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ROYAL GOVERNMENT OF BHUTAN
DEPARTMENT OF FORESTS AND PARK SERVICES
OFFICE OF THE CHIEF FORESTRY OFFICER
THIMPHU FOREST DIVISION

MANAGEMENT PLAN
FOR
CHAMGANG HELELA FOREST MANAGEMENT UNIT

THIMPHU DZONGKHAG
(2017-2027)

Plan Prepared by:

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Thimphu Territorial Division.
Tashi Norbu Waiba (Sr. Forestry Officer, FRMD)
Tshering (Sr.Forestry Officer), FRMD.

AUTHORITY FOR PREPARATION, REVISION AND APPROVAL

PERIOD OF THE PLAN

This Plan is valid for the period of 10 years from 1st August, 2017 to 31st July, 2027.

AUTHORITY FOR PREPARATION, REVIEW AND APPROVAL

The authority for preparation of this plan was delegated to the Territorial Forest Division, Thimphu by Department of Forests and Park Services, Ministry of Agriculture and Forests, Royal Government of Bhutan.

PROVISION FOR REVISIONS AND CHANGES

This Plan may be revised during the period when it is in effect if major changes occur in the Forest Management Unit (FMU), or if new information becomes available, that may have significant bearing on the implementation of the Plan, or if there arise huge challenge and need to relook and reemphasize the management plan, the Head of Department, DoFPS, can authorise a revision of this plan.

APPROVAL

This Plan has been examined by a wide section of user groups, clients and organizations. The final version of this Plan was presented to the Department and was reviewed and technically cleared by the Head, FRMD, and an environmental clearance was obtained from National Environment Commission Secretariat. It is then submitted to Head, DoFPS, who, after further review and amendments, forward with his recommendation for approval to the Secretary, MoAF. The Secretary, MoAF, further reviewed and submitted the Plan to the Minister, MoAF for his approval for implementation.

Submitted for approval:

Chief Forestry Officer
Forest Resources Management Division
Thimphu
Date.....

Recommended for approval:

Director
Department of Forests & Park Services
Date.....

Recommended for approval:

Secretary
Ministry of Agriculture & Forests
Date.....
10/7/17

APPROVED/NOT APPROVED

Hon'ble Minister
Ministry of Agriculture & Forests
Date:.....

ACKNOWLEDGEMENT

This management plan is an outcome of concerted efforts and contribution of many people, without which the plan would not have materialized. The planners would like to thank Mr. Lobzang Dorji, CFO, FRMD for rendering unwavering support and for being accessible to the planners to provide technical guidance and direction while preparing this plan.

Since reliable information and data are key components for accurate planning, the inventory team have worked hard to collect the data. Therefore, the planners would like to thank them for their dedication and sincerity shown to their work.

Mr. Sacha Dorji (Unit-In charge) under the guidance of Mr.Gyeltshen Dukpa (CFO, Thimphu) aided immensely in facilitating the field works and logistics for which the planners are thankful.The planners will remain thankful to all the seniors of the Department for their continuous support and kind advices during the plan drafting process.

Finally, the planners would also like to thank the Department for decentralising the FMU planning to field divisions;this endeavourhas not only given ideas and knowledge on FMU planning and management but also engendered new perspectives of FMU management and piqued research interest among others.

ENVIRONMENTAL CLEARANCE

རྒྱལ་ཡོངས་མཐའ་འཁོར་གནས་སྐྱོང་ལྷན་ཚོགས།
དཔལ་ལྡན་འབྲུག་གཞུང་།
National Environment Commission
Royal Government of Bhutan

NECS/ESD/Dzo-Thimphu/3448/2017/ 891 June 20, 2017

Environmental Clearance

In accordance with Section 34.1 of the Environmental Assessment Act 2000 and Section 34 of the Water Act 2011, this Environmental Clearance (EC) is hereby issued to Director, Department of Forests and Park Services, Thimphu for operation of Third Forest Management Unit (FMU) Plan (2017-2027) of Chamgang-Helela FMU under Dagala Gewog, Thimphu Dzongkhag with the following terms and conditions:

I. General

The holder shall:

1. comply with provisions of the National Environment Protection Act 2007, Environmental Assessment Act 2000 and its Regulation 2016, Waste Prevention & Management Act of Bhutan 2009 and its Regulation 2016, and The Water Act of Bhutan 2011 and its Regulation 2014;
2. ensure that activity is in line with Initial Environmental Examination report submitted for EC;
3. ensure that local communities, properties and any religious, cultural, historic and ecologically important sites are not adversely affected by the activity;
4. restore the damage of any public or private properties caused by the activity;
5. inform NECS and any other relevant authorities of any unanticipated or unforeseen chance-find of any precious metals or minerals or articles, that have economic, cultural, religious, archeological, and/or ecological importance; and
6. erect a signboard at the take-off point of the main entry of the FMU stating the name of the FMU and contact address.

II. Environmental standards

The holder shall comply with the existing Environmental Standards.

III. Import and use of secondhand equipment

The holder shall ensure that import and use secondhand equipment and machineries are strictly prohibited.

IV. Water use and management

The holder shall:

1. ensure that activity does not disrupt the water flow and pollute the water bodies; and
2. ensure that 30 meter or 100 feet buffer is maintained from the water resources at all times.

NATIONAL ENVIRONMENT COMMISSION

V. Waste prevention and management

The holder shall:

1. manage wastes generated from the activity (FMU site, labour camps, offices etc.) with the application of 4R (Reduce, Reuse, Recycle, Responsibility) principle and other environmentally friendly methods of waste management; and
2. ensure that import and use of hazardous wastes are strictly prohibited.

VI. Management of excavated materials and run-off

The holder shall put appropriate measures to avoid erosion and landslides.

VII. Implementation plan

The holder shall prepare a detailed implementation plan focusing on the implementation of terms and conditions of this EC and submit to NECS within three (03) months from the date of issue of this EC.

VIII. Monitoring and reporting

The holder shall:

1. ensure that the effective day-to-day monitoring of the EC terms and conditions are carried out by the environmental unit or designated environment focal person; and
2. maintain proper records on wastes generated and its management, stating types of wastes, quantities and characteristic and submit to NECS annually.

IX. Renewal and modification

The holder shall:

1. ensure that renewal of this EC is processed at least three (03) months prior to its expiry along with a copy EC and a report on the implementation of its terms and conditions; and
2. obtain prior approval from NECS for any modification to the existing proposal/application .

Reservation

1. The NECS may stop the activity or impose additional terms and conditions, as may be deemed necessary; and
2. The EC shall be subject to periodic review and modifications as per Article 25 of the EA Act 2000, without any liability on the part of the Royal Government.

The holder may adopt best practices in executing these terms and conditions to avoid adverse environmental impacts.

Failure to comply with any of the above terms and conditions shall constitute an offence and the proponent shall be liable in accordance to the Environmental Assessment Act 2000 and/or existing environmental laws.

Validity:
This EC is issued with valid from **June 21, 2017** until **June 20, 2022** for the operation of Third FMU plan (2017-2027) of Chamgang-Helela FMU only.

(Sign & Seal)
Secretary

NATIONAL ENVIRONMENT COMMISSION
THIMPHU:BHUTAN

To,
Director
Department of Forests and Park Services
Ministry of Agriculture and Forests
Thimphu

Copy to:
1. Dashø Dzongdag, Dzongkhag Administration, Thimphu for kind information.
2. Chief Environment Officer, Compliance Monitoring Division, NECS for information.
3. Environment Officer, Dzongkhag Administration, Thimphu for necessary action.
4. Guard file, Dzo-Thimphu, ESD, NECS for record.

LIST OF ABBREVIATIONS

%	Percent
AAC	Annual Allowable Cut
BL	Broadleaf
BP	Blue Pine
CFO	Chief Forestry Officer
Cm	Centimeter
DBH	Diameter at Breast Height
DBHOB	Diameter at Breast Height (Over Bark)
DoFPS	Department of Forest and Park Services
EIA	Environmental Impact Assessment
FMP	Forestry Master Plan
FMU	Forest Management Unit
FRMD	Forest Resources Management Division
FRO	Forest Range Officer
GIS	Geographic Information System
Ha	Hectare
CHFMU	Chamgang Helela Forest Management Unit
Km	Kilometer
M	Meter
m^3	cubic meter
MC	Mixed Conifer
Mm	Millimeter
MoAF	Ministry of Agriculture and Forests
Msl	Meters above sea level
NEC	National Environment Commission
NRDCL	Natural Resources Development Corporation Ltd.
Nu	Ngultrum
NWFP	Non-Wood Forest Products
OP	Operational Plan
PFM	Participatory Forest Management
PRA	Participatory Rural Appraisal
RGoB	Royal Government of Bhutan
RNR	Renewable Natural Resources
RO	Range Officer
RRA	Rapid Rural Appraisal
SES	Socio Economic Study
SFED	Social Forestry & Extension Division
sp(p)	species (plural)
UIC	Unit-In-Charge
UM	Unit Manager
WC	Working Circle

EXECUTIVE SUMMARY

This is the Third Management Plan for Chamgang-HelelaForest Management Unit. The structure of this management plan is as per the guidelines on the contents of forest management plan reflected in Forest Management Code of Bhutan. It consists of three parts:

PART 1: GENERAL DESCRIPTION AND THE CURRENT SITUATION

PART 2: FUTURE MANAGEMENT

PART 3: IMPLEMENTATION OF THE PLAN

PART 1: GENERAL DESCRIPTION AND THE CURRENT SITUATION

- Chamgang-Helela Forest Management Unit (CHFMU) is located in Thimphu Dzongkhag, under Dagala Gewog between 89°20' E and 89°30' E, 27°17' N and 27°28' N. Ground elevation varies from 2360 to 4100 masl. The ridge leading from Simtokha to Talakha peak constitutes its western boundary, while Longgey Zala ridge north of Kashim Derim Chu forms its northern boundary. The eastern and southern boundary is formed by the ridge between the FMU and the surrounding valleys.
- Total area of the FMU is 4508.783 hectares,which is divided into Blue pine and mixed conifer forests. The AAC for last management plan was set at 2000 m^3 and owing to over harvesting during the last plan period, the FMU is in a depleted stage, and tremendous gaps have been observed in the total area harvested and planted.
- Access to the forest is provided by 33.16km of road built within the FMU and no additional forest roadconstructions are required during this management plan period.
- In total there are 142 households and population of 695 persons. Almost all the communities within the FMU are mainly engaged in animal husbandry and farming.

