrastigma rumicispermum*	Vitaceae				0.01
564	*Goniothalamus sesquipedalis*	Asclepiadaceae				0.01
565	*Caesalpinia crista*	Sterculiaceae				0.01
566	*Smilax ferox*	Smilacaceae				0.01
567	*Smilax lanceifolia*	Smilacaceae				0.01
568	*Tetrastigma bracteolatum*	Vitaceae				0.00
569	*Toxocarpus himalensis*	Asclepiadaceae				0.00
570	*Derris recticulata*	Leguminosae				0.00
571	*Actinidia strigosa*	Actinidiaceae				
572	*Aeshynanthus sikkimensis*	Hippocastanaceae				
573	*Argyreia venusta*	Convolvulaceae				
574	*Aristolochia tagala*	Aristolochiaceae				
575	*Aschynanthus sikkimensis*	Aristolochiaceae				
576	*Celastrus stylosus*	Celastraceae				
577	*Cissus rapanda*	Vitaceae				
578	*Euchrestra horsfieldii*	Leguminosae				
579	*Flemingia fruticulosa*	Leguminosae				
580	*Hodgsonia macrocarpa*	Cucurbitaceae				
581	*Hoelboellia latifolia*	Cucurbitaceae				
582	*Holmskioldia sanguinea*	Verbenaceae				
583	*Lonicera acuminata*	Caprifoliaceae				

584	*Millettia extensa*	Leguminosae				
585	*Mimosa himalayana*	Leguminosae				
586	*Mucuna imbricata*	Leguminosae				
587	*Mucuna macrocarpa*	Leguminosae				
588	*Paederia cruddasiana*	Rubiaceae				
589	*Piper sylvaticum*	Piperaceae				
590	*Porana racemosa*	Convolvulaceae				
591	*Pueraria edulis*	Leguminosae				
592	*Pueraria lobata*	Leguminosae				
593	*Smilax lanceifolia*	Elaeocarpaceae				
594	*Smilax aspericaulis*	Smilacaceae				
595	*Smilax minutiflora*	Smilacaceae				
596	*Smilax prolifera*	Smilacaceae				
597	*Stephania glabra*	Thymelaeaceae				
598	*Stephania glandulifera*	Menispermaceae				
599	*Thunbergia coccinea*	Acanthaceae				
600	*Trachelospermum lucidum*	Apocynaceae				
601	*Trichosanthes cordata*	Cucurbitaceae				
602	*Dioscorea bulbifera*	Dioscoreaceae				
603	*Rhaphidophora grandis*	Araceae				
604	*Rhophidophora hookeri*	Commelinaceae				
605	*Rubia hispidicaulis*	Rubiaceae				
606	*Stephania glabra*	Menispermaceae				
607	*Thladiantha cordifolia*	Cucurbitaceae				
608	*Thunbergia grandiflora*	Acanthaceae				
	Sub-total		**7.76**	**0.13**	**5.02**	**5.56**
	Evergreen Palm					
609	*Wallichia densiflora*	Arecaceae(Palmae)	0.59		0.53	0.01
610	*Calamus acanthospathus*	Arecaceae(Palmae)	0.03			0.06
611	*Caryota urens*	Arecaceae(Palmae)	0.03			0.78
612	*Cythea spinusa*	Gramineae		5.80		
613	*Plectocomia himalayana*	Arecaceae(Palmae)		0.12	0.17	0.04
614	*Calamus latifolius*	Arecaceae(Palmae)		0.04		0.05
615	*Cycas pectinata*	Cycadaceae			24.25	
616	*Phoenix rupicola*	Arecaceae(Palmae)			2.65	
617	*Cythea spinosa*	Gramineae				1.33
618	*Arenga westerhoutii*	Arecaceae(Palmae)				0.83
619	*Musa griersonii*	Musaceae				0.80
620	*Musa thomsonii*	Musaceae				0.36
621	*Pandanus unguifer*	Pandanaceae				0.07
622	*Calamus erectus*	Arecaceae(Palmae)				0.03
623	*Calamus flagellum*	*Arecaceae(Palmae)*				
624	*Phoenix acaulis*	*Arecaceae(Palmae)*				

625	*Phoenix aurea*	*Arecaceae(Palmae)*				
626	*Phoenix loureiri*	*Arecaceae(Palmae)*				
627	*Wallichia disticha*	*Arecaceae(Palmae)*				
	Sub-total		**0.64**	**5.96**	**27.60**	**4.36**
	Grassess & Bamboos					
628	*Chimonobambusa callosa*	Gramineae	2.35	3.36	8.71	0.01
629	*Thysanolaena latifolia*	Gramineae	0.02		0.02	0.26
630	*Drepanostachyum annulatum*	Gramineae	0.01		0.01	
631	*Yushania maling*	Gramineae		0.04	0.09	
632	*Arundinaria racemosa*	Gramineae			1.57	
633	*Arundo donax*	Gramineae			0.02	
634	*Dendrocalamus hamiltonii*	Gramineae				0.48
635	*Pseudostachyum polymorphum*	Gramineae				0.03
636	*Borinda grossa*	*Gramineae*				
637	*Arundinella hookeri*	*Gramineae*				
638	*Brachypodium sylvaticum*	*Gramineae*				
639	*Danthonia cumminsii*	*Gramineae*				
640	*Drepanostachyum khasiaum*	*Gramineae*				
641	*Eragrostis nigra*	*Gramineae*				
642	*Eragrostis tenella*	*Gramineae*				
643	*Festuca wallichiana*	*Gramineae*				
644	*Imperata cylindrica*	*Gramineae*				
645	*Muhlenbergia huegelii*	*Gramineae*				
646	*Poa annua*	*Gramineae*				
647	*Saccharum spontaneum*	*Gramineae*				
	Sub-total		**2.39**	**3.40**	**10.42**	**0.78**
	Herbs					
	Perennial Herb		**RD%**	**RD%**	**RD%**	**RD%**
648	*Potentilla peduncularis*	Rosaceae	126.06			115.84
649	*Pilea approximata*	Urticaceae	60.45			
650	*Ainsliaea latifolia*	Compositae	59.09			52.82
651	*Diplazium esculentum*	Diapensiaceae	57.31		11.57	3.59
652	*Cautleya spicata*	Zingiberaceae	56.04			
653	*Amomum subulatum*	Zingiberaceae	55.03			
654	*Elatostema heteroloba*	Urticaceae	51.87			
655	*Juncus brachystigma*	Juncaceae	50.55			
656	*Elatostema platyphyllum*	Urticaceae	49.18	6.19		8.45
657	*Asplenium nidus*	Malpighiaceae	43.66			
658	*Achyrospermum wallichianum*	Labiatae	39.10	49.23		84.93
659	*Elatostema hookerianum*	Urticaceae	37.50	37.19		
660	*Bistorta vacciniifolia*	Polygonaceae	34.02			
661	*Strobilanthes jennyae*	Acanthaceae	32.78			43.40

662	*Tupistra nutans*	Convallariaceae	32.60		2.16	
663	*Hedychium spicatum*	Zingiberaceae	23.12		16.12	95.04
664	*Cautleya gracilis*	Zingiberaceae	22.03		4.14	0.72
665	*Streptolirion volubile*	Commelinaceae	19.33		0.71	
666	*Juncus thomsonii*	Juncaceae	19.10			17.91
667	*Hemiphragma heterophyllum*	Scrophulariaceae	18.16			7.78
668	*Carex nubigena*	Cyperaceae	17.73			
669	*Isodon lophanthoides*	Labiatae	14.81			
670	*Elatostema monandrum*	Urticaceae	13.40	4.55		
671	*Acanthocalyx nepalensis*	Morinaceae	13.08			
672	*Aconitum bulbilliferum*	Ranunculaceae	12.00			
673	*Selaginella bisulcata*	Crassulaceae	11.90	152.34		68.70
674	*Elatostema nasutum*	Urticaceae	11.65		3.79	5.05
675	*Begonia hatacoa*	Begoniaceae	11.57			
676	*Carex atrofusca*	Cyperaceae	11.56			25.27
677	*Rubus calycinus*	Rosaceae	10.08			2.48
678	*Arisaema flavum*	Araceae	9.86			
679	*Arisaema consanguineum*	Araceae	9.55			
680	*Elatostema obtusum*	Urticaceae	9.03			0.57
681	*Oxalis griffithii*	Oxalidaceae	8.79			1.41
682	*Ranunculus diffusus*	Ranunculaceae	8.11		1.12	
683	*Alocasia fallax*	Araceae	8.03		0.85	
684	*Valeriana jatamansi*	Valerianaceae	7.47			
685	*Bistorta griffithii*	Polygonaceae	7.05			
686	*Urtica parviflora*	Urticaceae	6.92	51.82		
687	*Pteridium aquilinum*	Rubiaceae	6.87			
688	*Juncus sphacelatus*	Juncaceae	6.76			
689	*Persicaria runcinata*	Polygonaceae	6.35			
690	*Juncus benghalensis*	Juncaceae	6.28			
691	*Lloydia flavonutans*	Liliaceae	6.05			
692	*Paris polyphylla*	Trilliaceae	5.75			2.84
693	*Arisaema nepenthoides*	Araceae	5.30			
694	*Strobilanthes tamburensis*	Acanthaceae	5.30			
695	*Lysionotus serratus*	Gesneriaceae	5.14			
696	*Petasites tricholobus*	Compositae	4.99			
697	*Commelina maculata*	Commelinaceae	4.86			0.30
698	*Bistorta perpusilla*	Polygonaceae	4.76			
699	*Arisaema tortuosum*	Araceae	4.42			
700	*Elatostema sessile*	Urticaceae	4.28		3.83	4.55
701	*Bistorta amplexicaulis*	Polygonaceae	4.06			3.89
702	*Juncus himalensis*	Juncaceae	4.03			4.45
703	*Strobilanthes lamiifolia*	Acanthaceae	3.79		26.18	
704	*Pilea insilens*	Urticaceae	3.31			

705	*Viola bulbosa*	Violaceae	3.11			
706	*Viola diffusa*	Violaceae	3.09			
707	*Fritillaria cirrhosa*	Liliaceae	2.92			
708	*Ranunculus pulchellus*	Ranunculaceae	2.84			
709	*Mimulus nepalensis*	Scrophulariaceae	2.82			
710	*Bergenia purpurascens*	Saxifragaceae	2.73			
711	*Leibnitzia nepalensis*	Compositae	2.61			
712	*Plantago erosa*	Plantaginaceae	2.45			
713	*Caltha scaposa*	Ranunculaceae	2.43			
714	*Peperomia tetraphylla*	Piperaceae	2.38			
715	*Fragaria nubicola*	Rosaceae	2.38			11.10
716	*Bistorta macrophylla*	Polygonaceae	2.32			
717	*Strobilanthes lachenensis*	Acanthaceae	2.28			
718	*Clintonia udensis*	Uvulariaceae	2.18			1.30
719	*Polygonatum singalilense*	Convallariaceae	1.96			
720	*Procris crenata*	Urticaceae	1.80			
721	*Commelina paludosa*	Commelinaceae	1.72		37.58	
722	*Pilea clarkei*	Urticaceae	1.72		0.43	
723	*Arisaema speciosum*	Araceae	1.70		2.98	
724	*Hemidesmus indicus*	Hemerocallidaceae	1.53			
725	*Astilbe rivularis*	Saxifragaceae	1.50			
726	*Pouzolzia hirta*	Urticaceae	1.37	9.29		
727	*Allium rhabdotum*	Alliaceae	1.36			
728	*Elatostema subincisum*	Urticaceae	1.19			
729	*Euphorbia stracheyi*	Euphorbiaceae	1.00			
730	*Ophiopogon decanoides*	Convallariaceae	0.99			
731	*Geum elatum*	Rosaceae	0.94			1.56
732	*Persicaria nepalensis*	Polygonaceae	0.86			
733	*Ophiorrhiza rosea*	Rubiaceae	0.85			
734	*Hedychium aurantiacum*	Zingiberaceae	0.78			
735	*Viola biflora*	Violaceae	0.76			2.41
736	*Pedicularis rhinanthoides*	Scrophulariaceae	0.76			
737	*Begonia josephii*	Begoniaceae	0.72	24.79		
738	*Pyrola corbieri*	Pyrolaceae	0.64			
739	*Senecio scandens*	Compositae	0.63			5.01
740	*Caltha palustris*	Ranunculaceae	0.60			0.96
741	*Carex duthiei*	Cyperaceae	0.54			
742	*Iris clarkei*	Iridaceae	0.43			
743	*Potentilla microphylla var. latiloba*	Rosaceae	0.43			
744	*Aletris gracilis*	Melanthiaceae	0.43			
745	*Pilea bracteosa*	Urticaceae	0.42			
746	*Begonia gemmipara*	Begoniaceae	0.32			
747	*Bistorta milletii*	Polygonaceae	0.31			

748	*Roscoea alpina*	Zingiberaceae	0.31			0.57
749	*Anemone demissa*	Ranunculaceae	0.16			
750	*Pinguicula alpina*	Lentibulariaceae	0.05	184.76		27.13
751	*Aconitum ferox*	Ranunculaceae		102.63		
752	*Allium wallichii*	Alliaceae		28.47	43.50	
753	*Anemone rivularis*	Ranunculaceae		22.24	5.28	77.33
754	*Arisaema elephas*	Araceae		15.80		
755	*Arisaema galeatum*	Araceae		15.46		
756	*Artemisia tukuchaensis*	Compositae		14.29		11.85
757	*Asplenium yoshinegae*	Malpighiaceae		7.44		
758	*Aster diplostephioides*	Compositae		7.07	17.89	2.20
759	*Begonia annulata*	Begoniaceae		4.82		
760	*Begonia cathcartii*	Begoniaceae		4.02		6.43
761	*Begonia megaptera*	Begoniaceae		3.26		
762	*Begonia palmata*	Begoniaceae		3.13		
763	*Cardiocrinum giganteum*	Liliaceae		0.46		
764	*Carex atrata*	Cyperaceae	27.83			9.25
765	*Carex alopecuroides*	Cyperaceae		0.36		
766	*Carex alopecuroides*	Cyperaceae		0.25	95.64	
767	*Carex baccans*	Cyperaceae			89.89	
768	*Carex breviculmis*	Cyperaceae			83.45	1.35
769	*Carex condensata*	Cyperaceae			65.97	
770	*Carex decora*	Cyperaceae			52.56	
	Chromolaena odoratum	Compositae			42.30	
771	*Dipteris conjugata*	Dipsacaceae			2.60	
772	*Elatostema dissectum*	Urticaceae			2.02	
773	*Elatostema imbricans*	Urticaceae			1.99	
774	*Elatostema rupestre*	Urticaceae			1.92	
775	*Euphorbia griffithii*	Euphorbiaceae			1.54	
776	*Gerbera maxima*	Compositae			0.84	
777	*Hedychium ellipticum*	Zingiberaceae			0.43	
778	*Pilea umbrosa*	Urticaceae				126.95
779	*Selaginella monospora*	Crassulaceae				87.54
780	*Nephrolepis cordifolia*	Sapindaceae				60.81
	Pilea hookeriana	Urticaceae				37.80
781	*Kobresia woodii*	Cyperaceae				35.90
782	*Theropogon pallidus*	Convallariaceae				30.28
783	*Pyrossia sp*	Pyrolaceae				25.07
784	*Pilea racemosa*	Urticaceae				18.90
785	*Persicaria microcephala*	Polygonaceae				16.74
786	*Oxalis leucolepis*	Oxalidaceae				15.81
787	*Rumex nepalensis*	Polygonaceae				13.67
788	*Parasenecio quinquelobus*	Compositae				12.48

789	*Maianthemum purpureum*	Convallariaceae				11.51
790	*Ligularia fischeri*	Compositae				11.42
791	*Ophiopogon clarkei*	Convallariaceae				10.51
792	*Persicaria capitata*	Polygonaceae				10.38
793	*Ligularia mortonii*	Compositae				9.29
794	*Pedicularis siphonantha*	Scrophulariaceae				8.08
795	*Lindenbergia grandiflora*	Scrophulariaceae				7.10
796	*Lloydia longiscapa*	Liliaceae				6.05
797	*Polygonatum hookeri*	Convallariaceae				5.03
798	*Juncus duthiei*	Juncaceae				4.67
799	*Rungia himalayensis*	Acanthaceae				4.60
800	*Molineria crassifolia*	Hypoxidaceae				4.04
801	*Selaginella imbracta*	Crassulaceae				3.93
802	*Potentilla supina*	Rosaceae				2.59
803	*Lycopodium spp*	Solanaceae				2.37
804	*Phrynium placentarium*	Marantaceae				2.20
805	*Persicaria dolichopoda*	Polygonaceae				2.13
806	*Tacca integrifolia*	Taccaceae				2.10
807	*Pteridium aquilinum*	Rubiaceae				2.05
808	*Streptopus simplex*	Uvulariaceae				1.91
809	*Pilea symmeria*	Urticaceae				1.89
810	*Pteris dactylina*	Rubiaceae				1.58
811	*Rubus pectinaroides*	Rosaceae				1.07
812	*Selaginella fimbrata*	Crassulaceae				0.90
813	*Viola betonicifolia*	Violaceae				0.64
814	*Viola pilosa*	Violaceae				0.60
815	*Strobilanthes hamiltoniana*	Acanthaceae				0.60
816	*Trifolium repens*	Leguminosae				0.46
817	*Maianthemum oleraceum*	Convallariaceae				0.24
818	*Ranunculus silerifolius*	Ranunculaceae				0.18
819	*Viola bhutanica*	Violaceae				0.16
820	*Arenaria edgeworthiana*	*Caryophyllaceae*				
821	*Arenaria ludlowii*	*Caryophyllaceae*				
822	*Artemisia bhutanica*	*Compositae*				
823	*Astragalus cytissoides*	*Leguminosae*				
824	*Bistorta vaccinifolia*	*Polygonaceae*				
825	*Cassiope fastigiata*	*Ericaceae*				
826	*Cassiope selaginoides*	*Ericaceae*				
827	*Costus speciosus*	*Costaceae*				
828	*Iris domestica*	*Iridaceae*				
829	*Potentilla peduncullaris*	*Rosaceae*				
830	*Salix lindleyana*	*Salicaceae*				
831	*Saxifraga saxorum*	*Saxifragaceae*				

832	*Treutlera insignis*	*Asclepiadaceae*				
833	*Aconogonon campanulatum*	*Polygonaceae*				
834	*Acorus calamus*	*Acoraceae*				
835	*Allium macranthum*	*Alliaceae*				
836	*Amaranthus spinosus*	*Amaranthaceae*				
837	*Amaranthus viridis*	*Amaranthaceae*				
838	*Anagallis arvensis*	*Primulaceae*				
839	*Anemone obtusiloba*	*Ranunculaceae*				
840	*Anemone rupestris*	*Ranunculaceae*				
841	*Anisodus luridus*	*Solanaceae*				
842	*Arisaema concinnum*	*Araceae*				
843	*Arisaema griffithii*	*Araceae*				
844	*Artemisia austroyunnanensis*	*Compositae*				
845	*Asplenium gueinzianum*	*Malpighiaceae*				
846	*Asplenium macrophyllum*	*Malpighiaceae*				
847	*Asplinium macrophyllum*	*Malpighiaceae*				
848	*Aster albescens*	*Compositae*				
849	*Aster himalaicus*	*Compositae*				
850	*Aster neoelegans*	*Compositae*				
851	*Begonia ovatifolia*	*Begoniaceae*				
852	*Boenninghausenia abiflora*	*Urticaceae*				
853	*Bryocarpum himalaicum*	*Primulaceae*				
854	*Carlemannia griffithii*	*Carlemanniaceae*				
855	*Carpesium nepalense*	*Compositae*				
856	*Colocasia fallax*	*Araceae*				
857	*Corallodiscus bhutanicus*	*Gesneriaceae*				
858	*Curcuma aromatica*	*Zingiberaceae*				
859	*Cuscuta reflexa*	*Cuscutaceae*				
860	*Cyananthus lobatus*	*Campanulaceae*				
861	*Cyperus cyperoides*	*Cyperaceae*				
862	*Dipteris wallichiana*	*Dipsacaceae*				
863	*Doronicum roylei*	*Compositae*				
864	*Drynaria coronans*	*Caryophyllaceae*				
865	*Drynaria mollis*	*Caryophyllaceae*				
866	*Drynaria propinqua*	*Caryophyllaceae*				
867	*Dubyaea hispida*	*Compositae*				
868	*Duchesnea indica*	*Rosaceae*				
869	*Euphorbia hirta*	*Euphorbiaceae*				
870	*Euphorbia thymifolia*	*Euphorbiaceae*				
871	*Fragaria nubicola*	*Rosaceae*				
872	*Gentiana capitata*	*Gentianaceae*				
873	*Gentiana depressa*	*Gentianaceae*				
874	*Gentiana elwesii*	*Gentianaceae*				

