

**FOREST AND NATURE CONSERVATION CODE OF BEST
MANAGEMENT PRACTICES OF BHUTAN
VOLUME IV: PROTECTED AREA MANAGEMENT**



Department of Forests and Park Services

DEDICATION

A tribute to our benevolent Druk Gyalpo, His Majesty Jigme Khesar Namgyel Wangchuck, for His Selfless Service and Leadership to the People and Country





MINISTER

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ROYAL GOVERNMENT OF BHUTAN
Ministry of Agriculture and Forests
Tashichhodzong
Thimphu: Bhutan



MESSAGE



I applaud the Department of Forest and Park Services for coming up with the Forest and Nature Conservation Code of Best Management Practices of Bhutan which is an updated version of the erstwhile Forest Management Code of Bhutan, 2004. The erstwhile code only covered sustainable management of Forest Management Units. However, with the shift of forest management paradigm to include other important aspects such as climate change, wetland and watershed management, biodiversity conservation & monitoring, agroforestry, payment for ecosystem services etc., a more comprehensive guideline has become imperative.

The revised *Code* broadens the scope of applicability covering wide range of contemporary forestry practices providing detailed guidelines on the technical aspects of forest resources management and biodiversity conservation.

The revision of the *Code* is timely and will play a significant role towards sustainable management of our forest resources especially in light of the global climate change and its anticipated impacts on our fragile mountain ecosystems. The *Code* will also take into account the application of advanced technologies in forest management and biodiversity conservation and will provide strong emphasis on monitoring and evaluation of forest and forestry programs which has always been our weakness.

The revised *Code* will also become handy to our colleagues in the field as it will serve as the single source of scientific guideline for all forestry management regimes in the country.

With the publication of this *Code*, Bhutan joins many countries who manage their forest through such technical guidelines. Our country now establishes a robust technical guideline for management of all forest resources in the country and I am confident that it will fulfill our aspiration of bringing all forest resources under sustainable management fulfilling the objectives of our National Forest Policy and the Constitutional mandate of maintaining 60% of forest cover all times to come.

I would like to commend the efforts and hard work of our colleagues in the Department of Forest and Park Services, particularly those who were involved in the revision of this *Code* and I hope this code will be useful to wide range of stakeholders outside of the Department as well.

Tashi Delek!

Yeshe Penjor



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ROYAL GOVERNMENT OF BHUTAN
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SECRETARY

MESSAGE



I commend the Department of Forest and Park Services in bringing out the revised Forest and Nature Conservation Code of Best Management Practices of Bhutan which presents a comprehensive technical guideline for sustainable management of forest resources and biodiversity conservation in the country.

The intricate combination of several programs and activities on sustainable forest management and biodiversity conservation is fundamental to sustainable development, from their vital role as climate regulator, carbon sequestration and the vital ecosystem services they provide. Sustainable management of these forest resources are therefore essential if these benefits for the environment and societies are to be maintained for future generations. Such long-term feats can be achieved only if we are able to manage the huge forest base resources holistically.

Such holistic achievement can only be possible through a science based technical guideline - the *Code*. Its implementation will also ensure that the forests in Bhutan are managed through the integration of good science, research, technology and decades of forest management experiences.

The code also provides consistent and transparent approach to planning and implementation of sustainable forest management plans, conservation plans and activities at all levels and across all other cross-cutting management regimes. The *Code* now provides the deep nexus in making appropriate science-based decisions on several forestry and conservation issues.

I would like to congratulate the Department and in particular the technical working group members for coming up with this code which is a milestone in our effort towards sustainable forest management and biodiversity conservation.

I urge all relevant stakeholders, government and non-government, besides the colleagues of the Department of Forest and Park Services to actively use and implement the Code in managing our forest resources for the benefit of present and future generations.

Tashi Delek!

A blue ink signature of Rinzin Dorji.

Rinzin Dorji



DIRECTOR

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ROYAL GOVERNMENT OF BHUTAN

Ministry of Agriculture and Forests

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Thimphu: Bhutan



FOREWORD



Forests have always played a key role in the livelihood of Bhutanese and is intrinsically intertwined with the social, culture and tradition of our country. In view of its pivotal role not only on socio economic development but also on climate regulatory function through several means and vital ecosystem services, sustainable forest resources management has always played a key role in sustaining our natural forest resources. Bhutan is one of the few countries in the world that enshrines forest and environmental conservation aspects in its Constitution. Article 5 of the Constitution of the Kingdom of Bhutan reflects commitment to ensure that, in order to conserve the country's natural resources and to prevent degradation of the ecosystem, a minimum of sixty percent of Bhutan's total land shall be maintained under forest cover for all time. Bhutan also committed to remain carbon neutral at the 15th Conference of Parties to the United Nations Framework Convention on Climate Change (UNFCCC) in 2009 in Copenhagen, Denmark. In addition, the Intended Nationally Determined Contribution (INDC) submitted in September 2015 towards finalization of Paris Agreement further re-iterated Bhutan's pledge to remain carbon neutral. Today with over 71% of the total land of Bhutan under forest cover (2,717,161 ha), forests form an important and indispensable national asset sequestering around 8.5 million tonnes of carbon, generating continuous water flow to sustain our hydro power systems, providing timber and firewood resources to Bhutanese citizens etc.. Out of the total forest area (2,717,161 ha) about 33.29% (904,423.78 ha) fall within the Protected Area Systems (National Parks, Wildlife Sanctuaries and Strict Nature Reserve) and about 19.96% (542,346.32 ha) is managed as Forest Management Units, Community Forests and Local Forest Management Areas.

Therefore, in order to fulfill our international commitment to remain carbon neutral and constitutional mandate of maintaining 60% forest cover for all times to come besides harnessing other benefits such as social, cultural, economic and ecosystem services, it is imperative that the Department possesses a *Code* outlining science based management of the overall forests and biodiversity resources which will enhance the productive and ecological functions of our forest ecosystems. This *Code* has been developed through integration of good science, research, technology and decades of forest management experiences. It gives me a great pleasure in congratulating the entire Technical Working Group involved in the preparation of this *Code*. This *Code* will definitely strengthen the sustainable forest resources management and biodiversity conservation practices in Bhutan for eons to benefit the present and future generations.

Tashi Delek!

Lobzang Dorji

INTRODUCTION

The Volume IV of the Forest and Nature Conservation Code of Best Management Practices of Bhutan, 1st Edition 2020; hereinafter referred to as the *Code*, shall provide guidance on the preparation and implementation of scientific conservation management plans for the Protected Areas of Bhutan (National Parks, Wildlife Sanctuaries, Strict Nature Reserves and Biological Corridors).

The Conservation management plan sets a long-term vision for each protected area. It shall contain background information about the protected areas and outlines objectives and strategies developed to meet the vision. The conservation management plan for each Protected Area in Bhutan is prepared for ten years. The scientific management planning and implementation processes are described under the following two chapters;

Chapter 1: National Parks, Wildlife Sanctuaries and Strict Nature Reserve

Chapter 2: Biological Corridors

The chapters provide detailed explanation on the various steps for the preparation of scientific management plans for the Protected Areas. The document draws best practices for various steps of management planning processes from past experiences in Bhutan and elsewhere and, various publications (Guidelines, framework, etc.,).

ACRONYM

AOO	Area of Occupancy
BAFRA	Bhutan Agriculture and Food Regularity Authority
BCs	Biological Corridors
Bhutan METT+	Bhutan Management Effectiveness Tracking Tools Plus
BMG	Biodiversity Monitoring Grids
BWS	Bumdeling Wildlife Sanctuary
CA TS	Conservation Assured Tiger Standards
CMR	Capture-mark-recapture
CSOs	Civil Society Organizations
DBH	Diameter at Breast Height
DFO	Divisional Forest Offices
DoFPS	Department of Forests and Park Services
DoL	Department of Livestock
EoI	Expression of Interest
FRMD	Forest Resources Management Division
GNH	Gross National Happiness
BTC	Bhutan Tiger Center
IUCN	International Union for Conservation of Nature
JDNP	Jigme Dorji National Park
JKSNR	Jigme Khesar Strict Nature Reserve
KBA	Key Biodiversity Area
MAB	Man and Biosphere
NCD	Nature Conservation Division
NFI	National Forest Inventory
NP	National Parks
OECMS	Other Effective Area-Based Conservation Measures
PAs	Protected Areas
RAI	Relative Abundance Index
REM	Random Encounter Modelling
RMNP	Royal Manas National Park
RUB	Royal University of Bhutan
SAC	Species Accumulation Curve
SECR	Spatially Explicit Capture Recapture Models
SES	Socio-economic survey
SNR	Strict Nature Reserve
SoP	Standard Operating Procedure
SPSS	Statistical Package for Social Scientists
SRFL	State Reserve Forest Land
SWOT	Strength, Weakness, Opportunity, Threats
SWS	Sakteng Wildlife Sanctuary
TAC	Technical Advisory Committee
ToR	Terms of Reference
UNESCO	United Nations Educational, Scientific and Cultural Organization
UWICER	Ugyen Wangchuck Institute for Conservation and Environment Research
WCNP	Wangchuck Centennial National Park
WS	Wildlife Sanctuaries

Definitions

Forest refers to any land with trees spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover more than 10 percent.

Protected Area refers to an area, which has been declared to be a National Park, Wildlife Reserve, Wildlife Sanctuary, Biosphere Reserve, Nature Reserve, Strict Nature Reserve, and Critical Watershed, Biological Corridor or any other area meriting protection.

State Reserved Forest Land refers to any land and water body outside a Thromde, the ownership of which is not vested in any person and is under the custody of the State.

Technical Advisory Committee refers to the highest decision-making body within the Department, comprised of Chiefs and Specialists of various divisions which shall formulate guidelines, advice the Department on technical matters whenever required.

Ecotourism Product refers to natural, culture and man-made resources, attractions, facilities, activities and services which are used to meet the demand of tourists.

Forest resources refers to the diverse reservoirs of biodiversity or forest produce grown or found in SRF land, alive or dead, which also generate widespread ecosystem services such as soil nutrients, air and water, providing several tangible and intangible benefits to humanity.

Biodiversity refers to the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.

Ecosystem refers to a community of living organisms in conjunction with the non-living components of their environment, interacting as a system.

Impact shall mean the net effects of pests or diseases on the productivity, usefulness and values of a given resource or resources with respect to specific resource management goals and objectives.

Annual herb refers to non-woody herbaceous plant that completes its life cycle from germination to the production of seed and then dies, within one year.

Biannual herb refers to non-woody herbaceous plant that develop its vegetative structures in the first year, and complete its biological lifecycle in the second year by entering into dormancy period.

Calcar refers to a cartilaginous or bony spur like projection arising from the ankle that supports the interfemoral membrane.

Canine refers to a single tall and pointed tooth situated behind the incisors in each toothrow.

Echolocation refers to navigation in flight by means of the echo of sound pulses.

Umbrella species refers to species selected for making conservation-related decisions, typically because protecting these species indirectly protects many other species that make up the ecological community of its habitat.

Vulnerability refers to the degree to which an ecosystem is sensitive to and unable to adapt to or moderate the consequences of climate change and other pressures/hazards on its ecological character.

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1. National Parks, Wildlife Sanctuaries & Strict Nature Reserve

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1. National Parks, Wildlife Sanctuaries & Strict Nature Reserve

1.1. Management Context

Protected Areas (PA) are clearly defined geographical areas which are declared as National Park (NP), Wildlife Sanctuary (WS), Strict Nature Reserve (SNR), Biological Corridor (BC), or any Conservation Area, by the parliament of Bhutan and dedicated and managed to achieve the long term goal of conservations of nature with associated ecosystem services and sociocultural values.

The concept of PA in Bhutan dates back to early 1960s, when Royal Manas National Park (RMNP) was recognized as the first PA. Since then, more than half of the country's geographical area was declared as PA with the inclusion of 8.61% as Biological Corridors (BC), which was declared as the gift to Earth from the people of Bhutan in 2008 and the Wangchuck Centennial National Park (WCNP), as a tribute to 100 years of the Wangchuck Dynasty, in 2008.

Box 1.1 IUCN definitions of NP, WS and SNR

National Parks are "Large natural or near natural areas set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible spiritual, scientific, educational, recreational and visitor opportunities".

Strict Nature Reserves are "Protected areas that are strictly set aside to protect biodiversity and also possibly geological/geomorphological features, where human visitation, use and impacts are strictly controlled and limited to ensure protection of the conservation values. Such protected areas can serve as indispensable reference areas for scientific research and monitoring".

Wildlife sanctuaries are "protected areas wherein species conservation and management of habitats is a major priority to provide a favourable environment for wildlife sustenance".

While the management planning processes for the NP, WS and SNR are the same, characteristics differentiating the SNR from the NP and WS are the degree of protection in the management prescriptions.

1.2. Objective

The objectives of establishing protected areas are mainly to:

- protect natural biodiversity along with its underlying ecological structure and supporting environmental processes, and to promote education and recreation;
- maintain viable and ecologically functional populations and assemblages of native species at densities sufficient to conserve ecosystem integrity and resilience in the long term;
- contribute in particular to conservation of wide-ranging species, regional ecological processes and migration routes;
- maintain, conserve and restore species and habitats;
- maintain ecosystem functionality for sustained ecosystem services for eternity; and
- enhance livelihood of local communities through nature-based ecotourism opportunities.

1.3. Roles and Responsibilities

The roles and responsibilities of the main agencies/offices involved in the PA management are shown in Table 1.1.

Table 1.1 Roles and Responsibilities

Office	Responsibilities
Nature Conservation Division (NCD)	<ul style="list-style-type: none"> • Provide technical backstopping for the preparation and implementation of the plan. • Review plan and submit plan to DoFPS Directorate for endorsement. • To carry out annual Monitoring of Plan activities. • To carry out mid-term and final evaluation of the Protected Area activities.
Protected Area Office	<ul style="list-style-type: none"> • Survey planning and data collection. • Prepare, present and finalize draft Plan. • Implement activities reflected in the plan. • Monitor and evaluate PA activities.

1.4. Timeline for Developing Management Plan

The tentative time required for the development of a management plan as per individual activities is detailed in Table 1.2.

Table 1.2 Timeline for activities

Sl.no	Activities	Timeline	Responsibility
1	Desktop Review (Review of previous plan, existing survey data, etc.)	4 weeks	Protected Area Office
2	Survey planning including training workshop	1 weeks	Protected Area Office
3	Field data collection	10 weeks	Protected Area Office
4	Data entry and analysis	4 weeks	Protected Area Office
5	Plan drafting	5 weeks	Protected Area Office
6	First review	3 weeks	Nature Conservation Division
7	Incorporation of comments and feedbacks	2 weeks	Protected Area Office
8	Plan presentation to NCD	1 day	Protected Area Office
9	Final revision	1 week	Protected Area Office
10	Presentation to TAC and endorsement	1 day	Nature Conservation Division
11	Incorporation of comments from TAC, if any	1 week	Protected Area Office
12	Final Plan endorsement, printing and implementation		Protected Area Office

1.5. Management planning

The following steps (Figure 1.1), adopted from the IUCN Management planning framework (Thomas, Lee and Middleton, Julie, 2003), shall be followed for development of the conservation management plan for NP, WS and SNR;

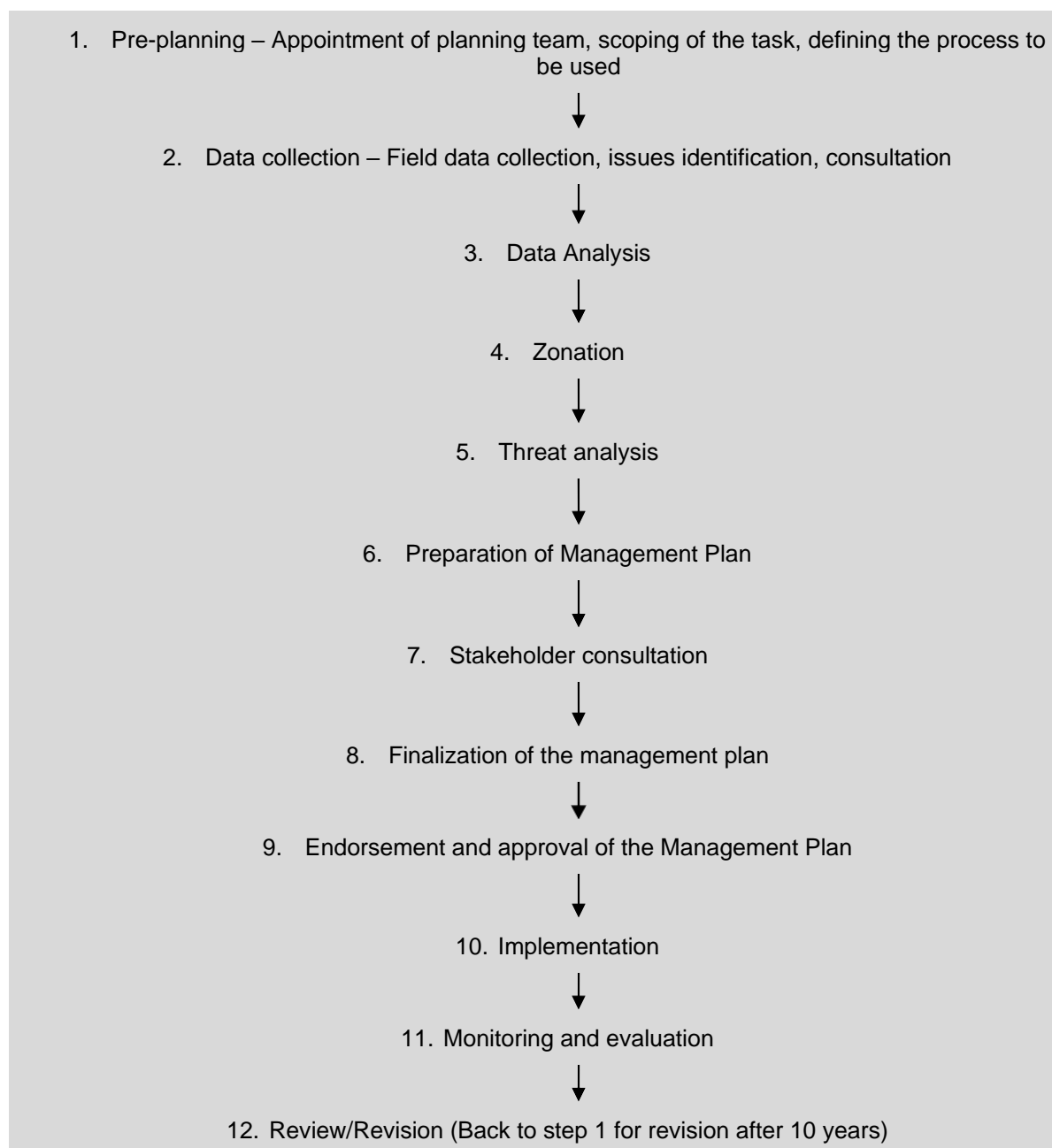


Figure 1.1 Steps for management planning process

1.5.1. Pre-planning Phase

The pre-planning phase is one of the most important steps in the management planning process. This phase defines what should be achieved, how it is to be carried out, timing considerations and who is to be involved, etc. The planning phase shall include;

- identifying the purpose and management objective of the NP, WS, SNR and ensuring that all stakeholders involved can understand them;

- identifying and forming survey team members;
- training of the survey team members;
- preparing and following a well-laid out work schedule for the management planning process;
- identifying people for preparing the plan; and
- comprehensive review of the previous management plan in case of management plan revision

Note: In case of management plan revision, the PA management shall list down all the major achievements and key issues/challenges for each objective specified in the final review and evaluation reports. This will also serve an important basis for collection of biodiversity and socio-economic data in the later step.

1.5.2. Data Collection and Analysis

1.5.2.1. Large Mammals

1.5.2.1.1. Data Collection

Transect Survey

Direct observation is often not an efficient method to detect mammal species in the forest with thick ground and canopy cover as the detection is very low. Mammals often leave behind signs of characteristic appearance that indicate their presence. Instead, indirect evidence of presence such as tracks, hairs, scats, dung piles, scent marks, or scrapes can be more easily recorded in the course of any survey.

Trail transect survey is an inexpensive method commonly used for surveying of mammals over time to determine species distribution of most carnivore groups, including several felids and ungulates. Given the relative ease and low cost of data collection, detection/non-detection or patch occupancy methodologies have become one of the most commonly used surveying methods currently in use, and one that is increasing in popularity (Marsh & Trenham, 2008). Transect survey can be a best option to survey mammals given limited financial and human resources.

Materials required

- | | | |
|--------------|--------------------|----------------|
| • GPS device | • Clinometer | • Survey forms |
| • Compass | • Topographic maps | • Pen/Pencils |

Survey design and methods

The Biodiversity Monitoring Grids (BMG) are firstly stratified based on vegetation types after which grids are randomly sampled for conducting the Mammal transect survey. The BMG corresponds to the 4X4 km grid around the National Forest Inventory (NFI) Cluster Plot, and as such, the NFI Plot ID number shall be used for Biodiversity Monitoring Grid (BMG) as well. The survey form as prescribed in Table 1.3 shall be used.

Table 1.3 Mammal transect survey form

MAMMAL TRANSECT SURVEY FORM

PA/ FD:
Grid ID:
Transect ID:
Date (YYYY/MM/DD):
Weather:
Surveyors:
Start GPS (Deg Dec):
End GPS (Deg Dec):
Locality:

A: acoustic SP: scrape
C: carcass ST: scratch
D: dropping CW: clawing
T: track WL: wallow
S: sighting PL: ploughing
FR: forage BD: bedding
BP: body part HL: hole

ST: sub-tropical WB: warm broadleaf
CB: cool broadleaf B: bamboo C: Conifer (Fir/Chir/Pine/Bluepine/Hemlock)
MC: Mixed conifer WL: wetland
GL: grassland AM: Alpine meadows

GR: Grazing
P: Poaching
DA: Road/Transmission/
NRE: Timber/NWFP
extraction/Fodder/Fuelwood
FR: Forest Fire
N: Erosion/landslides/
PD: Pest/Diseases/Invasive
spp.

Species	Time	Dist (m)	Direct sighting				Evidence	Latitude [N] Deg Decimal	Longitude [E] Deg Decimal	Altitude (m)	Aspect (deg)	Slope (deg)	Habitat type	Threats and Disturbance	Remarks
			Count no	M	F	J									

Note: M = male, F = female, J=juvenile under direct sighting column

- For each selected biodiversity grid (4km x 4km), the GPS coordinate of the centre of the grid should be recorded and marked in the GPS which would be used for calibration while surveying.
- Within each selected BMG, a trail transects measuring upto 3-5 km (natural trails or existing footpaths) depending on the accessibility of the area should be walked covering major habitat types within the grid. If the area is inaccessible, 3-5 shorter trail transects of at least 1 km each should be searched for mammal and mammal signs (Figure 1.2).
- Ensure that the survey team enters inside the grid to initiate the survey.
- If there are more than one trails within the grid, the trail leading towards the centre of the grid should be selected for surveying.
- Mammal sightings and mammal signs including tracks, scats, dung, scratch marks, etc., encountered on the trail transect should be recorded.



Figure 1.2 Survey grid (4x4 km) with 5 km transects (BMG A: Where a single long transect is executed; BMG B: where three shorter transects are executed)

- GPS location at every 500m distance covered should be recorded in the datasheet even if there is no animal or sign observed.
- In case of direct sighting, record the species, GPS location details of the observer, number of animals seen and sex and age of the animal in the datasheet in the Table 1.3.
- If animal signs are encountered, record species, sign type, GPS location details and habitat type of the areas in the datasheet.
- In case of animal trails, each trail set is considered as one sign (not every indirect sign as a new sign). If an animal continues to walk along a trail for a long distance in the same direction, then this should be considered as one sign.
- If no sign is seen on the track for over 50 m then encountering a fresh track set is considered as a new sign.
- Photographic records with proper scale reference and GPS location should be taken if there is difficulty in sign identification.