PART 2: FUTURE MANAGEMENT

- The overall goal of the management plan is to manage Chamgang-Helela FMU on a multiple use, sustained yield basis for production of timber, fuel wood and other forest products.
- The goal of this current plan in particular is to restock the past harvested areas and restore the FMU to its past environmental status.
- To facilitate the planning, implementation and recording of activities, Chamgang HelelaFMU is divided into blocks, compartments and sub-compartments. The FMU has been divided into three Management Circles, which allows different areas to be managed and evaluated separately, and increases the ease of management and implementation. The Management Circles has been identified, using forest function mapping and they are: Protection, Production, Non-Production. The objectives for each Management Circles have been identified and the Production Management Circles have been further divided into Working Circles, so that the objectives are

tailored to the type of stand being harvested. The objectives for each Management Circles have been listed in a logical framework along with the Management Options and responsibility for easy reference by implementers and monitoring agency.

- The current plan have no AAC prescribed for commercial use. However, sanitation logging shall be carried on priority basis with due approval from FRMD. The AAC for the FMU in this plan period is 1800 m^3(standing volume).
- Although no active harvesting activities shall be carried out in the FMU, production management circle and its working circles needs to be managed to build up future timber production potential. In the Production Management Circles, two regular Working Circles of Mixed Conifer and Blue Pine has been prescribed.
- In accordance with the Environment Assessment Act 2000, Environmental Statement has been prepared for the Chamgang Helela FMU. Using a series of environmental criteria, outlined in the Act and adopted by the National Environment Commission, the guidelines recommended have been examined to ensure that the practice within Chamgang Helela FMU meets the requirement.
- A financial forecast (cash flow) for Ten years has been prepared for the FMU summarizing the total cost and royalties for NRDCL for the plan period. The forecast is a projection based on the plan prescriptions and may not reflect the actual workings during the plan period.

PART 3: IMPLEMENTATION OF THE PLAN

- The CFO, Thimphu /Unit In-charge CHFMU will be responsible for the implementation of this management plan, assisted by the Unit In-charge and other staffs.
- A rolling biennial Operation Plan will be prepared by CFO, Thimphu / Unit In-charge CHFMU and Unit In-charge to facilitate the timely implementation of this management plan. Guidelines for the preparation of the Operational Plan have been prepared and are available from FRMD.
- FMU Level Management Committee chaired by CFO, Thimphu has been established to assist in objective setting and to ensure the smooth implementation of the Management Plan. The FMU Level Management Committee is comprised of the stakeholders of the FMU and each member has an equal right to say in the recommended management and implementation of the FMP. Planned activities to achieve the FMU objectives will be discussed in the FMU Level Management Committee meetings.
- Monitoring and evaluation is a crucial component of the management planning that has been virtually disregarded in the past. Recently it has been pointed out that due to the lack of reviews; FMUs have ended up in poor conditions and corrective measures

may be too late. It is essential that the Operational Plan activities be reviewed annually, that the mid-term review of the management plan take place and that the final evaluation be completed.

- The possible risks and constraint in smooth implementation of the management plans are:
  - Inadequate fund for implementation of the plan
  - Uncertainty of natural regeneration, due to grazing and undergrowth competition
  - Lack of research information
  - Lack of skilled and trained forest workers
  - Poor communication between field and office staff and between involved parties
  - Lack of awareness campaign to the residents of the FMU
- To implement and monitor this management plan, it is essential that the CFO, Thimphu be provided with sufficient staff and fund. As well as a necessary budget, it is important to have in place adequate technical capability and appropriate institutional set-up.
- Unforeseen circumstances may warrant deviations from the plan prescriptions and in such an event the CFO, Thimphu must obtain prior written approval from the Head of the Department.

Action required by FMU plan	Responsibility	Section in plan
Implementation and Review		
CFO Thimphu/Unit In-charge CHFMU will be responsible for the implementation of this Management Plan, assisted by the Unit In-charge and staff.	CFO Thimphu/ Unit In-charge CHFMU	20.0
The FMU Management Committee chaired by CFO Thimphu will be maintained to ensure the smooth implementation of the Management Plan.	CFO Thimphu	21.3
CFO, FRMD, will ensure that the Plan is reviewed five years after implementation, and at the end of the plan period.	Head, FRMD	21.2
Monitoring and Evaluation		
CFO Thimphu will ensure that the monitoring is carried out on an annual basis according to the guidelines issued by FRMD	CFO Thimphu	21.1
CFO, FRMD, will ensure that evaluation is carried out at five year intervals, based on the	Head, FRMD	21.2

Action required by FMU plan	Responsibility	Section in plan
information collected by annual monitoring and other necessary information.		
Operation Planning		
A Biennial Operation Plan will be prepared by CFO Thimphu to facilitate the timely implementation of this Management Plan, the OP will be completed by October every year so that FMU Management Committee can review it before NRDCL's financial year begins	CFO Thimphu FMU IC	21.1
Objective for each Management Circle will be met with the implementation of specific activities.	FMU IC	11.3
Silviculture system for each Working Circle will be adhered to, following cutting cycle guidelines to ensure sustainability.	FMU IC	15 & 20.1
The harvesting Plan set out for each Working Circle will be followed unless pests and diseases arise.	FMU IC,NRDCL RM	14
Unit In-charge will determine the location and extend of cable lines in the compartment to be harvested during outbreak of pest and disease and plantation activities annually, in consultation with NRDCL staff, as prescribed in the Operational Plan. (Following Annual Coupe and Tree Marking guidelines)	FMU IC	20.2
CFO Thimphu and the Regional Manager, NRDCL will co-operate and co-ordinate to ensure that the logging operation and the log outturn are conducted smoothly and in accordance with local and other demands	CFO Thimphu , NRDCL DM	20.4
The FMU IC will ensure that stocking of natural regeneration is regularly monitored following completion of harvesting operation.	FMU IC	20.5
Enrichment planting, if necessary, will be carried out by NRDCL	NRDCL RM	20.5
Fencing, or other action to protect regeneration will be carried out by NRDCL, in consultation with the FMU IC	NRDCL RM	20.5

Action required by FMU plan	Responsibility	Section in plan
Road survey, design and construction will be carried out by NRDCL	NRDCL	20.7
NRDCL road engineers must follow the standards, given in Annex 4, during designing and estimating and provide supervision during construction to ensure that the environment standards are met.	NRDCL staff	20.7
Regular inspection will be conducted by the FMU staff to detect and report any pest and disease outbreaks to enable earliest possible remedial or preventive measures to be initiated.	FMU staff	16.2
Participatory Forest Management		
Records of all tree marked and issued for local use or for conversion within the forest, by Blocks and Compartments will be maintained by the Unit staff and furnished monthly to CFO Thimphu	FMU IC	14.2
Grazing will be minimized in the Protection Management Circle and grazing will be encouraged in the Non-Production Management Circle.	FMU IC	16.3
The views of stakeholder groups will be incorporated into the operational plans through the inclusion of stakeholder representatives on the FMU level Management Committee.	CFO Thimphu	21.3
Local communities have priority in use of forest products from the area set aside for Local use (Forest Function Socl).	FMU IC,via Operational Plan	14.3

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GENERAL DESCRIPTION

1. LOCATION AND BACKGROUND

1.1 Location

Chamgang-Helela Forest Management Unit (CHFMU) is located in Thimphu Dzongkhag, under Dagala Gewog between 89°20' E and 89°30' E, 27°17' N and 27°28' N. Ground elevation varies from 2360 to 4100 masl. The ridge leading from Simtokha to Talakha peak constitutes its western boundary, while Longgey Zala ridge north of Kashim Derim Chu forms its northern boundary. The eastern and southern boundary is formed by the ridge between FMU and the surrounding valleys. The access to the unit is through northwest side of the FMU from Simtokha-Thimphu-Wangdi Highway. The gross area is 4692.85 hectares.

1.2 Area statement (Revised).

Out of the total area of 4692.85 ha, the area of Chamgang Helela FMU has now been calculated to 4508.783 ha after excluding KachuPenzhu and Rinchending Community Forests within the FMU. The following table and figure gives area of various land use types dominant in the FMU. The information has been mostly derived from LUPP 1994, LCMP 2010 and Topographic maps.

Table 1.1 Area Statement by land use

Land use	Area (ha)	Percentage Area
Mixed Conifer Forest	3477.298	77.12
Blue Pine Forest	843.578	18.7
Settlements	77.384	1.71
Meadows	45.078	0.99
Shrubs	65.448	1.45
Total	**4508.783**	**100**

1.3 Historical Background

Historical background was mostly obtained through semi-structured interviews and talking informally with the elderly and key residents of the FMU, and examining previous Management Plans and forest records.

Prior to the resettlement of present dwellers, it is said that CHFMU was used as summer migration area from the neighbouring Chang and Babesa Geogs. In 1991, people who presently live in Chamgang village were resettled as per the Royal Command. These people originally came from Dagala and are yak herders by profession and had *Tsamdo* land within the FMU before being resettled.