875	*Gentiana karelinii*	*Gentianaceae*				
876	*Gentiana veitchiorum*	*Gentianaceae*				
877	*Gypsophylla cerastioides*	*Caryophyllaceae*				
878	*Hedychium thyrsiforme*	*Zingiberaceae*				
879	*Houttuynia cordata*	*Saururaceae*				
880	*Hoya polyneura*	*Asclepiadaceae*				
881	*Ixeridium beauverdianum*	*Compositae*				
882	*Leontopodium jacotianum*	*Compositae*				
883	*Lepisorus loriformis*	*Sapindaceae*				
884	*Lindenbergia indica*	*Scrophulariaceae*				
885	*Llyodia tibetica*	*Liliaceae*				
886	*Lycopodium clavatum*	*Solanaceae*				
887	*Lygodium japonicum*	*Solanaceae*				
888	*Mazus surculosus*	*Scrophulariaceae*				
889	*Megacodon stylophorus*	*Gentianaceae*				
890	*Microssorium phyllomanes*	*Cruciferae*				
891	*Mikania micrantha*	*Compositae*				
892	*Mulgedium bracteatum*	*Compositae*				
893	*Neopicrorhiza scrophulariiflora*	*Scrophulariaceae*				
894	*Ophiopogon bodinieri*	*Convolvulaceae*				
895	*Oxygraphic polypetala*	*Oxalidaceae*				
896	*Panax pseudo ginseng*	*Ranunculaceae*				
897	*Pauzolzia hirta*	*Passifloraceae*				
898	*Pilea glaberrima*	*Urticaceae*				
899	*Polygonatum cathcartii*	*Convallariaceae*				
900	*Polygonatum sibiricum*	*Convallariaceae*				
901	*Potentilla cuneata*	*Rosaceae*				
902	*Potentilla griffithii*	*Rosaceae*				
903	*Pteris wallichiana*	*Rubiaceae*				
904	*Ranunculus brotherusi*	*Ranunculaceae*				
905	*Rheum australe*	*Polygonaceae*				
906	*Rubus fockeanus*	*Rosaceae*				
907	*Saussurea obvallata*	*Compositae*				
908	*Saxifraga strigosa*	*Saxifragaceae*				
909	*Scirpus ternatanus*	*Cyperaceae*				
910	*Synotis wallichii*	*Compositae*				
911	*Verbena officinalis*	*Verbenaceae*				
	Sub-total		**1275.04**	**749.87**	**619.27**	**1310.64**
	Annual Herb					
912	*Ageratum conyzoides*	Compositae	133.25			
913	*Thalictrum foetidum*	Ranunculaceae	50.94			21.28
914	*Lecanthus peduncularis*	Urticaceae	50.51			
915	*Thalictrum foliolosum*	Ranunculaceae	17.31	2.17		

916	*Meconopsis paniculata*	Papaveraceae	12.73			
917	*Rheum accuminatum*	Polygonaceae	12.60			
918	*Chamabainia cuspidata*	Urticaceae	10.28			2.41
919	*Blumea lanceolaria*	Compositae	6.08			
920	*Polygonum plebeium*	Polygonaceae	5.46	7.74		
921	*Halenia elliptica*	Gentianaceae	4.70			4.08
922	*Cirsium falconeri*	Compositae	3.82			2.16
923	*Geranium procurrens*	Geraniaceae	3.64			
924	*Anaphalis margaritacea*	Compositae	3.48			
925	*Swertia bimaculata*	Gentianaceae	3.44			
926	*Phytolacca acinosa*	Phytolaccaceae	3.13			
927	*Achyranthes bidentata*	Amaranthaceae	2.63			
928	*Shuteria involucrata*	Leguminosae	2.58			
929	*Primula calderiana*	Primulaceae	2.56			
930	*Primula primulina*	Primulaceae	2.21			
931	*Blumea lacera*	Compositae	2.14			
932	*Vincetoxicum hirundinaria*	Asclepiadaceae	2.13		1.41	
933	*Pycnoplinthopsis bhutanica*	Cruciferae	2.04			
934	*Meconopsis horidula*	Papaveraceae	2.03			
935	*Swertia pseudohookeri*	Gentianaceae	2.03			
936	*Meconopsis sinuata*	Papaveraceae	2.02			
937	*Impatiens arguta*	Balsaminaceae	1.54			
938	*Galium aparine*	Rubiaceae	1.38			
939	*Primula whitei*	Primulaceae	1.31			
940	*Senecio wallichii*	Compositae	1.31			30.54
941	*Galium elegans*	Rubiaceae	1.29			
942	*Anaphalis busua*	Compositae	1.19			
943	*Primula sikkimensis*	Primulaceae	1.18			
944	*Primula macrophylla*	Primulaceae	1.15			
945	*Rheum spiciforme*	Polygonaceae	1.14			
946	*Veronica persica*	Scrophulariaceae	1.03			
947	*Anaphalis xylorhiza*	Compositae	1.01			
948	*Primula strumosa*	Primulaceae	1.01			
949	*Spergula arvensis*	Caryophyllaceae	0.94			
950	*Impatiens puberula*	Balsaminaceae	0.82			
951	*Senecio laetus*	Compositae	0.81			
952	*Oxytropis lapponica*	Leguminosae	0.81			
953	*Primula elongata*	Primulaceae	0.70			
954	*Androsace strigillosa*	Primulaceae	0.68			
955	*Androsace geraniifolia*	Primulaceae	0.68			
956	*Silene nepalensis*	Caryophyllaceae	0.65			
957	*Primula denticulata*	Primulaceae	0.54			10.31
958	*Silene indica*	Caryophyllaceae	0.51			

959	*Pegaeophyton scapiflorum*	Cruciferae	0.51			
960	*Mandragora caulescens*	Solanaceae	0.49			
961	*Anaphalis contorta*	Compositae	0.46			
962	*Androsace hookeriana*	Primulaceae	0.41			
963	*Drosera peltata*	Droseraceae	0.37			
964	*Omphalogramma elwesiana*	Primulaceae	0.37			
965	*Primula atrodentata*	Primulaceae	0.34			
966	*Primula gracilipes*	Primulaceae	0.33			
967	*Geranium nakaoanum*	Geraniaceae	0.31			
968	*Oxyria digyna*	Polygonaceae	0.30			
969	*Arenaria densissima*	Caryophyllaceae	0.25			
970	*Monotropa uniflora*	Monotropaceae	0.25			
971	*Anaphalis nepalensis*	Compositae	0.17			
972	*Angelica cyclocarpa*	Umbelliferae	0.16			
973	*Achyranthes aspera*	Amaranthaceae		106.08		1.95
974	*Adiantum edgeworthii*	Compositae		91.14		
975	*Ainsliaea aptera*	Compositae		49.54		
976	*Anaphalis triplinervis*	Compositae		26.03		
977	*Arachniodes henryi*	Leguminosae		20.79		
978	*Asymbelenthus sikkimensis*	Leguminosae		7.03		
979	*Blumea aromatica*	Compositae		2.84		
980	*Bolbitis augustifolia*	Nyctaginaceae		1.69		
981	*Crassocephalum crepidioides*	Compositae			19.39	
982	*Desmodium laxum*	Leguminosae			6.24	
983	*Desmodium triflorum*	Leguminosae			5.52	
984	*Dicliptera bupleuroides*	Acanthaceae			4.23	
985	*Elsholtzia blanda*	Labiatae			1.88	
986	*Elsholtzia stachyodes*	Labiatae			1.88	
987	*Flemingia macrophylla*	Leguminosae			1.11	
988	*Galium megacyttarion*	Rubiaceae			1.10	
989	*Geranium lambertii*	Geraniaceae			0.86	
990	*Girardinia diversifolia*	Urticaceae			0.76	
991	*Gueldenstaedtia himalaica*	Leguminosae			0.52	
992	*Hydrocotyle himalaica*	Umbelliferae			0.23	
993	*Hydrocotyle nepalensis*	Umbelliferae			0.21	
994	*Hymenasplenium*	Acanthaceae			0.15	
995	*Impatiens balsamina*	Balsaminaceae			0.12	
996	*Impatiens discolor*	Balsaminaceae			0.09	
997	*Peliosanthes griffithii*	Convallariaceae				64.60
998	*Solanum torvum*	Solanaceae				10.51
999	*Silene gonosperma*	Caryophyllaceae				7.83
1000	*Rubus fragarioides*	Rosaceae				7.59
1001	*Indigofera trifoliata*	Leguminosae				4.02

1002	*Ligusticum acuminatum*	Umbelliferae				1.93
1003	*Urtica ardens*	Urticaceae				0.55
1004	*Thalictrum javanicum*	Ranunculaceae				0.36
1005	*Thalictrum punduanum*	Ranunculaceae				0.19
1006	*Impatiens racemosa*	Balsaminaceae				0.80
1007	*Impatiens urticifolia*	Balsaminaceae				0.66
1008	*Boenninghausenia albiflora*	*Rutaceae*				
1009	*Centella asiatica*	*Umbelliferae*				
1010	*Girardinia palmata*	*Urticaceae*				
1011	*Pleurospermum hookeri*	*Umbelliferae*				
1012	*Saussurea gossypiphora*	*Compositae*				
1013	*Sida acuta*	*Malvaceae*				
1014	*Sida rhombifolia*	*Malvaceae*				
1015	*Triumfetta annua*	*Tiliaceae*				
1016	*Triumfetta rhomboidea*	*Tiliaceae*				
1017	*Urena lobata*	*Malvaceae*				
1018	*Acmella uliginosa*	*Compositae*				
1019	*Acronema hookeri*	*Umbelliferae*				
1020	*Agelica sikkimensis*	*Agavaceae*				
1021	*Agrimonia pilosa*	*Rosaceae*				
1022	*Alectra avensis*	*Magnoliaceae*				
1023	*Aletris pauciflora*	*Melanthiaceae*				
1024	*Bidens pilosa*	*Compositae*				
1025	*Bistorta vivipara*	*Polygonaceae*				
1026	*Brassica juncea*	*Cruciferae*				
1027	*Bupleurum dalhousieanum*	*Umbelliferae*				
1028	*Campanula pallida*	*Campanulaceae*				
1029	*Capsella bursa-pastroris*	*Cruciferae*				
1030	*Cardamine macrophylla*	*Cruciferae*				
1031	*Chenopodium album*	*Chenopodiaceae*				
1032	*Chirita bifolia*	*Gesneriaceae*				
1033	*Chirita oblongifolia*	*Gesneriaceae*				
1034	*Chirita pumila*	*Gesneriaceae*				
1035	*Clinopodium umbrosum*	*Labiatae*				
1036	*Conyza floribunda*	*Compositae*				
1037	*Cortia drepressa*	*Umbelliferae*				
1038	*Corydalis ecristata*	*Fumariaceae*				
1039	*Crassocephalum crepidoides*	*Compositae*				
1040	*Cyanotis vaga*	*Commelinaceae*				
1041	*Cynoglossum furcatum*	*Boraginaceae*				
1042	*Dichrocephala integrifolia*	*Compositae*				
1043	*Disporum cantoniense*	*Uvulariaceae*				
1044	*Draba elata*	*Cruciferae*				

1045	*Galinsoga parviflora*	*Compositae*				
1046	*Galium aparene*	*Compositae*				
1047	*Galium sikkimense*	*Rubiaceae*				
1048	*Geranium donianum*	*Geraniaceae*				
1049	*Geranium nepalense*	*Geraniaceae*				
1050	*Gerenium nepalense*	*Compositae*				
1051	*Impatience spirifer*	*Illiciaceae*				
1052	*Impatiens cristata*	*Balsaminaceae*				
1053	*Impatiens exilis*	*Balsaminaceae*				
1054	*Impatiens florigera*	*Balsaminaceae*				
1055	*Impatiens radiata*	*Balsaminaceae*				
1056	*Leucas ciliata*	*Labiatae*				
1057	*Lobelia pyramidalis*	*Liliaceae*				
1058	*Lobelia nummularia*	*Campanulaceae*				
1059	*Lysimachia japonica*	*Primulaceae*				
1060	*Lysimachia lobelioides*	*Primulaceae*				
1061	*Maianthemum fuscum*	*Convallariaceae*				
1062	*Mellisa axillaris*	*Labiatae*				
1063	*Mianthemum oleraceum*	*Rubiaceae*				
1064	*Myosotis alpestris*	*Boraginaceae*				
1065	*Ophiorrhiza fasciculata*	*Rubiaceae*				
1066	*Oxalis corniculata*	*Oxalidaceae*				
1067	*Parthenium hysterophorus*	*Compositae*				
1068	*Picris hieracioides*	*Compositae*				
1069	*Polygonum chinense*	*Polygonaceae*				
1070	*Primula bellidifolia*	*Primulaceae*				
1071	*Primula bracteosa*	*Primulaceae*				
1072	*Primula chasmophila*	*Primulaceae*				
1073	*Primula glabra*	*Primulaceae*				
1074	*Primula listeri*	*Primulaceae*				
1075	*Primula obliqua*	*Primulaceae*				
1076	*Prunella vulgaris*	*Labiatae*				
1077	*Pseudognaphalium affine*	*Compositae*				
1078	*Rungia pectinata*	*Acanthaceae*				
1079	*Sanicula elata*	*Umbelliferae*				
1080	*Scoparia dulcis*	*Scrophulariaceae*				
1081	*Scutellaria discolor*	*Labiatae*				
1082	*Senoeio raphanifolius*	*Compositae*				
1083	*Siegesbeckia orientalis*	*Malvaceae*				
1084	*Solanum americanum*	*Solanaceae*				
1085	*Sphaeranthus indicus*	*Compositae*				
1086	*Spongiocarpella purpurea*	*Leguminosae*				
1087	*Stachys melissaefolia*	*Labiatae*				

1088	*Stellaria vestita*	*Caryophyllaceae*				
1089	*Swertia wardii*	*Gentianaceae*				
1090	*Tabacum nicotianum*	*Myrtaceae*				
1091	*Thalictrum chelidonii*	*Ranunculaceae*				
1092	*Thalictrum rostellatum*	*Ranunculaceae*				
1093	*Tiarella polyphylla*	*Saxifragaceae*				
1094	*Tongoloa loloensis*	*Umbelliferae*				
1095	*Tricyrtis maculata*	*Uvulariaceae*				
1096	*Uticularia striatula*	*Urticaceae*				
1097	*Verbascum thapsus*	*Scrophulariaceae*				
1098	*Viola canescens*	*Violaceae*				
1099	*Youngia japonica*	*Compositae*				
	Sub-total		**370.10**	**315.06**	**45.70**	**171.77**
	Grasses & Bamboos					
1100	*Polystichum squarrosum*	Gramineae	69.01			
1101	*Oplismenus compositus*	Gramineae	34.71	123.90	52.94	68.70
	Yushania maling	Gramineae	27.90			
1102	*Ophiopogon wallichianus*	Convallariaceae	22.37		3.87	
1103	*Digitaria cruciata*	Gramineae	5.32			0.42
1104	*Digitaria ciliaris*	Gramineae	3.22	8.06		
	Chimonobambusa callosa	Gramineae			48.16	3.39
1105	*Cymbopogon flexuosus*	Gramineae			17.07	
1106	*Cyrtococcum patens*	Gramineae			8.59	
1107	*Digitaria abludens*	Gramineae			4.14	
1108	*Drepanostachyum intermedium*	Gramineae			2.53	
1109	*Dynaria cordata*	Gramineae			2.32	13.75
1110	*Dynaria quercifolia*	Gramineae			2.31	0.39
1111	*Yushania microphylla*	Gramineae				52.54
1112	*Oplismenus undulatifolius*	Gramineae				11.52
1113	*Oplismenus compositus var. rariflorus*	Gramineae				8.80
	Thysanolaena latifolia	Gramineae				6.91
1114	*Oplismenus burmannii*	Gramineae				2.78
	Sub-total		**162.53**	**131.96**	**141.93**	**169.20**
	Orchid					
1115	*Phaius mishmensis*	Orchidaceae	48.97		3.02	
1116	*Calanthe biloba*	Orchidaceae	18.34		0.86	
1117	*Cypripedium cordigerum*	Orchidaceae	3.13			
1118	*Goodyera viridiflora*	Orchidaceae	2.84			
1119	*Calanthe plantaginea*	Orchidaceae	1.88		1.52	
1120	*Calanthe alismifolia*	Orchidaceae	1.33	1.41		3.35
1121	*Cheirostylis moniliformis*	Orchidaceae	0.86			
1122	*Calanthe sylvatica*	Orchidaceae		1.49		

1123	*Calanthe triplicata*	Orchidaceae		1.34		60.70
1124	*Cypripedium guttatum*	Orchidaceae			13.90	
1125	*Cypripedium himalaicum*	Orchidaceae			8.67	
1126	*Goodyera hemsleyana*	Orchidaceae			0.74	
1127	*Goodyera procera*	Orchidaceae			0.70	
1128	*Goodyera vittata*	Orchidaceae			0.67	
1129	*Odontochilus crispus*	Orchidaceae				8.17
1130	*Paphiopedilum fairrieanum*	Orchidaceae				6.05
1131	*Phaius flavus*	Orchidaceae				3.23
1132	*Aorchis spathulata*	Orchidaceae				
1133	*Calanthae brevicornu*	Orchidaceae				
	Sub-total		**77.36**	**4.24**	**30.07**	**81.50**
	Climbers					
	Piper longum	Piperaceae	80.26			
1134	*Monachosorum henryii*	Cucurbitaceae	61.81			
	Piper mullesua	Piperaceae	17.36		24.70	
1135	*Crawfurdia speciosa*	Gentianaceae	16.27			
	Smilax ferox	Smilacaceae	13.70			
1136	*Cynanchum auriculatum*	Asclepiadaceae	13.09			
	Hedera nepalensis	Araliaceae	10.65			2.93
	Rubia manjith	Rubiaceae	5.05	1.13		
	Rhaphidophora hookeri	Araceae	4.01			
1137	*Holboellia latifolia*	Lardizabalaceae	3.93			
1138	*Crawfurdia campanulacea*	Gentianaceae	3.44			
	Tetrastigma serrulatum	Vitaceae	2.31			37.27
	Clematis acutangula	Ranunculaceae	1.28			
1139	*Parthenocissus semicordata*	Vitaceae	1.28			
1140	*Rubia sikkimensis*	Rubiaceae	1.12			
1141	*Piper chuvya*	Piperaceae	1.12		4.98	
	Cyclea bicristata	Menispermaceae	0.86			
1142	*Cissampelopsis corifolia*	Compositae	0.82		0.96	
	Rubia wallichiana	Rubiaceae	0.79			
1143	*Solena amplexicaulis*	Cucurbitaceae	0.67			
1144	*Rhaphidophora calophylla*	Araceae	0.42	0.98		3.49
	Jasminum dispermum	Oleaceae	0.11			31.37
1145	*Ariopsis peltata*	Convolvulaceae		17.28	0.94	
1146	*Asparagus filicinus*	Asparagaceae		13.09		
1147	*Asparagus racemosus*	Asparagaceae		8.92		
	Chonemorpha fragrans	Apocynaceae			46.95	
	Clematis acuminata	Ranunculaceae			32.82	
	Clematis buchananiana	Ranunculaceae			30.34	
1148	*Clematis puberula*	Ranunculaceae			21.29	
1149	*Dioscorea kamoonensis*	Dioscoreaceae			3.73	