Data compilation and storage

- After every transect survey, data gathered in the datasheet should be entered into a spreadsheet for further analysis and storage.
- Species wise data entry should be done as per the format in Table 1.4 (one spreadsheet for each species).
- One copy each of compiled data should be submitted to the National Data Repository Centre of the Department for storage, and to the NCD for analysis and reporting at the national level. Analyzed data should be reported as species status updates on a regular basis through technical reports, policy briefs, scientific papers, etc.

Table 1.4 Format for tabulating transect survey data

[illegible]

Camera Trapping

Camera-trapping is a useful and widely used non-invasive tool to study wildlife. It can gather information on a wide range of species simultaneously and continuously, over large survey areas for long duration. Camera traps can be used as a monitoring tool to document detection/non-detection of a target species or to conduct a species inventory for a given area. The use of camera traps can also advance to major researches such as deducing wildlife abundance and density through Spatially Explicit Capture Recapture Models (SECR) which is well suited for many wild felids with distinct body pattern, Random Encounter Modelling (REM), species interaction and activity pattern, etc.

Equipment and Materials required

Camera trap, batteries	GPS	Clinometer	Survey forms
Memory card	Compass	Topographic maps	Pen/Pencils

Sampling Design

Within the 4 x 4 km sampling frame/reference grids (Figure 1.2), camera traps shall be randomly placed along the trails at 2-4 meters away from the center of the trail on both sides. The camera trap installation sites shall be selected while conducting the transect survey in the same grid. Camera stations should be stratified by habitat type to address habitat use by the species. For the purpose of development of the conservation management plan, where only species distribution patterns, wildlife abundance and their presence-absence are to be estimated, a single camera trap per station can be adopted based on the resource availability.

However, two cameras per station should be installed when the objective is to identify individuals of a species for the purpose of estimating animal abundance and density using SECR models which is suited for wild felids.

Camera Trap Installation Methods

Camera traps are particularly well-suited to survey terrestrial mammals, especially those known to use roads or trails as travel paths. Placing cameras on such paths therefore, is efficient and increases detection rates. In forested environments, cameras can easily be attached to trees with bungee cords, nylon webbing straps and other binding ropes/wire. In areas with few or no trees, stakes can be used effectively.

Surveyor must keep in mind the following while installing camera traps:

- Setup the camera in such a way that best suits one's needs. Setting up of image pixel, capture time lapse and movie length depends on the trapping duration and SD card memory. However, it is recommended to set image size at 3 MB and video length at 10 seconds as images in these resolutions are good enough to identify images.
- In case of using two cameras, place one camera on right and another on the left side of trail.
- Avoid placing cameras directly facing each other, as white flashes can create washout in the opposing camera. The issue is relatively minor for infrared flash built-in cameras.
- Do not place cameras too close to trails because digital cameras tend to slow trigger speeds resulting in numerous blank photos or partial pictures and battery exhaustion.
- Cameras must be placed at 2-4 m away on either side from the center of the trail (Figure 1.3).

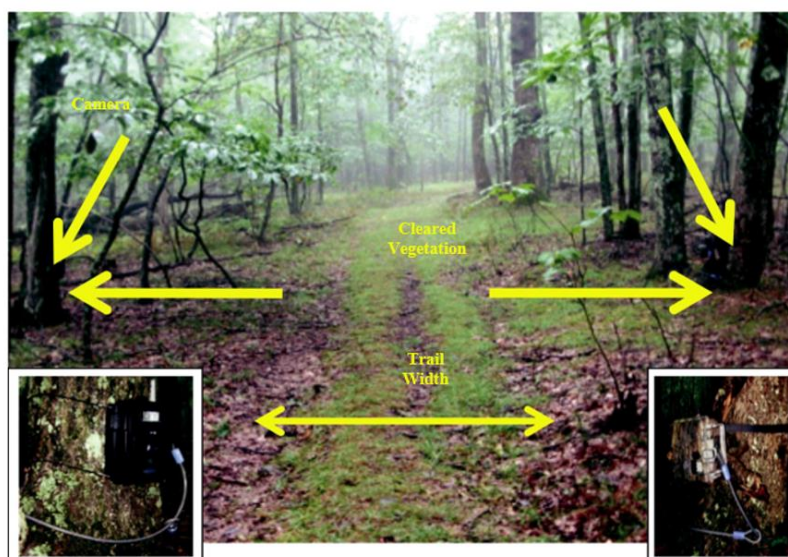


Figure 1.3 Example of field camera placement with 2 cameras per station

- Cameras should not be placed far off the field of view, beyond 6 - 8 m will be hard to distinguish animals, especially for smaller species. Refer flash illumination specifications of each camera model to maintain appropriate distance and guidance.
- Place/fix camera at 20-40 cm or knee height on tree or pole. Bit of height adjustment would be required for elephants and large ungulates to ensure capture of full body parts.
- In case of difficulty in setting up two cameras on a single station, second camera can be set up within 50m along the same trail.
- Cameras should be placed parallel to the ground to ensure effective capture.
- Ensure that the camera is not against the sun and moving objects within the detection zone to avoid capturing ghost/black pictures.
- Once the camera trap is set, fill the datasheet provided (
- Table 1.5) and then arm the camera.

Table 1.5 Data Form for Camera Trap Installation, Monitoring & Retrieval

Grid No	Camera ID	Date (yyyy/mm/dd)	Time	Setup/Monitoring/Retrieval	Altitude	Aspect	Habitat	Surveyors	GPS Latitude [N]	GPS Longitude [E]	Remarks
									Degree decimal	Degree decimal	

Camera functionality check and maintenance

Camera traps placed at a site are usually subject to theft and malfunction due to extreme weather conditions, battery drain-out and damage by wild animals. Therefore, timely monitoring is necessary to ensure its functionality and replacement.

Surveyor must bear in mind the followings during the survey:

- Always take extra cameras and batteries when replacement is required.
- Do first camera check in 10 days of trapping to make sure everything is operational and to determine photographic rates and battery status.
- After the initial camera check, monitoring shall be done twice a month to avoid the risk of losing data if early malfunction of the camera occurs or a camera gets damaged by animals.
- In the subtropical climatic condition, site clearing of each camera shall be done to avoid obstruction within the detection zone, especially during April – October.
- During the monitoring of camera traps, you should record battery drain (%), photographs taken and general malfunction if any in the remarks corner of forms, Figure 1.3. This will help to evaluate the performance of the camera.
- It can be very easy to lose track of what data came from which camera when downloading memory cards to a computer. An easy solution is to trigger each camera with a placard that has station code, camera number, and date. Alternatively, a stake can be placed into the ground within the camera's viewfinder that documents the station code and camera number. However, placard methods are preferred, because the date written on the placard can later be used to recalibrate a camera if data/time stamp becomes corrupted.
- All cameras shall be set to display both time and date on the image as this information is essential in future analyses.
- All cards shall be downloaded at the end of each camera check or at the end of monitoring date so long as SD card storage permits. This will also avoid data loss if camera gets stolen.
- Ensure cleaning and drying of camera right after retrieval from the field.

Data Compilation and Storage

Data Compilation

The camera trap installation/monitoring/retrieval form should be entered into a spreadsheet by the surveyor. The respective PA Offices should keep a copy of raw data (camera trap images) saved in a separate folder giving proper grid IDs. While one set of data is kept as raw, the other set should be sorted species wise for each camera trap station (Figure 1.4).

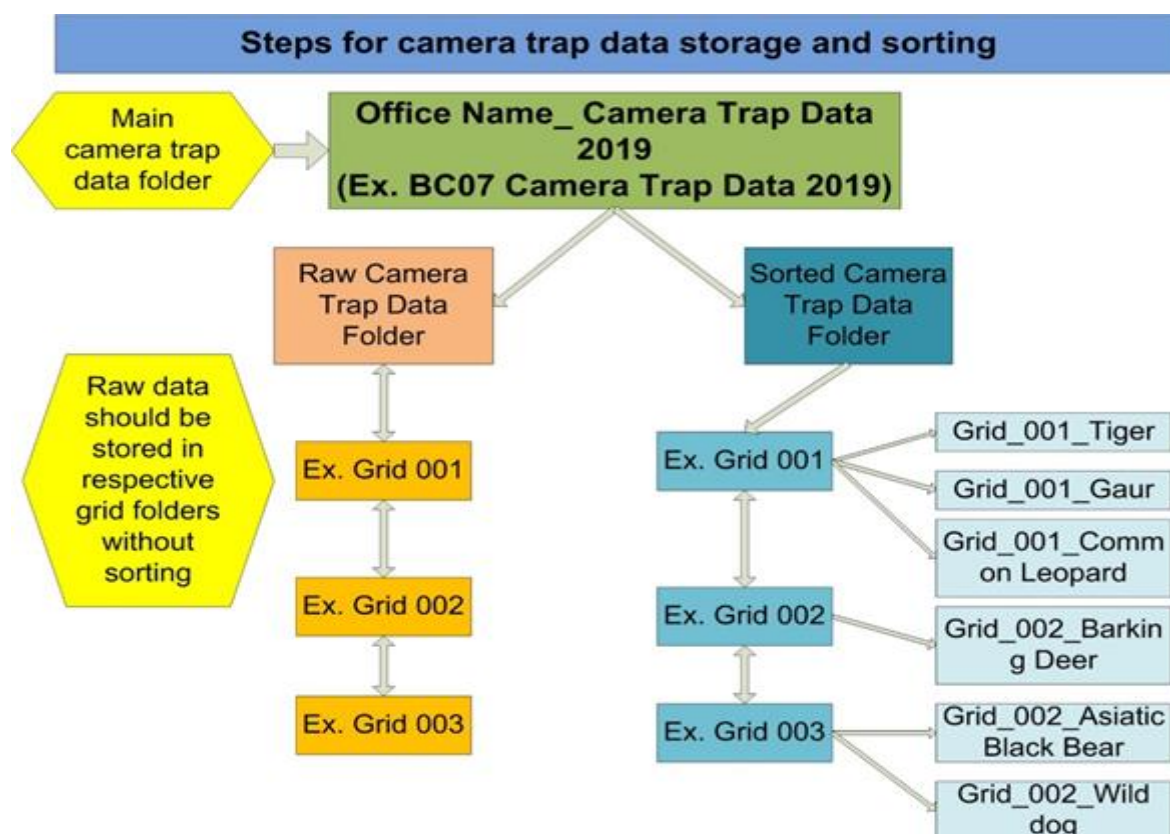


Figure 1.4 Schematic diagram showing the steps of camera trap data sorting and organization

Details of the captured image such as time of capture and number of individuals in the image shall be entered into the spreadsheet manually or using relevant applications such as *ReNamer* or *CameratrapR*, as prescribed in (Table 1.6).

Table 1.6 Sample datasheet for entering camera trap data (Similar sheet should be developed for each species captured in the camera trap)

[illegible]

1.5.2.1.2. Data Analysis

Occupancy and habitat use

Using both the transect survey data and camera trap data, occupancy models (MacKenzie et al., 2006) can be used to detect changes in presence of a species or proportion of sites (or area) occupied by the species. For the ease of analysis, single season occupancy models shall be used to understand the occupancy. In case the available data does not fulfill the assumptions of occupancy models, habitat use analyses can be performed (e.g. Phillips et al., 2006). Following steps can be followed for performing the analysis:

- Complete the data compilation and storage process as prescribed above.
- Generate and obtain all the environmental covariates such as elevation, distance from settlement/road, distance from water, forest types, etc., from relevant sources.
- Obtain the naïve occupancy from both camera trap data and transect data. Naïve occupancy is quantified as the number of camera trap locations at which each species is detected divided by the total number of camera trap locations or number of transects where animal signs are detected divided by total transects walked.
- Obtain the required programmes such as PRESENCE, or R with required library such as “unmarked” or “wiqid” for performing the single season occupancy models using the relevant environmental covariates.
- Based on results obtained from occupancy modelling, produce species occupancy maps either on R using the relevant library such as “raster” or in ArcGIS or QGIS.
- For data that does not fulfill the assumptions for occupancy models, site use probability maps should be produced using species distribution models like Maxent, or Generalized Linear Models.
- Where possible, comparisons should be made between current results with that of the past conditions to understand the change in occupancy and habitat use pattern of the species for the same area, which will help determine conservation prescriptions.

Species abundance and density

Using the data from camera trap survey, capture-mark-recapture (CMR) models shall be used to estimate the abundance (population) of a species in a particular area. This is applicable to species which have distinct colour pattern such as tiger, snow leopard, common leopard, clouded leopard, etc.

- Spatial Capture Recapture (SMR) models and analysis can be performed either on programmes CAPTURE (Efford & Fewster, 2013) or in R using the relevant packages such as “secr” (Efford, (2018)).
- Using the results from SMR models, species density map should be produced either on R using the relevant library such as “raster” or in ArcGIS or QGIS.
- Where possible, comparisons should be made between current results with that of the past conditions to understand the change in occupancy and habitat use pattern of the species for the same area, which will help determine conservation prescriptions.

Index of abundance or relative density

This is commonly known as Relative Abundance Index (RAI) and it is calculated as the number of captures divided by the total sampling effort in days multiplied by 100 (O'Brien 2011; Hedwig et al. 2018). Camera trap data can be used for obtaining the RAI of individual species encountered/captured during the survey. Following formula can be applied for obtaining the RAI.

$$RAI_{spa} = \text{events} * \frac{100 \text{ camera trap nights}}{\text{sampling effort}} \quad (1)$$

Where RAI_{spa} =relative abundance index for species 'a';

events=number of independent records per species;

100 camera trap nights=unit of standardization to compare data with other studies; and

sampling effort=total amount of nights that the camera trap stations were working.

- Only one individual per species can be counted at each camera trap station within a 24hr period (independent record); with the exception of gregarious species and felids.
- For gregarious species, when instances of more than one individual are recorded at the same time and for the same station, the number of independent records is considered equal to the number of individuals observed in the same frame.
- For felids (or other species where individuals could be identified) consecutive records of the same individual, at the same station can be as independent records when there is a 24h interval between consecutive detections.

Species Activity Pattern

Activity data reflect an important dimension of animal behaviour and ecology, as they provide relevant information on species' natural history and ecological niche. Activity patterns of surveyed species can be analyzed using images of the same species taken at intervals of ≥ 1 h from each transect.

- Establish activity patterns, analyze the temporal patterns of records using Oriana 4.0 software (Kovach, 2011) or ReNamer (Sanderson & Harris, 2013).
- Analysis can be restricted to species with more than 10 independent photographic records.
- Each photographic record can be classified as diurnal, nocturnal or crepuscular according with the time of local sunrise and sunset.
- Diurnal ($\geq 70\%$ of records occurring during the day), nocturnal ($\geq 70\%$ of records during the night), crepuscular (from 50 to 60% of records during crepuscular periods), crepuscular/nocturnal (from 60 to 70% of records during the night and crepuscular periods), crepuscular/diurnal (from 60 to 70% of records during the day and crepuscular periods) or cathemeral, when records were randomly distributed along the daily cycle. Crepuscular records are those occurring within 1h before or after sunrise or sunset.

Species Accumulation Curve (SAC)

Species accumulation curve (SAC), also known as species-richness curves or collector's curves or species effort curves, can be used to estimate the number of species in a particular area. They can also be used to indicate the adequacy of a fauna survey in representing the fauna in a particular area. Using the camera trap data, cumulative number of species detected against the survey effort can be plotted to

reach an asymptote when all species have been recorded. While species accumulation curves can be used to compare diversity between different samples, the shape of the curve can vary with the relative abundance of different species (Thompson & Withers, 2003). Communities with a high proportion of abundant species have a steeper initial slope than communities with a high proportion of rare species.

1.5.2.1.3. Reporting

The results/inferences drawn from the above-mentioned analysis should be used to make appropriate prescriptions in the conservation management. The details of the analysis and results can be produced in the form of technical reports. Useful summary data such as total number of species captured, total number of trap nights for an entire survey, the total number of photographs “events” for each species and trap rates for each species for an entire survey can be included in the report. The copies of both raw and sorted data should be submitted to FRMD and the NCD.

1.5.2.1.4. Other information

Information on small mammals, freshwater fish, macroinvertebrates, herpetofauna, insects, etc. may also be collected. Detailed methodology is mentioned in National Biodiversity Monitoring Protocol described in Volume I of the *Code*.

1.5.2.2. Bird Survey

1.5.2.2.1. Sampling Design

The 4x 4 km sampling frame grid shall be subdivided into 16 numbers of 1x1 km survey squares (SS). The SS are assigned with unique id codes from (01 – 39,450). The geo-coordinates of the centroids are used to geo-reference any other biodiversity, geophysical and climatic data (Figure 1.5).

Randomly select 5 SS in each BMG and conduct the survey using the best applicable method. Random numbers can be selected using random number generators from scientific calculators, from most database packages (such as Excel), or from statistical tables. Alternatively, bits of paper each with the grid coordinates of 1 square can be put into a hat and drawn-out blind (this is only random if every square has a corresponding piece of paper).

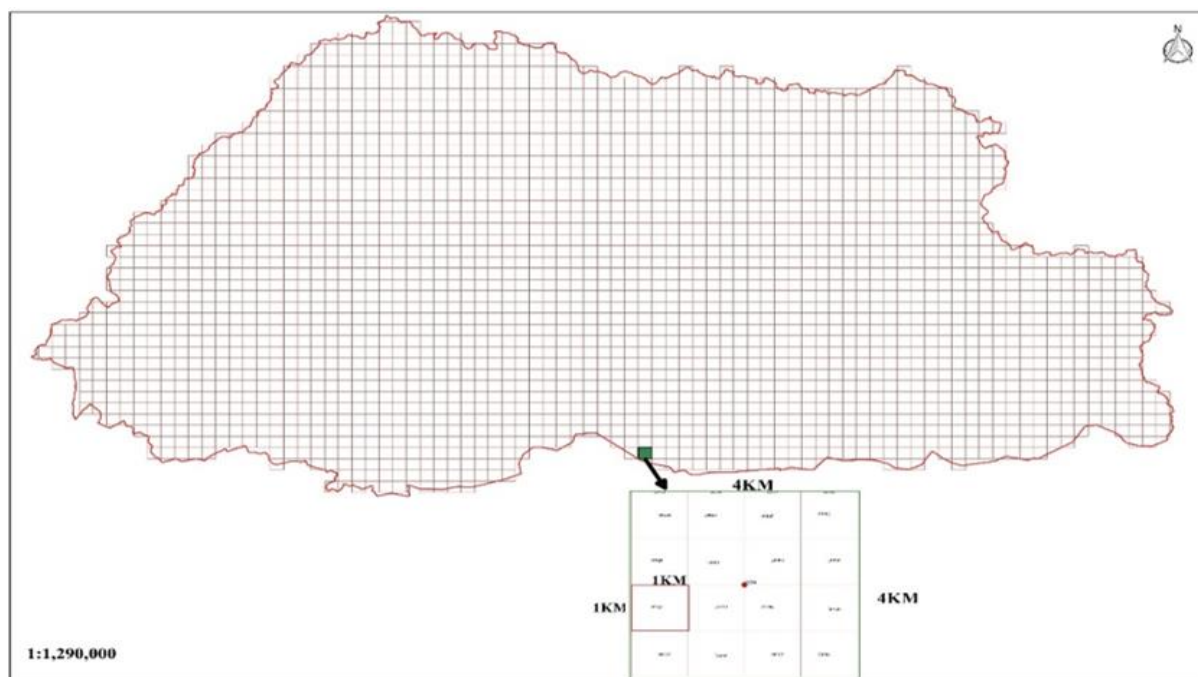


Figure 1.5 Survey design showing National Biodiversity Monitoring Grid (4x4 km) and Survey Squares (1x1 km)



Figure 1.6 Two 4x4 km Biodiversity Monitoring Grids

The Green & Pink polygon outlines with 1x1 km Survey Squares and trail transects (Red Lines) falls in GelephuThrom (2282) & Maokhola (2283)

1.5.2.2.2. Materials required

Binoculars & Camera	Altimeter/GPS Unit/Compass	Field Guide/Bird Songs	Pencil/ BallPoint Pen
Laser Range Finder	Topographic Map of the Survey Area	Data Form/App	

1.5.2.2.3. Methods

Data Collection: Trail Transect

In the SS, layout 1 km trail transects. In case, the SS has more than one habitat type, run as many 1 km trails transects as possible. In case the SS has more than one habitat type, run one 1 km trail transect in each habitat. Each SS should have 3-5 transects (Gregory et al. 2004). A trail transect involves walking along an existing trail (footpath, animal track, and roads) and recording birds on either side of the observer. The distance a bird is seen or heard from the transect line is normally recorded as an absolute measure, perpendicular to the trail transect line with the laser range finder. The data collection should be done as prescribed the data collection form prescribed in

Table 1.7.

Table 1.7 Bhutan Bird Monitoring Data Form

Grid Code	Sub-grid Code	Transect ID	Dzongkhag	Gewog	Chiwog	Park/TD	Range	Beat			
Date (YYYY-MM-DD)	Location	Weather		Start:	Northing	Easting	Altd (m)	Time (Hrs)			
Surveyors				End:							
1.		2.		3.			4.				
SPECIES	COUNT				Distance Band (meters)						
	M	F	Juv	Un	DIST (m)	Hrs	Alt(m)	Habt	BrdC	Acty	Remark

Grid & Sub-grid Codes: use pre-assigned numeric code on map, **Transect ID:** alphabetical & numeric combo, **Dzongkhag;** **Gewog;** **Chiwog:** use annex acronyms, **Park/TD;** **Range;** **Beat:** use annex acronyms, **S:** sunny, **OC:** overcast, **C:** cloudy, **SN:** snowy, **HS:** hailstone, **R:** rainy, **D:** drizzle, **ST:** still, **B:** breezy, **W:** windy, **SW:** Strong wind, **SM:** storm, **M:** male, **F:** female, **Juv:** juvenile, **Un:** no sexualdimorphism, **BrdC**[breeding code]:- **PsB:** possible breeding- pair, courtship, **PrB:** probable breeding, **BrC:** breeding confirmed- nest,egg, chick, poop sac, **Acty**[activity code]:- **FF:** forage/feed, **R:** perch/rest, **FL:** fly, **BS:** Bird Song **Habt:** **SBLF:** subtropical braod leaf forest, **WBLF:** warm broadleaf forest, **CBLF:** cool broadleaf forest, **WL:** Wetlands

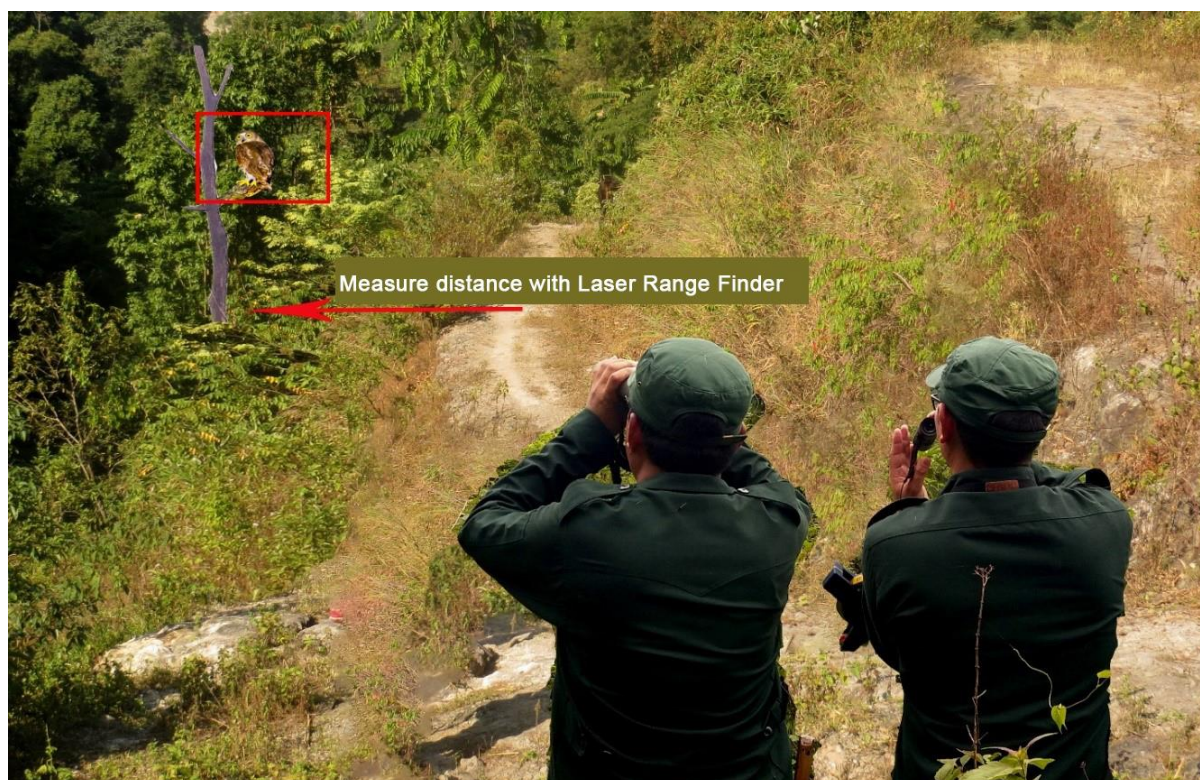


Figure 1.7 Observing birds along the trail transect and measuring perpendicular distance from the trail transect line to the bird sighting using laser range finder

Box 1.2 Advisory Points

1. **Listen to Bird Songs:** Start to listen to bird songs of Bhutan to familiarize with calls and identify bird by songs.
2. **Study Guide Books:** Constantly study the field guide to the birds of Bhutan to assist easy identification of during the field observations.
3. **Constant Speed:** On each transect, walk along the transect at a fairly constant speed, looking either side of the line and record all the birds sighted.
4. **Measure Distance:** For cluster birds consider the perpendicular distance at the center of the cluster from the trail transect line.
5. **Survey Team:** Compose bird survey team of THREE members (one data recorder & 2 observers).
6. **Data Recorder:** One data recorder shall be responsible for accurately and consistently recording the bird observations provided by two observers.
7. **Record Flying Birds:** If birds fly away as you are counting, record them from the point you first saw them.
8. **Detection:** All the birds on the trail (0m distance) are detected.
9. **Sighting Position:** More commonly, birds will be flushed away from you, so keep an eye on the line of travel ahead of you and try to record the positions from which the birds are flushed.
10. **Bird onto Wings:** If birds are seen to take to the air, then these birds should be included in the count and an estimate of distance is made from the take-off point perpendicular to the line transect.
11. **Knowing Form:** Familiarize trail transect data form carefully and understand the parameters to be filled.
12. **Completely Fill:** Leaving the parameters empty will create problems at the data analysis stage.