For some time considerable harvesting has taken place in the CHFMU under various programmes and projects. However, no scientifically based plan was prepared for comprehensive management of this unit until 1993. The CHFMU has been under heavy

pressure from Thimphu city and neighbouring dzongkhags for production of timber and fuel wood due to the ever-increasing population and growing economics of the area and outside as well.

Harvesting and past management in the FMU was carried out on a more or less adhoc basis before the preparation of 1993-2002 Management Plan. Forests in the proximity of populated and more accessible areas, especially in the lower parts of the FMU, were heavily cut for local use. The onset of bark beetle epidemic at the beginning of the eighties necessitated an immediate salvage logging operation. Felling of affected areas was carried out mainly by the newly created Bhutan Logging Corporation (now NRDCL). New forest roads were constructed to gain access to areas most urgently in need of epidemic control. Mostly Selection Cum Improvement System was used in forest harvested; and Group Selection System had been introduced just prior to the last plan. It is still too early to make a final judgement on the success of natural regeneration in the areas treated by this system. Till date regeneration success is mixed and more intense silviculture may be required on sensitive sites to have successful established regeneration. Grazing and bush competition (mainly Bamboo) seem to be detrimental factors and more attention needs to be given to these problem.

The 1993-2002 Management Plan indicated 'signs of over-cutting and uncontrolled harvesting are becoming clearly visible'. This was a result of opening up the forest with construction of fairly dense forest road networks, and with close proximity to major wood demand centre of Thimphu (for both construction and fuel wood) the rich and well stocked forest stands came under intense pressure. Demand is exceeding the sustainable supply and because of the nature of user groups competing for wood allocation it is exceptionally difficult, if not impossible to control the pressure. This statement was made twenty years ago and still holds true today. Action will need to be taken so that this statement does not appear in the next management plan.

The last management plan, 1st January 2003 to December 31st 2013, established the CHFMU area as 4692.85 ha divided into three blocks, these blocks are further divided into compartments and sub-compartments based on natural features. The net operable area was said to be 1843 ha and the protection forest was 1418.2 ha. Four working groups were established, they were: Blue Pine 545.34 ha, Mixed Conifer 1390.67 ha, Fir 204.71 ha and Hardwood 162.06 ha. Silvicultural system that was to be used was selection/group selection systems for Blue Pine, group selection system for Fir and mixed conifers, clear felling for Hardwood. The AAC of the last plan was calculated as 2000 m^3 per year. With 1350 m^3 allocated to rural use and rest 650 m^3 to NRDCL. Natural regeneration was to be the main source of restocking with artificial regeneration used in areas where it was observed that no adequate regeneration was taking place, 33.16 km of forest road was opened up at the end of the second plan period by NRDCL who were to carry out all of the harvesting operations.

1.4 Forest Condition

Chamgang Helela FMU was under commercial harvesting for last two decades and the area already exhausted and many parts exposed.

Due to the harvesting for the last 20 years and owing to increasing demand from local people, the forests within CHFMU has been degraded in many areas. These areas require immediate planting; this has to be addressed during this plan period.The harvesting of easily accessible timber has resulted in deforestation in the forest near settlements and forest roads. The regeneration in all of the harvested areas appears to be suffering from a number of causes, mainly grazing and brush competition. Allocation of wind fallen trees along the old cable lines to rural people had damaged the established natural regeneration due to log rolling. The double grazing of cattle in the summer and yak in the winter has resulted in erosion and compaction of soils and has seriously impeded progress of natural regeneration in the openings created by harvesting.

The natural regeneration in Blue Pine stand and around the settlements is expanding its territory into the open areas. Natural regeneration in the operated cable lines is very low, with bamboo invasion.Plantations from the past plan (2002-2013) by NRDCL in the FMU constitutes only 14.89 ha with 43.57% survival rate.

1.5 Legal Status

1.5.1 Ownership

The Forest and Nature Conservation Act, 1995, defines **forests** as *"any land and water body, whether or not under vegetative cover, in which no person has acquired a permanent and transferable right of use and occupancy, whether such land is located inside or outside the forest boundary pillars, and includes land registered in a person's name as Tsamdrog (grazing land) or Sokshing (woodlot for collection of leaf litter)".*

All such areas are considered as State Reserved Forest and the entire CHFMU falls within this category of reserved forest, except for human settlement and agriculture lands which is about 77. 384 ha (1.71%) and are private.

1.5.2 Rights and privileges

The right and the privileges of the local inhabitants, concerning the forest use is as per the Forest and Nature Conservation Act of 1995 and the National Forest Policy of 2011. According to the Forest and Nature Conservation Act, grazing, collection of firewood, fodder and leaf mould for the domestic use is allowed either free or on royalty basis. Collection of firewood is permitted from only dead and fallen trees. Timber trees are issued for bona fide domestic use, after they have been marked by a Forest Officer and royalty has been paid. Hunting wild animals is completely prohibited in the forest

1.5.3 Grazing rights

The local communities have the traditional rights for grazing their cattle in the forest, within the forest management unit. People here are totally depended on animal husbandry. They migrate along with their cattle to the southern Dzongkhag in winter. Some Yak herders are also using the higher altitude meadows for grazing.

Nearly 90% of the FMU area is classified as *tsamdos*, which are SRF land leased to either an individual or community. Any harvesting activity within the FMU will be in consultation with the local people who have grazing rights for that area.

1.5.4 Water rights

Villagers within the FMU have traditional rights to use perennial streams for drinking, watering livestock and irrigation. The local community of Babesa obtains its drinking water directly from the FMU, specifically from the top end of the Chamgang Chu. Thimphu City Corporation also supplies water to Thimphu City from the FMU. *The Department has to look into plough back mechanisms or PES (Payment for Environmental Services) schemes, for the water catchments preserved and protected for the continuous supply of water down streams to the inhabitants of Thimphu thromde.*

1.5.5 Historical Monuments and Monasteries

There are no monuments or Monasteries within Chamgang-Helela FMU. The existing Talakha Goemba is located near the western boundary and access to this Goemba is through the FMU and no buffer is required for this Goemba. Although during the second plan period a new community Lhakhang has been set up, the lhakhang is surrounded by private registered land, thus no buffer is required.

1.5.6 Proximity to Protected Areas

Although the CHFMU does not lie in any protected areas the introduction of biological corridor has few hectares of FMU area under BC II connecting JSWNP and JDNP. The BC overlaps in the northern boundary of Helela Compartment II. However, no harvesting of trees takes place in this compartment since the areas falls under Protection circle of the FMU during this plan period.

2. PERMANENT SITE FACTORS

2.1 Topography

The FMU extends from bottom of the valley of Ola Rong Chu just above Simtokha and consists of three clearly defined valleys; Chamgang along Chamgang Chu, Helela valley along Badi Chu and the valley of Khashi Kerim Chu. Altitude along bottom of the valley is approximately 2400 meters whereas the altitude of the ridge that forms the FMU boundary varies from approximately 2800masl to 4100masl. There are gentle slopeareas distributed throughout the

FMU, however the topography is mostly steep with gradients ranging from 50 to well over 100 percent. Towards top of the ridges in the upper reaches of the valleys, topography is very steep.

2.2 Slope

Major part of FMU is within 40 to 80% slope class. Slope classification was done through measure of distance between 40m contours on the 1:50,000 topographical maps. Areas that were considered over 100% were delineated on the Function Map as *SP-Soil Protection* where no activities can take place. Slopes that ranged from 76-100% are classified as *SC-Soil Conservation* where limited activities can take place(Map 3).

2.3 Climate

Climate for CHFMU is typical for the western part of Bhutan, the dominant climatic feature is the southwest monsoon in the period of June to September, during which most precipitation occurs.

2.3.1 Meteorological Stations

There is no meteorological station within CHFMU and the data available are from Semtokha metrological station, which is about 5 km from the FMU.

2.3.2 Temperature

Monthly maximum and minimum temperature of the CHFMUfor the past 19 years is given in the following tables and graph.

Table 1.2Average monthly maximum and minimum temperatures for the past 19 years.

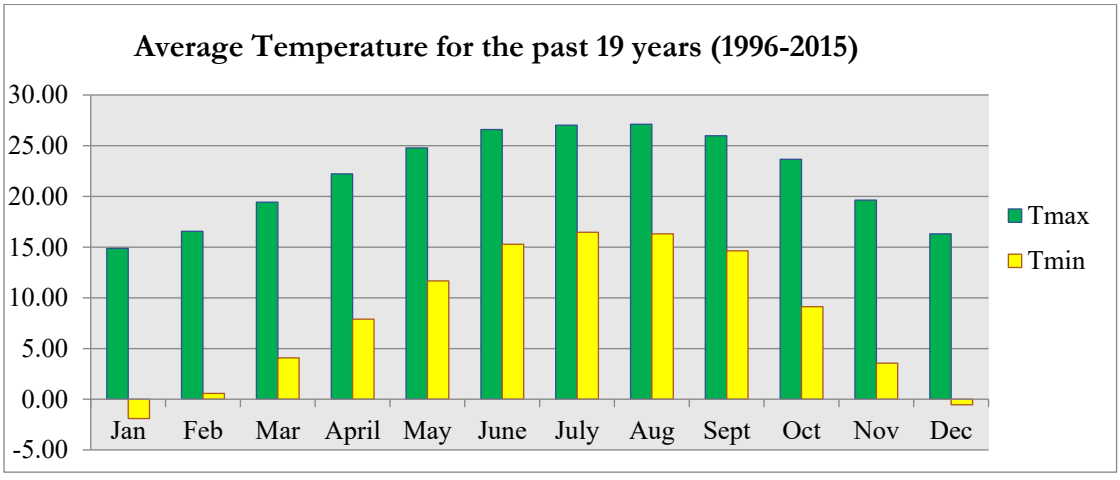


Figure 1.1. Monthly mean maximum and minimum temperature for the past 19 years

2.3.3 Precipitation

Maximum average rainfall falls shows that CHFMU received highest precipitation during the month of July and lowest during the month of November. Briefly during the months of winter the area receives precipitation in the form of snow. Although affecting mainly high elevation sites the snow can suspend logging operation and make travel through the FMU difficult.