1150	*Dioscorea prazeri*	Dioscoreaceae			3.03	
1151	*Ficus pubigera*	Moraceae			1.28	
1152	*Gouania leptostachya*	Rhamnaceae			0.58	0.63
1153	*Hedyotis scandens*	Rubiaceae			0.40	
1154	*Smilax perfoliata*	Smilacaceae				53.13
1155	*Lonicera angustifolia*	Caprifoliaceae				45.26
	Toxocarpus aurantiacus	Asclepiadaceae				36.86
	Tetrastigma leucostaphylum	Vitaceae				24.12
	Tetrastigma objectum	Vitaceae				17.27
1156	*Mossaenda treutleri*	Rubiaceae				15.90
1157	*Rhaphidophora glauca*	Araceae				10.38
1158	*Pothos cathcartii*	Araceae				7.41
	Piper suipigua	Piperaceae				3.88
	Tetrastigma rumicispermum	Vitaceae				2.85
	Tetrastigma corymbosum	Vitaceae				2.59
1159	*Manachosorum henryi*	Malvaceae				2.18
1160	*Piper peepuloides*	Piperaceae				1.89
	Rhaphidophora decursiva	Araceae				1.82
	Toxocarpus himalensis	Asclepiadaceae				0.96
1161	*Smilax aspera*	Smilacaceae				0.85
1162	*Lonicera macrantha*	Caprifoliaceae				0.50
1163	*Jasminum elongatum*	Oleaceae				0.27
	Tetrastigma bracteolatum	Vitaceae				0.07
	Smilax elegans	Smilacaceae				0.05
	Sub-total		**240.34**	**41.41**	**171.99**	**303.90**
	Evergreen Shrub					
1164	*Chloranthus elatior*	Chloranthaceae	167.67	14.06	17.88	82.12
1165	*Rhododendron setosum*	Ericaceae	123.85			
1166	*Rhododendron lepidotum*	Ericaceae	50.87			
	Osyris lanceolata	Santalaceae	30.82			
	Strobilanthes himalayana	Acanthaceae	25.78		24.67	15.90
1167	*Cassiope fastigata*	Ericaceae	14.70			
1168	*Vaccinium nummularia*	Ericaceae	12.09			23.03
	Agapetes serpens	Ericaceae	10.00			
	Smilax myrtillus	Smilacaceae	9.60	1.49	2.94	73.09
	Strobilanthes divaricata	Acanthaceae	9.06			
1169	*Elatostema lineolatum*	Urticaceae	4.34	3.35	0.03	
1170	*Rhododendron anthopogon*	Ericaceae	4.04			
1171	*Pilea scripta*	Urticaceae	3.53			8.89
1172	*Dischidia benghalensis*	Asclepiadaceae	3.17			
	Strobilanthes claviculata	Acanthaceae	2.87			
	Periploca calophylla	Asclepiadaceae	2.42			
1173	*Ageratina adenophora*	Compositae		57.89		

	Ardisia macrocarpa	Myrsinaceae		19.19		
1174	*Athyrium foliolosum*	Acanthaceae		6.62		
	Baliospermum densiflorum	Euphorbiaceae		6.03		
1175	*Barleia strigosa*	Acanthaceae		5.22		
1176	*Barleria cristata*	Acanthaceae		4.84		16.13
	Boehmeria macrophylla	Urticaceae		2.00		
1177	*Boehmeria penduliflora*	Urticaceae		1.73		
1178	*Jasminum officinale*	Oleaceae				24.42
	Piper pedicellatum	Piperaceae				21.03
	Sarcococca wallichii	Buxaceae				4.82
1179	*Strobilanthes echinata*	Acanthaceae				3.91
1180	*Strobilanthes inflata*	Acanthaceae				2.85
1181	*Strobilanthes frondosa*	Acanthaceae				1.99
1182	*Rauvolfia serpentina*	Apocynaceae				1.08
1183	*Rhododendron edgeworthii*	Ericaceae				0.71
	Strobilanthes capiata	Acanthaceae				0.26
	Vernonia volkameriifolia	Compositae				0.12
	Sub-total		**474.83**	**122.43**	**45.53**	**280.35**
	Deciduous Shrub					
	Aconogonon molle	Polygonaceae	43.51			
	Daphne bholua	Thymelaeaceae	22.70			
1184	*Rhodiola himalensis*	Crassulaceae	7.57			4.31
1185	*Spiraea arcuata*	Rosaceae	5.07			
1186	*Artemisia parviflora*	Compositae	3.40			
1187	*Rhodiola humilis*	Crassulaceae	3.04			
1188	*Rhodiola crenulata*	Crassulaceae	2.43			
1189	*Rhodiola cretinii*	Crassulaceae	1.52			
	Hypericum choisianum	Hypericaceae	1.15			
1190	*Hoya lanceolata*	Asclepiadaceae	0.69			
1191	*Duhaldea cappa*	Compositae	0.68			0.32
1192	*Aeschynanthus parviflorus*	Gesneriaceae		90.04		
1193	*Aeschynanthus sikkimensis*	Gesneriaceae		80.49		
	Daphne involucrata	Thymelaeaceae			8.46	
	Desmodium elegans	Leguminosae			6.34	
1194	*Diacalpe aspidoides*	Philadelphaceae			5.29	
	Dichroa febrifuga	Hydrangeaceae			4.46	
	Mackaya indica	Acanthaceae				49.77
	Oxyspora paniculata	Melastomataceae				32.33
1195	*Reinwarntia indica*	Linaceae				21.99
	Psilanthus bengalensis	Rubiaceae				21.19
	Rubus pentagonus	Rosaceae				16.84
1196	*Rhynchotechum ellipticum*	Gesneriaceae				14.33
1197	*Rubus biflorus*	Rosaceae				12.66

1198	*Reinwardtia indica*	Linaceae				0.79
1199	*Tectaria polymorpha*	Bignoniaceae				0.33
1200	*Pogostemon benghalensis*	Labiatae				0.08
	Sub-total		**91.76**	**170.53**	**24.54**	**174.94**
	Evergreen Palm					
	Calamus acanthospathus	Arecaceae(Palmae)		1.54		
	Cycas pectinata	Cycadaceae			18.80	
	Plectocomia himalayana	Arecaceae(Palmae)				8.51
	Wallichia densiflora	Arecaceae(Palmae)				0.56
	Pandanus unguifer	Pandanaceae				0.08
	Sub-total			**1.54**	**18.80**	**9.15**
	Epiphytic Orchids					
			RD%	**RD%**	**RD%**	**RD%**
	Arethuseae					
1201	*Coelogyne barbata*	Orchidaceae			7.25	0.88
1202	*Coelogyne cristata*	Orchidaceae	16.85	21.62	2.17	7.79
1203	*Coelogyne fimbriata*	Orchidaceae	1.53			0.18
1204	*Coelogyne fuscescens var. fuscescens*	Orchidaceae	2.14	2.14		
1205	*Coelogyne nitida*	Orchidaceae				0.35
1206	*Coelogyne prolifera*	Orchidaceae	0.92	7.50	6.52	0.18
1207	*Coelogyne stricta*	Orchidaceae		0.47		1.42
1208	*Neogyna gardneriana*	Orchidaceae	0.46		0.72	1.06
1209	*Otochilus fuscus*	Orchidaceae			6.52	25.66
1210	*Otochilus lancilabius*	Orchidaceae	9.80	14.99	5.07	0.35
1211	*Pholidota articulata*	Orchidaceae	1.38	8.68	6.88	1.24
1212	*Pholidota imbricata*	Orchidaceae				1.59
1213	*Pholidota pallida*	Orchidaceae		5.13	5.07	0.18
1214	*Pholidota protracta*	Orchidaceae		0.36	0.36	
1215	*Pleione hookeriana*	Orchidaceae				3.19
1216	*Pleione humilis*	Orchidaceae	0.31	0.31		
1217	*Pleione praecox*	Orchidaceae		0.18		0.53
	Sub-total		**33.38**	**61.37**	**40.58**	**44.60**
	Cymbidieae					
1218	*Cymbidium erythraeum*	Orchidaceae		1.37	0.72	1.95
1219	*Cymbidium hookerianum*	Orchidaceae	0.46	0.46		
1220	*Cymbidium iridioides*	Orchidaceae		0.18		0.53
	Sub-total		**0.46**	**2.01**	**0.72**	**2.48**
	Dendrobieae					
1221	*Bulbophyllum affine*	Orchidaceae	2.14	2.56		1.24
1222	*Bulbophyllum bisetum*	Orchidaceae	0.46		3.62	
1223	*Bulbophyllum creyanum*	Orchidaceae	0.92	0.92		
1224	*Bulbophyllum cylindraceum*	Orchidaceae				1.77

1225	*Bulbophyllum griffithii*	Orchidaceae		0.88		2.65
1226	*Bulbophyllum gymnopus*	Orchidaceae		1.59		4.78
1227	*Bulbophyllum hirtum*	Orchidaceae		0.12		0.35
1228	*Bulbophyllum odoratissimum*	Orchidaceae	0.15		5.43	
1229	*Bulbophyllum reptans*	Orchidaceae		1.47		4.42
1230	*Bulbophyllum secundum*	Orchidaceae	2.76			0.71
1231	*Bulbophyllum sterile*	Orchidaceae	0.61	1.08		1.42
1232	*Bulbophyllum thomsonii*	Orchidaceae		0.53		1.59
1233	*Bulbophyllum wallichii*	Orchidaceae	15.31			
1234	*Cymbidium longifolium*	Orchidaceae	0.31	0.31		
1235	*Dendrobium amoenum*	Orchidaceae		0.36	0.36	
1236	*Dendrobium chrysanthum*	Orchidaceae	0.46	1.84	1.09	0.88
1237	*Dendrobium densiflorum*	Orchidaceae	3.68		10.14	5.31
1238	*Dendrobium devonianum*	Orchidaceae		1.09	1.09	
1239	*Dendrobium falconeri*	Orchidaceae	0.15		2.90	4.96
1240	*Dendrobium fimbriatum*	Orchidaceae		1.49	0.72	2.30
1241	*Dendrobium jenkinsii*	Orchidaceae		1.87	1.81	0.18
1242	*Dendrobium longicornu*	Orchidaceae				0.53
1243	*Dendrobium nobile*	Orchidaceae	0.92	2.85	1.81	0.35
1244	*Dendrobium spatella*	Orchidaceae	0.61		1.81	
1245	*Epigenium fuscescens*	Orchidaceae		1.83		5.49
1246	*Flickingeria fugas*	Orchidaceae	30.63			
	Sub-total		**59.11**	**20.80**	**30.80**	**38.94**
	Epidendreae					
1247	*Agrostophyllum callosum*	Orchidaceae	0.41		1.24	1.65
	Sub-total		**0.41**		**1.24**	**1.65**
	Malaxideae					
1248	*Liparis cespitosa*	Orchidaceae	0.46	0.46		
1249	*Oberonia acaulis*	Orchidaceae		2.65	2.54	0.35
1250	*Oberonia caulescens*	Orchidaceae				2.65
1251	*Oberonia falcata*	Orchidaceae		1.09	1.09	
1252	*Oberonia maxima*	Orchidaceae	0.77	0.77		
	Sub-total		**1.23**	**4.97**	**3.62**	**3.01**
	Podochileae					
1253	*Eria amica*	Orchidaceae		1.45	1.45	
1254	*Eria carinata*	Orchidaceae		0.59		1.77
1255	*Eria coronaria*	Orchidaceae	1.53	1.89	0.36	
1256	*Eria discolor*	Orchidaceae	1.53		9.06	3.54
1257	*Eria excavata*	Orchidaceae	0.46	0.46		
1258	*Eria ferruginea*	Orchidaceae	0.31		3.62	0.88
1259	*Eria graminifolia*	Orchidaceae		0.06		0.18
1260	*Eria paniculata*	Orchidaceae			0.36	
1261	*Eria pannea*	Orchidaceae	0.15	2.69	2.54	

1262	*Eria stricta*	Orchidaceae		1.45	1.45	
	Sub-total		**3.98**	**8.59**	**18.84**	**6.37**
	Vandeae					
1263	*Aeides multiflorum*	Orchidaceae		0.36	0.36	
1264	*Aeides roseum*	Orchidaceae	0.92			
1265	*Cleisostoma filiforme*	Orchidaceae		0.48	0.36	0.35
1266	*Cleisostoma racemiferum*	Orchidaceae		0.24		0.71
1267	*Cleisostoma williamsonii*	Orchidaceae			1.45	1.06
1268	*Gastrochilus acutifolius*	Orchidaceae		0.72	0.72	
1269	*Gastrochilus calceolaris*	Orchidaceae	0.31	0.67	0.36	
1270	*Gastrochilus distichus*	Orchidaceae	0.31			
1271	*Luisia filiformis*	Orchidaceae	0.31	0.31		
1272	*Luisia zeylanica*	Orchidaceae		0.18		0.53
1273	*Micropera mannii*	Orchidaceae		1.09	1.09	
1274	*Papilionanthe teres*	Orchidaceae			1.09	
1275	*Vanda bicolor*	Orchidaceae		0.12		0.35
	Sub-total		**1.84**	**4.16**	**5.43**	**3.01**
1276	*Anipelocissus divasicata*	Orchidaceae				
1277	*Acampe rigida*	Orchidaceae				
1278	*Agrostophyllum brevipes*	Orchidaceae				
1279	*Anoectochilus roxburghii*	Orchidaceae				
1280	*Bulbophyllum cauliflorum*	Orchidaceae				
1281	*Bulbophyllum cylindraceum*	Orchidaceae				
1282	*Bulbophyllum guttulatum*	Orchidaceae				
1283	*Bulbophyllum leopardinum*	Orchidaceae				
1284	*Bulbophyllum leptanthum*	Orchidaceae				
1285	*Bulbophyllum obrienianum*	Orchidaceae				
1286	*Bulbophyllum spathulatum*	Orchidaceae				
1287	*Calanthe masuca*	Orchidaceae				
1288	*Callostylis rigida*	Orchidaceae				
1289	*Cephalanthera domasonium*	Orchidaceae				
1290	*Ceratostylis himalaica*	Orchidaceae				
1291	*Cheirostylis yunnanesis*	Orchidaceae				
1292	*Chiloschista usneoides*	Orchidaceae				
1293	*Cleisostoma linearilobatum*	Orchidaceae				
1294	*Coelogyne corymbosa*	Orchidaceae				
1295	*Coelogyne ovalis*	Orchidaceae				
1296	*Coelogyne schultesii*	Orchidaceae				
1297	*Cryptochilus lutea*	Orchidaceae				
1298	*Cymbidium bicolor*	Orchidaceae				
1299	*Cymbidium eburneum*	Orchidaceae				
1300	*Cymbidium hookerianum*	Orchidaceae				
1301	*Cymbidium lancifolium*	Orchidaceae				

1302	*Cymbidium longifolium*	Orchidaceae				
1303	*Cymbidium mastersii*	Orchidaceae				
1304	*Dendrobium acinaciforme*	Orchidaceae				
1305	*Dendrobium aphyllum*	Orchidaceae				
1306	*Dendrobium denudans*	Orchidaceae				
1307	*Dendrobium heterocarpum*	Orchidaceae				
1308	*Dendrobium hookerianum*	Orchidaceae				
1309	*Dendrobium monticola*	Orchidaceae				
1310	*Dendrobium moschatum*	Orchidaceae				
1311	*Dendrobium terminale*	Orchidaceae				
1312	*Dendrobium transparens*	Orchidaceae				
1313	*Epigenium amplum*	Orchidaceae				
1314	*Esmeralda clarkei*	Orchidaceae				
1315	*Habenaria dentate*	Orchidaceae				
1316	*Ione cirrhata*	Orchidaceae				
1317	*Lipari bootanensis*	Orchidaceae				
1318	*Liparis cathcartii*	Orchidaceae				
1319	*Liparis viridiflora*	Orchidaceae				
1320	*Listera pinetorum*	Orchidaceae				
1321	*Luisia zeylanica*	Orchidaceae				
1322	*Malaxis muscifera*	Orchidaceae				
1323	*Mycaranthes floribunda*	Orchidaceae				
1324	*Odontostema glandulosa*	Orchidaceae				
1325	*Panisea yunnanensis*	Orchidaceae				
1326	*Papiliolanthe vandarum*	Orchidaceae				
1327	*Phalaenopsis taenialis*	Orchidaceae				
1328	*Pleione maculatea*	Orchidaceae				
1329	*Pleione praecox*	Orchidaceae				
1330	*Rhynchostylis retusa*	Orchidaceae				
1331	*Satyrium nepalensis*	Orchidaceae				
1332	*Schoenorchis gemmata*	Orchidaceae				
1333	*Spiranthes sinensis*	Orchidaceae				
1334	*Trichotosia ferruginea*	Orchidaceae				
1335	*Vanda cristata*	Orchidaceae				
1336	*Vanda cristata*	Orchidaceae				
1337	*Vanda griffithii*	Orchidaceae				

Note 1: Species listed without RBA% or RD% are those species not recorded in recent RBS survey but listed in earlier surveys or opportunistically by staff of the national park.

Note 2: Species without species number are species listed recurrently. For instance, species listed in the tree plot as well as in the herb plots.

Appendix 3. Faunal Diversity of JSWNP

3.1. Mammals of JSWNP

Name of PA: Jigme Singye Wangchuck National Park
Taxa: MAMMALS

Sl. No.	Common Name	Scientific Name	Family	Status of Distribution	IUCN	FNCA	CITES
1	Red Panda	*Ailurus fulgens*	Ailuridae	Moderate	VU	SC I	I
2	Dhole	*Cuon alpinus*	Canidae	Abundant	EN		II
3	Red Fox	*Vulpes vulpes*	Canidae	Rare	LC		III
4	Clouded Leopard	*Neofelis nebulosa*	Felidae	Rare	VU	SC I	I
5	Common Leopard	*Panthera pardus*	Felidae	Moderate	VU	SC I	I
6	Leopard Cat	*Prionailurus bengalensis*	Felidae	Moderate	LC	SC I	II
7	Asiatic Golden cat	*Catopuma temmincki*	Felidae	Abundant	NT		I
8	Tiger	*Panthera tigris tigris*	Felidae	Moderate	EN	SC I	I
9	Snow leopard	*Panthera uncia*	Felidae	Rare	VU	SC I	I
10	Marbled cat	*Pardofelis marmorata*	Felidae	Moderate	NT		I
11	Jungle cat	*Felis chaus*	Felidae	Rare	LC		II
12	Yellow Throated Marten	*Martes flavigula*	Mustelidae	Abundant	LC		III
13	Common Otter	*Lutra lutra*	Mustelidae	Moderate	NT		I
14	Himalayan Black Bear	*Ursus thibetanus*	Ursidae	Moderate	VU	SC I	I
15	Spotted Linsang	*Prionodon pardiclor*	Prionodontidae	Rare	LC		I
16	Himalayan Palm Civet	*Paguma larvata*	Viverridae	Rare	LC		III
17	Binturong/Asian Bearcat	*Arctictis biturong*	Viverridae	Rare	VU		III
18	Large Indian Civet	*Verra zibetha*	Viverridae	Rare	LC		III
19	Chinese Pangolin	*Manis pentadactyla*	Manidae	Rare	CR	SC I	I
20	Crab eating Mongoose	*Herpestesurva*	Herpestidae	Rare	LC		III
21	Gaur	*Bos gaurus*	Bovidae	Rare	VU	SC I	I
22	GoralNT	*Naemorhedus goral*	Bovidae	Moderate	NT		I
23	Serow	*Capricornis sumatraensis thar*	Bovidae	Moderate	NT	SC I	I
24	Barking Deer	*Muntiacus muntjak*	Cervidae	Abundant	LC		NA
25	Sambar	*Cervus unicolor*	Cervidae	Abundant	VU		NA
26	Musk Deer	*Moschus leucogaster*	Moschidae	Rare	EN	SC I	I
27	Asian Elephant	*Elephas maximus*	Elephantidae	Rare	EN	SC I	I
28	Wild Boar	*Sus scrofa*	Suidae	Abundant	LC		NA
29	Assamese Macaque	*Macaca assamensis*	Cercopithecidae	Abundant	NT		II