MacKinnon Lists

MacKinnon List (ML) is the method of listing all individuals encountered in chronological order of detection. This master list is then broken down into sub-lists or samples of a pre-determined number of species; ten is often recommended. Each list thus provides a sample of the species community at the study site. The ML method shall then be used to derive abundance indices of individual species by calculating the proportion of samples in which each species occurs. This method shall be followed if the purpose is for one-time rapid assessment of birds. Different listings shall be done for different habitats, as prescribed in Table 1.8, Table 1.9 and Table 1.10.

Table 1.8 Datasheet for MacKinnon Listing in Broadleaf Forests

Grid ID:		Trans/Plot ID:		Date (YYYYMMDD):				Habitat:				
Start Time:		End Time:		Weather:				List:				
GPS Start:		GPS End:		Surveyor:								
Sl. No	Time (Hrs)	Species	Cluster Size				Ald. (m)	Evid.	Behv.	GPS Coordinate		Remark
			M	F	J	USex				Northing	Easting	
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												

Habitat Type: SBLF: subtropical broad leaf forest, WBLF: warm broadleaf forest, CBLF: cool broadleaf forest, Remark: keep note of any special observations. CLUSTER SIZE: (M: male, F: female, J: juvenile, USex: Non dimorphic): Keep notes of threats (traps, snares, poaching): Hornbill nest trees.

Ald.: altitude, Evid.: evidence (o: observed, c: call, f: feather, db: dead body, d: dropping), Behv.: behaviour (fd: feed, rt: rest, pn: preen, cs: courtship, fl: fly).

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Table 1.9 Datasheet for MacKinnon Listing in Conifer Forests

Grid ID:		Trans/Plot ID:		Date (YYYYMMDD):				Habitat:				
Start Time:		End Time:		Weather:				List:				
GPS Start:				GPS End:				Surveyor:				

Sl No	Time (Hrs)	Species	Cluster Size				Ald. (m)	Evid.	Behv.	GPS Coordinate		Remark
			M	F	J	USex				Northing	Easting	
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												

Habitat Type: DTCF: dry temperate conifer forests (blue pine & spruce), MTCF: moist temperate conifer forest (hemlock, fir), SACF: subalpine conifer forest (juniper, rhodo& willow shrubs)

DCF: dry chirpine forest, CLUSTER SIZE: (M: male, F: female, J: juvenile, USex: Non dimorphic): Keep notes of threats (traps, snares, poaching), Remark: keep note of any special observations

Ald.: altitude, Evid.: evidence (o: observed, c: call, f: feather, db: dead body, d: dropping), Behv.: behaviour (fd: feed, rt: rest, pn: preen, cs: courtship, fl: fly)

Table 1.10 Data form for MacKinnon Listing in Wetlands

Grid ID:		Trans/Plot ID:		Date (YYYYMMDD):		Habitat:						
Start Time:		End Time:		Weather:		List:						
GPS Start:		GPS End:		Surveyor:								
Sl No	Time (Hrs)	Species	Cluster Size				Altd. (m)	Evid .	Behv.	GPS Coordinate		Remark
			M	F	J	USex				Northing	Easting	
1												
2												
3												
4												
5												

Habitat Type: AS: farmland & settlement, WL: Wetlands (riverbeds, rivers, streams, lakes, marshes), AM: alpine meadows, OM: open meadows

CLUSTER SIZE: (M: male, F: female, J: juvenile, USex: Non dimorphic): Keep notes of threats (traps, snares, poaching), Remark: keep note of any special observations

Altd.: altitude, Evid.: evidence (o: observed, c: call, f: feather, db: dead body, d: dropping), Behv.: behaviour (fd: feed, rt: rest, pn: preen, cs: courtship, fl: fly)

1.5.2.2.4. Data Analysis

Data generated from the survey grids within a BMG shall be managed in an appropriate database software. A qualitative (species richness or accumulation curve, presence-absence and identify important bird areas) and a quantitative (Shannon-Wiener Diversity Index, Mann-Whitney U Test, Single Species Occupancy and Multi-Species Occupancy) analysis will be performed. Currently available analytical software (Microsoft Excel, SPSS, Minitab and R packages) shall be used to perform aforementioned analysis.

For quantitative analysis, Shannon-Wiener Diversity Index (1) shall be computed and Mann-Whitney U Test (2) performed to compare data across BMG, seasons and habitats. Advanced analysis can be conducted to understand density, relative abundance and estimate population, mapping distributions using Single-Species Occupancy Model (SSOM) and Multi-Species Occupancy Model (MSOM) in R. For management purpose, data analysis shall be carried out using Shannon-Weiner Diversity and Mann-Whitney U Test.

Shannon Diversity Index

The Shannon-Wiener Diversity Index is calculated with the mathematical formula (Equation 2).

$$\text{Shannon Index (H)} = \sum_{i=1}^s p_i \ln p_i \quad (2)$$

Where;

s: is number of species

n: is number of individuals of a particular species

N: is total number of individuals of all species

p: is the proportion (n/N) of a particular species

ln: is natural log

i: i^{th} start at 1

Σ: is sum of calculations

Figure 1.8 shows an example to compute Shannon-Wiener Diversity Index.

Habitat	SBLF			
Species	n	Pi	ln(Pi)	Pi * ln (Pi)
Ashy Bulbul	7	0.01	-4.70	-0.04
Ashy Drongo	12	0.02	-4.17	-0.06
Asian Brown Flycatcher	1	0.00	-6.65	-0.01
Asian Fairy Bluebird	7	0.01	-4.70	-0.04
Asian Palm Swift	2	0.00	-5.96	-0.02
Barn Swallow	55	0.07	-2.64	-0.19
N	84			

Figure 1.8 Example to compute H

Mann-Whitney U Test

The Mann-Whitney U Test is computed with mathematical formula (3) and (4). The small value of U_1 and U_2 is used to determine the significance table to infer the difference between two groups of data set. The Mann-Whitney U Test can be performed online on

(<https://www.socscistatistics.com/tests/mannwhitney/>).

$$U_1 = R_1 - \frac{n_1(n_1 + 1)}{2} \quad (3)$$

$$U_2 = R_2 - \frac{n_2(n_2 + 1)}{2} \quad (4)$$

Where;

n_1 : is the number of species in group 1

n_2 : is the number of species in group 2

R_1 : is the sum of ranks of species in group 1 when data from group 1 and group 2 are put together and ranked

R_2 : is the sum of ranks of species in group 2 when data from group 1 and group 2 are put together and ranked

Beside the aforementioned quantitative analysis, a qualitative analysis shall also be performed to extract information to identify important birding areas based on species status in the Red List-IUCN (International Union for Conservation of Nature).

1.5.2.3. Flora Survey

1.5.2.3.1. Materials required

Following tools and equipment are required to carry out the field work

Compass	GPS	Measuring tape	Knife
Altimeter	Clinometer	Camera	Topo map
Spherical densiometer	Diameter tape	Plant Press	Zip lock folder

1.5.2.3.2. Sampling Design

Flora Survey will be conducted within the 4X4 km BMG. The following protocol shall be followed:

- In the sampled grid of 4x4km, two plots of 20x20m shall be established as far as possible along altitudinal gradient not less than 0.5km apart.
- Ensure the team enters 200-300m inside the grid.
- Plots shall not be established within 200m from vehicular roads and 100m from the footpath
- Establish vegetation plot inside the grid representing the major forest types of the particular area
- Use SW Maps while navigating to the grid.

1.5.2.3.3. Method

Laying Tree & shrub plot

Option 1:

Fixed area plot of 20x20m is established by using the nylon ropes and wooden pegs. 4 nylon ropes of 20m length are used with a knot made on all the ropes at 10m to mark the centre of the quadrat. The nylon ropes are pulled towards the 4 cardinal directions from the center of the plot and marked at 10m with wooden pegs corresponding with the knot. These wooden pegs corresponding with the knot are the midpoint of each side of the quadrat plot. From the midpoint, the two ends of the nylon ropes are further pulled to two respective cardinal directions (north-south and east-west) perpendicular to the centre of the plot to find the corners of the plot. The process is repeated with all the remaining nylon ropes to find the four corners of the quadrat plot and finally, the traverse of all the nylon ropes are closed, eventually forming a 20x20m quadrat plot.

Option 2:

Fixed area plot size of 20x20m is established for the enumeration of trees and shrubs. The establishment of the plot begins from the center of the plot and extends towards each side. This method is based on the Pythagoras theorem wherein the field personnel measure the hypotenuse to get the sides. By doing so, it minimizes errors and ensures that a more accurate square shaped plot is generated as compared to other conventional methods.

Following steps can be followed to layout the 20x20 plot under this option (Figure 1.9).

- Starting from the center, setup an azimuth and walk 14.14 meters diagonally towards A.
- Then 90° right to A, move 14.14 meters towards B from the center
- Then 90° right to B, move 14.14 meters towards C from the center
- Then 90° right to C, move 14.14 meters towards D from the center
- Together, these become the four sides of the plot and should measure exactly 20x20 m. Mark the points A, B, C, and D and install wooded/iron pegs.
- Now secure the four pegs with 20-meter nylon ropes

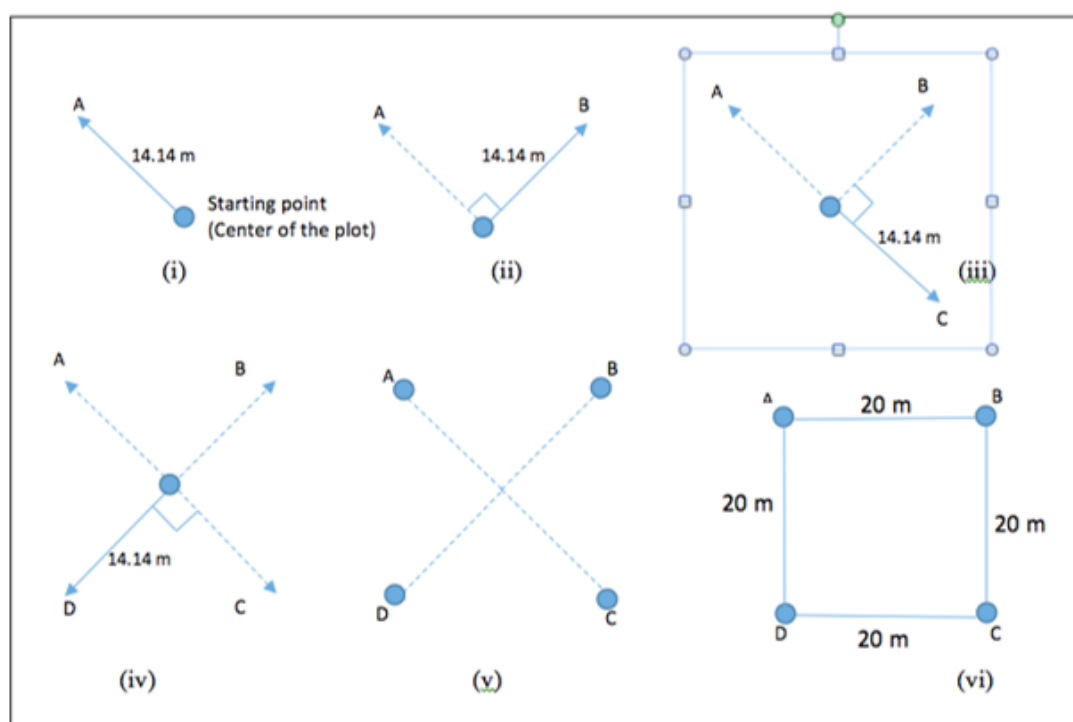


Figure 1.9 Schematic diagram showing the process of laying 20x20 plot

Cautionary notes:

- To save time, it is advisable to keep 4 numbers each of 14.14 and 20-meter nylon ropes ready.
- Ensure that the measurements are correct, avoid too much tension or sagging of rope.
- Avoid trampling and destruction of plants while setting up the plot.
- Use slope correction table while establishing the plot in the absence of hypsometer.

Tree & shrub data collection procedure

1. Record the plot id, both trees and shrubs species on the same data form as in Table 1.11.
2. Collect the voucher specimen incase the species is unidentified.
3. Start measurement from the North direction (clockwise) till completion.
4. Always measure the DBH from uphill and avoid sagging, twisting, buttressed etc...,
5. Measure the DBH of all the individual species using DBH tape above $> 1.3\text{m}$ height and height using the hypsometer.
6. Record as “S” for sprout under the stem type column.
7. Tag all species with number.

Table 1.11 Data Form for recording Trees and Shrubs in the vegetation plot of 20x20 m

[illegible]

Cautionary notes:

1. The growth form of the same species differs significantly, depending on what type of environmental condition they grow, although they belong to the same life-form group.
2. Consider forking below DBH as 2 trees.
3. Multiple stems emerging from the single root system is called "sprout" stem type and this should be considered as one tree, although the measurement should be done for all the sprouts. For calculating the species diversity only one main stem data is taken into consideration.
4. In case of the woody liana and climber species, only DBH is recorded, height/length may not be possible.

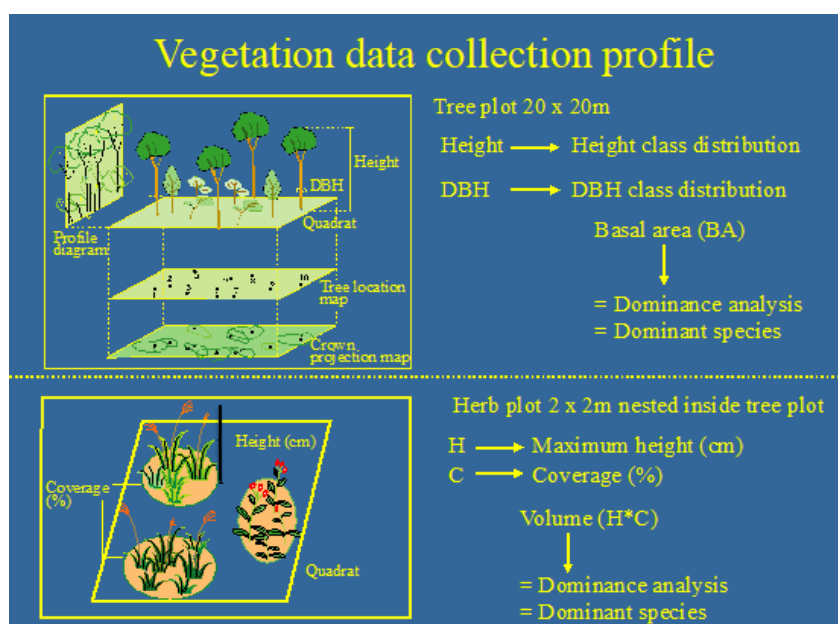


Figure 1.10 Vegetation profile showing the (A) Tree/shrub plot and (B) Herb plot measurement standard practice (Source: Wangda and Ohsawa 2006a)

Crown Cover

The readings of the crown cover % using the densitometer/ fisheye lens (hemispherical photograph) of the crown cover is taken in all the 4 quadrants of 10x10m. The average reading is recorded for the 20x20m plot.

Ground vegetation plot establishment and procedure

Ground flora is known to be especially sensitive to changes in environmental conditions and provide valuable information about the impact of chronic stresses on the forest ecosystem. The dynamics of ground flora vary from season to season. Ground vegetation plot size of 2x2m quadrat is established inside the tree and shrub plot of 20x20 m.

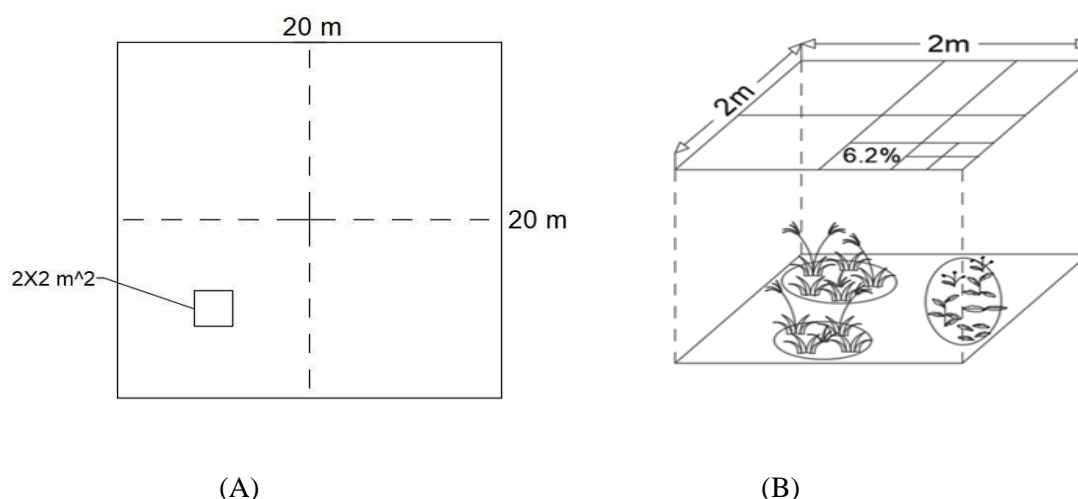


Figure 1.11 2x2m quadrat plot with grid to measure the cover % of each species (A) and the location of the herb plot in one of the quadrants (B)

Ground vegetation (herbs) data collection procedure

1. Inside the 2x2 m plot, record the plot id and species details as shown in the data form in Table 1.12.
2. Measure height of the tallest species using the 5m-fiber glass tape.
3. Estimate and record the Area of Occupancy (AOO) of each species inside the quadrat in % (IUCN 2001).
4. Collect the voucher specimen of the unidentified species (refer Cautionary for specimen collection).

Example on how to estimate AOO

Two (2) different plant communities is shown in Figure 1.11 (A).

One plant community with long flowering stalk cover % is approx. 25% meaning 1/4 portion of the quadrat is completely occupied.

On the other hand, one plant community with short flowering stalk is just the half of the first one, so the estimate is 12%.

Table 1.12 Data Form for recording ground vegetation (Herbs) in the plot of 2x2 m

Data Form for recording ground vegetation (Herbs)				
Location:		Grid No:		
Date:		Plot No		
Altitude (m):		Sub-plot No:		
Inclination (°):		Sub-Plot Size:		
Aspect:		Recorder:		
Threshold: Tallest Ht, Ht=Height				
Sl/No.	Species	Ht. (cm)	C (%)	Remarks

Cautionary note:

1. In order to avoid trampling of herbaceous species, sapling and seedlings by the survey team members, it is mandatory to collect the data of the ground vegetation first considering the tree & shrub plot is already established.
2. The height of the scrambling or leaning herbaceous species is measured from the tip perpendicular to the ground surface rather than measuring the height of the leaning species from the base to the tip.
3. Always collect the voucher specimen outside the plot

Regeneration Survey inside the herb plot

Regeneration status is recorded within the 2X2 m herb plots as shown in fig 1.11. Seedlings are counted

Data Form for recording regeneration status							
Location:				Grid No:			
Date:				Plot No:			
Altitude (m):				Sub-plot No:			
Inclination (°):				Sub-plot Size:			
Aspect:				Recorder:			
Threshold: Tree species <1.3m in height							
Sp. No.	Species name (Seedling)	Ht.	Age	Sp. No.	Species name (Seedling)	Ht.	Age

to find out the regeneration density. The height is measured for all the individual species and the species name is recorded as usual.

Steps:

1. Record the plot Id first
2. Enumerate species details as shown in the form at Table 1.13.
3. Measure height of each species using the 5m-fiberglass tape
4. Record the age of each species Table 1.13 Data Form for recording regeneration status in the plot of 2x2 m

Cautionary note:

1. In order to avoid trampling of regeneration by the survey team members, it is mandatory to collect the data of regeneration first considering the quadrat for tree & shrub plot is already established.
2. Seedling should not be messed up with the herbaceous species. Regeneration in this context is strictly in reference to the capable tree seedling able to reach its maturity, however there is no guarantee to it.
3. Count the inter nodes to estimate the age and for conifers count the whorl of the branches.
4. During each year of growth, the seedling produces a whorl of branches out from the stem. To get an estimate of the seedling's age, we can count the whorls up the stem, and if the whorls have broken off, we can count the little scars that remained

Epiphyte data collection procedure.

1. Record the plot Id first.
2. Enumerate species details within the 20X20m plot as shown in the form as in Table 1.14.
3. Count the frequency of species in each individual tree (Refer tree id) separately.

Table 1.14 Data Form for recording epiphytes in the vegetation plot

Data Form for recording epiphytes in the vegetation plot			
Location:		Grid No:	
Date:		Plot No:	
Altitude (m):		Plot Size:	
Inclination (°):		Recorder:	
Aspect (°):			
Sl/No.	Species	No.	Remarks

Cautionary note:

1. Consider the clump for orchid species as one irrespective of size.
2. Consider Runners as one individual.

1.5.2.3.4. Data compilation, storage, analysis and reporting

Data sorting, storage and sharing

Once data collection is completed in the field, all the filled data sheets should be converted into digital format, either through scanning or photography. Both material data and digital data should be securely saved. Digitalization is particularly important for saving the data in multiple copies, and to prevent degeneration of the data over time.

All the data should also be adequately processed in Microsoft excel or Microsoft access for analytical purposes. A copy of both raw data and processed data should be shared with the National Data Repository of the Department and Nature Conservation Division.