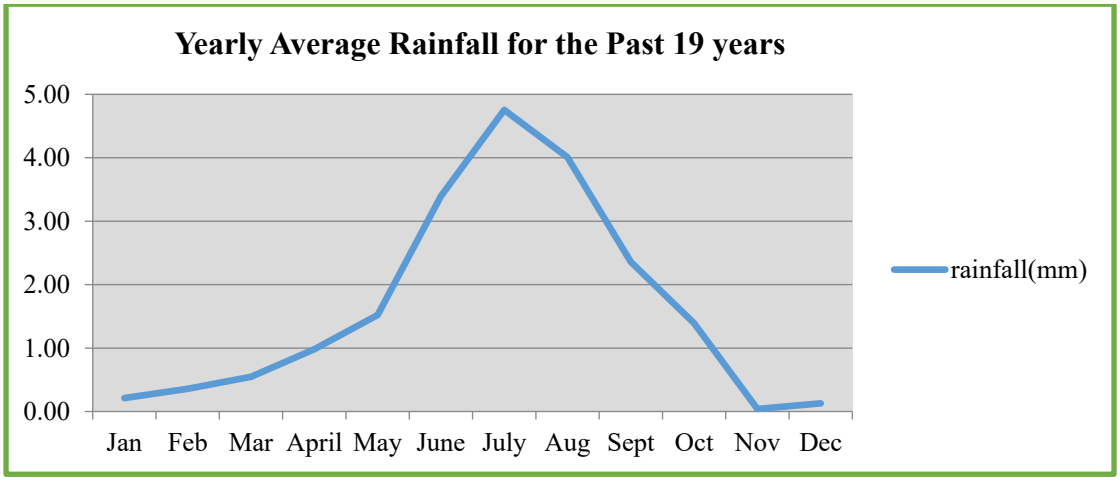


Figure 1.2. Average Mean Rainfall for the past 19 years

2.4 Geology

The FMU area is located in what is known as Central Crystalline Zone of the Himalayas. It is dominated by metamorphic and granitic rocks, which are referred to as the Thimphu formation. The main rocks are gneisses. The main rock formations in general area of the FMU are biotic schist, augen gneiss with quartz intrusions and occasional intrusions of granite. Generally, soils have good permeability and moderate moisture retention with medium texture and cation exchange capacity. They are moderately acidic and are prone to further acidification.Six soil samples from different vegetation types within the FMU were analysed at the Soil and Plant Analytical Laboratory in Semtokha.

2.5 Hydrology

The entire FMU forms watershed for Wang Chu. The Ola Rong Chu (which then feeds Wang Chu) flows past the northern section of the FMU and is fed by the three tributaries that are totally encompassed by FMU boundary. These tributaries are: Khasi Karim Chu, Badi Chu and Chamgang Chu.

3. VARIABLE SITE FACTORS

3.1 Population and Demography

Chamgang village community consists of yak herders from Dagala who were resettled in the area in 1991,as per the Royal Command. In the resettlement programme, 48 households were

allotted land within the FMU area. To date, 142 households have built residential homes at Chamgang, there are five *Chewogs* within the FMU viz. Chamgang Toed, Chamgang Maed, Wangdro, Dungdro, Gyetala. The total population of Dagala Geog is 695 out of which 334 are female and 361 are male.

3.2 Agriculture and Farming Systems

Farmers in the FMU use traditional farming systems due to low risk bearing capacity and lack of better alternatives. They mainly cultivate potatoes, most of which is either consumed or laid aside for self-consumption during the lean season. Some of the potatoes are sold locally in Thimphu or in Phuentsholing. Apart from potatoes, the people also grow radish, turnip, onions and other vegetables that are mostly used for their own consumption.

The age-old practice of yak herding and cattle remains the focus of involvement of people within the FMU and the sale of livestock produce is the main source of income. Many people also own horses and mules, which are used for draught power during farming operations.

3.3 Traditional Uses of Forest

Timber required for house construction and renovation is met from the FMU, fencing posts and flag poles are also provided from the FMU.

Since marking of oak was totally banned by the government for firewood or any other purposes firewood was made available for local people in the FMU from dead, dying and diseased trees and also from lops and tops.

There are many *sokshings* and *tsamdos* within the CHFMU. Grazing is one of the main pressures in the FMU. Local cattle graze in the FMU during the summer months and Yak graze during the winter months. This is discussed further in Section 3.4.

3.4 Grazing

A total of 2741 yaks, 55 cattle, and 138 horses owned by community, dwell within the FMU. Majority of cattle and yak graze freely and are shifting from high to low elevations throughout the year and it is one of the prime reasons for young regeneration in operated areas getting destroyed.

3.5 Wildlife

A wildlife survey was conducted during the inventory collection in 1991 and 1999, other information regarding their presence were gathered from forestry staffs and local people. The wildlife that have been recorded, by either evidence of dung, footprint and browse or debarking of trees are:

Sambar (*Cervus unicolor*)

Barking deer (*Muntiacus muntjak*)

Wild boar (*Sus scrofa*)

Himalayan Black Bear (*Selenarctos thibetanus*)

Leopard (*Panthera pardus*)

Tiger (*Panthera tigris*)

Wild dogs (*Cuon alpinus*)

Monkey (*Rhesus sp*.)

Yellow Throated Marten (*Martes falvigula)*

Red Fox (*Vulpes vulpes)*

Grey Langur (*Presbytis entellus)*

Red Panda (Aliurus Fulgens Fulgens)

Serrow *(Capricornis sumatraensis)*

Blood Pheasant and various other fauna and avian-fauna.

The habitat for the above mentioned species does not appear to be threatened as the harvesting operation were done only in small patches and cable corridors. To ensure an undisturbed habitat, a protection area has been established with this plan using the forest function mapping techniques stated earlier (Map 9).Most of the wildlife found in the CHFMU feed on forbs, grasses, bark, wild fruits and bamboo.

3.6 Forest fires

The first plan indicates incidence of two forest fires, in the North-East and South -West boundary of the FMU. However, during the last ten years no fire incidences were recorded.

3.7 Pests and diseases

Five hectares of spruce at Tauding block was clear felled and converted into plantation after the attack of bark beetle (*Ips schmutzenhoferi*) are now in a good state and no other outbreak of bark beetles has been reported from the area. However, Dwarf Mistletoe (*Arceuthobium minutissimum)* occurs in the lower portions of the valley, where much of rural timber is extracted. Rural entitlements, has to be met from the affected trees as a priority over the healthy pines in order to control the outbreak to the young regeneration in these areas.

3.8 Non-Wood Forest Products

Within Chamgang HelelaFMU mushrooms, bamboo, leaf mould, fodder, stone, rocks and medicinal plants are collected. People here in the FMU extract bamboo for various domestic as well as commercial purposes. Medicinal tubers(*Paris pollyphylla*), rhizomes and Sew Shamu found growing on Rosa spp are collected and sold to local exporters (Annexure IX-Photos)**.**

Table 3.1 Non-wood forest products and their uses

Particulars	Uses
Bamboo	**Mat, fences**
Daphne	**Paper making and Dapa**
Mushroom (variety)	**Food**
Berry *(Rubus spp*)	**Fruits eaten**
Berbaris spp.	**Dye**
Gastroda elata	**Medicinal value (tuber)**
Rhododendron spp.	**Medicinal value**

4. ECOLOGY

Bhutan comprises an important part of the so-called East Himalayan biodiversity "hot spot" (Salter 1995). Globally, it is one of the few places with an exceptional concentration of species and endemism. This rich biodiversity is due to the wide variation in altitude, slope and aspect within a short latitudinal range, a varied climate and Bhutan's location at the interface of Indo-Malayan and Palaearctic Realms, where essentially different groups of species have evolved (Salter 1995).

4.1 Floral Associations

The CHFMU has a diverse floral association starting from cool broad-leaved mixed with blue pine and mixed conifer at the valley bottom, blue pine, hemlock and broadleaved, mixed conifer, Pure Fir zone and the flora turns to become pure *rhododendron spp*. At higher altitude*Acer spp* spreads across the FMU and bamboo is famous undergrowth prohibiting the regeneration of many tree spp. Many medicinal plant species has been present and new ones identified.

Blue pine stand is seen proliferating very quickly and is even observed in opened fir stands above at 3400 m altitude. Small pockets of pure Larix stand were also present especially in an around marshy areas.

5. SILVICULTURAL ASSESSMENT

5.1 Past Silvicultural Treatment

Four working circles were established in the previous management plan, they were: the Mixed Conifer Working Circle, Blue Pine Working Circle, Fir Working Circle and Hardwood working circle. Silvicultural systems discussed in the last plan were: Thinning and seed tree system for blue pine working circle, Group Selection system with maximum group size of 0.15 ha for mixed conifer working circle and group selection system with maximum opening size of 0.1 ha for Fir working circle. For hardwood working circle it was recommended that no harvesting will take place unless extremely necessary. All Working Circles were to incorporate Selection and Group Selection systems depending on the forest types and site conditions. These systems

were to be carried out using cable crane logging systems. Thinning had been prescribed in the Blue pine stands to improve quality of the final harvest. Natural regeneration was to be the main source of restocking and in areas where there was no adequate regeneration artificial regeneration was to be carried out.

In reality, Group Selection system was used, this is due to the use of cable cranes and the ease of extracting timber using this method. Some manual thinning has been done in the Blue pine stands when rural marking has taken place.