30	Golden Langur	*Trachypithecus geei*	Cercopithe-cidae	Moderate	EN	SC I	I
31	Grey Langur	*Semnopithecus schistaceus*	Cercopithe-cidae	Moderate	LC		I
32	Himalayan Crest-less Porcupine	*Hystrix bracyhura*	Hystricidae	Abundant	LC		NA
33	Malayan Giant Squirrel	*Ratufa bicolor*	Sciuridae	Moderate	NT		II
34	Orange-Bellied himalyan Squirrel	*Dremomys lokriah*	Sciuridae	Abundant	LC		NA
35	Spotted Giant Flying Squirrel	*Petaurista caniceps*	Sciuridae	Rare	LC		NA
36	Himalayan Striped Squirrel	*Tamiops macclellandi*	Sciuridae	Moderate	LC		NA
37	Bhutan Giant Flying Squirrel	*Petaurista nobilis*	Sciuridae	Rare	NT		NA
38	Asiatic Brush-tailed Procupine	*Artherurus macrourus*	Hystricidae	Rare	LC		NA
39	House Rat	*Rattus rattus*	Muridae	Abundant	LC		NA
40	Himalayan field Rat	*Rattus nitidus*	Muridae		LC		NA
41	Indochinese Forest Rat	*Rattus andamanensis*	Muridae		LC		NA
42	Himmalayan White-bellied Rat	*Niviventer niviventer*	Muridae	Abundant	LC		NA
43	Smoke-bellied Rat	*Niviventer eha*	Muridae		LC		NA
44	Sikkim Mouse	*Mus pahari*	Muridae		LC		NA
45	Sikkim Vole	*Neodon sikimensis*	Cricetidae		LC		NA
46	Hodgson's Brown-toothed Shrew	*Episoriculus caudatus*	Soricidae		LC		NA
47	Asian/House Shrew	*Suncus murinus*	Soricidae		LC		NA
48	Himalayan Shrew	*Soriculus nigrescens*	Soricidae		LC		NA
49	Eurasian Pygmy shrew	*Sorex minutus*	Soricidae		LC		NA
50	Himalayan Pika	*Ochotona himalayana*	Ochotonidae				
51	Large eared-Pika	*Ochotona macrotis*	Ochotonidae		LC		NA
52	Himalayan Mole	Euroscaptor micrura	Talpidae		LC		NA
53	Indian Pipistrelle	*Pipistrellus coromandra*	Vespertilion-idae	Moderate	LC		NA
54	Yellow bellied Weasel	*Mustela kathiah*	Mustelidae		LC		III

3.2. Birds of JSWNP

Sl. No.	Common Name	Scientific Name	Family	IUCN
1	Black Eagle	*Ictinaetus malaiensis*	Accipitridae	LC
2	Crested Serpent Eagle	*Spilornis cheela*	Accipitridae	LC
3	Northern Goshawk	*Accipiter gentilis*	Accipitridae	LC
4	Golden Eagle	*Aquila chrysaetos*	Accipitridae	LC
5	Hen Harrier	*Circus cyaneus*	Accipitridae	LC
6	Himalayan Griffon	*Gyps himalayensis*	Accipitridae	NT
7	Palla's Fish Eagle	*Haliaeetus leucoryphus*	Accipitridae	EN
8	Besra	*Accipiter virgatus*	Accipitridae	LC
9	Mountain Hawk Eagle	*Nisaetus nipalensis*	Accipitridae	LC
10	Black-throated Tit	*Aegithalos concinnus*	Aegithalidae	LC
11	Common iora	*Aegithina tiphia*	Aegithinidae	LC
12	Oriental Skylark	*Alauda gulgula*	Alaudidae	LC
13	Common Kingfisher	*Alcedo atthis*	Alcedinidae	LC
14	Pied Kingfisher	*Ceryle rudis*	Alcedinidae	LC
15	White-throated Kingfisher	*Halcyon smyrnensis*	Alcedinidae	LC
16	Crested Kingfisher	*Megaceryle lugubris*	Alcedinidae	LC
17	Gadwall	*Anas strepera*	Anatidae	LC
18	Common Shelduck	*Tadorna tadorna*	Anatidae	LC
19	Eurasian wigeon	*Mareca penelope*	Anatidae	LC
20	Northern shoveler	*Anas clypeata*	Anatidae	LC
21	Forktail Swift	*Apus pacificus*	Apodidae	LC
22	Himalayan Swiftlet	*Collocalia brevirostris*	Apodidae	LC
23	Cattle Egret	*Bubulcus ibis*	Ardeidae	LC
24	White-bellied Heron	*Ardea insignis*	Aroleidae	CR
25	Great Hornbill	*Buceros bicornis*	Bucerotidae	VU
26	Wreathed hornbill	*Aceros undulatus*	Bucerotidae	VU
27	Rufous-necked Hornbill	*Aceros nipalensis*	Bucerotidae	VU
28	Eurasian Thick-knee	*Burhinus oedicnemus*	Burhinidae	LC
29	Bar-winged Flycatcher Shrike	*Hemipus picatus*	Campephagidae	LC
30	Grey-chinned Minivet	*Pericrocotus solaris*	Campephagidae	LC
31	Long-tailed Minivet	*Pericrocotus ethologus*	Campephagidae	LC
32	Scarlet Minivet	*Pericrocotus flammeus*	Campephagidae	LC
33	Short-billed Minivet	*Pericrocotus brevirostris*	Campephagidae	LC
34	Black-winged cuckooshrike	*Lalage melaschistos*	Campephagidae	LC
35	Grey Nightjar	*Caprimulgus indicus*	Caprimulgidae	LC
36	Eurasian Treecreeper	*Certhia familiaris*	Certhiidae	LC
37	Rusty-flanked Treecreeper	*Certhia nipalensis*	Certhiidae	LC
38	Brown-throated Treecreeper	*Certhia discolor*	Certhiidae	LC
39	Mountain Tailorbird	*Phyllergates cucullatus*	Cettiidae	LC
40	Slaty-bellied Tesia	*Tesia olivea*	Cettiidae	LC

41	Black-faced Warbler	*Abroscopus schisticeps*	Cettiidae	LC
42	Red-wattled Lapwing	*Vanellus indicus*	Charadriidae	LC
43	River Lapwing	*Vanellus duvaucelii*	Charadriidae	NT
44	Golden-fronted Leafbird	*Chloropsis aurifrons*	Chloropseidae	LC
45	Orange-bellied Leafbird	*Chloropsis hardwickii*	Chloropseidae	LC
46	Black Stork	*Ciconia nigra*	Ciconiidae	LC
47	Brown Dipper	*Cinclus pallasii*	Cinclidae	LC
48	White-throated Dipper	*Cinclus cinclus*	Cinclidae	LC
49	Black-throated Prinia	*Prinia atrogularis*	Cisticolidae	LC
50	Plain Prinia	*Prinia inornata*	Cisticolidae	LC
51	Grey-headed Canary Flycatcher	*Culicicapa ceylonensis*	Cisticolidae	LC
52	Hill Prinia	*Prinia atrogularis*	Cisticolidae	LC
53	Striated Prinia	*Prinia crinigera*	Cisticolidae	LC
54	Grey-crowned Prinia	*Prinia cinereocapilla*	Cisticolidae	VU
55	Common Tailorbird	*Orthotomus sutorius*	Cisticolidae	LC
56	Barred Cuckoo Dove	*Macropygia unchall*	Columbidae	LC
57	Emerald Dove	*Chalcophaps indica*	Columbidae	LC
58	Snow Pigeon	*Columba leuconota*	Columbidae	LC
59	Mountain Imperial Pigeon	*Ducula badia*	Columbidae	LC
60	Oriental Turtle Dove	*Streptopelia orientalis*	Columbidae	LC
61	Rock Pigeon	*Columba livia*	Columbidae	LC
62	Speckled Wood Pigeon	*Columba hodgsonii*	Columbidae	LC
63	Spotted Dove	*Spilopelia chinensis*	Columbidae	LC
64	Wedge-tailed Green Pigeon	*Treron sphenura*	Columbidae	LC
65	Dollar Bird	*Eurystomus orientalis*	Coraciidae	LC
66	House Crow	*Corvus splendens*	Corvidae	LC
67	Spotted Nutcracker	*Nucifraga caryocatactes*	Corvidae	LC
68	Collared Treepie	*Dendrocitta frontalis*	Corvidae	LC
69	Common Green Magpie	*Cissa chinensis*	Corvidae	LC
70	Eurasian Jay	*Garrulus glandarius*	Corvidae	LC
71	Grey Treepie	*Dendrocitta formosae*	Corvidae	LC
72	Large-billed Crow	*Corvus macrorhynchos*	Corvidae	LC
73	Red billed Chough	*Pyrrhocorax pyrrhocorax*	Corvidae	LC
74	Yellow-billed Blue Magpie	*Urocissa flavirostris*	Corvidae	LC
75	Himalayan Cuckoo	*Cuculus saturatus*	Cuculidae	LC
76	Hodgson's Hawk Cuckoo	*Hierococcyx fugax*	Cuculidae	LC
77	Eurasian Cuckoo	*Cuculus canorus*	Cuculidae	LC
78	Greater Coucal	*Centropus sinensis*	Cuculidae	LC
79	Green-billed Malkoha	*Phaenicophaeus tristis*	Cuculidae	LC
80	Large Hawk Cuckoo	*Hierococcyx sparverioides*	Cuculidae	LC
81	Chestnut-winged Cuckoo	*Clamator coromandus*	Cuculidae	LC
82	Grey-bellied Cuckoo	*Cacomantis passerinus*	Cuculidae	LC
83	Lesser Cuckoo	*Cuculus poliocephalus*	Cuculidae	LC

84	Oriental Cuckoo	*Cuculus optatus*	Cuculidae	LC
85	Indian Cuckoo	*Cuculus micropterus*	Cuculidae	LC
86	Fire-breasted Flowerpecker	*Dicaeum ignipectus*	Dicaeidae	LC
87	Plain Flowerpecker	*Dicaeum concolor*	Dicaeidae	LC
88	Lesser Racket-tailed Drongo	*Dicrurus remifer*	Dicruridae	LC
89	Ashy Drongo	*Dicrurus leucophaeus*	Dicruridae	LC
90	Black Drongo	*Dicrurus macrocercus*	Dicruridae	LC
91	Spangled Drongo	*Dicrurus hottentottus*	Dicruridae	LC
92	Bronzed drongo	*Dicrurus aeneus*	Dicruridae	LC
93	Little Bunting	*Emberiza pusilla*	Emberizidae	LC
94	Crested Bunting	*Melophus lathami*	Emberizidae	LC
95	Rustic bunting	*Emberiza rustica*	Emberizidae	VU
96	White-rumped Munia	*Lonchura striata*	Estrididae	LC
97	Scaly-breasted Munia	*Lonchura punctulata*	Estrildidae	LC
98	Long-tailed Broadbill	*Psarisomus dalhousiae*	Eurylaimidae	LC
99	Common Kestrel	*Falco tinnunculus*	Falconidae	LC
100	Common Rosefinch	*Carpodacus erythrinus*	Fringiilidae	LC
101	Plain Mountain Finch	*Leucosticte nemoricola*	Fringiilidae	LC
102	Red-fronted Rosefinch	*Carpodacus punicus*	Fringiilidae	LC
103	Scarlet Finch	*Haematospiza sipahi*	Fringiilidae	LC
104	White-winged Grosbeak	*Mycerobas carnipes*	Fringiilidae	LC
105	Brown Bullfinch	*Pyrrhula nipalensis*	Fringiilidae	LC
106	Spot-winged Grosbeak	*Mycerobas melanozanthos*	Fringiilidae	LC
107	Yellow-breasted Greenfinch	*Carduelis spinoides*	Fringiilidae	LC
108	Himalayan white-browed rosefinch	*Carpodacus spp.*	Fringiilidae	LC
109	Brandt's Mountain Finch	*Leucosticte brandti*	Fringiilidae	LC
110	Dark-breasted Rosefinch	*Carpodacus nipalensis*	Fringiilidae	LC
111	Red-headed Bullfinch	*Pyrrhula erythrocephala*	Fringiilidae	LC
112	Gold-naped Finch	*Pyrrhoplectes epauletta*	Fringiilidae	LC
113	Small Pratincole	*Glareola lactea*	Glaroelidae	LC
114	Asian House Martin	*Delichon dasypus*	Hirundinidae	LC
115	Nepal House Martin	*Delichon nipalensis*	Hirundinidae	LC
116	Red-rumped Swallow	*Cercopis daurica*	Hirundinidae	LC
117	Ibisbill	*Ibidorhyncha struthersii*	Ibidorhynchidae	LC
118	Yellow-rumped Honeyguide	*Indicator xanthonotus*	Indicatoridae	NT
119	Brown Shrike	*Lanius cristatus*	Laniidae	LC
120	Grey-backed Shrike	*Lanius tephronotus*	Laniidae	LC
121	Long-tailed Shrike	*Lanius schach*	Laniidae	LC
122	Brown-headed Gull	*Chroicocephalus brunniceph-alus*	Laridae	LC
123	Blue-winged Laughingthrush	*Trochalopteron squamatum*	Leiotrichidae	LC
124	Grey-sided Laughingthrush	*Garrulax caerulatus*	Leiotrichidae	LC
125	Himalayan Cutia	*Cutia nipalensis*	Leiotrichidae	LC

126	Scaly Laughingthrush	*Trochalopteron subunicolor*	Leiotrichidae	LC
127	Spotted Laughingthrush	*Garrulax ocellatus*	Leiotrichidae	LC
128	Streaked Laughingthrush	*Trochalopteron lineatum*	Leiotrichidae	LC
129	Striated Laughingthrush	*Garrulax striatus*	Leiotrichidae	LC
130	Red-faced Liocichla	*Liocichla phoenicea*	Leiotrichidae	LC
131	Blue-winged minla	*Minla cyanouroptera*	Leiotrichidae	LC
132	Black-faced Laughingthrush	*Garrulax affinis*	Leiotrichidae	LC
133	Blue-bearded Bee-eater	*Nyctyornis athertoni*	Meropidae	LC
134	Black-naped Monarch	*Hypothymis azurea*	Monarchidae	LC
135	Olive-backed Pipit	*Anthus hodgsoni*	Motacillidae	LC
136	Blyth's Pipit	*Anthus godlewskii*	Motacillidae	LC
137	Rosy Pipit	*Anthus roseatus*	Motacillidae	LC
138	Paddyfield Pipit	*Anthus rufulus*	Motacillidae	LC
139	Grey Wagtail	*Motacilla cinerea*	Motacillidae	LC
140	White Wagtail	*Motacilla alba*	Motacillidae	LC
141	Citrine Wagtail	*Motacilla citreola*	Motacillidae	LC
142	Ultramarine Flycatcher	*Ficedula superciliaris*	Muscicapidae	LC
143	White-browed Bush Robin	*Tarsiger indicus*	Muscicapidae	LC
144	White-capped Redstart	*Phoenicurus leucocephalus*	Muscicapidae	LC
145	Dark-sided Flycatcher	*Muscicapa sibirica*	Muscicapidae	LC
146	Slaty-blue Flycatcher	*Ficedula hodgsonii*	Muscicapidae	LC
147	Rufous-gorgetted Flycatcher	*Ficedula strophiata*	Muscicapidae	LC
148	Ferruginous Flycatcher	*Muscicapa ferruginea*	Muscicapidae	LC
149	Pale Blue Flycatcher	*Cyornis unicolor*	Muscicapidae	LC
150	Verditer Flycatcher	*Eumyias thalassina*	Muscicapidae	LC
151	Pygmy Blue Flycatcher	*Muscicapella hodgsoni*	Muscicapidae	LC
152	White-winged Redstart	*Phoenicurus erythrogaster*	Muscicapidae	LC
153	White-throated Redstart	*Phoenicurus schisticeps*	Muscicapidae	LC
154	Plumbeous Water Redstart	*Rhyacornis fuliginosus*	Muscicapidae	LC
155	White-capped Water Redstart	*Chaimarrornis leucocephalus*	Muscicapidae	LC
156	Black Redstart	*Phoenicurus ochruros*	Muscicapidae	LC
157	Blue-fronted Redstart	*Phoenicurus frontalis*	Muscicapidae	LC
158	Hodgson's Redstart	*Phoenicurus hodgsoni*	Muscicapidae	LC
159	Spotted Forktail	*Enicurus maculatus*	Muscicapidae	LC
160	Slaty-backed Forktail	*Enicurus schistaceus*	Muscicapidae	LC
161	Little Forktail	*Enicurus scouleri*	Muscicapidae	LC
162	Little Pied Flycatcher	*Ficedula westermanni*	Muscicapidae	LC
163	Oriental Magpie Robin	*Copsychus saularis*	Muscicapidae	LC
164	Gray Bush Chat	*Saxicola ferrea*	Muscicapidae	LC
165	Common Stonechat	*Saxicola torquata*	Muscicapidae	LC
166	Chestnut-bellied Rock Thrush	*Monticola rufiventris*	Muscicapidae	LC
167	Large Niltava	*Niltava grandis*	Muscicapidae	LC
168	Rufous-bellid Niltava	*Niltava sundara*	Muscicapidae	LC

169	Small Niltava	*Niltava macgrigoriae*	Muscicapidae	LC
170	Taiga Flycatcher	*Ficedula albicilla*	Muscicapidae	LC
171	Himalayan Bluetail	*Tarsiger cyanurus rufilatus*	Muscicapidae	LC
172	Rufous-breasted Bush Robin	*Tarsiger hyperythrus*	Muscicapidae	LC
173	Blue-throated Blue Flycatcher	*Cyornis rubeculoides*	Muscicapidae	LC
174	Blue-and-White Flycatcher	*Cyanoptila cyanomelana*	Muscicapidae	LC
175	Asian Brown Flycatcher	*Muscicapa dauurica*	Muscicapidae	LC
176	White-rumped shama	*Copsychus malabaricus*	Muscicapidae	LC
177	Blue rock thrush	*Monticola solitarius*	Muscicapidae	LC
178	Green-tailed Sunbird	*Aethopyga nipalensis*	Nectariniidae	LC
179	Fire-tailed Sunbird	*Aethopyga ignicauda*	Nectariniidae	LC
180	Black-throated Sunbird	*Aethopyga saturata*	Nectariniidae	LC
181	Crimson Sunbird	*Aethopyga siparaja*	Nectariniidae	LC
182	Mrs. Gould's Sunbird	*Aethopyga gouldiae*	Nectariniidae	LC
183	Scarlet-backed Flowerpeker	*Dicaeum cruentatum*	Nectariniidae	LC
184	Streaked Spiderhunter	*Arachnothera magna*	Nectariniidae	LC
185	Eurasian Golden Oriole	*Oriolus oriolus*	Orioliidae	LC
186	Black-hooded Oriole	*Oriolus xanthornus*	Orioliidae	LC
187	Maroon Oriole	*Oriolus traillii*	Orioliidae	LC
188	Slender-billed Oriole	*Oriolus tenuirostris*	Orioliidae	LC
189	Brown Parrotbill	*Cholornis unicolor*	Paradoxornithidae	LC
190	Golden-breasted Fulvetta	*Lioparus chrysotis*	Paradoxornithidae	LC
191	White-browed Fulvetta	*Fulvetta vinipectus*	Paradoxornithidae	LC
192	Great Tit	*Parus major*	Paridae	LC
193	Black-browed tit	*Aegithalos iouschistos*	Paridae	LC
194	Fire-capped Tit	*Cephalopyrus flammiceps*	Paridae	LC
195	Coal Tit	*Parus ater*	Paridae	LC
196	Grey-crested Tit	*Parus dichrous*	Paridae	LC
197	Rufous-vented Tit	*Parus rubidiventris*	Paridae	LC
198	Yellow-browed Tit	*Sylviparus modestus*	Paridae	LC
199	Green-backed Tit	*Parus monticolus*	Paridae	LC
200	Sultan Tit	*Melanochlora sultanea*	Paridae	LC
201	Yellow-cheeked Tit	*Parus spilonotus*	Paridae	LC
202	Eurasian Tree Sparrow	*Passer montanus*	Passeridae	LC
203	Russet Sparrow	*Passer cinnamomeus*	Passeridae	LC
204	Alpine Accentor	*Prunella collaris*	Passeridae	LC
205	House Sparrow	*Passer domesticus*	Passeridae	LC
206	Great Cormorant	*Phalacrocorax carbo*	Phalacrocoracidae	LC
207	Blood pheasant	*Ithaginis cruentus*	Phasianidae	LC
208	Hill Partridge	*Arborophila torqueola*	Phasianidae	LC
209	Chestnut-breasted Partridge	*Arborophila mandellii*	Phasianidae	VU
210	Grey Peacock Pheasant	*Polyplectron bicalcaratum*	Phasianidae	LC
211	Kalij Pheasant	*Lophura leucomelanos*	Phasianidae	LC