Data Analysis

After the data is compiled in the excel sheets, species richness (H'), dominance, cluster and multivariate are analyzed using any of the following statistical analysis software;

1. R Stat
2. SPSS (Social Science and others)
3. GenStat (Agriculture and others)
4. PC-ORD(Ecological analysis package)
5. Excel analysis (Focus)-Many Cases

However, the most commonly used software are Excel analysis and PC-ORD.

A. Excel analysis

Use Microsoft Excel functions to clean, sort and arrange the data

1. Prepare Height class and Diameter at Breast Height(DBH) Class

1. Prepare Height class and Diameter at Breast Height (DBH) class using the function=CEILING(number, multiple), the number is the height/DBH of tree and the multiple is the height/DBH range
2. Arrange and prepare Height and DBH class matrix manually

2. Calculate indices of a species diversity Shannon-Wiener index (H')

$$H' = - \sum ni/n \log_2 ni/n ; \text{ OR } H' = \sum_{i=1}^s -(P_i * \ln P_i) \quad (5)$$

1. Calculate the Basal Area (BA) using formula =PI()*DBH^2/4
2. Calculate Relative Basal Area % (RBA%) using formula =BA/total basal area (insert \$ sign between the letter and the number to fix the value*100)
3. Use the value of PI=PI/100
4. Calculate LogPI using this function=LN(PI/100)
5. Calculate PI*LogPI, sum of all PI*LogPI gives the (H')

3. Pivot Table Analysis

The function of a pivot table is to summarize the data (data reduction process), sort, reorganize, group, count, total or average data stored in a database. It allows its users to transform columns into rows and rows into columns. It allows grouping by any data field and they are very flexible.

1. Find and click on the Pivot table
2. Select the pivot table fields for summarizing the data
3. Click the field to summarize, then drag and drop to the appropriate fields, that is Row, Column and value

4. Dominance analysis

$$d = 1/N \left\{ \sum_{i \in T} (\chi_i - \chi')^2 + \sum_{j \in U} \chi_j^2 \right\} \quad (6)$$

Where χ_i is the actual percent share (relative basal area is adopted here) of the top species (T), i.e., in the top dominant in the one-dominant model, or the two top dominants in the two-dominant model and so on; χ' is the ideal percent share based on the model as mentioned above and χ_j is the percent share of the remaining species (U). N is the total number of species.

1. Calculate RBA% for 100% $= (RBA\% - 100)^2$ for the species number 1 and $= RBA\%^2$ from the species number 2 onwards
2. Calculate RBA% for 50% $= (RBA\% - 50)^2$ for the species number 1,2 and $= RBA\%^2$ from the species number 3 onwards
3. Calculate RBA% for 33.3% $= (RBA\% - 33.3)^2$ for the species number 1,2,3 and $= RBA\%^2$ from the species number 4 onwards
4. Repeat the same process for 25%, 20%, 16.6%, 14.3%, 12.5% respectively

B. PCORD

Steps to prepare the main matrix for Cluster analysis in PCORD

1. Arrange RBA% plot wise.
2. Custom sort RBA% from Largest to Smallest for all the plots.
3. Assign species code in each species name (PCORD does not recognize scientific name).
4. Transpose the species from Row to column and delete the scientific names.
5. Fill in the first column & first row with the number of plots and on the second column with the text as "Plot" (thumb rule).
6. Fill in the first column second row with the number of columns/species and on the second column with the text "Species" (thumb rule).
7. Fill in the variable type with capital letter "Q" in the second column third row till the end of the species (thumb rule).
8. Fill in the variable name in the second column fourth row with the species code.

Steps to do cluster analysis in PCORD

PCORD is a windows program for multivariate analysis of ecological data entered in spreadsheets. It emphasizes nonparametric tools, graphical representation, and randomization tests for analysis of community data. It offers many ordination and classification techniques not available in major statistical packages.

1. Open the PCORD and import the main matrix of the excel sheet.
2. Select the Excel Spreadsheet and file and then open.
3. Click "OK" in the pop up transformed Matrix.
4. Activate the matrix by clicking one of the menu button.

5. Click the button for the result txt syntax for the cluster cycle.
6. Click cluster analysis under the Groups menu.
7. Select the Sorensen (Bray-Curtis) for distance measure and Group Average for Group Linkage Method.
8. Type in the title of the result and the dendrogram results will be displayed in the Result txt syntax showing cluster cycle.
9. Click cluster dendrogram under the Graph menu for final result.

1.5.2.4. Socio-Economic Survey

Social science can help natural resource managers (1) identify and evaluate social as well as ecological trade-offs associated with different management options; (2) make decisions that are better for the environment and human well-being, given that social-ecological systems are integrated and influence one another; (3) make decisions that are more appropriate to a particular social-ecological setting; and (4) obtain information from a broad, science-based sample of people to better anticipate variation in their interests, and in the effects of management decisions on human communities (Charnley *et al.*, 2017). The conservation social sciences can provide unique and important contributions to society's understanding of the relationships between humans and nature and to improving conservation practice and outcomes (Bennett *et al.*, 2017).

1.5.2.4.1. Data Collection Protocol

The socio-economic survey could be conducted once at the starting of planning period and during the midterm review as a process of monitoring and evaluation (5 years).

The sources of data required for the planning and monitoring from social perspective shall be relied on the primary data and secondary data collection. The process of obtaining the data are explained in detail below:

Primary data collection

Primary data collection shall be carried out in two main stages involving focus group discussion and followed by household survey. The focus group discussion shall be carried out using semi-structured Questionnaire with mainly open-ended questions, while household survey can be conducted using structured questionnaire that consists of both open and closed-ended questions. These two different sets of questionnaires aim to generate information about selected individual household while PRA helps to generate information about a village holistically (Sperienburg *et al.*, 2002).

Focused group discussion

- The Focus Group Discussion (FGD) can be carried out at Village, Chiwog and Gewog level based on availability of resource, time and field condition. The selection of venue and meeting hall arrangement is crucial to enable conducive environment. Effective communication and interaction shall lead to high-quality results from the FGD. The focused group discussion shall be called once with minimum of 10 heads comprised of minimum 30% of female participation. This shall be guided by the semi-structured questionnaire forms (Table 1.15).
- The duration can vary depending on the dynamics of the participants, but ideally an FGD takes between 60 to 90 minutes.
- At least two people are required to conduct it effectively. Responsibility can be identified between two surveyors as to take the task of 'Facilitator' and 'Transcriptionist' or 'Notetaker'.

- The facilitator is recommended to speak local language to the participants (if possible) as to convey clear message and make them respond at best possible way.
- Transcriptionist should interrupt the session to clarify himself to keep the note as reported, discussed or agreed by the participants. Since questions in PRA are open-ended the follow-up questions to be asked is very important.
- Since response from different gender, age and economic background shall differ, facilitator should take control of dominant respondent or participant throughout the session to ensure that all participants are equally involved in the discussion.
- Use prompting questions to ensure active participation. Split the group to accommodate contrasting views and backgrounds to generate more discussion.
- Record all the information that were discussed. The entire discussion and all points raised should be recorded, because the process is based on open or guiding questions, to ensure nothing is missed or points taken out of context. Note-taking should be shared and, if possible, supplement with a voice recorder with prior permission

Table 1.15 Household Questionnaire Survey Form

Part B: PRA Form

1. Village information


Dzongkhag :
Gewog :
Chiwog
Village :
Location: Lat..... Long..... Alt.....
Vegetation type:
Interviewer :
Date:

2. Details of Participants

Sl.no	Name	Age	Sex	Position in the family
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				

3. Historical Timeline


2020 (update)



* History of the village, developmental progress, changes of resource use trend, etc.

4.Resource mapping

N



* Resource location & trend, outside users, user conflicts, local rules/regulation,

6. Natural Resources harvesting calendar

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7. Natural Resources Trend Analysis

Draw line Graph

Past

Current

Future (prediction)

8. Matrix ranking for Natural Resources use

Uses/species									
Timber									
Fuelwood									
Fodder									
Furniture									
Shinglep									
Medicine									
Flag poles									
Fencing post									
Traditional curving and handicraft									

9. Pairwise ranking for timber species

Species									
	*								
		*							
			*						
				*					
					*				
						*			
							*		
								*	
									*

10. Stake holder analysis using Venn diagram (To identify and rank developmental partners in the area) (Box 1.3)

11. SWOT analysis on Environment and Conservation

Strength	Weakness
Opportunities	Threat

12. Problem Tree Analysis and Ranking on Environment and Conservation

Problems
Root Causes
Possible solution

Box 1.3 Stakeholder Analysis

Stakeholder Analysis

Stakeholder analysis is a technique to identify stakeholders and analysis of their needs, interests, and influence. It can be used as an evaluation and monitoring tool to assess how relationships and perceptions of relationships changed over time.

There are many stockholder analysis techniques and methods developed and used in a different field, however, in Bhutan stakeholder analysis and mapping using the Venn diagram is widely practiced while working with local communities considering the low literacy rate.

Resources Required

- A large piece of paper to hang up or lay flat on a table that the group can gather around
- Construction paper circles of various sizes (small, medium, large)
- Tape
- Markers or other writing utensils

How to do

- Label and date your paper. Also helpful is assigning a note-taker to record any insights uncovered through the process.
- List the organization whose stakeholders you are assessing (e.g., Gewog developmental program) by writing the organization name on one of the large circles and placing it in the middle of the paper.
- Have the group identify stakeholders and partners. (You may already have a list that provides a good starting point.) Have the group decide how important each stakeholder is to your organization, choose a corresponding circle size (small = somewhat important;

medium = important; large = critically important), and write the stakeholder's name on the circle.

- Decide how close the current relationship is between the selected stakeholder and organization (e.g. Gewog). If the relationship is close, tape the circle very close to or touching the organization. If the relationship is distant, tape the circle toward the edge of the paper, etc.
- Assess each stakeholder this way, encouraging group members to write the names on the circles and post them. Disagreement about the importance of stakeholders is okay. Ask questions to understand why members feel the way they do.

You have now identified and created a stakeholder map. Have the group assess it as a whole.

- Does anything strike the group?
- Are any groups missing?
- Are any relationship patterns surprising?
- Does an existing partner have a strong relationship with a partner you would like to work more closely with?
- Do any problems or opportunities present themselves?
- Does the group lack a good relationship with any important stakeholders?

1.5.2.4.2. Sampling and Sample size

Determining adequate sample size of the total house population is very important to ensure that the survey result is statistically relevant. However, the sample size also has to be balanced with the available resources viz., financial, human and time. Random sampling is used to ensure that the sample is representative of the study area/survey, thus avoiding bias in sampling and ensuring that each household within the sample frame has an equal chance of being sampled judiciously.

Gewog administrative boundary as sampling frame and total households in the Gewog should be considered as population. The sample size shall be determined using Yamane's (1967) method which is widely used and accepted in social science surveys.

Using the formula;

The sample allocation shall be proportionate to Chiwog household and household interviews shall be done randomly. The house numbers e.g. MA-12-268 of the sample households will be tabulated in excel and randomly selected for questionnaire survey.

Determining sample size using Yamane formula (Yamane, 1973)

$$n = \frac{N}{1+N*(e)^2}$$

n=Sample size

N= Population size

e=Margin of error (MoE),

At 95 % confidence interval e= 0.05

Example

Let's assume that the population (Household) in Gewog is 2000. At 5 % MoE, the sample size would be:

$$n = \frac{N}{1+N*(e)^2} = \frac{2000}{1+2000*(0.05)^2} = 333 \text{ (Households)}$$

Sample allocation

The sample allocation should be proportionate to Chiwog household.

Example

- If Chiwog 'A' has 1000 hh
1000/2000 *333 =166.5 (167 hh)
- If Chiwog 'B' has 700 hh
700/2000 = 116.55 (117hh)
- If 'Chiwog 'C' has 300 hh
300/2000 * 333 = 49.95 (50hh)

List down the households in the Chiwog (with the name of the head of household) and deploy simple random sampling techniques to select household to be interviewed. Use whisk social gathering technique which is the most convenient method in the field. Write down, on individual pieces of paper, the number of each household or representative group. Place the pieces of paper in a container, shake it and then pick out the required number at random. You can also use scientific calculator or excel program in the computer to generate random number which can be assigned to the list of households.

Household questionnaire survey (Face to Face interview)

The questionnaire for household survey should be pre-tested before conducting actual survey. The questionnaire shall be both closed and open-ended questions. The main aim of the survey is to collect specific qualitative and quantitative information from the representative households.

It can be conducted "face to face" with respondent considering the less literacy rate (especially in English medium). The surveyor or interviewer need to be very conscious throughout the interview in terms of keeping memo or notes for additional information that respondents provide through the session. The interviewer should follow the following norms:

- Meet with your interviewee and greet with a friendly smile and try to establish a relationship that makes him/her feel comfortable and relaxed. Pay attention to posture and body language.
- Describe the purpose and objectives of the survey and explain the rules on confidentiality.
- Establish ground rules. Explain that it is fine if he/she does not know the answer.
- Keep it short, check the time and, if a respondent becomes restless, change the subject. If he/she stop paying attention, stop or take a break if needed. Do not rush; be patient and calm, but serious. Be prepared to find alternative ways to ask the same question.
- Do not give direction to informant or suggest your own opinion as an answer.
- Be patient and give the respondent time to think.
- Respect the various views, regulations and traditional culture (e.g. a man may not be able to interview female respondent on his own).
- Drop a sensitive issue or put it aside for a second interview. Do not force the informant to answer.

- Let the respondent talk, and even slightly deviate from the question, but not for too long.
- Provide teaching aids, maps or drawings to help you explain an idea.
- Do not make any promises.
- Make sure to thank the informant. Advise respondent that you may need to come back or call for any missing information.

Household Questionnaire Survey Form

Part I: Interviewer details

Name :	Designation:
Office:	Contact No.:
Email ID:	Date:

Part II: Household information and Source of Income (Give details per household member)

2.1 Respondent Detail

Dzongkhag:	Name of respondent:
Gewog:	Village:
Age/sex: M <input type="text"/> F <input type="text"/>	Cell Phone #:

2.2. Household member Information

[illegible]

*with the household (> 6 months/year at home)

****Registered with HH but not living here (< 6 months/year absent)**

2.3. What are the main sources of income to the family? (Rank as per importance 1-5 with 1 being the most important and 5 the least)

Source	Rank
Agriculture	
Livestock	
Horticulture crop	
NWFPs	
Tourism/Pottering	
Labour	
Employment	
Business	
Others (Specify)	

2.3.1 Area of Household Expenses

Particular	Estimated Amount (in Nu.)
School expenditure	
House hold expenses	
Rituals	
Constructions /Renovation	
Pilgrimage	
Leisure items	
Vehicles	
Farm Machineries	
Others (specify)	

2.4. Type of land holdings

Type:	cultivated/used by HH	fallow/unused	sharecropped / rented in	sharecropped / rented out
Chhuzhing, wetland				
Kamzhing, dryland				
Tsesha, kitchen garden/Khemsas				
Orchard				
Tsamdrog				
Others: _ _ _ _ _				

Part III: Agriculture Crops

3.1 Type of Agriculture crop

Which are the main crops grown by the household? <i>□ rank in ascending order in order of importance (1 being most important followed by 2,3, etc)</i>	wetland rice upland rice maize millet	wheat barley mustard potato	radish/turnips bitter buckwht sweet buckwht Chilli	vegetables ----- ----- -----
Which are the cash crops grown? <i>□ rank in ascending order in order of importance (1 being most important followed by 2,3, etc)</i>	apple other temp. fruit cardamom	Orange other subtrop. fruit walnut	other nuts ----- -----	
Does HH have other, special crop or livestock activities <i>□ if yes, tick</i>	<input type="checkbox"/> grow mushrooms <input type="checkbox"/> keep silk <input type="checkbox"/> keep bees <input type="checkbox"/> ----- worms <input type="checkbox"/> ----- <input type="checkbox"/> -----			
What are the main problems for Agriculture? <i>□ rank in ascending order in order of magnitude (1 being most problematic followed by 2,3,etc)</i>	<input type="checkbox"/> damage by wild animals <input type="checkbox"/> insufficient labour <input type="checkbox"/> bad road <input type="checkbox"/> insufficient irrigation <input type="checkbox"/> pests and diseases <input type="checkbox"/> road/market far <input type="checkbox"/> water <input type="checkbox"/> insufficient land <input type="checkbox"/> erosion <input type="checkbox"/> insufficient funds to invest <input type="checkbox"/> poor soil <input type="checkbox"/> unreliable transport <input type="checkbox"/> other ___ ----- <input type="checkbox"/> other ___ -----			

3.2 What is the annual income from Agriculture crops?

Sl.#	Type of crops	Quantity (Unit)	Unit cost	Total amount	Remarks
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

3.3 What are the main problems/constraints for Agriculture of the HH? (Rank as per importance 1-5 with 1 being the most important and 5 the least)

Problem/Constrain	Rank
<input type="checkbox"/> Damage by wild animals <input type="checkbox"/> Poor accessibility <input type="checkbox"/> Poor marketing <input type="checkbox"/> Soil erosion <input type="checkbox"/> Poor soil fertility <input type="checkbox"/> Insufficient irrigation water <input type="checkbox"/> Insufficient funds to invest <input type="checkbox"/> Shortage of labor <input type="checkbox"/> Pests and diseases <input type="checkbox"/> Insufficient land Erratic Climate condition Others (Specify)	

Part IV: Livestock holding and importance

4.1. Type of Livestock holdings

Livestock type	Total
Yak	
Horse	
Cattle: Traditional/local breed Jersey breed Brownswiss breed Mithun breed Buffalo	
Bee keeping	
Fishery	
Goat	
Sheep	
Poultry	
Pigs	
Dog	

4.2 What is the annual income from livestock?

Livestock type	Item	Quantity	Unit	Rate/unit in Nu.	Total	Remarks If any....
Yak	Milk					
	Cheese					
	Butter					
	Meat					
	Manure					
	Sale of live animal					
	Others.....					
Buffalo	Milk					
	Cheese					
	Butter					
	Meat					
	Manure					
	Sale of live animal					
	Others.....					
Cattle	Milk					
	Cheese					
	Butter					
	Meat					
	Manure					
	Sale of live animal					
	Others.....					
Horse	Transportation charges					
	Sale of live animal					
	Others					
Poultry	Egg					
	Meat					
	Sale of live animal					
	Others					
Pig	Meat					
	Manure					
	Sale of live animal					
	Others					
Goat	Meat					
	Sale of live animals					
	Other					
Others						

4.3. What is the importance of livestock to the household? Rank as per importance 1-5 with 1 being the most important and 5 the least

Source of income	Rank
Source of food	
Draught power	
Manure	
Means of transportation	
Others (Specify)	

4.4. What are the main problems/constraints regarding livestock for the HH? Rank as per importance 1-5 with 1 being the most important and 5 the least

<input type="checkbox"/> losses due to predators	<input type="checkbox"/> insufficient fodder	<input type="checkbox"/> diseases
<input type="checkbox"/> low milk yields	<input type="checkbox"/> insufficient grazing	<input type="checkbox"/> Parasites
<input type="checkbox"/> poor quality local breeds	<input type="checkbox"/> poor quality grazing	<input type="checkbox"/> other _ _ _ _ _
<input type="checkbox"/> few extension visits		

Where does the household graze their livestock? *Please Tick*

Improved pasture
Open Forest
Abandon agriculture field
Tethered and Stall feeding

Part V: Forest Resources use & People's outlook

5.1 Does he/she collect Forest resources?

Yes ☐ No ☐

If yes

5.2 What does he/she collect and income from forest resources?

Resources	Qty. With scale/unite		Rate per scale/unit	Annual income from sale	Distance from village to the collection site (Km or hr walk)	Trend (Increasing, Stable, Decreasing)	Remarks
	Consumption	Sale					
Firewood							
Fodder							
Medicinal plants							
Mushrooms							

Incense							
Fern							
Thatch grass							
Canes							
Bamboo							
Fern/leaves for bedding							
Top soil/leaf moulds							
Cordyceps collection							
Agricultural tools							
Religious drums							
Wood burl/burr for <i>Dhapa</i>							
Others (specify)							

Note: Annual income from sale can be calculated later

Trend: I=Increasing, S=Stable/Same, D=Decreasing

5.3 List five most preferred timber species for construction purposes?

- 1)
- 2)
- 3)
- 4)
- 5)

5.4 What are the threats to forest resources? Rank as per importance 1-5 with 1 being the most important and 5 the least

- 1)
- 2)
- 3)
- 4)
- 5)

Part VI: Wildlife Conservation

6.1 What animals and at what frequency do you sight wild animals in your areas and what is your feeling towards them? Also, your views on the population trend

Sl.no	Species	Frequency of sighting	Your feeling to Wildlife	Population trend	Reasons for increase or decrease (use additional sheet if space is not enough to write)

Frequency: A= Always, O=Occasionally. Feelings: L=Like, N=Neutral, D=Dislike

Population Trend: I=Increasing, S=Stable/Same, D=Decreasing

Part VII: Human-wildlife conflict

7.1 Did you get any of the following problems due to wildlife? Please tick in the appropriate cell

Problem	Yes	No	Minor	Severe
Crop Damages				
Livestock predation				
Property damages				
Disease transmission				
Social Harassment				
Others				

7.2 Has the household lost livestock to wild predators in the past three years? ☐ Yes / ☐ No

		*Indicate code for the identification evidence of the predator for each case: s=animal seen, h=animal heard, p=pugmarks, t=type of killing, etc.						
Type of livestock killed	Breed	Date of Kill (month/year)	Age	Sex	Dist. from village (hr or km)	Cost	Predator	Evidence*

7.3. What are the root causes for Livestock depredation?

- 1.
- 2.
- 3.
- 4.
- 5.

7.4. What are the prevailing mitigation measures adopted? Rank as per importance 1-5 with 1 being the most important and 5 the least

Action	Rank	Remarks
Traditional Fencing (specify types in the remarks column)		
Electric/Solar fencing		
Guarding		
Scarecrow		
Trapping in field		
Hunting in field		
Endowment funds/insurance scheme		
Others (specify).....		

7.5. Do you have any other innovative ideas to curb livestock depredation?

- 1.
- 2.
- 3.
- 4.
- 5.

Do the wild animals depredate/damage the crop? ☐ Yes / ☐ No

If Yes, indicate the crops and the order of magnitude for each animal spp.

Crops	Animal species	Month	Qty (Kg, Drey, Sang etc..)	Local Rate per unit	Total Amount	Order of magnitude

What are the possible reasons for wild animals coming to field and damaging the crops?

- 1)
- 2)
- 3)
- 4)
- 5)

In your opinion what could be the solution for the conflict?

- 1)
- 2)
- 3)
- 4)
- 5)

7.9 Did the wild animals damage your properties in last three years? ☐ Yes ☐ No

If yes, indicate the properties damage by each animal

Type of properties	Animal species	Month	Frequency (Once, Occasionally, frequently)	Specify the damage	Total loss in amount

Part VIII: Climate change and adaptation

Have you ever heard the term Climate Change? Yes ☐ No ☐

If yes, do you notice climate change in your village? Yes ☐ No ☐

If yes, can you please share your experience of climate change in your village? (for example: weather, climate, plant phenology cycle change, movement or migration of birds and animal)

Weather or climate pattern:

i) Rainfall pattern in last 10 years: Increase ☐, decrease ☐ same ☐

ii) Temperature pattern in last 10 years: Increase ☐, decrease ☐ same ☐

iii) Snow fall duration and intensity: more duration and more amount ☐ duration and less amount ☐, less duration and more amount ☐

iv) Dry weather condition: Increase ☐, decrease ☐, same ☐

B. Plant phenology cycle change (flowering season, budding season, shifting in vegetation, invasive plants, etc.).

.....
.....
.....

C. Migratory birds or wild animals you have sighted or occurring in your village that was not present in the last 20 years or more. Please name them in local language or common English name.

.....
.....
.....

D. Birds or wild animals that have migrated out from your area? Please name them in local language or common English name.

.....
.....
.....