5.2 Plantations

Plantations from the last ten years are recorded in the NRDCL office and the Territorial office. The details of plantation carried out by NRDCL are listed in Table 5.1.

Table 5.1Chamgang Helela FMU Plantation (1992-2002)

Year	Area (ha)	Location *Block / Compartment.*
1992	6	Helela
1992	1	Chamgang
1999	2.27	Helela
1999	2.9	Helela
2001	4.73	Helela
2002	4.3	Tauding
Total	**21.2**	

Source: Plantation registers of FMU office (NRDCL & Territorial)

Table 5.2. Plantation creation in the Chamgang Helela FMU (2003-2008)

Sl. No	Block/ compartment	Year	Area (Ha)	Species	Plantation type	Survival % as of 2013
1	Chamgang	2003	3	Bluepine, Oak, larch, Acer & Fir	Regular & microsite plantation	65%
2	Helela	2004	2.20	Spruce, Oak, larch, Acer & Fir	do	65%
3	Chamgang	2004	0.40	B/pine, Oak, Larch & Acer	do	65%
4	Tauding	2005	4.3	B/pine, Larch, Oak & Acer	do	25%
5	Tauding	2006	0.77	Spruce, B/pine & Hemlock	do	30%
6	Tauding block II C	2007	2.07	B/pine, Spruce, Oak, Larch Acer, Fir & Hemlock	do	30%

Sl. No	Block/ compartment	Year	Area (Ha)	Species	Plantation type	Survival % as of 2013
7	Chamgang block II	2008	2.15	B/pine, Spruce, Oak, Larch Acer, Fir & Hemlock	do	25%
	Total Plantation Area		**14.89 ha**			**43.57%**

Out of the entire operated area of 30.06 ha only 14.89 ha plantation were created during the past plan for which the survival rate is 43.57%. Hence, creating plantation for the remaining 15.17 ha and restocking of areas with very less success rate is imperative for future management of the FMU.

5.3 Present Forest Types

The main forest types for the Chamgang Helela FMU are described briefly (Map 5).

Blue pine

Blue Pine is mostly found around the settlements and now started invading the open areas even into the Hemlock and Fir zone. The blue pine stand is at the new stand initiation stage and old growth is only in small patches. It occurs both in pure and in association with spruce (*Picea spinulosa*), oak (*Quercus semecarpifolia*) and poplar (*Populus cilata*). In the upper region, it is also found mixed with Hemlock (*Tsuga dumosa)*. Blue Pine is generally immature, ranging in age from 20-70 yrs and found along the lower valley.

Mixed Conifer

Mixed conifer is found all across the middle portion of the FMU. This forest type is dominated by spruce, blue pine, hemlock (*Tsuga dumosa*), larch (*Larix griffithii*), fir (*Abies densa*) and oak (*Quercus spp.).* Bark beetle infestation is the very common in the mixed conifer zone.

Broad-leaved (hardwood)

Hardwood forests were predominantly oak with acer, betula and hemlock. Mostly occurring in the moist northern valleys' of the FMU, which were harvested in the last two plan periods and currently colonised by bluepine and bamboo.

Fir

Fir forest in Chamgang Helela FMU is confined to the upper ridges up to the tree line and occurs mostly as pure stand, but it is also found mixed with Spruce and Hemlock. The dense canopy provides environment for luxuriant under storey of Rhododendron and other shrubs. Fir forest at the higher elevations are over matured old growth stand and protection should be the first priority, as regeneration is very slow on the steep and high altitude regions, hence harvest should be confined to suitable site conditions. Theinvasive nature of broadleaf species such as rhododendron hampers the regeneration of economically important species like Fir.

Table 5.3. Area of different Forest Types

Forest Type	Area (ha)	Percent Area
Blue pine	843.578	19.53
Mixed Conifer	3477.298	80.47
Total	4320.876	100

6. SOCIO-ECONOMICS

6.1 Common sources of Income

According to the socio-economic survey of 2015, main sources of income for the community in the FMU are agriculture, animal husbandry and small contract works. Majority of local communities are farmers having individual landholdings. Their main agricultural crops are potato, apple and buckwheat. They also cultivate a range of vegetables for personal consumption and also sold in Thimphu and Phuntsholing. Small contract works within the FMU consists mainly of the cutting and collection of firewood and extraction of timbers provided for rural use.

7. CURRENT TIMBER DEMAND AND SUPPLY

Due to enormous demand for commercial and rural timber in the past, the area of extraction has been exhausted and many parts were even clear felled. Clear felling in rural area resulted in deviation from the management plan prescription.

This has implications for FMU timber supply. AAC based on scientific, sustainable forest management has been revised downwards due to the improved knowledge gained during the first twenty years of fully managed operations. The AAC for second management plan had been reduced to 2000 m^3. This had been done because the area designated for commercial harvest had been almost completely logged and only small patch of forest was left unlogged. However, the 2nd management plan indicated a mixed conifer working circle to be operated with road construction of 4-5 km, but while extraction works were under full swing, the FMU was banned from commercial operations. Hence a patch of mixed conifer forest is still available for extraction but this plan doesn't recommend commercial operations with laying of cable lines.

However, rural and adhoc timber demands for religious institutions, dzongs, etc. shall be met based on single tree selection system from the designated area in the OPERATIONAL PLAN.

Table 7.1 The timber volumes harvested from CHFMU, over the last plan periods are listed below.

Quantity supplied per year in m^3					
Commercial (NRDCL) and Rural timber					
Year	Standing Volume Timber (m^3)		Firewood	Woodchips	Total
1st Management plan					
Commercial		**Rural**			
1995-96	5347	3220	2328		10895
1996-97	1520	1386	3313		6219
1997-98	16908	1092	1317		19316
1998-99	8998	4121	845		13964
1999-2000	3163	2884	469		6515
2000-2001	3162	5691	482		9335
Total					**66244**
	2nd Management Plan				
	Commercial	**Rural**			
2003	1541.45	1727.36	3829	55.96	7153.77
2004	786.66	1103.14	396	Nil	2285.8
2005	29.20	1390.48	11568	Nil	12987.68
2006	248.48	1462.02	2000	Nil	3710.5
2007	319.37	2071.42	40	139.96	2570.75
2008	933.30	436.83	2319	128	3817.13
2009	116.93	1699.68	184	118.21	2118.82
2010	15.41	2161.66	Nil	Nil	2177.07
2011	Nil	2147.28	164	Nil	2311.28
2012	Nil	3312.79	670	Nil	3982.79
2013	311.34	1416.34	276	Nil	2003.68
Total					45135.27
Grand Total					**111379.27**

Source: Production, Rural marking registers of CHFMU, final evaluation report for CHFMU 2014 and Forest Management Plan for CHFMU 2003-2013.(PS: Commercial extraction from 2009 onwards are wind fallen/thrown allotments)

8. ORGANIZATION AND ADMINISTRATION

8.1 Organisation

Chamgang Helela FMU is under the direct jurisdiction of the Thimphu Forest Division. The office of the Unit In-charge is situated at Chamgang near Chamgang Middle Secondary School, which is 9km from Thimphu.

8.2 Record Keeping

Record keeping within the FMU has been identified as a grave concern. Many of the records are incomplete or are not comparable at all. It is felt very important to maintain record of all the activities within the unit as per the record-keeping format of the FRMD reflected in the Forest Management Code of Bhutan.

While reviewing the area it was apparent that poor maintenance of data has led to many of the staff not knowing when the cable lines were actually operated. This in future could lead to extended rotation period as older cable lines are being neglected.

Survey notes for cable lines are maintained by the territorial field staff. The survey notes contain all of the information required except where the line starts. This result in notes that are may be completely useless. GPS points *must* be recorded for any traversed or surveyed cable line, plantation or other related activities. Plantation records needs to be maintained properly and NRDCL should erect and continuously maintain a sign board for each plantation area which is currently absent.

Activities within the FMU will be maintained on a sub-compartment basis as mentioned in Forest Management Code of Bhutan. Therefore, Chamgang-Helela FMU needs proper maintenance of activity records.

8.3 Health and Safety

In the environmental statement of the National Environmental Commission health and safety had been given a high priority.

Thimphu territorial office is taking up the implementation part of the forest management & the issue needs to be addressed by the implementers. At present health and safety measures are poor and sometimes absent altogether. Site specific risk assessment seems necessary if not Generic Risk assessment.

The major risk involved in the forestry operations are:

- Harvesting
- Transportation

The safety measures can be initiated with little or no expenditure to ensure the health and safety of the field staffs.

Below are the few recommendations to minimize hazards in the field;

- Ensure chain saws equipped with full functioning chain breaks.
- Licensed or certified chain saw operators should only be deployed.
- Always ensure feller to keep two tree lengths apart while felling.
- Explain the dangers of falling timbers.
- Stack timbers in the same direction and don't stack too high.
- Never climb or approach the log pile from the bottom of the slope.
- Always dismantle a stack from the top rather than from the bottom.
- Keep two products length while stacking mechanically.

9. INFRASTRUCTURE, TRANSPORT AND EQUIPMENT

9.1 Roads

Total length of motorable road in the Chamgang Helela FMU is 33.16 km. The road network throughout the FMU is not paved and some portions of the road are barely accessible, with monsoon showers making it difficult for plying.The only entry point to the FMU is through the existing take off point form Thimphu-Phuntsholing-Wangdue National Highway. The forest road network divided in various sections is shown in table 5.1.

Table9.1 Distribution of forest road network by blocks

Section	Road (km)
Main Chamgang road	5.47
Main Helela road	2.19
Talakha Goemba Road	8.546
Fir Top forest Road	5.16
Fir Spur forest Road	1.21
Lower Helela Forest Road	2.13
Upper Helela Forest Road	8.46
Total	**33.16**

9.2 Buildings

Office for Chamgang-Helela FMU is located within the FMU. Some of the staffs are based at this office with their families. Others have chosen to live in Thimphu and commute daily.