212	Red Junglefowl	*Gallus gallus*	Phasianidae	LC
213	Rufous-throated Partridge	*Arborophila rufogularis*	Phasianidae	LC
214	Satyr Tragopan	*Tragopan satyra*	Phasianidae	NT
215	Himalayan Monal	*Lophophorus impejanus*	Phasianidae	LC
216	Hume's Leaf Warbler	*Phylloscopus humei*	Phylloscopidae	LC
217	Large-billed Leaf Warbler	*Phylloscopus magnirostris*	Phylloscopidae	LC
218	Tickell's Leaf Warbler	*Phylloscopus affinis*	Phylloscopidae	LC
219	White-spectacled Warbler	*Phylloscopus intermedius*	Phylloscopidae	LC
220	Yellow-bellied Warbler	*Abroscopus superciliaris*	Phylloscopidae	LC
221	Lesser Yellownape	*Picus chlorolophus*	Picidae	LC
222	Darjeeling Woodpecker	*Dendrocopos darjellensis*	Picidae	LC
223	Fulvous-breasted Woodpecker	*Dendrocopos macei*	Picidae	LC
224	Bay Woodpecker	*Blythipicus pyrrhotis*	Picidae	LC
225	Crimson-breasted Woodpecker	*Dendrocopos cathpharius*	Picidae	LC
226	Pale-Headed Woodpecker	*Gecinulus grantia*	Picidae	LC
227	Grey-capped Pygmy Woodpecker	*Dendrocopos canicapillus*	Picidae	LC
228	Greater Yellownape	*Picus flavinucha*	Picidae	LC
229	Grey-headed Woodpecker	*Picus canus*	Picidae	LC
230	Rufous Woodpecker	*Celeus brachyurus*	Picidae	LC
231	Rufous-bellied Woodpecker	*Dendrocopos hyperythrus*	Picidae	LC
232	Speckled Piculet	*Picumnus innominatus*	Picidae	LC
233	White-browed Piculet	*Sasia ochracea*	Picidae	LC
234	Hooded Pitta	*Pitta sordida*	Pittidae	LC
235	Scaly-breasted wren-babbler	*Pnoepyga albiventer*	Pnoepygidae	LC
236	Large Woodshrike	*Tephrodornis virgatus*	Prionopidae	LC
237	Rufous-Breasted Accentor	*Prunella strophiata*	Prunellidae	LC
238	Ashy Bulbul	*Hemixos flavala*	Pycnonotidae	LC
239	Red-whiskered Bulbul	*Pycnonotus jocosus*	Pycnonotidae	LC
240	Black Bulbul	*Hypsipetes leucocephalus*	Pycnonotidae	LC
241	Black-crested Bulbul	*Pycnonotus melanicterus*	Pycnonotidae	LC
242	Mountain Bulbul	*Ixos mcclellandii*	Pycnonotidae	LC
243	Red-vented Bulbul	*Pycnonotus cafer*	Pycnonotidae	LC
244	Himalayan Bulbul	*Pycnonotus leucogenys*	Pycnonotidae	LC
245	Striated Bulbul	*Alcurus striatus*	Pycnonotidae	LC
246	White-throated Bulbul	*Alophoixus flaveolus*	Pycnonotidae	LC
247	White-breasted Waterhen	*Amaurornis phoenicurus*	Rallidae	LC
248	Ruddy-breasted Crake	*Zapornia fusca*	Rallidae	LC
249	Eurasian Coot	*Fulica atra*	Rallidae	LC
250	Black-tailed Crake	*Porzana bicolor*	Rallidae	LC
251	Blue-throated Barbet	*Megalaima asiatica*	Ramphastidae	LC
252	Golden-throated Barbet	*Megalaima franklinii*	Ramphastidae	LC
253	Blue-eared Barbet	*Megalaima australis*	Ramphastidae	LC
254	Great Barbet	*Megalaima virens*	Ramphastidae	LC

255	Lineated Barbet	*Megalaima lineata*	Ramphastidae	LC
256	Goldcrist	*Regulus regulus*	Regulidae	LC
257	White-throated Fantail	*Rhipidura albicollis*	Rhipiduridae	LC
258	Yellow-bellied Fantail	*Chelidorhynx hypoxanthus*	stenostiridae	LC
259	Common Greenshank	*Tringa nebularia*	Scolopacidae	LC
260	Eurasian Woodcock	*Scolopax rusticola*	Scolopacidae	LC
261	Beautiful Nuthatch	*Sitta formosa*	Sittidae	*VU*
262	Chestnut-bellied Nuthatch	*Sitta cinnamoventris*	Sittidae	LC
263	Velvet-fronted Nuthatch	*Sitta frontalis*	Sittidae	LC
264	White-tailed Nuthatch	*Sitta himalayensis*	Sittidae	LC
265	Wallcreeper	*Tichodroma muraria*	Sittidae	LC
266	Asian Barred Owlet	*Glaucidium cuculoides*	Strigidae	LC
267	Collared Owlet	*Glaucidium brodiei*	Strigidae	LC
268	Jungle Owlet	*Glaucidium radiatum*	Strigidae	LC
269	Tawny Fish Owl	*Ketupa flavipes*	Strigidae	LC
270	Common Myna	*Acridotheres tristis*	Sturmidae	LC
271	Spot-winged Starling	*Saroglossa spiloptera*	Sturmidae	LC
272	Great Myna	*Acridotheres grandis*	Sturnidae	LC
273	Common Hill Myna	*Gracula religiosa*	Sturnidae	LC
274	Chestnut-tailed Starling	*Sturnia malabarica*	Sturnidae	LC
275	Aberrant Bush Warbler	*Cettia flavolivacea*	Sylviidae	LC
276	Chestnut-crowned Bush Warbler	*Cettia major*	Sylviidae	LC
277	Pale-footed Bush Warbler	*Cettia pallidipes*	Sylviidae	LC
278	Yellow-vented Warbler	*Phylloscopus cantator*	Sylviidae	LC
279	Blyth's Leaf Warbler	*Phylloscopus reguloides*	Sylviidae	LC
280	Golden-spectacled Warbler	*Seicercus burkii*	Sylviidae	LC
281	Chesnut-crowned Warbler	*Seicercus castaniceps*	Sylviidae	LC
282	Broad-billed Warbler	*Tickellia hodgsoni*	Sylviidae	LC
283	Grey-sided Bush Warbler	*Cettia brunnifrons*	Sylviidae	LC
284	Ashy-throated Warbler	*Phylloscopus maculipennis*	Sylviidae	LC
285	Blyth's Reed Warbler	*Acrocephalus dumetorum*	Sylviidae	LC
286	Brownish-flanked Bush Warbler	*Cettia fortipes*	Sylviidae	LC
287	Dusky Warbler	*Phylloscopus fuscatus*	Sylviidae	LC
288	Greenish Warbler	*Phylloscopus trochiloides*	Sylviidae	LC
289	Grey-cheeked Warbler	*Seicercus poliogenys*	Sylviidae	LC
290	Grey-hooded Warbler	*Seicercus xanthoschistos*	Sylviidae	LC
291	Lemon-rumped Warbler	*Phylloscopus chloronotus*	Sylviidae	LC
292	Tickell's Leaf Warbler	*Phylloscopus affinis*	Sylviidae	LC
293	Grey-bellied Tesia	*Tesia Cyaniventer*	Sylviidae	LC
294	White-bellied Erpornis	*Erpornis zantholeuca*	Sylviidae	LC
295	Whistler's Warbler	*Seicercus whistleri*	Sylviidae	LC
296	Greater Rufous-headed Parrotbill	*Psittiparus ruficeps*	Sylviidae	LC
297	Grey-headed parrotbill	*Psittiparus gularis*	Sylviidae	LC

298	Bar-winged Wren Babbler	*Spelaeornis troglodytoides*	Timaliidae	LC
299	Pygmy Wren Babbler	*Pnoepyga pusilla*	Timaliidae	LC
300	Rufous-capped Babbler	*Stachyris ruficeps*	Timaliidae	LC
301	Rufous-fronted Babbler	*Stachyris rufifrons*	Timaliidae	LC
302	White-browed Scimitar Babbler	*Pomatorhinus schisticeps*	Timaliidae	LC
303	White-browed Shrike Babbler	*Pteruthius flaviscapis*	Timaliidae	LC
304	Rusty-cheeked Scimitar Babbler	*Pomatorhinus erythrocnemis*	Timaliidae	LC
305	Streak-breasted Scimitar Babbler	*Pomatorhinus ruficollis*	Timaliidae	LC
306	Coral-billed Scimitar Babbler	*Pomatorhinus ferruginosus*	Timaliidae	LC
307	Grey-throated Babbler	*Stachyris nigriceps*	Timaliidae	LC
308	Jungle Babbler	*Turdoides striata*	Timaliidae	LC
309	Pin-striped Tit Babbler	*Mixornis gularis*	Timaliidae	LC
310	Slender-billed Scimitar Babbler	*Xiphirhynchus superciliaris*	Timaliidae	LC
311	Golden Babbler	*Stachyris chrysaea*	Timaliidae	LC
312	Spotted Wren Babbler	*Spelaeornis formosus*	Timaliidae	LC
313	Rufous-throated Wren Babbler	*Spelaeornis caudatus*	Timaliidae	NT
314	White-naped Yuhina	*Yuhina bakeri*	Timaliidae	LC
315	Rufous-vented Yuhina	*Yuhina occipitalis*	Timaliidae	LC
316	Black-chinned Yuhina	*Yuhina nigrimenta*	Timaliidae	LC
317	Stripe-throated Yuhina	*Yuhina gularis*	Timaliidae	LC
318	Whiskered Yuhina	*Yuhina flavicollis*	Timaliidae	LC
319	Rufous-necked Laughingthrush	*Garrulax ruficollis*	Timaliidae	LC
320	Lesser Necklaced Laughingthrush	*Garrulax monileger*	Timaliidae	LC
321	Chestnut-crowned Laughingthrush	*Garrulax erythrocephalus*	Timaliidae	LC
322	Bhutan Laughingthrush	*Trochalopteron imbricatum*	Timaliidae	LC
323	Chestnut-tailed Minla	*Minla strigula*	Timaliidae	LC
324	Red-tailed Minla	*Minla ignotincta*	Timaliidae	LC
325	Long-tailed Sibia	*Heterophasia picaoides*	Timaliidae	LC
326	Rufous Sibia	*Heterophasia capistrata*	Timaliidae	LC
327	Rufous-winged Fulvetta	*Alcippe castaneceps*	Timaliidae	LC
328	Nepal Fulvetta	*Alcippe nipalensis*	Timaliidae	LC
329	Yellow-throated Fulvitta	*Alcippe cinerea*	Timaliidae	LC
330	Silver-eared Mesia	*Leiothrix argentauris*	Timaliidae	LC
331	Hoary-throated barwing	*Actinodura nipalensis*	Timaliidae	LC
332	Rusty-fronted Barwing	*Gampsorhynchus rufulus*	Timaliidae	LC
333	White-crested Laughingthrush	*Garrulax leucolophus*	Timaliidae	LC
334	White-throated Laughingthrush	*Garrulax albogularis*	Timaliidae	LC
335	Eurasian Wren	*Troglodytes troglodytes*	Troglodytidae	LC
336	Ward's Trogon	*Harpactes wardi*	Trugonidae	NT
337	Red-headed Trogon	*Harpactes erythrocephalus*	Trugonidae	LC
338	Blue Whistling Thrush	*Myophonus caeruleus*	Turdidae	LC
339	Blue-capped Rock Thrush	*Monticola cinclorhynchus*	Turdidae	LC
340	Orange-headed Thrush	*Zoothera citrina*	Turdidae	LC

341	White-collared Blackbird	*Turdus albocinctus*	Turdidae	LC
342	Grey-winged Blackbird	*Turdus boulboul*	Turdidae	LC
343	Green Cochoa	*Cochoa viridis*	Turdidae	LC
344	Grandala	*Grandala coelicolor*	Turdidae	LC
345	Alpine Thrush	*Zoothera mollissima*	Turdidae	LC
346	Long-billed Thrush	*Zoothera monticola*	Turdidae	LC
347	Scaly Thrush	*Zoothera dauma*	Turdidae	LC
348	Plain-backed Thrush	*Zoothera mollissima*	Turdidae	LC
349	Himalayan Forest Thrush	*Zoothera salimalii*	Turdidae	LC
350	Black-headed Shrike Babbler	*Pteruthius rufiventer*	Vireonidae	LC
351	Common Hoopoe	*Upupa epops*	Upupidae	LC
352	Oriental White-eye	*Zosterops palpebrosus*	Zosteropidae	LC
353	Striated Yuhina	*Yuhina castaniceps*	Zosteropidae	LC

3.3. Herpetofauna of JSWNP

Sl. No.	Common Name	Scientific Name	Family	Status of Distribution
1	Asian Vine Snake	*Ahaetulla prasina*	Colubridae	Rare
2	Himalayan Mountain Keelback	*Amphiesma platyceps*	Colubridae	Moderate
3	Multi Banded Cat Snake	*Boiga multifaciata*	Colubridae	Moderate
4	Tawny cat Snake	*Boiga ochracea*	Colubridae	Moderate
5	Copper-Headed Trinket	*Coelognathus radiatus*	Colubridae	Moderate
6	Painted Beonzeback	*Dendrelaphis pictus*	Colubridae	Rare
7	Blue Bronzeback tree snake	*Dendrelaphis cyanochloris*	Colubridae	Rare
8	Common wolf snake	*Lycodon aulicus*	Colubridae	Moderate
9	White-Banded Wolf Snake	*Lycodon septentrionalis*	Colubridae	Moderate
10	Walnut Kukri Snake	*Oligodon juglandifer*	Colubridae	Moderate
11	Russel's Kukri Snake	*Oligodon taeniolatus*	Colubridae	Moderate
12	Eastern Trinket	*Orthriophis cantoris*	Colubridae	Moderate
13	Striped Trinket	*Orthriophis taeniurus*	Colubridae	Moderate
14	Larged-Eyed False Cobra	*Pseudoxenodon macrops*	Colubridae	Moderate
15	Indo-Chinese Ratsnake	*Ptyas korros*	Colubridae	Rare
16	Green Ratsnake	*Ptyas nigromarginata*	Colubridae	Moderate
17	Orange-Collard Keelback	*Rhabdophis himalayanus*	Colubridae	Moderate
18	Collard Black-headed Snake	*Sibynophis collaris*	Colubridae	Moderate
19	Monocled Cobra	*Naja Kaouthia*	Elapidae	Moderate
20	Common Krait	*Bungarus caeruleus*	Elapidae	Moderate
21	Lesser Black Krait	*Bungarus lividus*	Elapidae	Rare
22	King Cobra	*Ophiophagus hannah*	Elapidae	Rare
23	MacClelland's Coral Snake	*Sinomicrurus macclellandi*	Elapidae	Rare
24	Burmese Python	*Python bivittatus*	Pythonidae	Rare

25	Mountain Pit Viper	*Ovophis monticola*	Viperidae	Rare
26	Himalayan Pit Viper	*Protobothrops himalayanus*	Viperidae	Moderate
25	Common Garden Lizard	*Calotes Versicolor*	Agamidae	Moderate
26	Jerdon's Forest Lizard	*Calotes jerdoni*	Agamidae	Moderate
27	Variegated Mountain Lizard	*Japalura variegata*	Agamidae	Rare
28	Brook's House Gecko	*Hemidactylus brookii*	Gekkonidae	Moderate
29	Flat-tailed Gecko	*Hemidactylus platyurus*	Gekkonidae	Moderate
30	Sikkimese Rock Skink	*Asymblepharus sikimmensis*	Scincidae	Moderate
31	Himalayan Litter Skink	*Sphenomorphus indicus*	Scincidae	Moderate
32	Spotted Forest Skink	*Sphenomorphus maculatus*	Scincidae	Rare
33	Himalan Torrent Frog	*Amolops marmoratus*	Ranidae	Moderate
34	Hill stream frog	*Amolops formosus*	Ranidae	Rare
35	Sikkim Lazy Toad	*Scutiger Sikimmensis*	Bufonidae	Rare
36	Himalayan Toad	*Duttaphrynus himalayanus*	Bufonidae	Moderate
37	Common Indian Toad	*Duttaphrynus melanostictus*	Bufonidae	Moderate
38	Skittering Frog	*Euphlyctis cyanophlyctis*	Dicroglossidae	Moderate
39	Sikkim Paa Frog	*Nanorana leibegii*	Dicroglossidae	Rare
40	Himalayan Tree Frog	*Polypedates himalayanus*	Rhacophoridae	Rare
41	Common tree frog	*Polypedates teraiensis*	Rhacophoridae	Rare
42	Giant Tree Frog	*Rhacophorus maximus*	Rhacophoridae	Moderate
43	Keeled Box Turtle	*Cuora mouhotii*	Geoemydidae	Rare

3.4. Fishes of JSWNP

Sl. No.	Common Name	Scientific Name	Family	IUCN	Distribution
1	Golden masheer	*Tor putitora*	Cyprinidae	EN	Mangdichu, Bertichu, Harachu confluence
2	Copper mahseer	*Neolissochilus hexagonolepis*	Cyprinidae	NT	Mangdichu, Bertichu, Harachu, Yangdigangchu, Wachenchu, Adha lake
3	Point-nosed snowtrout	*Schizothrax progastus*	Cyprinidae	LC	Mangdichu, Bertichu, Yangdigangchu, Harachu
4	Golden/spotted snow trout	*Schizothrax cf. plagiostomus*	Cyprinidae	NE	Yangdigangchu, Wanglingchu, Harachu, Adhachu
5	Blunt-snout snow trout	*Schizothrax richardsonii*	Cyprinidae	NE	Yangdigangchu, Mangdichu, Nabjichu confluence, Harachu
6	Lamta garra (Sucker fish	*Garra lamta*	Cyprinidae	LC	Bertichu, Yangdigangchu, Nabjichu, Harachu
7	Khasi garra, sucker fish	*Garra lissorhynchus*	Cyprinidae	LC	Bertichu
8	Stone roller	*Garra annandalei*	Cyprinidae	LC	Bertichu, Baebgangchu
9	Common carp	*Cyprinus carpio*	Cyprinidae	VU	Adha lake and Berti fishery ponds
10	Guntea loach	*Schistura cf. horai*	Nemacheilidae	LC	Bertichu, Yangdigangchu, Harachu

11	Torrent stone carp	*Psilorhynchus homaloptera*	Psilorhynchidae	LC	Harachu and Adha machu
12	Stone cat	*Exostoma labiatum*	Sisoridae	LC	Golipongchu, Wanglingchu, Kellachu
13	Sucatus catfish, Remora catfish	*Pseudecheneis sulcata*	Sisoridae	LC	Wanglingchu and Adhachu
14	Torrent catfish	*Parachiloglanis cf. hodgarti*	Sisoridae	LC	Adha machu, Lopokhachu
15	Brown trout, River trout	*Salmo trutta fario*	Salmonidae	LC	Nikachu, Adhachu
16	Indian mottled eel	*Anguilla bengalensis bengalensis*	Anguillidae	NE	Yangdigangchu, Baebgangchu