E. Is there any evidences of drying water sources in your locality?

☐ Yes ☐ No

If yes, Number of water source dried

F. How do you feel about the biodiversity and ecosystem of your community before 10 years and today?

Before				Today			
Excellent	Good	Bad	Reasons	Improved	Stable	Worst	Reasons

2. How do you feel about the impact of climate change and vulnerability?

a. Yearly Increasing ☐ b. Yearly Decreasing ☐ c. Same as before ☐

3. What are the probable reasons for climate change in your opinion?

Natural (please describe)

.....

.....

Human (please describe)

.....

.....

3. Have you ever experienced extreme weather events that affected your life in the last 10 years?

Yes ☐ No ☐

4. In what specific ways have this variability's/extreme climate affected your lives?

Nature of climate variability	Rank (1: most severe; 2,3,4....)	Impact on livelihood (Yes/No)	Impact on income (decrease or Increase)	Loss of properties / assets (Type)	Loss of lives (Yes/No)
-------------------------------	--	----------------------------------	--	---------------------------------------	---------------------------

Drought

Flood

Landslide

Soil erosion

Hailstorm/wind

Forest fire

Early onset of rain

delayed onset of rain

Prolonged rain

Scanty rain

Pest and diseases (forests and agriculture crops and diseases for human)

Others

5. Have you introduced new varieties of agriculture crops? If yes, why? Please give the reason

Reasons:

.....
.....

6. Which breeds of cattle is preferred by your community and why? Please give the reasons.

Reasons:

.....
.....

7. Do you consider it necessary to have adaptation strategies to cope with climate change impacts on livelihood of the society?

Yes ☐ No ☐ If yes, please suggest some strategies to cope with climate change.

1.....

2.....

3.....

1.5.2.4.3. Secondary data collection

In addition to the primary data collected at the Chiwog/Gewog level, a need to obtain secondary information about the survey area (Chiwog/Gewog) is important to get a better understanding on the household information and a wider view on different socio-economic well-being of the concerned village. As such, the secondary information required to be gathered at the central level includes the review of relevant scientific articles and journals, plan documents, policy and acts documents, and national reports. At Gewog/Chiwog level, related information to be collected includes records, Gewog statistics, Gewog plan documents, RNR documents, and other technical reports.

1.5.2.4.4. Data Processing and Analysis

Both quantitative and qualitative data collected from the field can be sorted for data entry in MS Excel Worksheet. It can be processed in PivotTable or SPSS (Statistical Package for Social Scientists) and any other widely accepted software and analytical tools. For qualitative data, non-parametric test, frequency distribution, and descriptive statistics may be performed as per need. Descriptive statistics may be applied to calculate the frequency, percentage, minimum value, maximum value, mean, standard deviation and standard error of different numerical and categorical data. To test the significance and relationships, statistical tool such as chi-square is recommended.

In order to derive the expected result out of Socio-economic Survey analysis, each part of the Household Questionnaire Survey and Participatory Rural Appraisal has a set of respective guiding hypothesis, outcome, and objectives.

PART A: Household Questionnaire Survey Analysis

Household information and source of income

Hypothesis: Limited land holding may result to State Reserved Forest (SRF) land encroachment while lack of income source is suspected to resort to illegal trade of wildlife, timber or NWFPs. Less number of people living in the village or more people living outside the village as student, monk, employee, etc. is expected to exert minimal pressure to the forests in case of natural resource utilization.

Expected outcome: Structure of household composition (age, type of occupation and job responsibility in the family), land holding, source of household income and area of expenses is understood.

Objective: To determine household profile in terms of their resource (human, land and income) and area of expenses.

Agriculture farming

Hypothesis: A small land holding, low-income generation from the sale of agriculture products may induce pressure on forest through NWFPs collection and poaching. Challenges in agriculture crop protection may entail to killing wild animals by farmers using lethal weapons. Constraints of inadequate irrigation water may lead to food crisis and subsequent impact on forest ultimately.

Expected outcome: Household agriculture farming and its associated problem, and income generation from the sale of agriculture products understood.

Objectives:

- i. To understand varieties of crops grown and annual income generated from the sale of agriculture products by a household;
- ii. To determine agriculture farming associated challenges/problems and food security or grain-self-sufficiency of a household.

Livestock farming

Hypothesis: A household involved in rearing various types of livestock have better livelihood than those households which do not rearing cattle at all. On the other hand, breed type and mode of rearing of cattle type varies resulting in different quality of livestock products and impacts on forest. For example, local breed, mithun and yaks compared to Jersey and Brown Swiss are expected to induce more pressure on the forests and are more vulnerable to predators if they stray into forest areas. So, retaliatory killing of predators by herdsman for cattle loss is one main factor that can decimate or even wipe out predator population in the locality.

Expected outcome: Household livestock farming practices and its associated problem, and income generation from the sale of livestock products understood.

Objectives:

- i. To understand various types of livestock (cattle, horse, poultry, pig, etc.) reared and annual income generated from the sale of livestock products;
- ii. To determine mode of livestock rearing and their associated problem

Forest Resource use

Hypothesis: Maximum dependence on various forest resources by the household is assumed to impact adversely and exacerbate the conservation problems in the locality. Unregulated collection of forest products (especially NWFPs) entails to local extinction at a faster rate.

Expected outcome: Household forestry resource use pattern and trend, and income generation from the sale of forest products understood.

Objectives:

- i. To understand the use of forest resources and its trend, and income generation from the sale of forest products;
- ii. To determine forestry associated challenges and their perception on resource availability.

Wildlife Conservation and people's outlook

Hypothesis: A few segments of local people's positive attitude in respect of conservation is appreciated and acknowledged by conservationists. On the other hand, some people's negative attitude and perceptions are never taken into account rationally. Therefore, frequent occurrence of wildlife species of conservation interest in the locality is more vulnerable in unavoidable situations with human encounters.

Expected outcome: People's attitude and perceptions about wildlife conservation understood.

Objective: To determine the attitude of people about wildlife conservation and their perception about the trend of wildlife occurrence in the locality.

Human-wildlife conflict

Hypothesis: Wild animals that are responsible for agriculture crop depredation and livestock predation are highly vulnerable to retaliatory killing by farmers. Crop protection measures prevailing in the locality are barely effective depending upon the wildlife species while migratory cattle are largely predated due to complacent herding practices.

Expected outcome: Human-wildlife conflict pattern and prevailing mitigation measure in the locality understood.

Objectives:

- i. To better understand driving factors and the area of human-wildlife conflict, and its pattern in the locality;
- ii. To determine the prevailing HWC measures and potential intervention measures.

Climate change and adaptation

Hypothesis: Local people are the better source for reporting climate change within some predetermined indicators. Interactions between farmers and wildlife have changed over the resource sharing and use pattern due to climate change impacts. People are already practicing resilient climate change adaptation measures especially in the area of agriculture and livestock farming practices.

Expected outcome: Knowledge on climate change impacts and resilient adaptation measures prevailing in the locality is enhanced

Objectives:

- i. To determine the climate change impacts (both adverse and benign) and its trend in the locality in a given time frame;
- ii. To understand the prevailing climate adaptation measures being practiced by the local people.

PART B: PRA Analysis

Historical Timeline

Hypothesis: There is either overlap in the development and conservation activities by various agencies in the village or total negligence of the village in development planning with an assumption of being supported by some other agencies other than PA.

Expected outcome: Knowledge on chronology and duplication or negligence of all development, religious, social and conservation activities in the village is enhanced.

Objective: To understand the structure of development activities and conservation programs set up in the village.

Resource mapping

Hypothesis: Resource sharing between local people and outsiders in the locality leads to deterioration of natural resources at a faster rate and conflict rises thereof. In some villages, there are village norms (from religious and cultural perspectives) for sustainable resource utilization besides resource sharing regimes instituted by the DoFPS.

Expected outcome: Areas of various forest resource collections (by the local people and outsiders), degradation/deterioration threats to natural resource and application of existing local norms understood.

Objectives:

- i. To determine utilization and area of collection of various forest products.
- ii. To understand threats to resources, resource sharing strategy and its associated conflict management in the locality.

Seasonal Calendar Activities

Hypothesis: Local people's farming season is often interrupted by development activities/planning which affect them. Collection of forest resources (NWFPs) is occurring inconsistently beyond the provisions of standing rules.

Expected outcome: Knowledge on farming and seasonal off-farm activities prevailing in the locality is enhanced.

Objective: To understand seasonal agriculture and livestock farming activity patterns, and seasonal off-farm activity (including forestry, culture, religious, etc.).

Ranking for natural resources

Hypothesis: Legitimate rights of local people for collection of timber and NWFPs are being respected and forestry personnel assume that their demand is fulfilled. But, in reality local people's desire for better species for some genuine reason always remains unfulfilled.

Expected outcome: Relative significance and utilization of forest resources understood.

Objective: To better understand the importance, priority, and utilization of particular resources (timber and NWFPs) for the local people.

Stakeholder Analysis

Hypothesis: There exists overlap in supporting the development and conservation activities by various agencies in the village or total negligence of the village in development planning with an assumption of being supported by some agencies other than field office

Expected outcome: Institutions or agencies involved in the development planning and funding the activities or program in the locality realized.

Objective: To identify stakeholders involved in planning and funding development activities in different fields (health, education, etc.) other than the RNR sector.

Strength, Weakness, Opportunity, Threats (SWOT) Analysis

Hypothesis: Local people are considered as threats from the perspective of resource sharing and encounter with wildlife, by many people including some conservation agencies. Local people's attitude and behavior in terms of biodiversity conservation are assumed rather negatively without carrying out in-depth situational analysis.

Expected outcome: Four dynamic variables (SWOT) – strength, weakness, opportunity, and threats of community on conservation assessed.

Objective: To determine strength, weakness, opportunity, and threats of local people from the perspective of biodiversity conservation.

Problem Tree Analysis

Hypothesis: Everyone sees different types of problems and look at them differently as an individual. In the case of HWC, conservationists and farmers have different perspectives. Knowledge on driving factors and their interconnectedness to an identified problem of a particular place and specific time is never looked at seriously by both the parties (conservationist and farmer).

Expected outcome: The main driving and underlying factors of specific wildlife associated problems encountered by the local community identified.

Objective: To better understand driving parameters and interconnectedness to an identified problem (e.g., Crop depredation by wild pig) occurring in a particular place and specific time.

Information on wild animals

Hypothesis: Different segments of people have their own perception about wildlife occupancy and their distribution. Local people reason out that stringent conservation policy has resulted in the increase in wildlife population which live nearby agriculture field or forest edge. On the other hand, conservationists assert that fragmentation of natural habitat of wild animals due to infrastructure development is one significant cause for displacement of wildlife from forest to nearby agriculture fields.

Expected outcome: Knowledge on occurrence of wild animals and its frequency of sightings in the locality enhanced.

Objective: To understand wild animal occurrence and rate of sightings by people in the vicinity of villages.

Ecotourism potential and governance

Hypothesis: Some villages in PAs already have community-based ecotourism and governance regime in place. But most of the villages do not have established community-based ecotourism activity other than occasional visit by tourists.

Expected outcome: Governance of existing-community based ecotourism and benefit sharing understood, and potential community-based ecotourism identified.

Objectives:

- i. To better understand the management regime or governance of community-based ecotourism and its benefit sharing modalities.
- ii. To determine potential area of community-based ecotourism from the perspective of natural, cultural and social values.

Household information and source of income

Hypothesis: Limited land holding may result State Reserved Forest land encroachment while lack of income source is suspected to resort into illegal wildlife trade including NWFPs and timber. Less number of people living in the village or more people living outside the village as student, monk, employee, etc. is expected to exert less pressure to the Forests in case of natural resource utilization.

Expected outcome: Structure of household composition (age, type of occupation and job responsibility in the family), land holding, source of household income and area of expenses is understood.

Objective: To determine household profile in terms of their resource (human, land and income) and area of expenses.

Agriculture farming

Hypothesis: A lack of income generation and insufficient grains from the sale of agriculture products may induce pressure on forest through NWFPs collection and poaching and trade of wild animals whose market destination are written on their body parts. Challenges in agriculture crop protection may entail to killing wild animals by farmers using lethal weapons. Constraints of inadequate irrigation water may lead to food crisis and subsequent impact on forest ultimately.

Expected outcome: Household agriculture farming and its associated problem, and income generation from the sale of agriculture products understood.

Objectives:

- i. To understand varieties of crops grown and annual income generated from the sale of agriculture products by a household;
- ii. To determine challenges/problems associated with agricultural farming and food security or grain-self-sufficiency of a household.

Livestock farming

Hypothesis: A household involved in rearing various types of livestock enjoys better livelihood than those households which are not rearing cattle at all. On other hand, breed type and mode of rearing of cattle type varies in product and impacts on forest. For example, local breed, mithun and yaks are

expected to exert more pressure on the forests compared to Jersey and Brown Swiss and are also more vulnerability of loss to predators when they are migrated. So, retaliatory killing of predators by herdsman for cattle loss is one accounted factor that can decimate or even wipe out predator population in the locality.

Expected outcome: Household livestock farming practices and its associated problem, and income generation from the sale of livestock products understood.

Objectives:

- i. To understand various types of livestock (cattle, horse, poultry, pig, etc.) reared and annual income generated from the sale of livestock products;
- ii. To determine mode of livestock rearing and their associated problem?

Forest Resource use

Hypothesis: Maximum dependence on various forest resources by the household is assumed to impact adversely and exacerbate the conservation problems in the locality. Unregulated collection of forest products entails to local extinction at a faster rate in the future.

Expected outcome: Household forestry resource use pattern and trend, and income generation from the sale of forest products understood.

Objectives:

- i. To understand the use of forest resources and its trend, and income generation from the sale of forest products;
- ii. To determine forestry associated challenges and their perception on resource availability.

Wildlife Conservation and people's outlook

Hypothesis: A few segments of local people's positive attitude in respect of conservation is appreciated and acknowledged by conservationist. On the other hand, some people's negative attitude and perceptions are never taken into account rationally. Therefore, frequent occurrence of wildlife species of conservation interest in the locality is more vulnerable in unavoidable situation with human encounter.

Expected outcome: People's attitude and perceptions about wildlife conservation understood.

Objective: To determine the attitude of people about wildlife conservation and perception about the trend of wildlife occurrence in the locality.

Human-wildlife conflict

Hypothesis: Wild animals that are responsible for depredation of agriculture crop and livestock predation are highly vulnerable to retaliatory killing by farmers. Crop protection measures prevailing in the locality are barely effective, while migratory cattle are largely predated due to complacent herding practices.

Expected outcome: Human-wildlife conflict pattern and prevailing mitigation measure in the locality understood.

Objectives:

- i. To better understand driving factors and area of human-wildlife conflict, and its pattern in the locality;
- ii. To determine the prevailing HWC measures and potential intervention measures.

Climate change and adaptation

Hypothesis: Local people are the better source for reporting the climate change with some predetermined indicators. Interactions between farmers and wildlife have changed over the resource sharing and use pattern due to climate change impacts. People are already into resilient climate change adaptation measures especially in the area of agriculture and livestock farming practices.

Expected outcome: Knowledge on interactions with wildlife, climate change impacts and resilient adaptation measures prevailing in the locality is enhanced

Objectives:

- i. To determine the climate change impacts (both adverse and benign) and its trend in the locality in a given time frame;
- ii. To understand the prevailing climate adaptation measures and their interactions with wildlife being practiced by the local people.

1.5.2.5. Timber Resources Assessment

Forest resources assessment shall be carried out within the multiple use zone. The assessment shall be carried out by laying systematic sampling points along the Inventory Plots using a wedge prism for timber and with a fixed sample circle for the enumeration of regeneration and saplings. It should be applied in all forest stands irrespective of type or age. The details of the resource assessment can be referred to Volume III, Chapter III of the *Code*.

1.5.3. Zonation

The fundamental aim of the park zonation is to classify the PAs into different zones for conservation of species and their habitats and to support resource use and other social needs for its residents. Apart from identifying areas important for biodiversity conservation, habitat preservation and protection for long-term persistence of biodiversity and ecosystem, park zonation will benefit in better management of ecosystem services to park residents, down-stream users and visitors alike.

1.5.3.1. Objectives

The main objective of zonation is to classify a PA into different zones as per the functions of the area and accordingly prescribe regulations and management interventions for the purpose of;

- a. Ensuring conservation of threatened, endemic and key stone species and its habitat;
- b. Enhancing social and community services through legal and traditional resource use rights without endangering conservation status.
- c. Strengthening effective management of the area through objective driven management interventions and resource allocations.

1.5.3.2. Types of Zones

Zonation is a process of classifying a national park, a wildlife sanctuary or a strict nature reserve into different zones to be managed for different specific purpose. The PAs may be classified into the following management zones;

1. Core Zone
2. Transition Zone
3. Buffer Zone
4. Multiple Use Zone

However, it may not be necessary for all PAs to have Transition Zones depending on the functions and space.

1.5.3.2.1. Core Zone

Core zones are areas with high conservation values that are seen to provide critical services for the persistence of flora and fauna of international, regional, national or local importance including resident or migratory fauna. This is a non-negotiable zone. except for regulated research and monitoring programs

Besides, it can also include habitats of ecological integrity or such areas undisturbed by significant human activity, free of modern infrastructure and where natural forces and processes predominate. Such areas are generally vulnerable to disturbances, and can tolerate only a minimum human use before it loses its ecological integrity to support species persistence.

Criteria for designation of Core Zone

While classifying core zone, one or more of the following criteria need to be fulfilled:

1. **Key (High) Biodiversity Areas (KBAs):** Areas that support globally or locally threatened plants, breeding of endangered species, flagship species or keystone species of that park.
2. **Areas of high endemism:** Areas that support biodiversity that may be endemic to that particular area or endemic to the country.
3. **Critical Freshwater Habitats:** Areas which are critical habitats and support spawning of endangered aquatic biodiversity.
4. **Areas serving as wildlife refuge:** Areas known to provide refuge for vagrant or migratory population of endangered, flagship or keystone species.
5. **Key wildlife habitats such as salt licks and water holes:** Areas mapped to have high numbers of saltlicks and water holes that are frequented by wildlife for its services.
6. **Migratory routes of wild animals and birds:** Migratory routes of wild animals and birds must be protected from human interference as the species could get disoriented, and affect amongst others, breeding patterns.

1.5.3.2.2. 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 (e.g., cordyceps collection areas and pasture lands).

The protection status of this zone is equivalent to that of the core zone except during the traditional/legal use-right season or for a fixed time use. The transition zone is normally adjacent to core zone, but can also be located away from the core zone.

This zone consists of important habitat patches or contiguous habitat that serves as an important refuge for wildlife or for movement of wildlife from core to other zones.

Criteria for designation of Transition Zone

While classifying transition zone, one or more of the following criteria with traditional or legal use rights should be fulfilled:

1. Areas important as wildlife habitat but with time bound human interference
2. Traditionally used grazing or pasture land
3. Historical/ancient trails
4. Cultural heritage sites
5. Sacred grooves

1.5.3.2.3. 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. The trails that pass through the transition zone will also become part of the buffer zone after assigning a minimum buffer width on either side.

The buffer zone may be regarded as an area in which human interventions is less intensive than what might be found in the multiple-use zone and may accommodate activities for environmental education, tourism, traditional resource use and recreation facilities.

Criteria for designation of Buffer Zone

While classifying Buffer zone, one or more of the following criteria should be fulfilled:

- around the multiple use zones
- along the roads and trails
- human settlement adjacent to the park boundary
- core or transition zone adjacent to the boundary

The minimum width of the buffer shall be as follows:

1. 500m around multiple use zones; campsites, religious sites and hot springs
2. 150m on both sides of national highway measured from the center of the road
3. 50m on both sides from the center of the farm roads
4. 20m buffer on both sides from the center of trails

5. For the settlement that lies right outside the park boundary, a buffer width of minimum 500m or more shall be kept along the border towards a core or transition zone.

1.5.3.2.4. 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 people, wildlife, biodiversity and environment.

The area shall be classified based on the resource mapping exercise and resource need assessment of local communities inside the park. The multiple use zones should have adequate provision to meet the resource demand of park residents in the future.

Criteria for designation of Multiple Use Zone

The multiple use zone may include the following areas;

- Resource allocation (collection of fuelwoods, timber, NWFP, stone, sand, soil, grazing, etc.,) to meet the local demand of the park residents
- Ecotourism and recreational purposes
- Construction of transmission lines, road, government institutions and other developmental activities that involves leasing of SRFL.
- Agricultural farmlands and communal lands
- Administrative and institutional areas
- Individual or communal grazing rights exists
- Visitor centres and interpretation centers have been developed or has potential for development
- Existing camping sites or potential camping sites

1.5.3.3. Zonation Process

Before initiating the zonation exercise, the main objective of managing a particular PA should be considered. The different zones in each PA should be classified based on the ecological and social setup and their functions. While carrying out the zonation, the following processes/steps shall be followed:

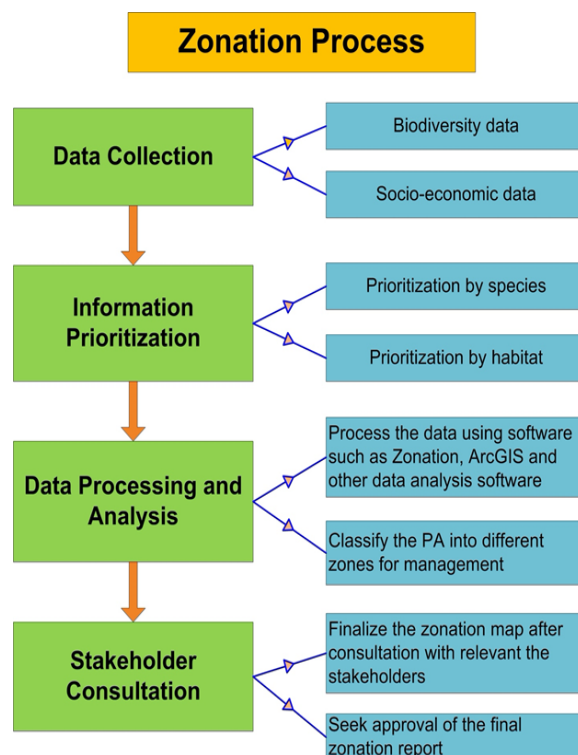


Figure 1.12 Zonation Process

1.5.3.3.1. Biodiversity and social data collection

As the different zones will be classified based on the presence and values of biodiversity and also on different dimensions of human needs, the biodiversity and socioeconomic data plays a very important role in deciding and zoning the PA into its different management zones. These data collection should be a part of the biodiversity and socio-economic survey during the PA management planning (1.5.2 Data Collection and Analysis).

1.5.3.3.2. Information Prioritization

The information from the biodiversity and socio-economic surveys shall form the basis for classifying the PA into different zones. Before classifying the area into different zones, the following prioritization exercises shall be carried out.

Prioritization by species

The respective PAs should identify single or multiple species of high conservation significance as the target species. The target species may be threatened, endemic, restricted-range, evolutionarily distinct, umbrella/flagship or migratory.

The dispersal ability of the target species should also be taken into account to optimize the retention of well-connected key habitat patches for the species (e.g., to protect foraging and breeding areas). The respective park management should set a target in defining percentage of areas to be conserved under such priority areas based on the socio-ecological condition of the park.

Once the species of interest are chosen, their range and distribution should be mapped which shall then be used as an important component for the classification of core and transition zones.

Prioritization by habitat

Important habitat(s) for keystone/flagship species as well as for human habitation need to be mapped out using the biodiversity and socio-economic survey data for the purpose of zoning. For the purpose of species persistence, the habitat requirement of that focus species is to be considered, while for human habitat, resource allocation and other needs are to be considered. Consideration should also be given to projected future changes and the requirement for this change in habitat due to changing climatic patterns both locally and at the landscape level.

1.5.3.3. Data Processing and Analysis

After completion of all these prioritizations, the information and data shall be processed using software like Zonation, ArcGIS and other data analysis software that shall produce the final zoned map of the PA. This zoned map shall be finalized after completion of the stakeholder consultation and awareness.