9.3 Transport

The FMU office doesn't have a separate vehicle but two wheeler bikes have been allotted to the FMU staffs for monitoring of activities. However, allotment of vehicle in future is necessary for better monitoring and smooth implementation of activities.

9.4 Equipment

Following equipment is registered in the FMU Office:

- One desk top computer (old)
- A telephone & a GPS (Garmin Etrex)
- Clinometer, compass, DBH Tape, meter tape, Tents.

10. EVALUATION OF PREVIOUS MANAGEMENT PLAN (2003-2013)

As a part of management planning process, it is necessary to review the period of last plan to recognize areas that are in need of improvement, or have overlooked. This review will comment on the objectives that were set for the last plan period and look at the field situation concerning harvesting, roads and regeneration. This is used as planning tool for plan writing but should also be used for future implementation in the field.

The recent evaluation of Chamgang Helela FMU was carried out in August 2014 by the Evaluation Committee appointed by Director General of Department of Forests and Park Services. The evaluation was carried out as per the Evaluation Form A, contained in the Forest Management Code of Bhutan. As per the Code, FMU evaluation for first five years have to be done as per Evaluation Form A & B, and its score are to be added to the final evaluation. However, for Chamgang Helela FMU, where planned operations started as early as 1993, midterm evaluation was not carried out and final evaluation was carried only in June 2014.

Chamgang Helela FMU was first established in 1993 but no records from that time are available. The last management plan from 2003-2013 is the only document for the last decade of harvesting. In 2009, FMU was declared as Thimphu Green Belt Zone hence all commercial operations were suspended. However, table 7.1 shows production of timber for commercial purposes, which is entirely based on the sanitation operations (allotment of wind fallen and wind thrown trees.) and not commercial operations.

10.1 Review of Goals and Objectives

Forest management plan for Chamgang-Helela FMU was written to protect the environment, wildlife, soil, water and timber aspect but it is imperative that this was not fully achieved. Due to the lack of budgetary requirement and support from other agencies, majority of the last plan was focused on timber harvesting as the key objectives. The CHFMU had broad goals and objectives that may not have been specific enough to drive management in the right direction. The new plan tries to tie together all aspect of the watershed to manage the CHFMU as an

entire unit involving stakeholders and the local people in the FMU. Many of the objectives in the new management plan are hoped to be achieved at some point during the plan period.

This should be used as tools to define where activities have been focused over the last 20 years and what areas have been neglected.

Goal

To protect the environment and at the same time provide sustainable supply of all forest produce to meet the needs of the local people.

The broad goal to manage the FMU on a multiple use and sustained yield basis was not achieved. This goal is usually considered as the long-term objective of the management. This means that unlike the management objectives which will be included in the management plan, it is not expected that goal will necessarily be achieved during the ten year planning period; only that by implementation all the objectives there will be some progress towards achieving the goal. The long term goal of establishing any FMU is sustainability of forest resources where restocking (natural or artificial regeneration) should go along with timber harvesting. However, CHFMU after the expiry of first management plan, from 1993 to 2002 the timber harvesting area had been depleted. The AAC (commercial) for second management plan from 2003 to 2013was drastically reduced to contain commercial harvesting and improve harvested areas, and subsequently commercial operations were halted in 2009 declaring the FMU as Green Belt Zone.

Therefore, the entire goal of sustainable management of forests to meet needs of local people have been achieved but the area to perform as the fully functional FMU had failed.

Objectives

To conserve, improve and maintain adequate tree cover to protect the environment, and to regulate water yield in the area.

Commercial area:

Timber extraction had been taking place in the Chamgang Helela FMU since time immemorial. After 17 years of commercial harvest first by Bhutan Logging Corporation and by NRDCL the FMU had been deforested and opened in many places.

Rural area:

Forest cover in Helela block had too been drastically reduced within the last 10 years

Following are the reasons behind the deforestation:

- Overlap of rural and commercial extraction site
- Excess allocation of rural timber from the same area
- Failure of maintaining mother trees in the area
- Illegal timber extraction

Therefore, to conserve, improve and maintain adequate tree cover had been not achieved.

Plantation

NRDCL had carried out plantations in many areas constituting around 14.89 ha of plantations. NRDCL had carried out mass plantation regime in the past with good outcomes and still needs to be done.

Areas harvested in the last 20 years by group selection system show good regeneration in blue pine zone, but lacks proper regeneration in mixed conifer and fir zone. This also signifies that maintaining adequate tree cover has not been achieved in the past plan.

To ensure sustained supply of timber, fuel wood and non-wood forest products.

The AAC for the second management plan (2003 to 2013) was set at 2000 m^3, with allocation of 650 m^3 to NRDCL and 1350 m^3 to rural usage.

Rural AAC of 1350 m^3 had never been complied and many issues had risen during the past management plan. Except in 2004 and 2008, the remaining years of the plan recorded deviation/excess allotment for rural use, tantamount to 22,131 m^3 equalling to Annual Allowable Cut for 16 years, thus creating a huge clear felled area. This had led to the exhaustion of potential production area for the future. Therefore, the objective *to ensure sustained supply of timber had failed.*

To regulate grazing in an orderly and sustainable manner, to benefit the local people.

Regulating grazing in the FMU is a huge challenge. People have right to use any forest area as a grazing land for their cattle. Chamgang Helela FMU serves as a summer pasture for around 55 cattles and 138 horses. The FMU serves as a winter pasture for around 2741 yaks. The cattle graze in the FMU for 6 months and move to the southern Dzongkhag in winter. Survival of plantations in the FMU due to grazing pressure is a big issue. NRDCL needs to fence the plantation areas near cowsheds and in areas where cattle densities are high. People also use tree species like Oak, for fodder with cut and carry system.

People should be educated with the knowledge of improved pasturelands or have to be encouraged to grow fodder species in their uncultivated private land or in vicinity of their cowsheds to reduce grazing pressure in the future. Hence, the objective remains to be fulfilled.

To involve local communities in the management of forest and tree growing in private land.

The participation of local people in protection and management of forest had picked up many years ago with the establishment of Kachu Penzhu and Rinchending Community Forests. The establishment of Community Forestry started in 2003 until the DoFPS had suspended establishment in 2013. The FMU level Forest Management Committee has been constituted and the series of committee meeting has already been held. The appointment of local stakeholders in the FMU Level Committee as member is expected to contribute positively to the protection and management of the forest. The objective thus is fulfilled.

To maintain and create conducive habitat for wild animals in the area.

Human wildlife conflict is still relevant in the CHFMU. Frequent encounter with bear and leopard pug mark near the settlements and cowsheds show these animals share their habitat with the cattle herds. Wild dogs are also considered a pest by the people. Sharing of habitat is as natural as cattle graze across the length and breadth of the FMU but forest as a whole supports a good number of wildlife population, as surveyed from their pug marks, droppings, pellets, and interviews from local people. Habitat as a whole had been bit disturbed specially in clear felled areas, nonetheless this goal seems to be achieved.

Involvement of the Local population through social forestry

Involvement of communities through Social Forestry had been enshrined in the old plan and communities were involved in forming community forests. Further, FMU level committee is also formed for decision making regarding the management of the CHFMU. However, the community had not been involved in plantation activities in the last plan. Thus, involvement of local population through social forestry had not been achieved.

Maintaining the aesthetic beauty of the forest, as seen from the National highway and Thimphu.

In an effort to maintain the aesthetic beauty of the forest, Government has declared the FMU as Green belt Zone and hence all commercial activities were suspended. None of the National Highway passes through the FMU, while viewing from Thimphu and plying through roads leading to the FMU, the FMU doesn't portray clear felled areas and aesthetic beauty is still intact.

10.2 Review of Harvesting Activities

Harvesting

To date, harvesting has been done with a fixed skyline and gravity cable system. The extensive reach of this cable system means that the impact from road construction has been minimised. Cable harvesting also causes far less damage to soils than other harvesting systems. Although alternatives to this system could speed up harvesting activities, it is unlikely that this system will be replaced in the near future.

Several issues have been realised within the CHFMU while reviewing the last plan period.

- Times between felling and extraction are too long, this had led to degraded timber and log splitting in the dry season. This needs to be better co-ordinated in the field so as not to leave timber lying in wait of cable set-ups.
- Un-extracted wind fallen trees and rejected rural timbers are breeding ground for bark beetle and needs their urgent removal.

- Congestion at the landing including poor log piling techniques, which isn't only safety hazard but also impedes production, this could be easily addressed with better landing management.
- Poor felling techniques such as high stumps, felling down steep slopes, which cause breakage and poor directional felling so that damage to surrounding standing timber occurs. This could be minimised with proper training of contract fellers, and should include safety issues relating to chainsaw use and maintenance.
- Cable lines can reach more than 1000 m, this has not always been used in the field. Cable lines should be extended to their full reach so as not to isolate patches of timber that will not be returned to.
- AAC is calculated in standing volume rather than using the volume from the depot register log. Volume measured in the timber depot is used to for NRDCL's record only. This lets NRDCL to leave behind unsound timber.
- Much of the harvesting has been of the highest quality stands,which yield maximum volume. This leaves many stands of lesser quality that will have to be harvested at some time. Stands should be alternated so as not to leave poor quality wood without harvesting.
- Some cable lines don't have any group openings. Proper cable line survey needs to be carried out and group openings should be created to efficiently utilise the matured trees around.
- Allocation of wind fallen trees for local use from commercial area had led to log rolling through the old cable corridor and damaging the established natural regenerations. Such incidences should not be repeated in the future.
- Allocation of wind fallen trees to rural people further away from the road had led to neglected logs and lops and tops which provides a breeding ground for bark beetle.