3.5. Butterflies of JSWNP

Sl. No.	Common Name	Scientific Name	Family
1	Absent Ace	*Halpe filda*	Hesperiidae (Skippers)
2	Banded Ace	*Halpe zema*	Hesperiidae (Skippers)
3	Bengal Spotted Flat	*Celaenorrhinus patura putara*	Hesperiidae (Skippers)
4	Bevan's Swift	*Borbo bevani*	Hesperiidae (Skippers)
5	Blue-Spotted Scrub Hopper	*Aeromachus kali*	Hesperiidae (Skippers)
6	Branded Orange Awlet	*Burara oedipodea belesis*	Hesperiidae (Skippers)
7	Brown Bush Bob	*Pedesta pandita*	Hesperiidae (Skippers)
8	Brown Pied Flat	*Coladenia agni*	Hesperiidae (Skippers)
9	Chestnut Angle	*Odontoptilum angulatum*	Hesperiidae (Skippers)
10	Chestnut Bob	*Iambrix salsala*	Hesperiidae (Skippers)
11	Chocolate Demon	*Ancistroides nigrita*	Hesperiidae (Skippers)
12	Colon Swift	*Caltoris cahira*	Hesperiidae (Skippers)
13	Common Awl	*Hasora barda*	Hesperiidae (Skippers)
14	Common Banded Awl	*Hasora chromus chromus*	Hesperiidae (Skippers)
15	Common Palm Dart	*Telicota colon stinga*	Hesperiidae (Skippers)
16	Common Wight	*Iton semamora*	Hesperiidae (Skippers)
17	Confucian Dart	*Potanthus spp.*	Hesperiidae (Skippers)
18	Conjoined Swift	*Pelopidas conjuncta*	Hesperiidae (Skippers)
19	Contiguous Swift	*Polytremis lubricans*	Hesperiidae (Skippers)
20	Crenulate Orange Flat	*Pintara tabrica*	Hesperiidae (Skippers)
21	Dark Palm Dart	*Telicota bambusae bambusae*	Hesperiidae (Skippers)
22	Dark Straight Swift	*Parnara apostata*	Hesperiidae (Skippers)
23	Dark Velvet Bob	*Koruthaialos butleri*	Hesperiidae (Skippers)
24	Detached Dart	*Potanthus trachala tytleri*	Hesperiidae (Skippers)
25	Double-spotted Flat	*Celaenorrhinus pyrrha*	Hesperiidae (Skippers)
26	Dusky Yellow-Breasted Flat	*Gerosis phisara*	Hesperiidae (Skippers)
27	Fringed Dawnfly	*Capila penicillatun*	Hesperiidae (Skippers)
28	Fulvous Pied Flat	*Pseudocoladenia dan*	Hesperiidae (Skippers)
29	Grass Demon	*Udaspes folus*	Hesperiidae (Skippers)

30	Green Awlet	*Burara vasutana*	Hesperiidae (Skippers)
31	Green-striped Palmer	*Pirdana hyela*	Hesperiidae (Skippers)
32	Grey Swift	*Parnara bada*	Hesperiidae (Skippers)
33	Hairy Angle	*Dharpa hanria*	Hesperiidae (Skippers)
34	Himalayan White Flat	*Seseria dohertyi dohertyi*	Hesperiidae (Skippers)
35	Indian Ace	*Halpe homolea*	Hesperiidae (Skippers)
36	Indian Awlking	*Choaspes benjaminii*	Hesperiidae (Skippers)
37	Indian Dart	*Potanthus pseudomaesa pseudomaesa*	Hesperiidae (Skippers)
38	Large Branded Swift	*Pelopidas subochracea*	Hesperiidae (Skippers)
39	Large Spotted Flat	*Celaenorrhinus patula*	Hesperiidae (Skippers)
40	Light Straw Ace	*Pithauria stramineipennis*	Hesperiidae (Skippers)
41	Lucas' Ace	*Sovia lucasii magna*	Hesperiidae (Skippers)
42	Mussoorie Bush Bob	*Pedesta masurinsis*	Hesperiidae (Skippers)
43	Northern Spotted Ace	*Thoressa cerata*	Hesperiidae (Skippers)
44	Orange-Striped Awlet	*Burara jaina jaina*	Hesperiidae (Skippers)
45	Orange-Tail Awl	*Bibasis sena*	Hesperiidae (Skippers)
46	Plain Palm Dart	*Cephrenes acalle*	Hesperiidae (Skippers)
47	Purple and Gold Flitter	*Zographetus satwa*	Hesperiidae (Skippers)
48	Purple Redeye	*Matapa purpurascens*	Hesperiidae (Skippers)
49	Restricted Demon	*Notocrypta curvifascia*	Hesperiidae (Skippers)
50	Rice Swift	*Borbo cinnara*	Hesperiidae (Skippers)
51	Sikkim Ace	*Halpe sikkima*	Hesperiidae (Skippers)
52	Slate Awl	*Hasora anura*	Hesperiidae (Skippers)
53	Small Branded Swift	*Pelopidas mathias*	Hesperiidae (Skippers)
54	Small Green Awlet	*Burara amara*	Hesperiidae (Skippers)
55	Smaller Dartlet	*Oriens goloides*	Hesperiidae (Skippers)
56	Snowy Angle	*Darpa pteria*	Hesperiidae (Skippers)
57	Spotted Demon	*Notocrypta feisthameli*	Hesperiidae (Skippers)
58	Spotted Redeye	*Pudicitia pholus*	Hesperiidae (Skippers)
59	Spotted Snow Flat	*Tagiades menaka*	Hesperiidae (Skippers)
60	Straight Swift	*Parnara guttata*	Hesperiidae (Skippers)
61	Striped Dawnfly	*Caipla javadeva*	Hesperiidae (Skippers)
62	Swinhoe's Flat	*Celaenorrhinus zea*	Hesperiidae (Skippers)
63	Tamil Grass Dart	*Taractrocera ceramas*	Hesperiidae (Skippers)
64	Tawny Angle	*Ctenoptilum vasava*	Hesperiidae (Skippers)
65	Tree Flitter	*Hyarotis adrastus*	Hesperiidae (Skippers)
66	Tufted Ace	*Sebastonyma dolopia*	Hesperiidae (Skippers)
67	Tytler's Multi-Spotted Flat	*Celaenorrhinus ratna tytleri*	Hesperiidae (Skippers)
68	Variable Ace	*Thoressa hyrie*	Hesperiidae (Skippers)
69	Veined Scrub Hopper	*Aeromachus stigmatus*	Hesperiidae (Skippers)
70	Water Snow Flat	*Tagiades litigiosa*	Hesperiidae (Skippers)
71	White Yellow-breasted Flat	*Gerosis sinica*	Hesperiidae (Skippers)

72	White-striped Snow Flat	*Tagiades cohaerens*	Hesperiidae (Skippers)
73	Yellow Flat	*Mooreana trichoneura*	Hesperiidae (Skippers)
74	Yellow Spot Swift	*Polytremis eltola*	Hesperiidae (Skippers)
75	Albocerulean	*Udara albocaerulea*	Lycaenidae (Blues)
76	Angled Sunbeam	*Curetis acuta*	Lycaenidae (Blues)
77	Azure Sapphire	*Heliophorus moorei*	Lycaenidae (Blues)
78	Banded Lineblue	*Prosotas aluta*	Lycaenidae (Blues)
79	Banded Royal	*Rachana jalindra*	Lycaenidae (Blues)
80	Bicolor Cupid	*Shijimia moorei*	Lycaenidae (Blues)
81	Bi-Spot Royal	*Ancema ctesia*	Lycaenidae (Blues)
82	Blue Imperial	*Ticherra acte*	Lycaenidae (Blues)
83	Blue Tit	*Chliaria kina*	Lycaenidae (Blues)
84	Branded Yamfly	*Yasoda tripunctata*	Lycaenidae (Blues)
85	Bright Sunbeam	*Curetis bulis*	Lycaenidae (Blues)
86	Burmese Bushblue	*Arhopala birmana*	Lycaenidae (Blues)
87	Centaur Oakblue	*Arhopala centaurus*	Lycaenidae (Blues)
88	Chocolate Royal	*Remelana jangala*	Lycaenidae (Blues)
89	Club Silverline	*Spindasis syama*	Lycaenidae (Blues)
90	Common Ciliate Blue	*Anthene emolus*	Lycaenidae (Blues)
91	Common Copper	*Lycaena phlaeas*	Lycaenidae (Blues)
92	Common Flash	*Rapala nissa*	Lycaenidae (Blues)
93	Common Gem	*Poritia hewitsoni*	Lycaenidae (Blues)
94	Common Hedge Blue	*Acytolepis puspa*	Lycaenidae (Blues)
95	Common Lineblue	*Prosotas nora*	Lycaenidae (Blues)
96	Common Pierrot	*Castalius rosimon*	Lycaenidae (Blues)
97	Common Quaker	*Neopithecops zalmora*	Lycaenidae (Blues)
98	Common Tinsel	*Catapaecilma major*	Lycaenidae (Blues)
99	Common Tit	*Hypolycaena erylus*	Lycaenidae (Blues)
100	Copper Flash	*Rapala pheretima*	Lycaenidae (Blues)
101	Cornelian	*Deudorix epijarbas*	Lycaenidae (Blues)
102	Dark Cerulean	*Jamides bochus*	Lycaenidae (Blues)
103	Dark Grass Blue	*Zizeeria karsandra*	Lycaenidae (Blues)
104	Dark Pierrot	*Tarucus ananda*	Lycaenidae (Blues)
105	Dark Sapphire	*Heliophorus indicus*	Lycaenidae (Blues)
106	Dingy Lineblue	*Petrelaea dana*	Lycaenidae (Blues)
107	Elbowed Pierrot	*Caleta elna*	Lycaenidae (Blues)
108	Fluffy Tit	*Zeltus amasa*	Lycaenidae (Blues)
109	Forest Pierrot	*Taraka hamada*	Lycaenidae (Blues)
110	Forest Quaker	*Pithecops corvus*	Lycaenidae (Blues)
111	Forget-Me-Not	*Catochrysops strabo*	Lycaenidae (Blues)
112	Great Darkie	*Allotinus drumila*	Lycaenidae (Blues)
113	Green Oakblue	*Arhopala eumolphus*	Lycaenidae (Blues)
114	Hooked Oakblue	*Arhopala paramuta*	Lycaenidae (Blues)

115	Indian Cupid	*Everes lacturnus*	Lycaenidae (Blues)
116	Indigo Flash	*Rapala varuna*	Lycaenidae (Blues)
117	Khaki Silverline	*Spindasis rukmini*	Lycaenidae (Blues)
118	Large Fourline Blue	*Nacaduba pactolus*	Lycaenidae (Blues)
119	Large Hedge Blue	*Celastrina huegelii*	Lycaenidae (Blues)
120	Lesser Grass Blue	*Zizina otis*	Lycaenidae (Blues)
121	Lime Blue	*Chilades lajus*	Lycaenidae (Blues)
122	Long-banded Silverline	*Spindasis lohita*	Lycaenidae (Blues)
123	Malayan	*Megisba malaya*	Lycaenidae (Blues)
124	Mandarin Blue	*Charana mandarinus*	Lycaenidae (Blues)
125	Metallic Cerulean	*Jamides alecto*	Lycaenidae (Blues)
126	Pale Grass Blue	*Pseudozizeeria maha*	Lycaenidae (Blues)
127	Pale Hedge Blue	*Udara dilecta*	Lycaenidae (Blues)
128	Pea Blue	*Lampides boeticus*	Lycaenidae (Blues)
129	Plain Hedge Blue	*Celastrina lavendularis*	Lycaenidae (Blues)
130	Plane	*Bindahara phocides*	Lycaenidae (Blues)
131	Powdered Oakblue	*Arhopala bazalus*	Lycaenidae (Blues)
132	Powdery Green Sapphire	*Heliophorus tamu*	Lycaenidae (Blues)
133	Purple Sapphire	*Heliophorus epicles*	Lycaenidae (Blues)
134	Rounded Six-Lineblue	*Nacaduba berenice*	Lycaenidae (Blues)
135	Scarce Shot Silverline	*Spindasis elima*	Lycaenidae (Blues)
136	Slate Flash	*Rapala manea*	Lycaenidae (Blues)
137	Spotted Royal	*Tajuria maculata*	Lycaenidae (Blues)
138	Tailed Cupid	*Everes argiades*	Lycaenidae (Blues)
139	Tailless Lineblue	*Prosotas dubiosa*	Lycaenidae (Blues)
140	Tailless Plushblue	*Flos areste*	Lycaenidae (Blues)
141	Transparent 6-Lineblue	*Nacaduba kurava*	Lycaenidae (Blues)
142	Water Hairstreak	*Euaspa milionia*	Lycaenidae (Blues)
143	White-banded Hedge Blue	*Lestranicus transpectus*	Lycaenidae (Blues)
144	Zebra Blue	*Leptotes spp.*	Lycaenidae (Blues)
145	Angled Red Forester	*Lethe chandica*	Nymphalidae (Brush-footed)
146	Autumn Leaf	*Doleschallia bisaltide*	Nymphalidae (Brush-footed)
147	Banded Treebrown	*Lethe confusa*	Nymphalidae (Brush-footed)
148	Bhutan Sergeant	*Athyma jina jina*	Nymphalidae (Brush-footed)
149	Bicolor Commodore	*Parasarpa zayla*	Nymphalidae (Brush-footed)
150	Black Forester	*Lethe vindhya*	Nymphalidae (Brush-footed)
151	Black Prince	*Rohana parisatis*	Nymphalidae (Brush-footed)
152	Blackvein Sergeant	*Athyma ranga*	Nymphalidae (Brush-footed)
153	Blue Admiral	*Kaniska canace*	Nymphalidae (Brush-footed)
154	Blue Duchess	*Euthalia duda*	Nymphalidae (Brush-footed)
155	Blue Duke	*Euthalia durga*	Nymphalidae (Brush-footed)
156	Blue Glassy Tiger	*Tirumala limniace*	Nymphalidae (Brush-footed)
157	Blue Oakleaf	*Kallima horsfieldi*	Nymphalidae (Brush-footed)

158	Blue Pansy	*Junonia orithiya*	Nymphalidae (Brush-footed)
159	Blue-Striped Palmfly	*Elymnias patna*	Nymphalidae (Brush-footed)
160	Blue-Tail Jester	*Symbrenthia niphanda*	Nymphalidae (Brush-footed)
161	Brighteye Bushbrown	*Mycalesis nicotia*	Nymphalidae (Brush-footed)
162	Broad-Banded Sailer	*Neptis sankara*	Nymphalidae (Brush-footed)
163	Bronze Duke	*Euthalia nara*	Nymphalidae (Brush-footed)
164	Brown Argus	*Callerebia hyagriva*	Nymphalidae (Brush-footed)
165	Brown Prince	*Rohana parvata*	Nymphalidae (Brush-footed)
166	Chestnut Tiger	*Parantica sita*	Nymphalidae (Brush-footed)
167	Chocolate Pansy	*Junonia iphita*	Nymphalidae (Brush-footed)
168	Circe	*Hestina nama*	Nymphalidae (Brush-footed)
169	Clear Sailer	*Neptis clinia susruta*	Nymphalidae (Brush-footed)
170	Club Beak	*Libythea myrrha*	Nymphalidae (Brush-footed)
171	Commander	*Moduza procris*	Nymphalidae (Brush-footed)
172	Commodore	*Auzakia danava*	Nymphalidae (Brush-footed)
173	Common Beak	*Libythea lepita*	Nymphalidae (Brush-footed)
174	Common Bushbrown	*Mycalesis perseus*	Nymphalidae (Brush-footed)
175	Common Castor	*Ariadne merione*	Nymphalidae (Brush-footed)
176	Common Crow	*Euploea core*	Nymphalidae (Brush-footed)
177	Common Duffer	*Discophora sondaica*	Nymphalidae (Brush-footed)
178	Common Earl	*Tanaecia julii*	Nymphalidae (Brush-footed)
179	Common Evening Brown	*Melanitis leda*	Nymphalidae (Brush-footed)
180	Common Faun	*Faunis canens*	Nymphalidae (Brush-footed)
181	Common Fivering	*Ypthima baldus*	Nymphalidae (Brush-footed)
182	Common Jester	*Symbrenthia hippoclus*	Nymphalidae (Brush-footed)
183	Common Lascar	*Pantoporia hordonia*	Nymphalidae (Brush-footed)
184	Common Leopard	*Phalanta phalantha*	Nymphalidae (Brush-footed)
185	Common Map	*Cyrestis thyodamas*	Nymphalidae (Brush-footed)
186	Common Maplet	*Chersonesia risa*	Nymphalidae (Brush-footed)
187	Common Nawab	*Polyura athamas*	Nymphalidae (Brush-footed)
188	Common Palmfly	*Elymnia hypermnestra*	Nymphalidae (Brush-footed)
189	Common Sailer	*Neptis hylas*	Nymphalidae (Brush-footed)
190	Common Satyr	*Aulocera swaha*	Nymphalidae (Brush-footed)
191	Common Sergeant	*Athyma perius*	Nymphalidae (Brush-footed)
192	Common Treebrown	*Lethe rohria*	Nymphalidae (Brush-footed)
193	Common Woodbrown	*Lethe sidonis*	Nymphalidae (Brush-footed)
194	Common Yeoman	*Cirrochroa tyche*	Nymphalidae (Brush-footed)
195	Constable	*Dichorrhagia nesimachus*	Nymphalidae (Brush-footed)
196	Courtesan	*Euripus nyctelius*	Nymphalidae (Brush-footed)
197	Creamy Sailer	*Neptis soma*	Nymphalidae (Brush-footed)
198	Cruiser	*Vindula erota*	Nymphalidae (Brush-footed)
199	Dark Archduke	*Lexias dirtea*	Nymphalidae (Brush-footed)
200	Dark Blue Tiger	*Tirumala septentrionis*	Nymphalidae (Brush-footed)

201	Dark Catseye	*Zipaetis scylax*	Nymphalidae (Brush-footed)
202	Dark Evening Brown	*Melanitis phedima*	Nymphalidae (Brush-footed)
203	Dark-Branded Bushbrown	*Mycalesis mineus*	Nymphalidae (Brush-footed)
204	Dingiest Sailer	*Neptis harita*	Nymphalidae (Brush-footed)
205	Dingy Sailer	*Neptis pseudovikasi*	Nymphalidae (Brush-footed)
206	Doherty's Satyr	*Aulocera loha*	Nymphalidae (Brush-footed)
207	Dusky Diadem	*Ethope himachala*	Nymphalidae (Brush-footed)
208	Dusky Labyrinth	*Neope yama*	Nymphalidae (Brush-footed)
209	Eastern Courtier	*Sephisa chandra*	Nymphalidae (Brush-footed)
210	Elongated Sergeant	*Athyma orientalis*	Nymphalidae (Brush-footed)
211	French Duke	*Euthalia franciae*	Nymphalidae (Brush-footed)
212	Gaudy Baron	*Euthalia lubentina*	Nymphalidae (Brush-footed)
213	Glassy Tiger	*Parantica aglea*	Nymphalidae (Brush-footed)
214	Golden Emperor	*Golden Emperor*	Nymphalidae (Brush-footed)
215	Grand Duchess	*Euthalia patala*	Nymphalidae (Brush-footed)
216	Great Archduke	*Lexias cyanipardus*	Nymphalidae (Brush-footed)
217	Great Eggfly	*Hypolimnas bolina*	Nymphalidae (Brush-footed)
218	Great Nawab	*Polyura eudamippus*	Nymphalidae (Brush-footed)
219	Great Yellow Sailer	*Neptis radha*	Nymphalidae (Brush-footed)
220	Green Commodore	*Sumalia daraxa*	Nymphalidae (Brush-footed)
221	Green Duke	*Euthalia sahadeva*	Nymphalidae (Brush-footed)
222	Grey Baron	*Euthalia anosia*	Nymphalidae (Brush-footed)
223	Grey Pansy	*Junonia atlites*	Nymphalidae (Brush-footed)
224	Himalayan Fivering	*Ypthima sakra*	Nymphalidae (Brush-footed)
225	Himalayan Jester	*Symbrenthia brabira*	Nymphalidae (Brush-footed)
226	Himalayan Sergeant	*Athyma opalina*	Nymphalidae (Brush-footed)
227	Hockey Sticksailer	*Neptis nycteus*	Nymphalidae (Brush-footed)
228	Indian Fritillary	*Argyreus hyperbius*	Nymphalidae (Brush-footed)
229	Indian Purple Emperor	*Apatura ambica*	Nymphalidae (Brush-footed)
230	Indian Red Admiral	*Vanessa indica*	Nymphalidae (Brush-footed)
231	Indian Tortoiseshell	*Aglais cashmiriensis*	Nymphalidae (Brush-footed)
232	Jezebel Palmfly	*Elymnias vasudeva*	Nymphalidae (Brush-footed)
233	Jungle Glory	*Thaumantis diores*	Nymphalidae (Brush-footed)
234	Large Silverstripe	*Childrena childreni*	Nymphalidae (Brush-footed)
235	Large Threering	*Ypthima nareda*	Nymphalidae (Brush-footed)
236	Large Yeoman	*Cirrochroa aoris*	Nymphalidae (Brush-footed)
237	Lemon Pansy	*Junonia lemonias*	Nymphalidae (Brush-footed)
238	Leopard Lacewing	*Cethosia cyane*	Nymphalidae (Brush-footed)
239	Lilacfork	*Lethe sura*	Nymphalidae (Brush-footed)
240	Lilacine Bushbrown	*Mycalesis francisca*	Nymphalidae (Brush-footed)
241	Long-Branded Blue Crow	*Euploea algea*	Nymphalidae (Brush-footed)
242	Long-Branded Bushbrown	*Mycalesis visala*	Nymphalidae (Brush-footed)
243	Moore's Bushbrown	*Mycalesis heri*	Nymphalidae (Brush-footed)