1.5.4. Threat analysis.

Threat analysis encompasses the assessment of threats in conservation planning and management. Such threats need to be identified and analyzed. It forms the integral part of conservation planning and management. Once the threat has been identified, threat ranking is done with the help of Miradi or any other relevant software, to prioritize interventions.

Some constraints are a function of the natural environment. Examples are the ecological processes which exist in the areas. Constraints may take one or more of the following forms:

- Legal obligations over land.
- Constraints of passages and bottlenecks.
- Managerial constraints.
- Natural features restricting movements.
- Habitat degradation that may need special focus of enrichment/management.

Box 1.4 Threat analysis with Miradi

In order to determine the rank of the threats, consultative meeting should be held to discuss the various criteria for threat ranking in Miradi. The team should consider the 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 team should determine the nature of threats 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

1.5.5. Preparation of Management Plan

The management plan shall be prepared for a duration of ten years as per the Management Plan Outline given in Table 1.16.

Table 1.16 Management Plan outline

Foreword
Preface
Acronyms and abbreviations
Part 1. Background
1.1 History and Significance of PAs in Bhutan (with special emphasis on the individual/relevant park)
1.2 Vision, mission, goals
1.3 Salient features of the plan (Brief summary of each chapter)
1.4 Zones of the Parks
Part 2: Current Status of protected area (Specific park)
2.1. Landscape Characteristics (Location along with Geo-coordinates, Elevation, slope, Geology, soil, hydrology, climate of park).
2.2. Floral description (Forests types, total species list, species diversity, density, ...).
2.3 Faunal description (Total list, Imp species, different type of species, Threatened species names,).
2.4 People and livelihood (social information on inhabitants), resource use, subsidized timber allocation information, resource need, traditional practices, traditional users, grazing, threats, issues.
2.5. Other Management Regimes (LFMA, NWFP, Watershed management)
2.6. Administrative, service delivery and park infrastructure
Part 3: Summary review of the past plan
3.1. Assessment of previous plan (major outputs from the objectives of previous plan)
3.2 lesson learnt
3.3 Gaps and carry over actions from previous plan

Part 4: Threat Analysis

-Identify conservation threats

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

-List management challenges

Part 5: Management prescription.

Strategies and actions (**management prescription**) are defined based on the overall goal of the plan to achieve and maintain proper habitat, species conservation and enhanced social livelihood (depending on whether its SNR, NPs or WSs). These strategic actions will be to solve problems or overcome the barriers that prevent us from achieving the objectives and subsequently the goals. These management prescriptions may include but not limit to the following; NWFP, CF, Habitat, Species, Ecotourism, Watershed, Forest Fire.

Part 6: Implementation plan and financial outlay

A realistic schedule and budget required for implementing the management plan prescriptions as per 1.5.9(Implementation framework/schedule) shall be prepared for the plan period of 10 years.

Part 7: Monitoring and Evaluation

The monitoring and evaluation plan shall be part of the management plan and shall include the indicators against which the performance of the protected area will be measured. The M&E plan shall be prepared as per the format below to ensure synergy with the implementation framework, PA monitoring framework and the conservation operation plans.

Objectives	Action	Output indicator	Baseline	Unit	Yearly target									
					Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
Maintain viable population of flora and fauna in the park.	Action 1: Conduct survey for important floral species	Survey report	0	Nos.		1	1	1						
	Action 2: Conduct surveys for faunal species		0	Nos					1	1				
	Action 3:													

1.5.6. Stakeholder consultation

In NP, WS and SNR where presence of stakeholders and rights holders have been mapped out, consultation meetings on the proposed management interventions and also on the restrictions and prohibitions shall be carried out thoroughly to avoid future complications.

1.5.7. Finalization of the conservation management plan

The management plan shall be finalized by the Chief Forestry Officer (CFO) of the concerned Park.

1.5.8. Endorsement and approval of conservation Management Plan

The draft plan shall be reviewed by NCD and subsequently endorsed by the Technical Advisory Committee (TAC) of the Department. The technically reviewed and endorsed Plan will then be recommended for approval to the Ministry by the head of the Department. The Head of the Ministry will approve the plan for implementation.

1.5.9. Implementation Framework

Implementation of Conservation Management Plan prescriptions as detailed out in the plan shall be carried out by the respective NP, WS and SNR on the location of the interventions prescribed. The implementation plan for the period of 10 years shall be developed as per the implementation framework/format (Table 1.17) with details of when the specific activity would be carried out and also mentioning the amount of funds required.

Table 1.17 Implementation framework

Objectives (These are the broad longterm goal(s) that the park wants to achieve)	Strategies (These are methods/plans designed to direct how to achieve the objective)	Action (These are list of activities to achieve the objectives)	Year along with budget (in Nu.m)										Remarks (to include detailed information of the actions such as where, what, etc)
			Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	
<i>Eg. Objective 1: Maintain viable population of flora and fauna in the park.</i>	<i>Strategy 1: Enhance knowledge on floral and faunal diversity</i>	<i>Action 1: Conduct survey for 3 important floral species</i>		0.3	0.3	0.3							Grass, <i>Neopicrorhiza</i> sp., and <i>Taxus baccata</i> .
		<i>Action 2: Conduct surveys for 2 faunal species</i>					0.4	0.4					Tiger, SL and Red panda.
		<i>Action 3:</i>											
	<i>Strategy 2:</i>												

Further, an annual conservation operational plan shall be developed based on the broad 10-year implementation plan as per the format (Table 1.18).

Table 1.18 Conservation Operational Plan

Framework for Conservation Operational Plan for Protected Areas of Bhutan						
* The Conservation Operational plan for the protected areas shall be prepared latest by 31 st July.						
Name of the office:						
Plan Period:						
Prepared by and date:						
Verified by and date:						
Recommended by and date:						
Approved by and date:						
I. REVIEW OF THE PREVIOUS YEARS' PLAN						
I.a. SUMMARY OF THE PLAN						
No. of Planned activities		Status of the activities (in Nos.)				
		Achieved	On-going	Not Implemented		
I.b. DETAILED REVIEW OF THE PLANNED ACTIVITIES						
Activities	Target with unit	Budget utilization status (in %age)	Brief report of the progress of the activities.	Remarks (Justification/reasoning if not completed or not implemented)		
II. ANNUAL CONSERVATION OPERATIONAL PLAN SCHEDULE						
II.a. DETAILS OF THE PLANNED ACTIVITIES						
Output Indicator as per the management plan/APA	Activities	Target with Unit	Timeline	Budget (in Nu.(m))	Fund Source	Specify location, if relevant

Program 1: Nature Conservation ¹						
Eg. Maintain viable population of flora and fauna in the park.	Conduct survey on Tiger					
	Develop action plan for Taxus bacata					
Eg. Effective HWC mitigation measures upscaled	QRT formation in affected communities					
Program II: Forest Resources Management ²						
Program III: Social Forestry and Extension ³						
Program IV: Forest Protection and Enforcement ⁴						
Program IV: Administration and Direction ⁵						
¹ . Program I shall include but not limited to; Surveys, research, HWC management, habitat management, watershed wetland protection, ecotourism nature recreation, waste management, wildlife rescue & rehabilitation.						
² . Program II shall include but not limited to; LFMA plan preparation, timber allocation and monitoring.						
³ . Program III shall include but not limited to; CF management, NWFP management, plantation, livelihood improvement initiatives.						
⁴ . Program IV shall include but not limited to; patrolling, forest offence compounding/prosecution, forestry clearances, pest & diseases surveillance, forest fire management.						
⁵ . Program V shall include but not limited to; Park management plan preparation, work planning, coordination meetings, administrative and accounting activities, monitoring and evaluation, data management.						
*Note: Activities such as Awareness, capacity building, etc., to be tagged with respective program activities.						

1.5.10. Amendment and plan revision

The approved Plan may be revised during the implementation period if major changes occur in the Protected Area and in the event of major disasters. The Head of Department, can authorize a revision of the plan based on a proposal for amendment from the respective field offices. The plan revision should be completed at the end of the 10th year of the previous plan so that the revised plan is ready for implementation when the previous plan expires.

1.5.11. Monitoring and Evaluation

1.5.11.1. Monitoring

Monitoring is a continuous assessment that aims at providing all stakeholders, with early detailed information on the progress or delay of the ongoing assessed activity giving an oversight of the implementation stage of the activity. The main purpose is to determine if the outputs, deliveries and schedules planned have been reached so that action can be taken to correct the deficiencies as quickly as possible.

The concerned CFOs shall regularly monitor the implementation of the PA management interventions using PA Monitoring Framework (Table 1.19). NCD shall carry out annual monitoring of the PA implementation using the same framework.

Table 1.19 PA monitoring framework

Data Sheet 1: Brief summary of Protected Area Sites								
Date of M&E Conducted (DD/MM/YY)								
Evaluators name & Office								
Name of protected area								
Size of protected area (ha)								
Number of technical staff								
Number of non-technical staff*								
Annual budget (Nu.) for both project and RGoB for the park								
* Non-technical staffs to include adm, accounts,								
Data Sheet 2: Assessment of the Output indicators for the Protected Area								
Output Indicators as per the Management Plan	Baseline	Unit of Measure	Target for Plan Period	Yearly target	As Reported by Park Management	Reasons for non-fulfillment of the targets	Observation by M&E Team	Recommendation for each target, if any*
Indicator 1: e.g. Survey report for 3 floral species	0	No	3	1	60% completed for 1 species			
Indicator 2:								
Indicator 3:								
Indicator 4:								
Indicator 5:								
* Detailed recommendation in data sheet 4								
Data sheet 3: Ad-hoc activities								
Datasheet 4: Detailed Recommendations								
Recommendations	Responsibility	Deadline						
e.g. PA to send the expedite the completion of the survey report preparation	Park Manager	Jun-20						

1.5.11.2. Evaluation

Evaluation shall be carried out using the “Bhutan METT+ (Management Effectiveness Tracking Tool)” (Dudley et al., 2016). *The objectives are* to evaluate the management effectiveness of Protected areas. Bhutan METT + evaluation shall be carried out once in every five years.

The Bhutan METT+ should be conducted at two levels, Internal Assessment and External Assessment.

The Internal Assessment is a self-assessment which should be carried out prior to the External Assessment by the respective field offices comprising the following members from their jurisdiction; 1. CFO, 2. Section Heads and 3. At least 2 officers from Range Offices.

The External Assessment should be coordinated by NCD and carried out in collaboration with relevant offices to ensure that the results from the internal assessment is unbiased. The team members for the external assessment may include Department Specialist, One representative from each functional division and UWICER and, one representative each from the adjoining Protected Area Office.

The Bhutan METT + includes six elements:

1. Data Sheet 1: records details of the assessment and some basic information about the site, such as name, size and location etc. Information on international designations: i.e. UNESCO World Heritage, Man and Biosphere sites and Ramsar wetland sites can also be added to this sheet.

2. Assessment Sheet 1: provides a slightly edited (e.g. marine questions removed as Bhutan is landlocked and some additional threats added) version of the generic list of threats which protected areas can face. On this Assessment Sheet the assessor is asked to identify threats and rank their impact on the protected area. Table 1.20 provide detailed guidance on interpreting the threat categories (as high, medium and low) in the Bhutanese context and should be referred to when completing the assessment.

3. Assessment Sheet 2: designed specifically for the Bhutan METT +, this sheet allows for a more detailed assessment of threats considered of medium or high significance (current or potential) in Assessment Sheet 1.

4. Assessment Sheet 3: this Assessment Sheet records the most important management activities at the site. The results show trends in management priorities and activities.

5. Assessment Sheet 4: the main METT assessment is structured around 33 questions presented in table format which includes three columns for recording details of the assessment, all of which should be completed.

Questions and scores: the assessment is made by *assigning a simple score ranging between 0 (poor) to 3 (excellent)*. A series of four alternative answers are provided against each question to help assessors to make judgements as to the level of score given. In addition, there are supplementary questions which elaborate on key themes in the previous questions and provide additional information and points.

Comment/explanation and next steps: boxes next to each question allow for qualitative judgements to be explained in more detail and next steps to be articulated. Explanation could range from local staff knowledge (in many cases, staff knowledge will be the most informed and reliable source of knowledge), a reference document, monitoring results or external studies and assessments – the reason is to give anyone reading the assessment an idea of why the assessment was made. It is very important that these boxes be completed as they can provide greater confidence in the results by making the basis of decision-making more transparent. Importantly, they provide a reference point and information for local staff in the future. By including next steps, the METT can provide an action list of management improvements to be made as a result of the assessment, and repeat assessment can also check if actions highlighted have been completed.

6. Assessment Sheet 5: as noted above the Bhutan METT + is intended to provide a baseline of data on the protected areas in the country. The METT however does not provide a detailed template on the assessment of outcomes. This sheet collects baseline data on outcome measures for Bhutan. This

information will be collated to develop a set of headline indicators for Bhutan. Once these are agreed work will commence on developing detailed indicators and monitoring systems and protocols for the headline indicators.

Protected Area Site Details: Data Sheet 1

Name, affiliation and contact details for person responsible for completing the Bhutan METT + (email etc.)				
Date assessment carried out				
Name of protected area				
WDPA site code (codes can be searched for on: www.protectedplanet.net/)				
Designations	National	IUCN Category	International (see below)	
Location of protected area (province and if possible, map reference)				
Date of establishment (dd/mm/yyyy)				
Ownership details (please tick)	State	Private	Community	Other
Management Authority				
Size of protected area (ha)				
Number of staff	Permanent		Temporary	
Annual budget (US\$)– excluding staff salary costs	Current budget (operational costs, e.g., staff costs):		Capital budget (infrastructure development, etc):	
What are the main values for which the area is designated				
List the two primary protected area management objectives				
Management objective 1				
Management objective 2				
No. of people involved in completing assessment				
Including: (highlight where appropriate)	PA manager	PA staff	Other PA agency staff	NGO
	Local community	Donors	External experts	Other
Please note if assessment was carried out in association with a particular project, on behalf of an organisation or donor.				

Information on International Designations (where applicable)		
UNESCO World Heritage site		
Date listed	Site name	Site area
Criteria for designation (i.e. criteria i to x)		
Statement of Outstanding Universal Value		
Ramsar site		
Date listed	Site name and number	Site area
Criteria for Designation & ecological character (see Ramsar Information Sheet)		
UNESCO Man and Biosphere Reserves		
Date listed	Site name	Site area Total: Core: Buffer: Transition:
Criteria for designation		
Fulfilment of three functions of MAB (conservation, development and logistic support.)		
Please list other designations and any supporting information below		
Name:	Detail:	
Name:	Detail:	
Name:	Detail:	

Protected Area Threats: Assessment Sheet 1

In the assessment below threats should be:

- Ranked as of **high** significance if they are seriously degrading values; **medium** if they are having some negative impact and **low** if they are present but not seriously impacting values. **Not applicable** (N/A) is selected when the threat is either not present or not applicable in the protected area.

Note that threats ranked as of medium and high significance can be assessed in more detail using Assessment Sheet 2 below.

- Assessed at three levels:
 - Current threat:** in which case a 'C' is put in either the High, Medium or Low box
 - Potential threat:** in which case a 'P' is put in either the High, Medium or Low box
 - Issues:** in which case an 'I' is put in either the High, Medium or Low box

Each threat identified could have both a current threat assessment (e.g., assessed as low) and a potential threat (e.g., assessed as medium). The category of 'issues' has been added because some management issues may not be strictly regarded as threats but need constant management intervention to ensure they do not become a threat. For example, plants collected for medicinal use could be a management **issue**; or a current or potential threat if management activities are not effective in controlling the collection levels or processes.

Guidance in making the assessment

Unlike many other countries in the region (and worldwide) the level of threats is fairly low at present in Bhutan and thus what might be considered of high threat here, may not be at anything like the same scale as in other countries. Guidance in what is meant by the categories *high*, *medium* and *low* threats in a Bhutanese context has thus been developed. **Threat categories with specific guidance are marked by a * (strisk).**

Specific guidance on assessing threats in the Bhutanese context are also given in boxes below against each threat.

1. Residential and commercial development within a protected area

Threats from human settlements or other non-agricultural land uses with a substantial footprint

High	Medium	Low	N/A	
				1.1 Housing and settlement
				1.2 Commercial and industrial areas
				1.3 Tourism and recreation infrastructure

2. Agriculture and aquaculture within a protected area

Threats from farming and grazing as a result of agricultural expansion and intensification, including silviculture, mariculture and aquaculture

High	Medium	Low	N/A	
				2.1 Annual and perennial non-timber crop cultivation
				2.1a Medicinal plant cultivation*
				2.2 Wood and pulp plantations
				2.2a Community forestry
				2.2b Private forestry (e.g., planting of exotic species)
				2.3 Livestock farming and grazing*
				2.3a Land encroachment for agriculture
				2.3b Land lease of government reserve land for commercial farming
				2.4 Freshwater aquaculture

Threat 2.1a Medicinal plant cultivation: Note that the collection of species from the wild is covered in threat 5.2

3. Energy production and mining within a protected area

Threats from production of non-biological resources

High	Medium	Low	N/A	
				3.1 Oil and gas drilling
				3.2 Mining and quarrying*
				3.3 Energy generation, including from hydropower dams*

3.3 Energy generation including HEP: This question looks specifically at threats within protected areas. Most of the hydropower developments in Bhutan are outside protected areas but distant HEP systems can still impact on the protected area, the impact of such threats is covered in threat 7.2.

4. Transportation and service corridors within a protected area

Threats from long narrow transport corridors and the vehicles that use them including associated wildlife mortality

High	Medium	Low	N/A	
				4.1 Roads and railroads (include road-killed animals) *
				4.2 Utility and service lines (e.g. electricity cable lines, telephone lines) *
				4.3 Flight paths*

4.2 Utility and service lines: Given the pace of infrastructure development in Bhutan (e.g., high tension cables, service centres, etc.) it was felt this threat should consider both impacts in the protected area and in the buffer zones.

4.3 Flight paths: It should be stressed that this threat is included considering flight paths of airplane, hot air balloons, gliders, etc., not the flight paths of birds

5. Biological resource use and harm within a protected area

Threats from consumptive use of "wild" biological resources including both deliberate and unintentional harvesting effects; also, persecution or control of specific species (note this includes hunting and killing of animals)

High	Medium	Low	N/A	
				5.1 Hunting, killing and collecting terrestrial animals (including killing of animals as a result of human/wildlife conflict)
				5.1a Human wildlife conflict*
				5.1b Wildlife Poaching*
				5.2 Gathering terrestrial plants or plant products (non-timber)*
				5.2a Mushrooms*
				5.2b Plant species for medicinal use*
				5.2c Plant species for food*
				5.3 Illegal logging and timber harvesting*
				5.3a Legal logging and timber harvesting
				5.4 Fishing and harvesting aquatic resources

6. Human intrusions and disturbance within a protected area

Threats from human activities that alter, destroy or disturb habitats and species associated with non-consumptive uses of biological resources

High	Medium	Low	N/A	
				6.1 Recreational activities and tourism
				6.1a Unmanaged ecotourism*
				6.2 War, civil unrest and military exercises*
				6.3 Research, education and other work-related activities in protected areas
				6.4 Activities of protected area managers (e.g., construction or vehicle use, artificial watering points and dams)
				6.5 Deliberate vandalism or destructive activities

6.2 War, civil unrest and military exercises: in the case of Bhutan war and civil unrest should include intrusion of political insurgency from across the border

7.Natural system modifications

Threats from other actions that convert or degrade habitat or change the way the ecosystem functions

High	Medium	Low	N/A	
				7.1 Fire and fire suppression (including arson) *
				7.2 Dams, hydrological modification and water management/use*
				7.3a Increased fragmentation within protected area
				7.3b Isolation from other natural habitat (e.g., deforestation, dams without effective aquatic wildlife passages)
				7.3c Other 'edge effects' on protected area values
				7.3d Loss of keystone species (e.g., top predators, pollinators, etc.)

Whereas threat 3 looked at impacts of infrastructure development in protected areas, threat 7 looks at impacts which may occur from developments far away from the actually protected area. As noted above most of the hydropower developments in Bhutan are outside protected areas but distant HEP systems can still impact on the protected area. Threat 7.2 should record impacts on habitat or changes in the way the ecosystem functions, such as changing water flow patterns.

8.Invasive and other problematic species and genes

Threats from terrestrial and aquatic non-native and native plants, animals, pathogens/microbes or genetic materials that have or are predicted to have harmful effects on biodiversity following introduction, spread and/or increase

High	Medium	Low	N/A	
				8.1a Invasive non-native/alien plants (weeds)
				8.1b Invasive non-native/alien animals
				8.1c Invasive non-native/alien freshwater fish
				8.1d Pathogens (non-native or native but creating new/increased problems)
				8.2 Introduced genetic material (e.g. genetically modified organisms)

9.Pollution entering or generated within protected area

Threats from introduction of exotic and/or excess materials or energy from point and nonpoint sources

High	Medium	Low	N/A	
				9.1 Household sewage and urban waste water
				9.1a Sewage and waste water from protected area facilities (e.g., toilets, hotels, etc.)
				9.2 Industrial, mining and military effluents and discharges (e.g., poor water quality discharge from dams, e.g., unnatural temperatures, de-oxygenated, other pollution)

				9.3 Agricultural and forestry effluents (e.g., excess fertilizers or pesticides)
				9.4 Garbage and solid waste*
				9.5 Air-borne pollutants
				9.6 Excess energy (e.g., heat pollution, lights, etc.)

10.Geological events

Geological events may be part of natural disturbance regimes in many ecosystems. But they can be a threat if a species or habitat is damaged and has lost its resilience and is vulnerable to disturbance. Management capacity to respond to some of these changes may be limited.