10.3 Review of Road Building Activities

Construction of road for timber extraction is very essential but at the same time environmental damages is also high. The total length of motorable road in the Chamgang Helela FMU is 33.16 km. The road network throughout the FMU is not paved and some portions of the road are barely accessible, with monsoon showers and winter snows making it difficult to ply.

Road condition

a. Side drains

Drains along the forest road are the most important component which ensures proper channelling of stream flow and surface runoff during monsoon. Proper maintenance of side drains preserves the structural integrity of the roads providing stability and reducing future maintenance cost.

Forest road in Chamgang Helela Forest Management Unit requires side drain maintenance as they were almost non-existent or were clogged with wooden debris and slide materials. Due to lack of side drain, road is waterlogged during the rainy season.

b. Stone soling

Roads in the FMU were initially constructed as seasonal roads during the time of Bhutan Logging Corporation without any stone soling. After preparation of the first Forest Management Plan for Chamgang Helela FMU the road was further maintained on need basis with stone soling but still it was observed that many portion of the road lacks proper stone soling.

c. Culverts

Culverts are the integral part of road structures. They ensure proper draining of storm water and efficient flow of small creeks. Proper culverts at strategic locations along the road will enhance durability and reduces maintenance cost. Roads in CHFMU need urgent and immediate instalments of new culverts in many places and maintenance of old un-functional ones. With presence of numerous creeks in the FMU, culverts should be maintained at any cost to safeguard function of environmental friendliness of the forest roads.

d. Retention walls

Due to the presence of unstable soil beneath and constant water logging of the roads, there were certain areas where retention walls needs to be erected. Signs of landslides have shown up in few areas which have to be mitigated immediately to prevent future environmental disaster.

e. Budget for maintenance

The road maintenance for CHFMU was ceased in 2009 after the commercial operations were at halt. However, maintenance budget of Nu. 12000/km/year (until 2009) is not sufficient for the FMU. NRDCL further deducts the tractor hire charge from the said amount, which leaves behind negligible amount to pay for the labourers. NRDCL, therefore, should revise the fund allocated to road maintenance.

10.4 Review of Reforestation

Various plantations done by NRDCL were visited and survey of regeneration survival status in some old operated cable lines had been carried out to confirm establishment of high density of seedlings reported through regeneration survey. Survival of the plantation was promising in few areas however reforestation through natural regeneration was questionable. Cable corridors and group openings falling inside blue pine working circle seem reforested well. However, those inside mixed conifer and fir working circle were still blank in many places. NRDCL from 2003 to 2013 had created 14.89 Ha of plantation which is far below the clear cut of 30.06 ha.

Grazing is a problem that has been identified by CHFMU staff. Unless action is taken to mitigate this problem then grazing will continue to affect the regeneration. Long periods of residual removal have an effect on regeneration. Cable lines must be cleaned as soon as

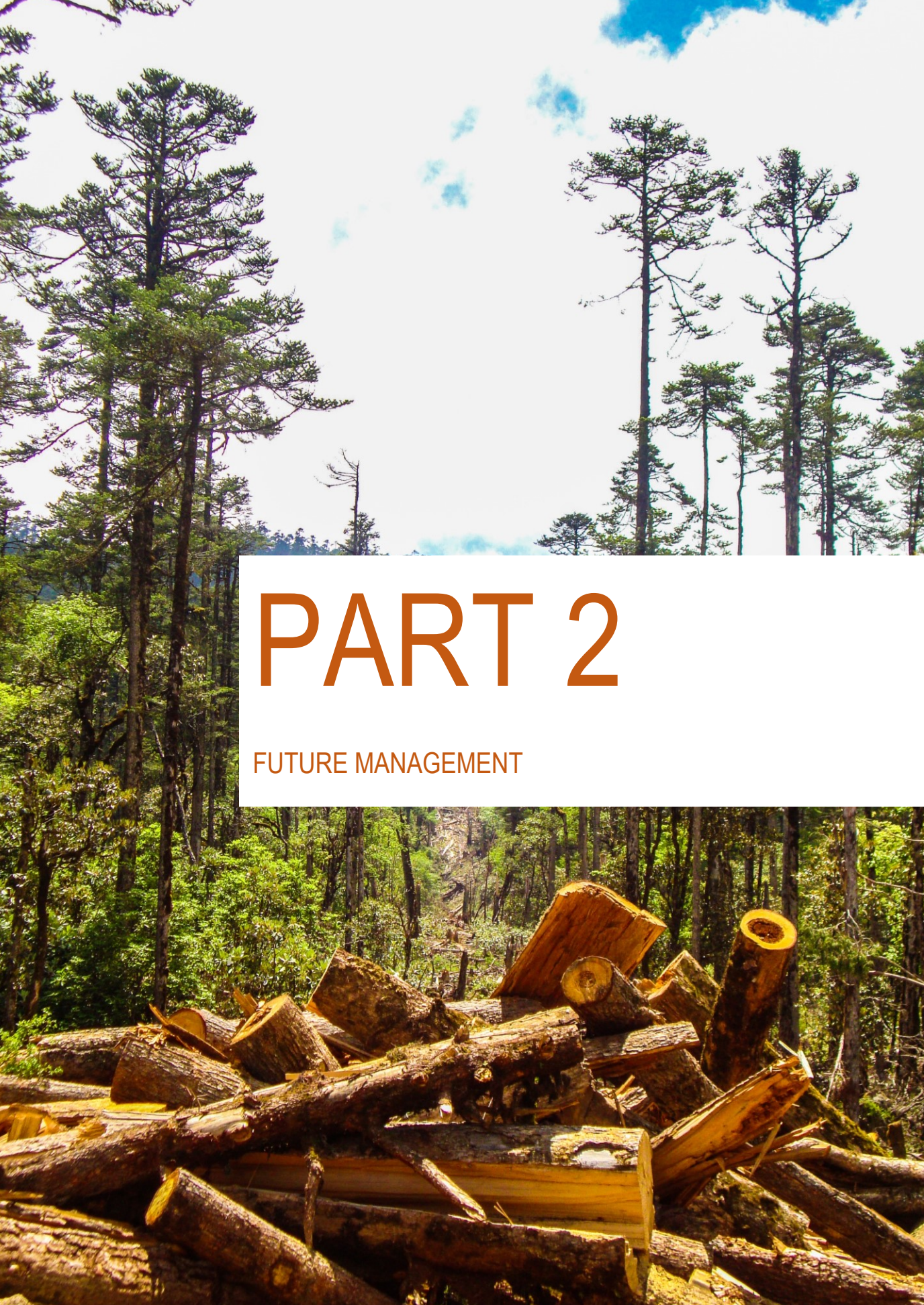
possible to allow the regeneration a chance to establish. Weed, bamboo and bush competition has effect on regeneration and there has been no control of these in the last plan period. Tending for regeneration is a must, as clearing and replanting will cost much more in the long run.

Allocation of wind fallen trees to local people along the old cable lines has destroyed established natural regeneration along the corridor and further the corridor width requirement have not been adhered. While the current plan doesn't foresee corridor width problem, owing to the ban on commercial operation, however such activities need to be addressed in the future, if commercial operation resumes.

10.5 AAC

The AAC of the last plan allocated to NRDCL does not exceed the overall AAC but the rural AAC had extremely exceeded.

Owing to the excessive harvesting in the first plan and years before that, the AAC for the second management plan had been reduced to 2000 m^3. This shows that AAC for the first management plan had been overestimated and as a result the FMU area for extraction had been completely exhausted during its very first plan period. The commercial AAC for the second management plan had entirely been achieved from alignment of transmission line only. Deviation from the commercial AAC is reasonable but rural AAC had been completely ignored which resulted in an overharvested clear felled areas.



PART 2

FUTURE MANAGEMENT

11. INTRODUCTION

Constitutional mandate of retaining at least 60% of the country under forest cover for all times to come and to satiate the needs of people for generations, forests need to be brought under sustainable scientific management.

Therefore, the Royal Government of Bhutan through firm national forest policy made mandatory requirement to have scientific management plans for all forest areas under commercial or any form of harvest.

11.1 Forest policy

The management plans for all protected areas and for all forests where commercial logging to be under taken needs to be approved and implemented according to the Forest and Nature Conservation Act of Bhutan 1995. This plan has been prepared in line with the Act and the Forest and Nature Conservation Rules of Bhutan. The plan reflects the Government's commitment to the sustainable management of its natural resources.

A conservation-oriented policy is adopted by the RGoB, which focuses on biodiversity conservation and meeting local demand through sustainable forest management.

According to the Kingdom's forest policy, four forestry sector goals have been set up:

Goal 1:*Protection of the land, its forests, soil, water resources, and biodiversity against degradation such as loss of soil fertility, soil erosion, landslides, floods and other ecological devastation and improvement of all the degraded forest and areas through proper management systems and practices.*

Goal 2:*Contribution to the production of food, water, energy and other commodities by effectively co-coordinating interaction between forestry and farming systems.*

Goal 3: *Meeting long-term needs of Bhutanese people for wood and other forest products by placing all the country's production forest resources under sustainable management.*

Goal 4:*Contribution to the growth of national economies, including export opportunities, through fully developed forest-based industries and to contribute to balanced human resources development through training and creation of employment opportunities.*

The Forest and Nature Conservation Act of Bhutan 1995, provides legislative framework to streamline community participation in forest management, and the preparation of supportive forest rules and regulations that layout best practices that apply nationwide.

11.2 Goal

To manage the forest on a multiple use, sustained yield basis for the production of timber, fuel wood and other forest products and for watershed, wildlife and environmental protection.

11.3 Objectives

The objectives of Chamgang Helela FMU have been divided under the management circles and the working circles were set up for the ease of implementation. Three management circles have been identified, Protection, Production and Non-Production with objectives listed below. This allows different areas to be managed and evaluated separately. Some of the same objectives may occur under different management circles.