244	Nepal Comma	*Polygonia agnicula*	Nymphalidae (Brush-footed)
245	Newar Three-ring	*Ypthima newara*	Nymphalidae (Brush-footed)
246	Nigger	*Orsotrioena medus*	Nymphalidae (Brush-footed)
247	Northern Jungle Queen	*Sticopthalma camadeva*	Nymphalidae (Brush-footed)
248	Orange Oakleaf	*Kallima inachus*	Nymphalidae (Brush-footed)
249	Orange Staff Sergeant	*Athyma cama*	Nymphalidae (Brush-footed)
250	Orange-backed Freak	*Calinaga brahma*	Nymphalidae (Brush-footed)
251	Painted Lady	*Vanessa cardui*	Nymphalidae (Brush-footed)
252	Pale Forester	*Lethe latiaris*	Nymphalidae (Brush-footed)
253	Pale Hockeystick Sailer	*Neptis manasa manasa*	Nymphalidae (Brush-footed)
254	Pallid Argus	*Callerebia scanda*	Nymphalidae (Brush-footed)
255	Pallid Faun	*Melanocyma faunula*	Nymphalidae (Brush-footed)
256	Panther	*Neurosigma siva*	Nymphalidae (Brush-footed)
257	Pasha	*Herona marathus*	Nymphalidae (Brush-footed)
258	Peacock Pansy	*Junonia almana*	Nymphalidae (Brush-footed)
259	Plain Earl	*Tanaecia jahnu*	Nymphalidae (Brush-footed)
260	Plain Sailer	*Neptis cartica*	Nymphalidae (Brush-footed)
261	Popinjay	*Stibochiona nicea*	Nymphalidae (Brush-footed)
262	Powdered Baron	*Euthalia monina kisava*	Nymphalidae (Brush-footed)
263	Queen of Spain Fritillary	*Issoria lathonia*	Nymphalidae (Brush-footed)
264	Red Caliph	*Enispe euthymius*	Nymphalidae (Brush-footed)
265	Red Lacewing	*Cethosia biblis*	Nymphalidae (Brush-footed)
266	Ringed Argus	*Callerebia annada*	Nymphalidae (Brush-footed)
267	Rusty Forester	*Lethe bhairava*	Nymphalidae (Brush-footed)
268	Scarce Red Forester	*Lethe distans*	Nymphalidae (Brush-footed)
269	Scarce White Commodore	*Sumalia zulema*	Nymphalidae (Brush-footed)
270	Sergeant Emperor	*Mimathyma chevana*	Nymphalidae (Brush-footed)
271	Sergeant Major	*Abrota ganga*	Nymphalidae (Brush-footed)
272	Siren	*Hestina persimilis*	Nymphalidae (Brush-footed)
273	Small Staff Sergeant	*Athyma zeroca*	Nymphalidae (Brush-footed)
274	Small Yellow Sailer	*Neptis miah*	Nymphalidae (Brush-footed)
275	Sordid Emperor	*Chitoriasordida*	Nymphalidae (Brush-footed)
276	Spotted Palmfly	*Elymnias malelas*	Nymphalidae (Brush-footed)
277	Staff Sergeant	*Athyma selenophora*	Nymphalidae (Brush-footed)
278	Stately Nawab	*Polyura doldon*	Nymphalidae (Brush-footed)
279	Straight Banded Treebrown	*Lethe verma*	Nymphalidae (Brush-footed)
280	Streaked Baron	*Euthalia alpheda*	Nymphalidae (Brush-footed)
281	Striped Blue Crow	*Euploea mulciber*	Nymphalidae (Brush-footed)
282	Striped Tiger	*Danaus genutia*	Nymphalidae (Brush-footed)
283	Studded Sergeant	*Studded Sergeant*	Nymphalidae (Brush-footed)
284	Tabby	*Pseudergolis wedah*	Nymphalidae (Brush-footed)
285	Tailed Labyrinth	*Neope bharda*	Nymphalidae (Brush-footed)
286	Tailed Red Forester	*Lethe sinorix*	Nymphalidae (Brush-footed)

287	Tamil Yeoman	*Cirrochroa thais*	Nymphalidae (Brush-footed)
288	Tiger Brown	*Orinoma damaris*	Nymphalidae (Brush-footed)
289	Vagrant	*Vagrans egista*	Nymphalidae (Brush-footed)
290	Variegated Rajah	*Charaxes kahruba*	Nymphalidae (Brush-footed)
291	Veined Labyrinth	*Neope pulaha pulaha*	Nymphalidae (Brush-footed)
292	White Commodore	*Parasarpa dudu*	Nymphalidae (Brush-footed)
293	White Emperor	*Helcyra hemina*	Nymphalidae (Brush-footed)
294	Whitebar Bushbrown	*Mycalesis anaxias*	Nymphalidae (Brush-footed)
295	White-Edged Blue Baron	*Euthalia phemius*	Nymphalidae (Brush-footed)
296	White-edged Woodbrown	*Lethe visrava*	Nymphalidae (Brush-footed)
297	White-patch Sergeant	*Athyma punctata*	Nymphalidae (Brush-footed)
298	Wood Mason's Bushbrown	*Mycalesis suaveolens*	Nymphalidae (Brush-footed)
299	Yellow Coster	*Acraea issoria*	Nymphalidae (Brush-footed)
300	Yellow Dryad	*Aemona amathusia*	Nymphalidae (Brush-footed)
301	Yellow Kaiser	*Penthema lisarda*	Nymphalidae (Brush-footed)
302	Yellow Owl	*Neorina hilda*	Nymphalidae (Brush-footed)
303	Yellow Pansy	*Junonia hierta*	Nymphalidae (Brush-footed)
304	Yellow Sailer	*Neptis ananta*	Nymphalidae (Brush-footed)
305	Yellow Woodbrown	*Lethe nicetas*	Nymphalidae (Brush-footed)
306	Bhutan Glory	*Bhutanitis lidderdalii*	Papilionidae (Swallowtails)
307	Blue Peacock	*Papilio arcturus*	Papilionidae (Swallowtails)
308	Common Birdwing	*Troides helena*	Papilionidae (Swallowtails)
309	Common Blue Apollo	*Parnassius hardwickii*	Papilionidae (Swallowtails)
310	Common Bluebottle	*Graphium sarpedon*	Papilionidae (Swallowtails)
311	Common Jay	*Graphium doson*	Papilionidae (Swallowtails)
312	Common Mime	*Papilio clytia*	Papilionidae (Swallowtails)
313	Common Mormon	*Papilio polytes*	Papilionidae (Swallowtails)
314	Common Peacock	*Papilio bianor*	Papilionidae (Swallowtails)
315	Common Raven	*Papilio castor*	Papilionidae (Swallowtails)
316	Common Rose	*Pachliopta aristolochiae*	Papilionidae (Swallowtails)
317	Common Windmill	*Byasa polyeuctes*	Papilionidae (Swallowtails)
318	Fivebar Swordtail	*Graphium antiphates*	Papilionidae (Swallowtails)
319	Fourbar Swordtail	*Graphium agetes*	Papilionidae (Swallowtails)
320	Glassy Bluebottle	*Graphium cloanthus*	Papilionidae (Swallowtails)
321	Golden Birdwing	*Troides aeacus*	Papilionidae (Swallowtails)
322	Great Mormon	*Papilio memnon*	Papilionidae (Swallowtails)
323	Great Windmill	*Byasa dasarada*	Papilionidae (Swallowtails)
324	Great Zebra	*Great Zebra*	Papilionidae (Swallowtails)
325	Krishna Peacock	*Papilio krishna*	Papilionidae (Swallowtails)
326	Lime Butterfly	*Papilio demoleus*	Papilionidae (Swallowtails)
327	Paris Peacock	*Papilio paris*	Papilionidae (Swallowtails)
328	Red Helen	*Papilio helenus*	Papilionidae (Swallowtails)
329	Redbreast	*Papilio alcmenor*	Papilionidae (Swallowtails)

330	Rose Windmill	*Byasa latreillei*	Papilionidae (Swallowtails)
331	Sixbar Swordtail	*Graphium eurous*	Papilionidae (Swallowtails)
332	Spangle	*Papilio protenor*	Papilionidae (Swallowtails)
333	Tailed Jay	*Graphium agamemnon*	Papilionidae (Swallowtails)
334	Tailed Redbreast	*Papilio bootes*	Papilionidae (Swallowtails)
335	Tawny Mime	*Papilio agestar*	Papilionidae (Swallowtails)
336	Veined Jay	*Graphium chironides*	Papilionidae (Swallowtails)
337	Yellow Helen	*Papilio nephelus*	Papilionidae (Swallowtails)
338	Bath White	*Pontia daplidice*	Pieridae (Whites and Yellows)
339	Bhutan Blackvein	*Aporia harrietae*	Pieridae (Whites and Yellows)
340	Bhutia Extended White	*Pieris extensa bhutya*	Pieridae (Whites and Yellows)
341	Chocolate Albatross	*Appias lyncida*	Pieridae (Whites and Yellows)
342	Common Albatross	*Appias albina*	Pieridae (Whites and Yellows)
343	Common Emigrant	*Catopsilia pomona*	Pieridae (Whites and Yellows)
344	Common Grass Yellow	*Eurema hecabe*	Pieridae (Whites and Yellows)
345	Common Gull	*Cepora nerissa*	Pieridae (Whites and Yellows)
346	Dark Clouded Yellow	*Colias fieldii*	Pieridae (Whites and Yellows)
347	Great Blackvein	*Aporia agathon*	Pieridae (Whites and Yellows)
348	Great Orange Tip	*Hebomoia glaucippe*	Pieridae (Whites and Yellows)
349	Green-Veined White	*Pieris melete*	Pieridae (Whites and Yellows)
350	Hill Jezebel	*Delias belladonna*	Pieridae (Whites and Yellows)
351	Indian Cabbage White	*Pieris canidia*	Pieridae (Whites and Yellows)
352	Large Cabbage White	*Pieris brassicae*	Pieridae (Whites and Yellows)
353	Lesser Gull	*Cepora nadina*	Pieridae (Whites and Yellows)
354	Mottled Emigrant	*Catopsilia pyranthe*	Pieridae (Whites and Yellows)
355	One-spot Grass Yellow	*Eurema andersonii*	Pieridae (Whites and Yellows)
356	Pale Jezebel	*Delias sanaca*	Pieridae (Whites and Yellows)
357	Plain Puffin	*Appias indra*	Pieridae (Whites and Yellows)
358	Plain Sulphur	*Dercas lycorias*	Pieridae (Whites and Yellows)
359	Red-base Jezebel	*Delias pasithoe*	Pieridae (Whites and Yellows)
360	Red-Breast Jezebel	*Delias acalis*	Pieridae (Whites and Yellows)
361	Red-spot Jezebel	*Delias descombesi*	Pieridae (Whites and Yellows)
362	Red-Spot Sawtooth	*Prioneris clemanthe*	Pieridae (Whites and Yellows)
363	Spot Puffin	*Appias lalage*	Pieridae (Whites and Yellows)
364	Spotless Grass Yellow	*Eurema laeta*	Pieridae (Whites and Yellows)
365	Spotted Sawtooth	*Prioneris thestylis*	Pieridae (Whites and Yellows)
366	Tailed Sulphur	*Dercas verhuelli*	Pieridae (Whites and Yellows)
367	Three-Spot Grass Yellow	*Eurema blanda*	Pieridae (Whites and Yellows)
368	Tree Yellow	*Gandaca harina*	Pieridae (Whites and Yellows)
369	Yellow Jezebel	*Delias agostina*	Pieridae (Whites and Yellows)
370	Yellow Orange-tip	*Ixias pyrene*	Pieridae (Whites and Yellows)
371	Columbine	*Stiboges nymphidia*	Riodinidae (Judies and Punches)
372	Dark Judy	*Abisara fylla*	Riodinidae (Judies and Punches)

373	Lesser Punch	*Dodona dipoea*	Riodinidae (Judies and Punches)
374	Mixed Punch	*Dodona ouida*	Riodinidae (Judies and Punches)
375	Orange Punch	*Dodona egeon*	Riodinidae (Judies and Punches)
376	Punchinello	*Zemeros flegyas*	Riodinidae (Judies and Punches)
377	Striped Punch	*Dodona adonira*	Riodinidae (Judies and Punches)
378	Tailed Judy	*Abisara neophron*	Riodinidae (Judies and Punches)
379	Tailed Punch	*Dodona eugenes*	Riodinidae (Judies and Punches)

3.6. Dragonflies and Damselflies of JSWNP

Sl. No.	Species Name	Family
ANISOPTERA: DRAGONFLY		
1	*Aeshna petalura*	Aeshnidae
2	*Polycanthagyna erythromelas*	Aeshnidae
3	*Chlorogomphus mortoni*	Chlorogomphidae
4	*Watanabeopetalia atkinsoni*	Chlorogomphidae
5	*Anisogomphus bivittatus*	Gomphidae
6	*Lamelligomphus risi*	Gomphidae
7	*Perissogomphus stevensi*	Gomphidae
8	*Crocothemis erythraea*	Libellulidae
9	*Crocothemis servilia*	Libellulidae
10	*Diplacodes nebulosa*	Libellulidae
11	*Diplacodes trivialis*	Libellulidae
12	*Lyriothemis bivittata*	Libellulidae
13	*Orthetrum glaucum*	Libellulidae
14	*Orthetrum internum*	Libellulidae
15	*Orthetrum luzonicum*	Libellulidae
16	*Orthetrum pruinosum*	Libellulidae
17	*Orthetrum sabina*	Libellulidae
18	*Orthetrum triangulare*	Libellulidae
19	*Palpopleura sexmaculata*	Libellulidae
20	*Pantala flavescens*	Libellulidae
21	*Sympetrum commixtum*	Libellulidae
22	*Sympetrum hypomelas*	Libellulidae
23	*Tramea virginia*	Libellulidae
24	*Trithemis aurora*	Libellulidae
25	*Trithemis festiva*	Libellulidae
26	*Trithemis pallidinervis*	Libellulidae
27	*Macromia moorei*	Macromidae
ZYGOPTERA: DAMSELFLY		
1	*Caliphaea spp.*	Calopterygidae
2	*Neurobasis chinensis*	Calopterygidae
3	*Aristocypha cuneata*	Chlorocyphidae

4	*Aristocypha quadrimaculata*	Chlorocyphidae
5	*Libellago lineata*	Chlorocyphidae
6	*Aciagrion pallidum*	Coenagrionidae
7	*Ceriagrion fallax*	Coenagrionidae
8	*Ischnura rubilio*	Coenagrionidae
9	*Pseudagrion rubriceps*	Coenagrionidae
10	*Anisopleura comes*	Eupaeidae
11	*Anisopleura subplatystyla*	Eupaeidae
12	*Bayadera indica*	Eupaeidae
13	*Megalestes gyalsey*	Synlestidae
14	*Indolestes cyaneus*	Lestidae
15	*Calicnemia eximia*	Platycnemididae

Appendix 4. Summary Sheet for Trong LFMA

Summary Results for Forest Management Area: Trong Gewog

Unit	Area Distribution					Average basal area (m2/ha)	Aver. Stand Volume (m3/ha)	No of Operable sample plots
	Non-Production	Protection	Production	Total				
ha	248.1	538.5	1045.5	1832.1				
%	14%	29%	57%	100%		23.6	302	245

Unit	Forest Type Distribution								
	Hemlock	Fir	Spruce	Mix. Con.	Blue-pine	Chirpine	Hardwood	Mixed HC	Total
%	0%	0%	0%	0%	0%	0%	84%	16%	**100%**

Unit	Age distribution					Stand type distribution			
	young	immature	mature	Over-mature	Total	plantation	natural	coppice	Total
%	10%	22%	67%	1%	**100%**	1%	99%	0%	**100%**

Unit	Canopy closure					Condition			
	dense	closed	open	un-stocked	Total	good	average	poor	Total
%	13%	56%	27%	5%	**100%**	45%	41%	14%	**100%**

Site Condition									
Unit	Slope			Erosiveness			Soil Cover		
	gentle	moderate	steep	stable	moderate	unstable	high	moderate	low
%	40%	37%	24%	54%	36%	11%	30%	55%	14%

Forest Use						
Unit	Intensive Side Uses			Extensive Side Uses		
	grazing	sokshing	lopping	grazing	sokshing	lopping
ha	632.8	23.8	140.5	300.8	41.0	171.6
%	35%	1%	8%	16%	2%	9%

NWFP Occurence and Firewood								
Unit	NWFP abundant				NWFP sparse			
	Firewood	Bamboo	Cane	Daphne	Firewood	Bamboo	Cane	Daphne
ha	976.6	270.5	99.6	4.9	379.9	273.2	349.3	124.3
%	53%	15%	5%	0%	21%	15%	19%	7%

Potential Production					
Unit	Timber				
	Drashing	Cham	Tsim	Poles, posts	Total
Ntot	17356	7130	3276	5197	**32959**
N/ha	17	7	3	5	**32**
m3	128263	7021	779	398	**136461**
m3/ha	122.7	6.7	0.7	0.4	**130.5**

Unit	Firewood				
	> 49cm	30-49cm	20-29 cm	10-19 cm	Total
Ntot	7534	28620	43323	124845	**204322**
N/ha	7	27	41	119	**195**
m3	38808	24167	11860	8852	**83687**
m3/ ha	37.1	23.1	11.3	8.5	**80.0**
Unit	**Sivicultural Measures**				
	Planting	**Thinning**	**Felling (fire-wood)**	**Felling (tim-ber)**	**No Ac-tivity**
ha	126.5	270.9	362.7	147.4	943.7
%	7	15	20	8	52
	Yield Regulation				
	AAC		**2460**	m3	
			2.4	m3/ha	
	Prod. Potential / AAC		**89**	years	

Table 35: Summary sheet for Trong LFMA.

Appendix 5. Summary sheet for Jigmechholing LFMA

Summary Results for Forest Management Area: Jigmechholing Gewog									
Unit	**Area Distribution**						**Average basal area (m2/ha)**	**Aver. Stand Volume (m3/ha)**	**No of operable sample plots**
	Non Forest	**Protec-tion**	**Inoper-able**	**Produc-tion**	**Total**				
ha	66.2	110.3	79.3	882.2	**1138.0**				
%	6%	10%	7%	78%	**100%**		16.8	521	278
Unit	**Forest Type Distribution**								
	Hemlock	**Fir**	**Spruce**	**Mix. Con.**	**Bluepine**	**Chirpine**	**Hard-wood**	**Mixed HC**	**Total**
%	0%	0%	0%	0%	0%	0%	100%	0%	**100%**
Unit	**Age distribution**					**Stand type distribution**			
	young	**imma-ture**	**mature**	**Overma-ture**	**Total**	**planta-tion**	**natural**	**coppice**	**Total**
%	13%	31%	55%	1%	**100%**	0%	100%	0%	**100%**
Unit	**Canopy closure**					**Condition**			
	dense	**closed**	**open**	**un-stocked**	**Total**	**good**	**average**	**poor**	**Total**
%	21%	42%	28%	10%	**100%**	44%	44%	12%	**100%**
Site Condition									
Unit	**Slope**			**Erosiveness**			**Soil Cover**		
	gentle	**moder-ate**	**steep**	**stable**	**moder-ate**	**unstable**	**high**	**moder-ate**	**low**
%	38%	39%	23%	43%	37%	19%	32%	54%	13%

Forest Use						
Unit	Intensive Side Uses			Extensive Side Uses		
	grazing	soksh-ing	lopping	grazing	sokshing	lopping
ha	365.6	41.3	339.8	142.6	19.2	54.0
%	41%	5%	39%	16%	2%	6%

NWFP Occurence and Firewood								
Unit	NWFP abundant				NWFP sparse			
	Firewood	Bam-boo	Cane	Daphne	Firewood	Bamboo	Cane	Daphne
ha	335.4	102.1	92.3	4.9	323.6	162.9	159.9	4.9
%	38%	12%	10%	1%	37%	18%	18%	1%

Potential Production					
Unit	Timber				
	Drashing	Cham	Tsim	Poles, posts	Total
Ntot	28002	4795	2317	1082	**36196**
N/ha	32	5	3	1	**41**
m3	262305	4690	651	78	**267724**
m3/ ha	297.3	5.3	0.7	0.1	**303.5**
Unit	Firewood				
	> 49cm	30-49cm	20-29 cm	10-19 cm	Total
Ntot	5749	14400	27377	94155	**141681**
N/ha	7	16	31	107	**161**
m3	37756	12086	7561	6713	**64116**
m3/ ha	42.8	13.7	8.6	7.6	**72.7**
Unit	Sivicultural Measures				
	Planting	Thin-ning	Felling (fire-wood)	Felling (timber)	No Activ-ity
ha	197.0	168.0	331.1	306.8	135.2
%	31	26	51	48	21
	Yield Regulation				
	AAC		**3538**	m3	
			4.0	m3/ha	
	Prod. Potential / AAC		**94**	years	

Table 36: Summary sheet for Jigmechholing LFMA.