High	Medium	Low	N/A	
				10.1 Volcanoes
				10.2 Earthquakes/Tsunamis
				10.3 Avalanches/ Landslides
				10.4 Erosion and siltation/ deposition (e.g. shoreline or riverbed changes)

11.Climate change and severe weather

Threats from long-term climatic changes which may be linked to global warming and other severe climatic/weather events outside of the natural range of variation

High	Medium	Low	N/A	
				11.1 Habitat shifting and alteration
				11.2 Droughts
				11.3 Temperature extremes
				11.4 Storms and flooding

12.Specific cultural and social threats

High	Medium	Low	N/A	
				12.1 Loss of cultural links, traditional knowledge and/or management practices
				12.2 Natural deterioration of important cultural site values
				12.3 Destruction of cultural heritage buildings, gardens, sites etc

Table 1.20 Guidance notes for threat analysis

Threat (question number)	Indicators	High	Medium	Low
Human Wildlife Conflicts (5.1a)	Number of conflicts Protected species killed Human life lost/serious, life changing injury	Within the last 5 years: Any deaths or suspected deaths of tiger, snow leopard or elephant And/or Any recorded deaths or life changing injury (e.g., loss of limbs which impacts livelihoods) And/or Loss of 50% of annual crops at a household level And/or Complete destruction of permanent infrastructure	Within the last 5 years: Any deaths or suspected deaths of 5 or more species (other than tiger, snow leopard or elephant which are considered as high threat) listed in the Forest and Nature Conservation Act And/or Records of 5 or more injuries (not life changing) And/or Loss of 25-49% of annual crops at a household level And/or Major damage to permanent infrastructure	Within the last 5 years: Less than 5 deaths or suspected deaths of species (other than tiger, snow leopard or elephant which are considered as high threat) listed in the Forest and Nature Conservation Act And/or Less than 5 records of injuries (not life changing) And/or Loss of less than 25% of annual crops at a household level And/or Minor damage to permanent and temporary infrastructure
NWFP Collection (5.2 a,b,c)	Evidence of species at serious risk	Widespread (over 50% of the area of the species collected) show evidence of any of the below: - Whole plant uprooting - Thriving market/demand and absence of management plan/regulations - No reliable data on resilience of species	Widespread (between 25-49% of the area of the species collected) show evidence of any of the below: - Whole plant uprooting - Thriving market/demand and absence of management plan/regulations - No reliable data on resilience of species	Some concern about species and/or habitat decline And/or Unreliable data on species ecology available

Threat (question number)	Indicators	High	Medium	Low
Road construction (4.1)	Evidence of impact of highway building	Evidence of major impacts on habitats and species through road building, widening and spill-over extends to over 15 metres width either side of the road/beyond the right of way in over 50% of road construction in the park. And/or No evidence of restoration; thus, the road construction has led to fragmentation of park/habitat. And/or The road construction cuts through the entire park including the core zone. There is negative impact on streams/rivers used by wildlife, regulations related to noise control not followed.	Evidence of major impacts on habitats and species through road building, widening and spill-over extends to over 15 metres width either side of the road beyond the right of way in less than 50% of the park. And/or Limited evidence of restoration; thus, the road construction has led to fragmentation of park/habitat. And/or The road construction cuts through some parts of the park (excluding the core zone which if impacted is seen as high threat) and there is negative impact on streams/rivers used by wildlife, regulations related to noise control followed but not effective	Evidence of major impacts on habitats and species through road building, widening and spillover extends to less than 15 metres width either side of the road beyond the right of way in over 25% of the park
Livestock farming and grazing (2.3)	Evidence of degradation	Grazing is causing major degradation, e.g., loss/reduction of species covering over more than 25% of the park. And/or Negative impact such as absence of natural regeneration, invasion by invasive species and impact of migratory cattle/sedentary ranching (herding in	Grazing is causing minor degradation, e.g., loss/reduction of species covering between 11-24% of the park. And/or Some evidence of negative impact such as absence of natural regeneration, invasion by invasive species and some evidence impact of migratory cattle/sedentary ranching (herding in	Grazing is causing minor degradation, e.g., loss/reduction of species covering over less than 10% of the park. And/or No evidence of negative impacts such as absence of natural regeneration, invasion by invasive species and no evidence of impact of

Threat (question number)	Indicators	High	Medium	Low
		one location) are prevalent.	one location) are prevalent.	migratory cattle/sedentary ranching (herding in one location) are prevalent.
Wildlife Poaching (5.1 b)	Number of wild animals lost (schedule I and II of fauna) Number of poachers arrested Number of poaching evidences (camps, traps, snares)	Evidence of poaching of at least one totally protected wild fauna and >25 of schedule II listed fauna and flora. And/or 15 + poachers arrested And/or 50 + poaching evidences (camps, traps, snares)	Evidence of poaching of at least one totally protected wild fauna and 1524 of schedule II listed fauna and flora of schedule I and II. And/or 6 – 10 poachers arrested And/or 11 – 30 poaching evidences (camps, traps, snares)	No evidence of poaching of schedule list I fauna and less than 15 numbers of poaching of schedule list II of both flora and fauna. And/or <5 poachers arrested And/or <10 poaching evidences (camps, traps, snares)
Solid Waste (9.4)	Evidence of Impact Enforcement/ compliance of rules	Major presence of non-biodegradable waste And/or Evidence of deaths caused by consumption of wastes by wildlife And/or Spillage of waste into rivers/streams And/or No enforcement/compliance of rules	Presence of non-biodegradable waste but being collected And/or Some evidence of deaths caused by consumption of wastes by wildlife And/or Some evidence of spillage of waste into rivers/streams And/or Some level of enforcement/compliance of rules	There is no evidence of impacts on habitats And/or Compliance of rules adequately
Hydro Power (7.2)	Evidence of Impact Loss of habitat of water birds	Evidence of some impacts on habitats including: • Core areas of park • Endangered species • Flight path. • Exceeding 50 meters on either side of transmission lines	Evidence of major impacts on habitats and species through road building, widening and spill-over extends to over less than 15 metres width either side of the road	Minor impacts of road construction and some evidence of mitigation/restoration despite EIA and Environmentally Friendly Road Construction

Threat (question number)	Indicators	High	Medium	Low
		<ul style="list-style-type: none"> • No evidence of mitigation/restoration • EIA guidelines not followed/complied 	<p>And/or</p> <p>Only limited evidence of restoration/mitigation</p> <p>And/or</p> <p>EIA and Environmentally Friendly Road Construction Guidelines are being followed in some but not all sites</p> <p>And/or</p> <p>Presence of fish migratory ladders but not properly designed & functional</p> <p>And/or</p> <p>Habitat restoration programmes in place but not functional</p>	<p>Guidelines reportedly being followed</p> <p>And/or</p> <p>Presence of fish migratory ladders but unclear if these are functional</p>
Power Transmission Lines (4.2)	Evidence of Impact Forest fire caused by faulty transmission lines Frequency of unnatural fires	Over 2 forest fires within the last 5 years caused by faulty transmission lines And/or There is major evidence of impacts on habitats and species in the immediate area of the transmission lines	1-2 forest fires within the last 5 years caused by faulty transmission lines And/or There is evidence of impacts on habitats and species in the immediate area of the transmission lines	There is some evidence of impacts on habitats and species in the immediate area of the transmission lines
Forest Fires (7.1)	Evidence of degradation	Evidence of major impacts on habitats and species through unnatural fire occurrences (arson, accident, etc.) fire has impacted up to 10% of the park area over the last 5 years. Impacts to consider include: <ul style="list-style-type: none"> • Fires burn for several days and response time is long 	Evidence of major impacts on habitats and species through unnatural fire occurrences (arson, accident, etc.) fire has impacted up to 59% of the park area over the last five years. Impacts to consider include: <ul style="list-style-type: none"> • Fires burn for several days and response time is long 	Evidence of major impacts on habitats and species through unnatural fire occurrences – (arson, accident, etc.) fire has impacted less than 5% of the park area over the last five years. Impacts to consider include: <ul style="list-style-type: none"> • Fires burn for several days and

Threat (question number)	Indicators	High	Medium	Low
		• No. of fires in the same locality	• No. of fires in the same locality	response time is long • No. of fires in the same locality
Illegal Timber Felling (5.3)	Evidence of degradation	Evidence of major impacts on habitats and species through illegal forest operation has impacted up to 10% of the park area over last 5 years	Evidence of major impacts on habitats and species through illegal forest operation has impacted up to between 5 -9% of the park area over last 5 years	Evidence of major impacts on habitats and species through illegal forest operation has impacted less than 5% of the park area over 5 last years
Legal Timber Felling (5.3a)	Evidence of Degradation	Evidence of major impacts on habitats and species through illegal forest operation has impacted up to 10% of the park area over last 5 years	Evidence of major impacts on habitats and species through illegal forest operation has impacted up to between 5-9% of the park area over last 5 years	Evidence of major impacts on habitats and species through illegal forest operation has impacted up to less than 5% of the park area over last 10 years
Extraction of minerals, quarries, etc. (3.2)	Evidence of impact including potential threat	2 or more mines inside the protected area and no proper guidelines for mining operations And/or Mines in core zone And/or Open cast mines	1 mine inside the protected area with no proper guidelines for mining operations	Mining takes place, but is managed under strict mining guidelines
Unmanaged ecotourism (6.1a)	Evidence of impact	No ecotourism plan for the protected area and No proper facilities or control over tourist travelling around the protected areas (e.g., in core zones)	Ecotourism plan exists for the protected area but there are no proper facilities for tourists and/or control over where tourists travel (e.g., in core areas)	Ecotourism Plan exists but is not effectively implemented or monitored

Protected Area Threats: Assessment Sheet 2

As the severity and impact of threats in Bhutan are expected to increase over the next few years, in part due to infrastructure development and the relative ease of access/communications that new roads and mobile phone coverage are facilitating, the Bhutan METT + includes a more detailed assessment of major threats.

The assessment form allows a more detailed assessment of the current or potential threats identified as having medium or high significance in Assessment Sheet 1.

1. Specify threat:		
Threat (specific if current or potential):		
Impact of threat		Management response
Extent: Describe the extent of the impact under one of the three descriptors given below	Severity: Describe how severe the impact under one of the three descriptors given below	Action: What actions are planned or have taken place to manage the threat
A: Small section of the site (5-10%):	A: Minor impact:	
B: Several areas of the site (11-50%):	B: Major impact but not continuous:	
C: Most of the site (51-100%):	C: Major continuous impact:	

Protected Areas Management Activities: Assessment Sheet 3

Please tick the two critical management activities currently undertaken in the protected area	Comment/Explanation
<input type="checkbox"/> Law enforcement and surveillance <input type="checkbox"/> Promoting sustainable resource use <input type="checkbox"/> Working with local communities <input type="checkbox"/> Education and awareness <input type="checkbox"/> Demarcation and zoning <input type="checkbox"/> Monitoring <input type="checkbox"/> Research <input type="checkbox"/> Management planning <input type="checkbox"/> Ecotourism <input type="checkbox"/> Building institutional and governance capacity <input type="checkbox"/> Species management <input type="checkbox"/> Infrastructure development <input type="checkbox"/> Fundraising <input type="checkbox"/> Restoration <input type="checkbox"/> Fire management <input type="checkbox"/> Resolving tenure problems <input type="checkbox"/> Human-wildlife conflict management <input type="checkbox"/> Alien species control <input type="checkbox"/> External communication and publicity <input type="checkbox"/> Equipment and facilities <input type="checkbox"/> Improving habitat <input type="checkbox"/> Species (re)introduction / control / breeding <input type="checkbox"/> Working with regional authorities <input type="checkbox"/> Other	

Protected Area Management Effectiveness: Assessment Sheet 4

Issue	Criteria	Score: Tick only one box per question		Comment/ Explanation	Next steps
1. Legal status	The protected area is not gazetted/covenanted	0			
Does the protected area have legal status (or in the case of private reserves is covered by a covenant or similar)?	There is agreement that the protected area should be gazetted/covenanted but the process has not yet begun	1			
<i>Context</i>	The protected area is in the process of being gazetted/covenanted but the process is still incomplete (includes sites designated under international conventions, such as Ramsar, or local/traditional law such as community conserved areas, which do not yet have national legal status or covenant)	2			
	The protected area has been formally gazetted/covenanted	3			
2. Protected area regulations	There are no regulations for controlling land use and activities in the protected area	0			
Are appropriate regulations in place to control land use and activities (e.g., hunting)?	Some regulations for controlling land use and activities in the protected area exist but these are major weaknesses	1			
	Regulations for controlling land use and activities in the protected area exist but there are some weaknesses or gaps	2			
<i>Planning</i>	Regulations for controlling inappropriate land use and activities in the protected area exist and provide an excellent basis for management	3			
3. Law enforcement	The staff have no effective capacity/resources to enforce protected area legislation and regulations	0			
Can staff (i.e. those with responsibility for managing the site) enforce protected area rules well enough?	There are major deficiencies in staff capacity/resources to enforce protected area legislation and regulations (e.g. lack of skills, no patrol budget, lack of institutional support)	1			
	The staff have acceptable capacity/resources to enforce protected	2			

Issue	Criteria	Score: Tick only one box per question		Comment/ Explanation	Next steps
Input	area legislation and regulations but some deficiencies remain				
	The staff have excellent capacity/resources to enforce protected area legislation and regulations	3			
4. Protected area objectives Is management undertaken according to agreed objectives? Planning	No firm objectives have been agreed for the protected area	0			
	The protected area has agreed objectives, but is not managed according to these objectives	1			
	The protected area has agreed objectives, but is only partially managed according to these objectives	2			
	The protected area has agreed objectives and is managed to meet these objectives	3			
5. Protected area design Is the protected area the right size and shape to protect species, habitats, ecological processes and water catchments of key conservation concern? Planning	Inadequacies in protected area design mean achieving the major objectives of the protected area is very difficult	0			
	Inadequacies in protected area design mean that achievement of major objectives is difficult but some mitigating actions are being taken (e.g., agreements with adjacent land owners for wildlife corridors or introduction of appropriate catchment management)	1			
	Protected area design is not significantly constraining achievement of objectives, but could be improved (e.g., with respect to larger scale ecological processes)	2			
	Protected area design helps achievement of objectives; it is appropriate for species and habitat conservation; and maintains ecological processes such as surface and groundwater flows at a catchment scale, natural disturbance patterns, etc.	3			
6. Protected area boundary demarcation Is the boundary known and	The boundary of the protected area is not known by the management authority or local residents/neighbouring land users	0			
	The boundary of the protected area is known by the management authority but	1			

Issue	Criteria	Score: Tick only one box per question		Comment/ Explanation	Next steps
demarcated? <i>Process</i>	is not known by local residents/neighbouring land users				
	The boundary of the protected area is known by both the management authority and local residents/neighbouring land users but is not appropriately demarcated	2			
	The boundary of the protected area is known by the management authority and local residents/neighbouring land users and is appropriately demarcated	3			
7. Management plan Is there a management plan and is it being implemented <i>Planning</i>	There is no management plan for the protected area	0			
	A management plan is being prepared or has been prepared but is not being implemented	1			
	A management plan exists but it is only being partially implemented because of funding constraints or other problems	2			
	A management plan exists and is being implemented	3			
Bhutan METT+: If a management plan is just running out and there is a process underway to redo the plan this is equivalent to score 3: a management plan exists					
Additional points: <i>Planning</i>					
7a. Planning process	The planning process allows adequate opportunity for key stakeholders to influence the management plan	1			
7b. Planning process	There is an established schedule and process for periodic review and updating of the management plan	1			
7c. Planning process	The results of monitoring, research and evaluation are routinely incorporated into planning	1			
8. Regular work plan Is there a regular work plan and is it being implemented <i>Planning/Outputs</i>	No regular work plan exists	0			
	A regular work plan exists but few of the activities are implemented	1			
	A regular work plan exists and many activities are implemented	2			
	A regular work plan exists and all activities are implemented	3			

Issue	Criteria	Score: Tick only one box per question		Comment/ Explanation	Next steps
9. Resource inventory Do you have enough information to manage the area? <i>Input</i>	There is little or no information available on the critical habitats, species and cultural values of the protected area	0			
	Information on the critical habitats, species, ecological processes and cultural values of the protected area is not sufficient to support planning and decision making	1			
	Information on the critical habitats, species, ecological processes and cultural values of the protected area is sufficient for most key areas of planning and decision making	2			
	Information on the critical habitats, species, ecological processes and cultural values of the protected area is sufficient to support all areas of planning and decision making	3			
10. Protection systems Are systems in place to control access/resource use in the protected area? <i>Process/Outcome</i>	Protection systems (patrols, permits etc) do not exist or are not effective in controlling access/resource use	0			
	Protection systems are only partially effective in controlling access/resource use	1			
	Protection systems are moderately effective in controlling access/resource use	2			
	Protection systems are largely or wholly effective in controlling access/ resource use	3			
11. Research Is there a programme of management oriented survey and research work? <i>Process</i>	There is no survey or research work taking place in the protected area	0			
	There is some survey and research work but it is not directed towards the needs of protected area management	1			
	There is some survey and research work which is at least partly directed towards the needs of protected area management	2			

Issue	Criteria	Score: Tick only one box per question		Comment/Explanation	Next steps
	There is a comprehensive, integrated programme of survey and research work, which is relevant to management needs	3			
12. Resource management Is active resource management being undertaken? <i>Process</i>	Active resource management is not being undertaken	0			
	Very few of the requirements for active management of critical habitats, species, ecological processes, cultural values and sustainable resource production (where relevant) are being implemented	1			
	Many of the requirements for active management of critical habitats, species, ecological processes, cultural values and sustainable resource production (where relevant) are being implemented but some key issues are not being addressed	2			
	Requirements for active management of critical habitats, species, ecological processes, cultural values and sustainable resource production (where relevant) are being substantially or fully implemented	3			
12a: Management of NTFPs	A management plan exists for the management of all major non timber forest products actively collected within the protected area	1			
12b: Management of medicinal plants	A management plan exists for the management of all major medicinal plants actively collected within the protected area	1			
12c: Management of timber	A management plan exists for all major areas where timber products are managed within the protected area	1			
Bhutan METT+: consideration of this question includes issues relating to land leasing					
13. Staff numbers Are there enough people employed to manage the	There are no staff	0			
	Staff numbers are inadequate for critical management activities	1			
	Staff numbers are below optimum level for critical management activities	2			

Issue	Criteria	Score: Tick only one box per question		Comment/ Explanation	Next steps
protected area? <i>Inputs</i>	Staff numbers are adequate for the management needs of the protected area	3			
14. Staff training Are staff adequately trained to fulfil management objectives? <i>Inputs/Process</i>	Staff lack the skills needed for protected area management	0			
	Staff training and skills are low relative to the needs of the protected area	1			
	Staff training and skills are adequate, but could be further improved to fully achieve the objectives of management	2			
	Staff training and skills are aligned with the management needs of the protected area	3			
15. Current budget Is the current budget sufficient? <i>Inputs</i>	There is no budget for management of the protected area	0			
	The available budget is inadequate for basic management needs and presents a serious constraint to the capacity to manage	1			
	The available budget is acceptable but could be further improved to fully achieve effective management	2			
	The available budget is sufficient and meets the full management needs of the protected area	3			
Bhutan METT+: Budgets in Bhutan are divided by capital budget (infrastructure development etc) and current budget (operational costs, e.g. staff costs).					
Consideration of both budgets should be made when answering question 15 (and 16 and 17). The comment/explanation column should be used to detail specific issues concerning budget allocations etc.					
16. Security of budget Is the budget secure? <i>Inputs</i>	There is no secure budget for the protected area and management is wholly reliant on outside or highly variable funding	0			
	There is very little secure budget and the protected area could not function adequately without outside funding	1			
	There is a reasonably secure core budget for regular operation of the protected area but many innovations and initiatives are reliant on outside funding	2			

Issue	Criteria	Score: Tick only one box per question		Comment/ Explanation	Next steps
	There is a secure budget for the protected area and its management needs	3			
17. Management of budget Is the budget managed to meet critical management needs? <i>Process</i>	Budget management is very poor and significantly undermines effectiveness (e.g. late release of budget in financial year)	0			
	Budget management is poor and constrains effectiveness	1			
	Budget management is good and actions are prioritised when funds are inadequate to meet management needs	2			
	Budget management is excellent and meets management needs	3			
18. Equipment Is equipment sufficient for management needs? <i>Input</i>	There are little or no equipment and facilities for management needs	0			
	There are some equipment and facilities but these are inadequate for most management needs	1			
	There are equipment and facilities, but still some gaps that constrain management	2			
	There are adequate equipment and facilities	3			
Bhutan METT+:Most protected areas cover large areas, there are thus likely to be differences in equipment availability in park headquarters and guard posts around the park. Question 18 should consider equipment across the whole protected area and specific concerns re availability should be included in the comment/explanation and next steps column					
19. Maintenance of equipment Is equipment adequately maintained? <i>Process</i>	There is little or no maintenance of equipment and facilities	0			
	There is some <i>ad hoc</i> maintenance of equipment and facilities	1			
	There is basic maintenance of equipment and facilities	2			
	Equipment and facilities are well maintained	3			
20. Education and awareness Is there a planned education	There is no education and awareness programme	0			
	There is a limited and <i>ad hoc</i> education and awareness programme	1			

Issue	Criteria	Score: Tick only one box per question		Comment/ Explanation	Next steps
programme linked to the objectives and needs? <i>Process</i>	There is an education and awareness programme but it only partly meets needs and could be improved	2			
	There is an appropriate and fully implemented education and awareness programme	3			
21. Planning for land and water use Does land and water use planning outside the protected area recognise the protected area and aid the achievement of objectives? <i>Planning</i>	Adjacent land and water use planning does not take into account the needs of the protected area and activities/policies are detrimental to the survival of the area	0			
	Adjacent land and water use planning does not takes into account the long term needs of the protected area, but activities are not detrimental the area	1			
	Adjacent land and water use planning partially takes into account the long term needs of the protected area	2			
	Adjacent land and water use planning fully takes into account the long term needs of the protected area	3			
Bhutan METT +: This question is specific to activities <u>outside</u> of the protected area. EIA’s are supposed to take place for any developments. Issues in Bhutan include hydropower, transmission lines and mining.					
Additional points: Land and water planning					
21a: Land and water planning for habitat conservation	Planning and management in the catchment or landscape containing the protected area incorporates provision for adequate environmental conditions (e.g., volume, quality and timing of water flow, air pollution levels etc) to sustain relevant habitats	1			
21b: Land and water planning for connectivity	Management of corridors linking the protected area provides for wildlife passage to key habitats outside the protected area (e.g. to allow migratory fish to travel between freshwater spawning sites and the sea, or to allow animal migration)	1			

Issue	Criteria	Score: Tick only one box per question		Comment/ Explanation	Next steps
21c: Land and water planning for ecosystem services and species conservation	Planning addresses ecosystem-specific needs and/or the needs of particular species of concern at an ecosystem scale (e.g. volume, quality and timing of freshwater flow to sustain particular species, fire management to maintain savannah habitats etc.)	1			
22. State and commercial neighbours Is there cooperation with adjacent land and water users? <i>Process</i>	There is no contact between managers and neighbouring official or corporate land and water users	0			
	There is contact between managers and neighbouring official or corporate land and water users but little or no cooperation	1			
	There is contact between managers and neighbouring official or corporate land and water users, but only some co-operation	2			
	There is regular contact between managers and neighbouring official or corporate land and water users, and substantial cooperation on management	3			
22a: State and commercial neighbours	There is regular contact and substantial cooperation with any hydropower developers and operators whose operations impact protected area management	1			
22b: State and commercial neighbours	There is regular contact and substantial cooperation with any developers and operators of linear infrastructure (e.g., transmission lines and/or roads) whose operations impact protected area management	1			
22c: State and commercial neighbours	Where the protected area provides important natural resources for commercial operations (e.g., municipal water companies or hydropower operators) payments for ecological services agreements are in place	1			

Issue	Criteria	Score: Tick only one box per question		Comment/ Explanation	Next steps
23. Local communities Do local communities' resident or near the protected area have input to management decisions? <i>Process</i>	Local communities have no input into decisions relating to the management of the protected area	0			
	Local communities have some input into discussions relating to management but no direct role in management	1			
	Local communities directly contribute to some relevant decisions relating to management but their involvement could be improved	2			
	Local communities directly participate in all relevant decisions relating to management, e.g., co-management	3			
Additional points Local communities					
23a: Impact on communities	There is open communication and trust between local people, stakeholders and protected area managers	1			
23b: Impact on communities	Programmes to enhance community welfare, while conserving protected area resources, are being implemented	1			
23c: Impact on communities	Local people actively support the protected area	1			
24. Economic benefit Is the protected area providing economic benefits to local communities, e.g., income, employment, payment for environmental services? Outcomes	The protected area does not deliver any economic benefits to local communities	0			
	Potential economic benefits are recognised and plans to realise these are being developed	1			
	There is some flow of economic benefits to local communities	2			
	There is a major flow of economic benefits to local communities from activities associated with the protected area	3			
25. Monitoring and evaluation Are management activities monitored against	There is no monitoring and evaluation in the protected area	0			
	There is some <i>ad hoc</i> monitoring and evaluation, but no overall strategy and/or no regular collection of results	1			

Issue	Criteria	Score: Tick only one box per question		Comment/ Explanation	Next steps
performance? <i>Planning/Process</i>	There is an agreed and implemented monitoring and evaluation system but results do not feed back into management	2			
	A good monitoring and evaluation system exists, is well implemented and used in adaptive management	3			
26. Visitor facilities Are visitor facilities adequate? <i>Outputs</i>	There are no visitor facilities and services despite an identified need	0			
	Visitor facilities and services are inappropriate for current levels of visitation	1			
	Visitor facilities and services are adequate for current levels of visitation but could be improved	2			
	Visitor facilities and services are excellent for current levels of visitation	3			
27. Commercial tourism operators Do commercial tour operators contribute to protected area management? <i>Process</i>	There is little or no contact between managers and tourism operators using the protected area	0			
	There is contact between managers and tourism operators but this is largely confined to administrative or regulatory matters	1			
	There is limited co-operation between managers and tourism operators to enhance visitor experiences and maintain protected area values	2			
	There is good co-operation between managers and tourism operators to enhance visitor experiences, and maintain protected area values	3			
28. Fees If fees (e.g., entry fees) are applied, do they help protected area management? <i>Inputs/Process</i>	Although fees are theoretically applied, they are not collected	0			
	Fees are collected, but make no contribution to the protected area or its environs	1			
	Fees are collected, and make some contribution to the protected area and its environments	2			

Issue	Criteria	Score: Tick only one box per question		Comment/Explanation	Next steps
	Fees are collected and make a substantial contribution to the protected area and its environs	3			
29. Fines If fines (e.g., poaching fines) are applied, do they help protected area management? <i>Inputs/Process</i>	There are no fines, or fines are theoretically applied but are seldom or never collected	0			
	Fines are collected, but make no direct contribution to the protected area or its environs	1			
	Fines are collected, and make some contribution to the protected area and its environs	2			
	Fines are collected and make a substantial contribution to the protected area and its environs	3			
Bhutan METT +: The term “protected area or its environs” can include incentive schemes such as payments to informers of poachers					
30. Condition of biodiversity and ecological values What is the condition of the important biodiversity values of the protected area as compared to when it was first designated? <i>Outcomes</i>	Many biodiversity and ecological values are being severely degraded	0			
	Some biodiversity and ecological values are being severely degraded	1			
	Some biodiversity and ecological values are being partially degraded but the most important values have not been significantly impacted	2			
	Biodiversity and ecological values are predominantly intact	3			
<i>Additional Points: Condition of values</i>					
30a: Condition of biodiversity values	The assessment of the condition of biodiversity and ecological values is based on research and/or monitoring	1			
30b: Condition of biodiversity values	Specific management programmes are being implemented to address threats to biodiversity and ecological values	1			
30c: Condition of biodiversity values	Activities to maintain key biodiversity and ecological values are a routine part of protected area management	1			

Issue	Criteria	Score: Tick only one box per question		Comment/ Explanation	Next steps
<u>Bhutan METT + questions</u>					
31. Condition of cultural values What is the condition of the important conservation values of the protected area as compared to when it was first designated? <i>Outcomes</i>	Many cultural values are being severely degraded	0			
	Some cultural values are being severely degraded	1			
	Some cultural values are being partially degraded but the most important values have not been significantly impacted	2			
	Cultural values are predominantly intact	3			
32. Access How accessible is the protected area? <i>Planning / Process</i>	Staff are unable to move around the protected area and thus much of the protected area is inaccessible throughout the year	0			
	There are significant restrictions on the ability of staff to move around the protected area throughout the year (e.g., in the rainy season) and thus much of the protected area (e.g. over 50 % of the area) is inaccessible some or all of the year	1			
	Staff are able to move relatively easily around the protected area and thus most of the protected area is accessible, although some areas (e.g., less than 50 % of the area) remain inaccessible some or all of the year	2			
	Staff are able to move easily around the whole protected area and the majority of the protected area is fully accessible	3			
33. Neighbouring protected areas Is there cooperation with adjoining protected areas	There is no contact between managers of adjoining protected areas on issues which impact protected area management effectiveness	0			
	There is limited contact between managers of adjoining protected areas but	1			

Issue	Criteria	Score: Tick only one box per question		Comment/ Explanation	Next steps
(national and international)? <i>Process</i>	little cooperation on issues which impact protected area management effectiveness				
	There is contact between managers of adjoining protected areas and some cooperation on protected area management effectiveness	2			
	There is regular contact between managers of adjoining protected areas and full cooperation on ensuring management effectiveness	3			
34. Is the protected area being consciously managed to adapt to climate change? <i>Planning</i>	There have been no efforts to consider adaptation to climate change in management	0			
	Some initial thought has taken place about likely impacts of climate change, but this has yet to be translated into management plans	1			
	Limited plans have been drawn up about how to adapt management to predicted climate change, which may or may not be being implemented	2			
	Detailed plans have been drawn up about how to adapt management to predicted climate change, and these are already being implemented	3			
35. Is the protected area being consciously managed to prevent carbon loss and to encourage further carbon capture? <i>Process</i>	Carbon storage and carbon dioxide capture has not been considered in management of the protected area	0			
	Carbon storage and carbon dioxide capture has been considered in general terms, but has not yet been significantly reflected in management	1			
	There are active measures in place to reduce carbon loss from the protected area, but no conscious measures to increase carbon dioxide capture	2			
	There are active measures in place both to reduce carbon loss from the protected area and to increase carbon dioxide capture	3			

Protected Area Outcome Baseline: Assessment Sheet 5

For this assessment to be completed a list of core indicators needs to be developed. Once indicators have been agreed then the form below should be completed for each indicator from each protected area, thus providing a summary of the baseline data available. An initial list of indicators was developed in the METT workshops¹.

Indicator	
Baseline data	Summary of data (e.g., number of species, vegetation cover, etc.)
Data: 2010-2015	
Data: 2000-2009	
Data: Pre-2000	
Data in preparation	
Data collection planned	
No data collection	
Additional notes	

¹See: Wildlife Conservation Division and Equilibrium Research (2015). *Management Effectiveness of Protected Areas in Bhutan: A training session and initial assessment of five protected areas*. Thimphu, Bhutan and Bristol, UK

1.5.12. Bibliography

- Dudley, N., Lham, D., Stolton, S., Wangchuk, S., Wangchuk, S (2016). *Bhutan Management Effectiveness Tracking Tool Plus*. Final Version 2016. Wildlife Conservation Division and Equilibrium Research, Thimphu, Bhutan and Bristol, UK
- Dhendup, T., K. Thinley & U. Tenzin (2019). *Mammal diversity in a montane forest in central Bhutan*. *Journal of Threatened Taxa* 11(13):14757-14763;
<https://doi.org/10.11609/jott.5058.11.13.14757-14763>
- Efford, Murray & Fewster, R.. (2013). *Estimating population size by spatially explicit capture-recapture*. *Oikos*. 122. 918-928. 10.2307/41937741.
- Efford, M. G. *Secr spatially explicit capture recapture models*. R package version 3.1.8, <http://CRAN.R-project.org/package=secr> (2018)
- Hedwig, D., I. Kienast, M. Bonnet, B.K. Curran, T. King, A. Courage, C. Boesch, H.S. Kuhl & T. King (2018). *A camera trap assessment of the forest mammal community within the transitional savannah-forest mosaic of the Bateke Plateau National Park, Gabon*. *African Journal of Ecology* 56(4): 777–790. <https://doi.org/10.1111/aje.12497>
- Kovach, W.L., 2011. Oriana – Circular Statistics for Windows, ver. 4. Kovach Computing Services, Pentraeth, Wales, U.K.
- Marsh, D. M., and Trenham, P. C. (2008). *Current trends in plant and animal population monitoring*. *Conservation Biology* **22**, 647–655. doi:10.1111/j.1523-1739.2008.00927.x
- O'Brien, T.G.O. (2011). *Abundance, density and relative abundance: a conceptual framework*, pp. 71–96. In: O'Connell, A.F., J.D. Nichols & U.K. Karanth (eds.). *Camera Traps in Animal Ecology*. Springer, Tokyo, xiv+271pp.
- Sanderson, Jim & Harris, Grant. (2013). *Automatic data organization, storage, and analysis of camera trap pictures*. *Journal of Indonesian Natural History*. 1. 11-19.
- Thomas, Lee and Middleton, Julie, (2003). *Guidelines for Management Planning of Protected Areas*. IUCN Gland, Switzerland and Cambridge, UK. ix + 79pp.
- Thompson, Graham & Withers, Philip. (2003). *Effect of species richness and relative abundance on the shape of the species accumulation curve*. *ECU Publications*. 28. 10.1046/j.1442-9993.2003.01294.x.
- Wangda, P., and Ohsawa, M. (2006a). Gradational forest change along the climatically dry valley slopes of Bhutan in the midst of humid eastern Himalaya. *Plant Ecology* **186**, 109–128. doi:10.1007/s11258-006-9116-5



2. Biological Corridors

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2. Biological Corridors

2.1. Management Context

Biological Corridors (BC) are areas set aside to connect one or more Protected Areas (PA) and facilitate free movement of wild animals which will facilitate long term conservation of wildlife population of wide range of species, promote gene flow and enable species to adapt to climate change impacts. Bhutan, as the world's role model for conservation, have successfully declared 8.61% of the total geographical area of the country as BC and gifted as a “*Gift to the Earth from the people of Bhutan*” in 1999 by Her Majesty Queen Ashi Dorji Wangmo Wangchuck in 1999.

The BC forms an effective network and provides linkages and connectivity between various PA. It provides connectivity ranging from the sub-tropical ecosystem of the Royal Manas National Park (RMNP) to the alpine regions of Jigme Dorji National Park (JDNP), and lateral connectivity from the Jigme Khesar Strict Nature Reserve (JKSNR) to the Sakteng Wildlife Sanctuary (SWS) and the Bumdeling Wildlife Sanctuary (BWS). For effective management, the BC are managed through scientific conservation management plans with a plan period of 10 years.

2.2. Objective

The objectives are to;

- provide a secured migratory habitat to facilitate movement (dispersal or migration) of species;
- prevent inbreeding of species which may otherwise lead to local extinction;
- maintain genetic diversity of species; and
- provide a supplementary feeding habitat for animals.

2.3. Roles and Responsibilities

The roles and responsibilities of the main offices involved in the PA management are shown in Table 2.1.

Table 2.1 Roles and responsibilities.

Office	Roles and responsibilities
Nature Conservation Division (NCD)	<ul style="list-style-type: none">• Provide technical backstopping for the preparation and implementation of the plan• Review Management Plan and submit for endorsement• Conduct periodic monitoring and evaluation
Divisional Forest Office(s)	<ul style="list-style-type: none">• Survey planning and data collection• Prepare draft Plan including presentation and finalization• Implement activities reflected in the plan• Monitor the planned activities

The following steps (Figure 2.1) adapted from the IUCN Management planning shall be followed for development of the conservation management plan for BCs;

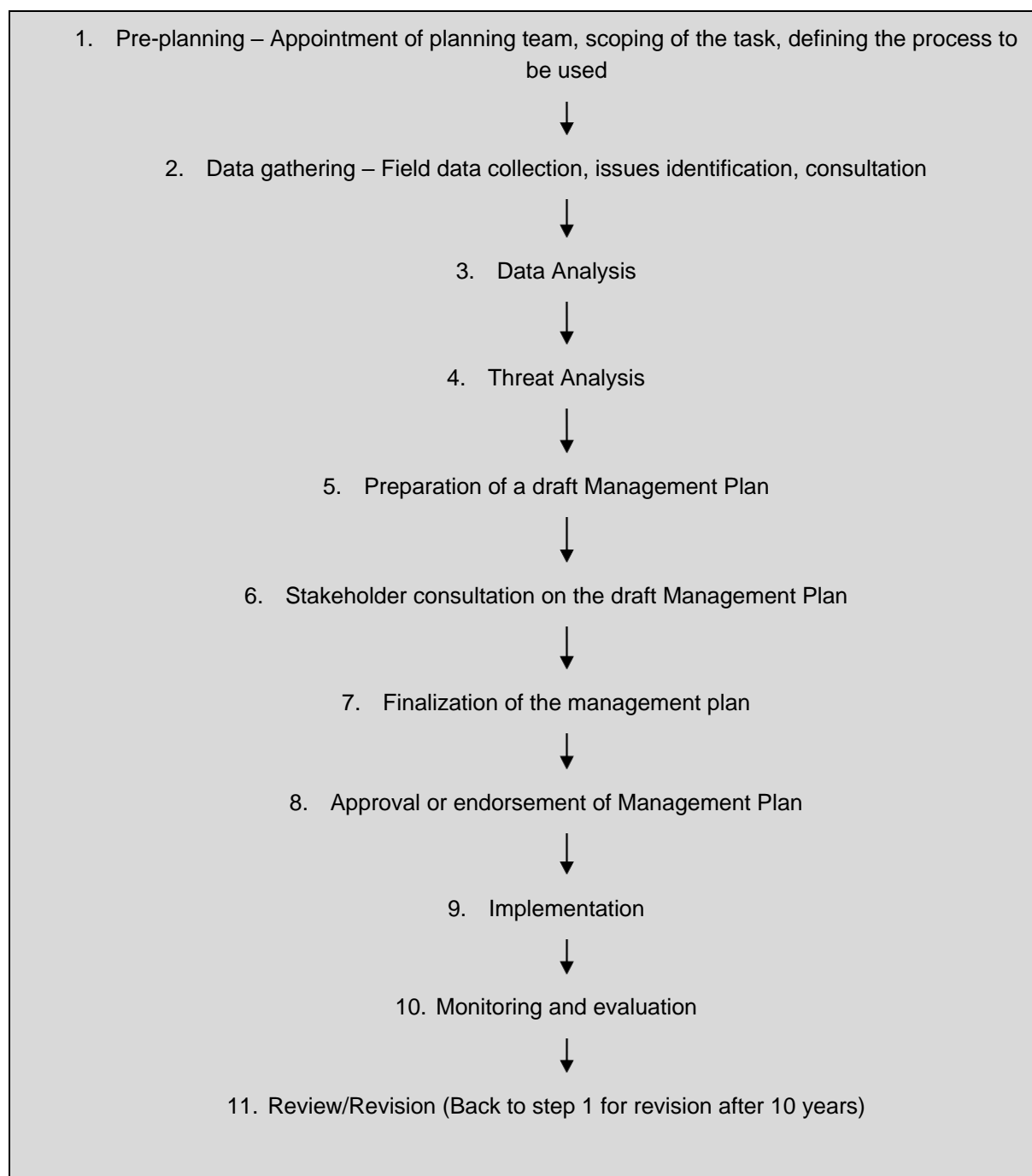


Figure 2.1 Steps for management planning

The detailed description for different steps for management planning for BC is same as the PA management planning process and can be referred to Chapter 1 of this volume (National Parks, Wildlife Sanctuaries & Strict Nature Reserve). A separate zonation exercise, as done in PA, is not deemed necessary owing to its size and management objective. However, all important habitats and hotspots shall be mapped in the BC for management.

2.3.1. Conservation Management Plan Format

In order to ensure uniformity of the conservation management plans for the BC of the country, the following outline for preparation of the management plan is recommended (Table 2.2).

Table 2.2 Plan format

Executive Summary

Summaries essential issues within the plan and relevant decisions. This is important as many of the final decision-makers will not have time to read and digest supporting details.

Chapter I Introduction

- Background of BC in Bhutan.
- Brief functions of the BC.
- Basic information of the BC such as area description (connectivity, location,) size.
- Vision, Mission, Goal and Objective of the BC

(State the purpose and scope of the plan, and provide an explanation of the purpose for which the protected area was established (including any legislative basis) and the authority for plan development. It may also contain some basic summary information about the protected area, such as its location, size, primary resources and values).

Chapter II Current status

- Physical features (detailed area description-choke points, etc.).
- Biological features.
 - Vegetation and Forest Types.
 - Floral diversity.
 - Faunal diversity.
- Socio-Economic characteristics.
- Resource Use - Present land use status within the BC (CF, transmission lines, roads, orchards, agricultural farms, grazing meadows, etc.).
- Present Threats (mentioning the extent of threat).
- Future plans of developmental activities in the BC.
- Forest Resource Area

Chapter III Threat Analysis

Survey results shall be analysed with the main focus on identifying the sources of threats as well as the potential threats to the BC.

- Threats to/by floral diversity
- Threats to/by faunal diversity
- Threats to/by local communities residing within and outside the corridor.

- A map of the BC showing all its important habitats.

Chapter IV Management Interventions

The management prescriptions/interventions shall be linked to the survey results and may also include potential opportunities based on non-consumptive use of BC resources such as ecotourism, and small micro enterprises guided by principles of sustainable use.

- Interventions for floral conservation
- Interventions for faunal conservation
- Intervention for improvement of local livelihood

Chapter V Implementation Schedule and Budget (For the plan period of 10 years)

- A realistic schedule and budget required for implementing the management plan prescriptions as per 2.7 (Implementation framework/schedule) shall be prepared for the plan period of 10 years.

Chapter VI Monitoring and Evaluation

- This chapter will outline how implementation of the plan will be monitored, and when and how an evaluation/review of the plan will be carried out. It will include the indicators against which the performance of the biological corridor will be measured in the format given below. This M&E plan format will ensure synergy with the implementation framework, BC monitoring framework and the conservation operation plans.

Objectives	Action	Output indicator	Baseline	Unit	Yearly target									
					Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
<i>Maintain viable population of flora and fauna in the park.</i>	<i>Action 1: Conduct survey for important floral species</i>	<i>Survey report</i>	0	Nos.		1	1	1						
	<i>Action 2: Conduct surveys for faunal species</i>		0	Nos					1	1				
	<i>Action 3:</i>													

2.3.2. Approval Procedures

The draft conservation management plan prepared by the DFO, shall be reviewed by NCD. The final plan shall be presented to the Technical Advisory Committee (TAC) of the Department for endorsement. The Head of the Department will then recommend the plan for approval to the Ministry.

2.3.3. Implementation Framework

The implementation plan for the period of 10 years shall be developed as per Table 2.3 with details of specific activity that would be carried out; duration, timing and the amount of fund required.

Table 2.3 Implementation framework

Objectives <i>(These are the broad longterm goal(s) that the park wants to achieve.)</i>	Strategies <i>(These are methods/plans designed to direct how to achieve the objective.)</i>	Action <i>(These are list of activities to achieve the objectives)</i>	Year along with budget (in Nu.m)										Remarks <i>(to include detailed information of the actions such as where, what, etc.)</i>
			Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	
Eg. Objective 1: Maintain viable population of flora and fauna in the BC.	Strategy 1: Enhance knowledge on floral and faunal diversity	Action 1: Conduct survey for 3 important floral species		0.3	0.3	0.3							Grass, <i>Neopicrorhiza</i> sp., and <i>Taxus bacata</i> .
		Action 2: Conduct surveys for 2 faunal species					0.4	0.4					Tiger, SL and Red panda.
		Action 3:											
	Strategy 2:												

Further, an annual conservation operational plan needs to be developed based on the broad 10-year implementation plan as per the format developed (Table 2.4)

Table 2.4 Conservation Operational Plan

Framework for Conservation Operational Plan for Biological Corridor of Bhutan						
* The Conservation Operational plan for the Biological corridor shall be prepared latest by 31 st July.						
Name of the office:						
Plan Period:						
Prepared by and date:						
Verified by and date:						
Recommended by and date						
Approved by and date:						
I. REVIEW OF THE PREVIOUS YEARS' PLAN						
I.a. SUMMARY OF THE PLAN						
No. of Planned activities	Status of the activities (in Nos.)					
	Achieved		On-going		Not Implemented	
I.b. DETAILED REVIEW OF THE PLANNED ACTIVITIES						
Activities	Target with unit	Budget utilization status (in %age)	Brief report of the progress of the activities.	Remarks (Justification/reasoning if not completed or not implemented)		

II. ANNUAL CONSERVATION OPERATIONAL PLAN SCHEDULE						
II.a. DETAILS OF THE PLANNED ACTIVITIES						
Output Indicator as per the management plan/APA	Activities	Target with Unit	Timeline	Budget (in Nu.(m))	Fund Source	Specify location, if relevant
Program 1: Nature Conservation ¹						
Eg. Maintain viable population of flora and fauna in the park.	Conduct survey on Tiger	Jun-21	Jun-21	0.8m	BFL	
	Develop action plan for <i>Taxus bacata</i>	1 plan	Mar-21	0.2m	RGoB	
E.g., Effective HWC mitigation measures upscaled	QRT formation in affected communities	3 communities	Apr-21	0.3m	RGoB	Meadtsh-o, Jarey and Saling Gewog
Program II: Forest Resources Management ²						
Program III: Social Forestry and Extension ³						

Program IV: Forest Protection and Enforcement ⁴						
Program IV: Administration and Direction ⁵						
¹ . Program I shall include but not limited to; Surveys, research, HWC management, habitat management, watershed wetland protection, ecotourism nature recreation, waste management, wildlife rescue & rehabilitation.						
² . Program II shall include but not limited to; LFMA plan preparation, timber allocation and monitoring.						
³ . Program III shall include but not limited to; CF management, NWFP management, plantation, livelihood improvement initiatives.						
⁴ . Program IV shall include but not limited to; patrolling, forest offence compounding/prosecution, forestry clearances, pest & diseases surveillance, forest fire management.						
⁵ . Program V shall include but not limited to; Park management plan preparation, work planning, coordination meetings, administrative and accounting activities, monitoring and evaluation, data management.						
*Note: Activities such as Awareness, capacity building, etc., to be tagged with respective program activities.						

2.3.4. Monitoring and Evaluation

2.3.4.1. Monitoring

Monitoring is a continuous assessment that aims at providing all stakeholders, with early detailed information on the progress or delay of the planned activities. Its purpose is to determine if the outputs, deliveries and schedules planned have been reached so that action can be taken to correct the deficiencies as quickly as possible.

The monitoring at the field/implementer level shall be done by the implementers continuously and throughout the implementation phase. PA Monitoring Framework (Figure 2.2) can be used for monitoring of BC and other relevant monitoring programs.

Data Sheet 1: Brief summary of Protected Area Sites							
Date of M&E Conducted (DD/MM/YY)							
Evaluators name & Office							
Name of protected area							
Size of protected area (ha)							
Number of technical staff							
Number of non-technical staff*							
Annual budget (Nu.) for both project and RGoB for the park							
* Non-technical staffs to include adm, accounts,							

Data Sheet 2: Assessment of the Output indicators for the Protected Area								
Output Indicators as per the Management Plan	Baseline	Unit of Measure	Target for Plan Period	Yearly target	As Reported by Park Management	Reasons for non-fulfillment of the targets	Observation by M&E Team	Recommendation for each target, if any*
Indicator 1: e.g. Survey report for 3 floral species	0	No	3	1	60% completed for 1 species			
Indicator 2:								
Indicator 3:								
Indicator 4:								
Indicator 5:								
* Detailed recommendation in data sheet 4								

Data sheet 3: Ad-hoc activities		

Datasheet 4: Detailed Recommendations		
Recommendations	Responsibility	Deadline
e.g. PA to send the expedite the completion of the survey report preparation	Park Manager	Jun-20

Figure 2.2 PA monitoring framework

2.3.4.2. Evaluation

“Bhutan METT+ (Management Effectiveness Tracking Tool)” is recommended to evaluate the management effectiveness of BC, and other relevant evaluating programs as deemed necessary (Dudley *et al.*, 2016).

The Bhutan METT+ shall be conducted at two levels, Internal Assessment and External Assessment once every five years.

The Internal Assessment is a self-assessment which shall be carried out prior to the External Assessment by the respective field offices comprising the following members from their jurisdiction; 1. CFO, 2. Section Heads and 3. At least 2 officers from each Range Offices.

The External Assessment shall be coordinated by NCD and carried out in collaboration with relevant offices to ensure that the results from the internal assessment is unbiased. The team members for the

external assessment may include Department Specialist, One representative from each functional division and UWICER and, one representative each from the adjoining Protected Area Office.

The detailed component of the Bhutan METT+ can be referred under 1.5.11.2 Evaluation under Chapter 1 of this Volume.

2.3.5. Bibliography

Dudley, N., Lham, D., Stolton, S., Wangchuk, S., Wangchuk, S (2016). Bhutan Management Effectiveness Tracking Tool Plus. Final Version 2016. Wildlife Conservation Division and Equilibrium Research, Thimphu, Bhutan and Bristol, UK

Thomas, Lee and Middleton, Julie, (2003). *Guidelines for Management Planning of Protected Areas*. IUCN Gland, Switzerland and Cambridge, UK. ix + 79pp.

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1. Former taskforce members for the FMCB (2014)

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7	Dimple Thapa	Chief Forestry Officer	Tsirang Division

2. FMCB Internal Review Workshop (22-27th December 2019)

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1	Pasang Wangchen Norbu	Specialist/Advisor	DoFPS
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3. Second Consultation Workshop, DoFPS Conference Hall (3rd January 2020)

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4. Writeshop in Phuentsholing (3-7th February 2020)

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5. Consultation with Chief Forestry Officer (8-10th February 2020)

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6. Writeshop in Punakha (25-30th July, 2020)

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7. Finalization workshop in Thimphu (12-24th October 2020)

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