Appendix 6. Summary sheet for Korphu LFMA

Summary Results for Forest Management Area: Korphu Gewog									
Unit	Area Distribution						Average basal area (m2/ha)	Aver. Stand Volume (m3/ha)	No of operable sample plots
	Non-Forest	Protection	Inoperable	Production	Total				
ha	77.5	796.1	439.7	2230.1	**3543.4**				
%	2%	22%	12%	63%	**100%**		16.4	164	691
Unit	Forest Type Distribution								
	Hemlock	Fir	Spruce	Mix. Con.	Bluepine	Chirpine	Hardwood	Mixed HC	Total
%	0%	0%	0%	0%	0%	0%	100%	0%	**100%**
Unit	Age distribution					Stand type distribution			
	young	immature	mature	Overmature	Total	plantation	natural	coppice	Total
%	10%	33%	51%	1%	**94%**	0%	100%	0%	**100%**
Unit	Canopy closure					Condition			
	dense	closed	open	unstocked	Total	good	average	poor	Total
%	6%	55%	31%	8%	**100%**	57%	31%	12%	**100%**
Site Condition									
Unit	Slope			Erosiveness			Soil Cover		
	gentle	moderate	steep	stable	moderate	unstable	high	moderate	low
%	24%	45%	30%	54%	40%	6%	36%	54%	10%
Forest Use									
Unit	Intensive Side Uses			Extensive Side Uses					
	grazing	sokshing	lopping	grazing	sokshing	lopping			
ha	1072.2	0.0	434.5	342.8	0.0	77.3			
%	48%	0%	19%	15%	0%	3%			
NWFP Occurence and Firewood									
Unit	NWFP abundant				NWFP sparse				
	Firewood	Bamboo	Cane	Daphne	Firewood	Bamboo	Cane	Daphne	
ha	687.9	190.2	76.8	6.4	734.2	404.0	193.6	231.8	
%	31%	9%	3%	0%	33%	18%	9%	10%	

Management Options						
Unit	**No activity**	**Improvm.**	**Timber**	**Firewood**	**Silvo-past.**	**Shoksh-ing**
ha	245.3	328.3	1056.1	600.4	0.0	0.0
%	11%	15%	47%	27%	0%	0%

Potential Production					
Unit	**Timber**				
	Drashing	**Cham**	**Tsim**	**Poles, posts**	**Total**
Ntot	24605	22479	42622	103996	**193702**
N/ha	11	10	19	47	**87**
m3	149939	19531	11769	7359	**188598**
m3/ha	67.2	8.8	5.3	3.3	**84.6**
Unit	**Firewood**				
	> 49cm	**30-49cm**	**20-29 cm**	**10-19 cm**	**Total**
Ntot	13213	34019	63362	153320	**263914**
N/ha	6	15	28	69	**118**
m3	50507	28393	17898	10830	**107628**
m3/ha	22.6	12.7	8.0	4.9	**48.3**

Unit	**Sivicultural Measures**			
	Planting	**Thinning**	**Felling**	
ha	337.5	947.3	954.2	0.0
%	15%	42%	43%	0%

	Yield Regulation		
	AAC	**2817**	m3
		1.3	m3/ha
	Prod. Potential / AAC	**105**	years

Table 37: Summary sheet for Korphu LFMA

Appendix 7. Summary sheet for Langthel LFMA

Summary Results for Forest Management Area: Langthel Gewog									
Unit	**Area Distribution**					**Average basal area (m2/ha)**	**Aver. Stand Volume (m3/ha)**	**No of Operable sample plots**	
	Non-Production	**Protection**	**Production**	**Total**					
ha	244.7	804.2	1907.7	2956.6					
%	8%	27%	65%	100%		23.7	324	185	
Unit	**Forest Type Distribution**								
	Hemlock	**Fir**	**Spruce**	**Mix. Con.**	**Blue-pine**	**Chirp-ine**	**Hard-wood**	**Mixed HC**	**Total**
%	0%	0%	0%	0%	0%	2%	78%	20%	**100%**
Unit	**Age distribution**					**Stand type distribution**			
	young	**immature**	**mature**	**Overmature**	**Total**	**plantation**	**natural**	**coppice**	**Total**

%	17%	31%	47%	5%	**100%**	2%	#VALUE!	1%	**#VALUE!**
Unit	**Canopy closure**					**Condition**			
	dense	**closed**	**open**	**un-stocked**	**Total**	**good**	**average**	**poor**	**Total**
%	13%	46%	30%	11%	**100%**	44%	42%	13%	**99%**
Site Condition									
Unit	**Slope**			**Erosiveness**			**Soil Cover**		
	gentle	**moder-ate**	**steep**	**stable**	**moder-ate**	**unsta-ble**	**high**	**moder-ate**	**low**
%	28%	55%	17%	53%	37%	10%	35%	50%	15%
Forest Use									
Unit	**Intensive Side Uses**			**Extensive Side Uses**					
	grazing	**sokshing**	**lopping**	**grazing**	**soksh-ing**	**lopping**			
ha	1525.7	180.4	934.5	639.1	14.3	655.5			
%	52%	6%	32%	22%	0%	22%			
NWFP Occurence and Firewood									
Unit	**NWFP abundant**				**NWFP sparse**				
	Firewood	**Bamboo**	**Cane**	**Daphne**	**Fire-wood**	**Bam-boo**	**Cane**	**Daphne**	
ha	1203.8	236.8	14.3	45.9	558.6	394.7	106.4	380.6	
%	41%	8%	0%	2%	19%	13%	4%	13%	
Potential Production									
Unit	**Timber**								
	Drashing	**Cham**	**Tsim**	**Poles, posts**	**Total**				
Ntot	35865	12509	5965	9510	**63849**				
N/ha	19	7	3	5	**33**				
m3	258667	12187	1624	672	**273150**				
m3/ha	135.6	6.4	0.9	0.4	**143.2**				
Unit	**Firewood**								
	> 49cm	**30-49cm**	**20-29 cm**	**10-19 cm**	**Total**				
Ntot	23984	49436	78315	245452	**397187**				
N/ha	13	26	41	129	**208**				
m3	150769	43421	22269	17471	**233930**				
m3/ha	79.0	22.8	11.7	9.2	**122.6**				
Unit	**Sivicultural Measures**								
	Planting	**Thinning**	**Felling (fire-wood)**	**Felling (timber)**	**No Ac-tivity**				
ha	291.0	206.0	511.0	439.5	1509.5				
%	10	7	17	15	51				
	Yield Regulation								
	AAC		**4868**	m3					
			2.6	m3/ha					
	Prod. Potential / AAC		**104**	years					

Table 38: Summary sheet for Langthel LFMA.

Appendix 8. Summary sheet for Tangsibji LFMA

Summary Results for Forest Management Area: Tangsibji Gewog									
Unit	Area Distribution						Average basal area (m2/ha)	Aver. Stand Volume (m3/ha)	No of Operable sample plots
	Non-Production	Protection	Production	Total					
ha	116.8	159.2	216.6	492.6					
%	24%	32%	44%	100%			21.9	206	66
Unit	Forest Type Distribution								
	Hemlock	Fir	Spruce	Mix. Con.	Blue-pine	Chirpine	Hard-wood	Mixed HC	Total
%	0%	0%	0%	0%	0%	0%	100%	0%	**100%**
Unit	Age distribution					Stand type distribution			
	young	immature	mature	Overmature	Total	plantation	natural	coppice	Total
%	17%	18%	64%	1%	**100%**	0%	#VALUE!	0%	**#VALUE!**
Unit	Canopy closure					Condition			
	dense	closed	open	un-stocked	Total	good	average	poor	Total
%	5%	52%	32%	12%	**101%**	33%	44%	23%	**100%**
Site Condition									
Unit	Slope			Erosiveness			Soil Cover		
	gentle	moderate	steep	stable	moderate	unstable	high	moderate	low
%	47%	41%	12%	45%	49%	6%	36%	59%	5%
Forest Use									
Unit	Intensive Side Uses			Extensive Side Uses					
	grazing	soksh-ing	lopping	grazing	soksh-ing	lopping			
ha	67.0	14.9	67.0	156.7	0.0	37.3			
%	14%	3%	14%	32%	0%	8%			
NWFP Occurence and Firewood									
Unit	NWFP abundant				NWFP sparse				
	Firewood	Bamboo	Cane	Daphne	Fire-wood	Bamboo	Cane	Daphne	
ha	147.8	59.1	0.0	9.9	59.1	54.2	0.0	59.1	
%	30%	12%	0%	2%	12%	11%	0%	12%	
Potential Production									
Unit	Timber								
	Drashing	Cham	Tsim	Poles, posts	Total				
Ntot	2451	781	4681	8916	**16829**				
N/ha	11	4	22	41	**78**				
m3	16638	726	0	0	**17364**				
m3/ha	76.8	3.4	0.0	0.0	**80.2**				

Unit	Firewood				
	> 49cm	30-49cm	20-29 cm	10-19 cm	Total
Ntot	1934	7526	10699	33434	**53593**
N/ha	9	35	49	154	**247**
m3	5527	6532	2945	2365	**17369**
m3/ha	25.5	30.2	13.6	10.9	**80.2**
Unit	**Sivicultural Measures**				
	Planting	**Thinning**	**Felling (firewood)**	**Felling (timber)**	**No Activity**
ha	44.8	0.0	67.2	22.4	358.3
%	9	0	14	5	73
	Yield Regulation				
	AAC		**343**	m3	
			1.6	m3/ha	
	Prod. Potential / AAC		**101**	years	

Table 39: Summary sheet for Tangsibji LFMA.

Appendix 9. Summary sheet for Athang LFMA

Summary Results for Forest Management Area: Athang Gewog									
Unit	**Area Distribution**						**Average basal area (m2/ha)**	**Aver. Stand Volume (m3/ha)**	**No of operable sample plots**
	Non-Forest	**Protection**	**Inoperable**	**Production**	**Total**				
ha	49.0	362.0	389.6	1915.3	**2715.9**				
%	2%	13%	14%	71%	**100%**		26.7	184	738
Unit	**Forest Type Distribution**								
	Hemlock	**Fir**	**Spruce**	**Mix. Con.**	**Blue-pine**	**Chirpine**	**Hardwood**	**Mixed HC**	**Total**
%	0%	0%	0%	0%	0%	35%	47%	18%	**100%**
Unit	**Age distribution**					**Stand type distribution**			
	young	**immature**	**mature**	**Overmature**	**Total**	**plantation**	**natural**	**coppice**	**Total**
%	6%	32%	62%	0%	**100%**	0%	100%	0%	**100%**
Unit	**Canopy closure**					**Condition**			
	dense	**closed**	**open**	**unstocked**	**Total**	**good**	**average**	**poor**	**Total**
%	11%	52%	35%	2%	**100%**	70%	28%	2%	**100%**
Site Condition									
Unit	**Slope**			**Erosiveness**			**Soil Cover**		
	gentle	**moderate**	**steep**	**stable**	**moderate**	**unstable**	**high**	**moderate**	**low**
%	30%	48%	22%	76%	19%	5%	55%	39%	6%

Forest Use						
Unit	Intensive Side Uses			Extensive Side Uses		
	grazing	soksh-ing	lopping	grazing	soksh-ing	lop-ping
ha	693.0	59.3	234.2	177.2	11.4	12.4
%	36%	3%	12%	9%	1%	1%

NWFP Occurence and Firewood								
Unit	NWFP abundant				NWFP sparse			
	Firewood	Bam-boo	Cane	Daphne	Fire-wood	Bam-boo	Cane	Daphne
ha	474.2	246.1	79.2	25.4	299.1	185.4	35.6	241.7
%	25%	13%	4%	1%	16%	10%	2%	13%

Management Options						
Unit	No activity	Im-provm.	Timber	Fire-wood	Silvo-past.	Shok-shing
ha	202.4	643.9	1214.8	649.9	0.0	0.0
%	11%	34%	63%	34%	0%	0%

Potential Production					
Unit	Timber				
	Drashing	Cham	Tsim	Poles, posts	Total
Ntot	18388	46549	14731	16554	**96222**
N/ha	10	24	8	9	**50**
m3	66727	39868	3971	1082	**111648**
m3/ha	34.8	20.8	2.1	0.6	**58.3**
Unit	Firewood				
	> 49cm	30-49cm	20-29 cm	10-19 cm	Total
Ntot	10950	42826	37510	167648	**258934**
N/ha	6	22	20	88	**135**
m3	34836	40859	10570	11847	**98112**
m3/ha	18.2	21.3	5.5	6.2	**51.2**
Unit	Sivicultural Measures				
	Planting	Thin-ning	Felling		
ha	257.0	607.9	684.5	0.0	
%	13%	32%	36%	0%	
	Yield Regulation				
	AAC		**3075**	m3	
			1.6	m3/ha	
	Prod. Potential / AAC		**68**	years	

Table 40: Summary sheet for Athang LFMA.

Appendix 10. Summary sheet for Sergithang LFMA

Summary Results for Forest Management Area: Sergithang Gewog									
Unit	Area Distribution						Average basal area (m2/ha)	Aver. Stand Volume (m3/ha)	No of operable sample plots
	Non-Forest	Protection	Inoperable	Production	Total				
ha	23.8	134.9	38.9	103.6	**301.2**				
%	8%	45%	13%	34%	**100%**		19.4	218	32
Unit	Forest Type Distribution								
	Hemlock	Fir	Spruce	Mix. Con.	Bluepine	Chirpine	Hardwood	Mixed HC	Total
%	0%	0%	0%	9%	0%	72%	6%	13%	**100%**
Unit	Age distribution					Stand type distribution			
	young	immature	mature	Overmature	Total	plantation	natural	coppice	Total
%	3%	19%	78%	0%	**100%**	0%	100%	0%	**100%**
Unit	Canopy closure					Condition			
	dense	closed	open	unstocked	Total	good	average	poor	Total
%	0%	66%	34%	0%	**100%**	34%	66%	0%	**100%**
Site Condition									
Unit	Slope			Erosiveness			Soil Cover		
	gentle	moderate	steep	stable	moderate	unstable	high	moderate	low
%	9%	78%	13%	31%	69%	0%	6%	88%	6%
Forest Use									
Unit	Intensive Side Uses			Extensive Side Uses					
	grazing	sokshing	lopping	grazing	sokshing	lopping			
ha	13.5	0.0	0.0	61.1	0.0	0.0			
%	13%	0%	0%	59%	0%	0%			
NWFP Occurence and Firewood									
Unit	NWFP abundant				NWFP sparse				
	Firewood	Bamboo	Cane	Daphne	Firewood	Bamboo	Cane	Daphne	
ha	3.1	0.0	0.0	0.0	54.9	0.0	0.0	3.1	
%	3%	0%	0%	0%	53%	0%	0%	3%	
Management Options									
Unit	No activity	Improvm.	Timber	Firewood	Silvopast.	Shokshing			
ha	48.0	37.2	174.5	141.6	0.0	0.0			
%	46%	36%	168%	137%	0%	0%			

Potential Production					
Unit	Timber				
	Drashing	Cham	Tsim	Poles, posts	Total
Ntot	2476	3146	4091	8798	**18511**
N/ha	24	30	39	85	**179**
m3	14238	2624	1104	538	**18504**
m3/ha	137.4	25.3	10.7	5.2	**178.6**
Unit	Firewood				
	> 49cm	30-49cm	20-29 cm	10-19 cm	Total
Ntot	27	1336	6994	8798	**17155**
N/ha	0	13	68	85	**166**
m3	54	1094	1966	968	**4082**
m3/ha	0.5	10.6	19.0	9.3	**39.4**
Unit	Sivicultural Measures				
	Planting	Thinning	Felling		
ha	6.2	35.2	42.5	0.0	
%	6%	34%	41%	0%	
	Yield Regulation				
	AAC		**228**	m3	
			2.2	m3/ha	
	Prod. Potential / AAC		**99**	years	

Table 41: Summary sheet for Sergithang LFMA.

Appendix 11. LFMP: Monitoring Sheet

Monitoring sheet for the extraction of trees from individual compartment																								
Compart-ment	Timber												Firewood											
	Drashing			Chams			Tsims			Poles			50+ cm			30-49 cm			20-29 cm			10-19 cm		
	Pro	Use	Bal	Pro	Use	Bal	Pro	Use	Bal	Pro	Use	Bal	Pro	Use	Bal	Pro	Use	Bal	Pro	Use	Bal	Pro	Use	Bal

Appendix 12. LFMP: Tree Marking Book for Construction

Tree Marking Book (Construction)																		
Year	Date	Location	Species	Dbh	Standing Volume in m3								Standing Volume in m3					
					Drashing		Shing.		Chams		Tsims		Poles (10-19cm)		Posts (10-19cm)		< 10 cm (Dangchu)	
					Vol	No	Vol	No	Vol	No	Vol	No	Vol	No	Vol	No	Vol	No

Appendix 13. LFMP: Tree Marking Book for Renovation

Tree Marking Book (Renovation)																		
Year	Date	Location	Species	Dbh	Standing Volume in m3								Standing Volume in m3					
					Drash.		Shing.		Chams		Tsims		10-19cm (Poles)		10-19cm (Posts)		Dang < 10 cm	
					Vol	No	Vol	No	Vol	No	Vol	No	Vol	No	Vol	No	Vol	No

Table 42: Tree Marking Book for Renovation allocation

Appendix 14. LFMP: Tree Marking Book for Firewood

T13. ree Marking Book (Firewood)													
Year	Date	Location	Species	Dbh	Firewood								
					> 50 cm		30-49cm		20-29cm		10-19cm		
					Vol	No	Vol	No	Vol	No	Vol	No	

Appendix 15. LFMP: Gewog Register (Construction)

Year	Date	Household			Volume of Timbers alloted in m3 (Standing Volume)						
		Name	Thram No.	House No.	Drashing	Shingleps	Chams	Tsims	Dangch.	Flag Poles	Posts

Appendix 16. LFMP: Gewog Register (Renovation)

Year	Date	Household			Volume of Timbers alloted in m3 (Standing Volume)						
		Name	Thram No.	House No.	Drash-ing	Shin-gleps	Chams	Tsims	Dangch.	Flag Poles	Posts

Appendix 17. LFMP: Timber Allotment Report

Annual statistics of rural timber supply		Year	2019	
		Gewog	Tashiding	

Purpose	Volume of Timbers alloted in m3 (Standing Volume)							
	Drashing	Shingleps	Chams	Tsims	Dangch.	Flag Poles	Posts	Total
Construction								
Renovation								
Other Construction								
Other Purpose								
Total								

Appendix 18. LFMP: Annual Report of LFMA

Enter data in blue cells		
Year	2019	
Gewog	shari	
AAC in m3/ year	1000	
Remark: volume refers to the standing volume of the tree		

Rural Supply of construction wood for year: 2019			Forest Management Area: shari							
Product	Construction		Renovation		Other construction		Other purpose		Total	
	Number	Volume (m3)	Number	Volume (m3)	Num-ber	Volume (m3)	Number	Volume (m3)	Num-ber	Volume (m3)
Drashing										
Shinglep										
Chams										
Tsims										
Poles										
Posts										
Dangchung										

Total Timber			
Firewood size	Number	Volume (m3)	
dbh >50 cm			
dbh 30-49 cm			
dbh 20-29 cm			
dbh 10-19 cm			
Total Firewood			
Realisation of AAC		Volume (m3)	
Balance from previous years			
Allowable Cut per year			
Already supplied			
Balance			

Durshing-Go; the door of Jowo Durshing

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