Protection Management Circle

- To conserve and enhance wildlife habitats and biodiversity
- To conserve water catchment functions
- To meet local need of NWFP on sustainable basis
- To raise awareness of the importance of biodiversity areas
- To respect the sanctity of religious places

Non-Production Management Circle

- To maintain and improve the forest condition
- To meet local needs for collection of NWFPs on sustainable basis
- To manage grazing for livestock
- To conserve and enhance biodiversity
- To conserve the water catchment function

Production Management Circle

- To meet local requirements as priority for timber, fuel wood and other forest products on a sustainable basis.
- To protect the forest from fire and illegal activities and grazing in regeneration areas
- To create local employment opportunities
- To improve health and safety standard of the workers
- To conserve water catchment function
- To maintain biodiversity within the production area

11.4 Management based on Forest Function

11.4.1 Introduction

Grouping different potential uses of forest is termed as Forest Function. Different forest potential includes, soil conservation, watershed conservation, habitat for flora and fauna and resource based for many kinds of human needs. The values and ranking of such functions are

different for each FMU and they depend on location, site, forest type, accessibility, landscape and other factors.

Schindele and Dhital (1997) describes concept of forest function planning as applied in Bhutan. This plan only deals with the application of forest functions of this particular FMU, whereas Schindele and Dhital (1997) provide complete background and its detail. Forest function map is the ultimate result of forest function planning. Forest function mapping is the planning tool and need to be overly discussed, as long as the basic concept is understood. The forest function map forms the bridge between the planning and implementation.

Section 5 Management Plans and Section 21 establishment of Protected Areas of the Forest and Nature Conservation Act of Bhutan 1995, provide legal backing for forest function planning. The objectives of forest function planning for this management plan are:

- To define, for a particular area (FMU), different environmental and social functions of the forest and depict them on map.
- To identify production forest, non-production forest and protected forest.
- To provide a tool for the management planner for balancing different requirements of nature conservation, environment protection, social forestry and commercial timber production, among others; and to provide spatial information required to compute sustainable AAC while, at the same time, satisfying the management prescription and restriction of different forest function.
- To provide FMU In-charge with information on the location of different forest functions in order to enable him/her to specify the required management prescriptions on the ground and to control their implementation.

11.4.2 Function Groups

The functions used in this management plan are listed in table below.

Table11.1 Different Forest Function used in the Plan

Code	Function Group (Bold) and Functions
S	Soil Conservation
SC	**Soil conservation**
SP	**Soil Protection**
W	Water and Watershed Conservation
WRR	**Riparian Reserve Protection**
WSh	**Watershed Conservation**
WLS	**Local Water Supply Protection**
N	Nature Conservation
NWP	**Wildlife Protection**
NWC	**Wildlife Conservation**

Code	Function Group (Bold) and Functions
Soc	Social Function
SocL	**Social (Local Use Only)**
SocRS	**Religious Sites Protection**
RB	**Road Buffer**

11.4.3 Mapping Forest Functions

The criteria used to prepare forest function map for CHFMU is given in the table 11.2 below. In this table, information for some criteria is not available or cannot be mapped at the scale used for planning. These criteria are indicated in *italics*. When Operational Plans are prepared new detail is to be collected and these criteria should be implemented.

Table 11.2 Criteria for Mapping Forest Functions

Function group and Codes	Criteria for Mapping
Soil Conservation	SP: **very steep areas (slopes of greater than 100%), *areas with indication of slight to moderate erosion.*** SC: **steep or sensitive areas (slopes of 76-100%)**
Water and Watershed Conservation	WSh: **catchment areas of water courses, water retention areas.** WRR: **areas within 30 m along all perennial streams, water logged areas, swamp etc.** WLS: **upper catchment areas of streams serving as drinking water supply for settlement downstream.**
Nature Conservation	NWP: **alpine areas, *ecosystems of high conservation value.*** NWC: **areas identified as biological corridors and all areas rich in wildlife, both in species and in number.**
Social Function	SocL: **area close to or accessible to settlement or village, the areas traditionally used already with definite boundaries.** SocRS: **lhakhangs/ goenpas, gney and other religious sites.**
Road Buffer	RB: **200 m uphill and 100 m downhill for motor able public road, 30 m uphill and 10 m downhill for unstable forest road**

11.4.4 Restriction of Forest Functions

The specific restriction to be applied to forest in the various function categories are summarized in following table;

Table11.3 Forest Function Restriction

Code	Function	Commercial Use	Local Use
SP	Soil Protection	No Commercial use	**No tree felling, Reduce human Interference**
SC	Soil Conservation	No Commercial use	**Low impact local use**
WRR	Riparian Reserve Protection	No Commercial use	**Only collection of NWFP**
WLS	Local Water supply	No Commercial use	**No tree felling**
NWP	Wildlife Protection	No Commercial use	**Restriction to activities that do not change habitat quality and disturb wildlife.**
RB	Road Buffer	No Commercial use	**No tree felling**
SocRS	Religious Site Protection	No commercial use	**Use only which do not disturb sanctity of place**
SocL	Social/ Local use only	No commercial use	**Local use only**
NWC	**Wildlife Conservation**	**No clear cutting; no conversion into plantation; leave snags; leave some undisturbed patches; minimize disturbance to under-storey vegetation.**	

12. QUANTITATIVE RESOURCE ASSESMENT

12.1 Forest Management Inventory

The Forest Resources Management Division had carried out two forest management inventories in the past. The third inventory for Chamgang Helela Forest Management Unit

was carried out in 2015. The general objective of the inventory was to provide essential background information for revising Chamgang Helela Forest Management Plan. More specifically, objectives of the inventory were:

- To study the changes in growing stock
- To provide relatively accurate overview of the growing stock and regeneration potential of natural forest in the area, according to major forest types
- To give an overview of general site characteristic of the natural forest, in terms of soil, non-green vegetation and the use by local population
- To provide an indication of timber quality in different forest type
- To furnish essential data on tree height to enable construction of local volume table for main species

The standard FMU inventory technique was used, with data being collected for the trees >10 cm DBHOB. **A total of 237 plots were laid throughout the CHFMU area at the spacing 450 m x 380 m.** The inventory was designed with target sampling error of +/- 10% and the coefficient of variation of 80%. Every fourth plot in the line was measured as special plots.

12.2 Forest Management Inventory Results

A total of 237 plots were measured but of these plots only 105 were used for production planning as the remaining plots were located outside the production area specified for non-production use. From the total plots 27 plots were inaccessible. These 105 plots were used in the calculation of the AAC and the 'discarded' plots were used in analysis of wildlife and other forest attributes.

The summary of the inventory results is shown in the tables 12.1 and 12.2

Table12.1 Summary of Inventory results for the FMU

Stratum name	Gross area (ha)	Number of plots	Stems per Ha (Ave)	SE* % of stems per Ha	Gross Volume per Ha (Ave)	SE* % of Volume per Ha	Basal area per ha (Ave)	SE* % of basal area
Blue Pine	843.578	14	155.714	9.39	216.16	49.676	17.363	39.123
Mixed Conifer	3477.300	91	148.132	9.865	241.244	20.715	24.438	16.154
Combined	4320.878	105	149.143	9.39	279.545	16.565	23.495	15.059

* SE = sampling error (95% level of probability)

** Note that the area sampled is less than the area of the FMU. The inventory results are only calculated for the operable/accessible areas of the FMU.

It should be noted that the above figures are for the stratum as a whole, and include all species recorded in the inventory plot.

13. AREA ORGANIZATION

13.1 Spatial Organisation

To facilitate management, the Unit is divided into Blocks. Blocks in Chamgang Helela FMU will remain same as in the last management plan. Blocks have been demarcated according to natural drainage and terrain features wherever possible. The FMU has been divided into 3 blocks: Chamgang, Helela and Tauding. Blocks are further divided into Compartments and Sub-compartments.

Compartment and sub-compartments boundaries will also remain the same, with exception to Chamgang block. With the establishment of Rinchending and Kachu Penzhu Community Forest within the FMU, area of compartments and sub-compartments in this block have been reduced. The division of area up to sub-compartment level would provide the field staff with an easier and more reliable way of recording information (Map 2).

The composition of Blocks and Compartments is given in Table 13.1 and shown on Map 2.

BLOCK NAME	BLOCK AREA	COMPARTMENT	SUB COMP	Area (Ha)
CHAMGANG	1405.31	I	1	265.15
		I	2	41.64
		II	1	7.41
		II	2	141.74
		III	1	39.66
		III	2	9.77
		III	3	35.16
		IV	1	87.69
		IV	2	102.21
		IV	3	17.22
		V	1	88.85
		VI	1	166.09
		VII	1	27.85
		VII	2	10.26
		VII	3	244.33
		VII	4	119.06
		I	1	38.29
		I	2	139.76
		II	0	485.31
		III	0	414.77
		IV	1	47.56

HELELA	2534.52	IV	2	16.60
		IV	3	7.35
		V	3	736.99
		VI	1	6.55
		VI	2	21.80
		VI	3	5.51
		VI	4	21.02
		VII	1	9.92
		VII	2	48.92
		VII	3	434.91
		VIII	1	57.47
		VIII	2	35.22
		VIII	3	6.58
THAUDING	570.13	I	0	211.59
		II	0	358.55
Total Area				**4508.78**

Since felling of trees along river banks, streams and in steep gullies is not permitted under the Forest Act, block boundaries have been drawn to, as far as possible, follow natural waterways to a point where a spur easily recognisable on the ground leads to a ridge top.

13.2 Determining Operable Area

FMU's are used for multiple-objective purposes, commercial and rural use forestry activities are only two of a number of functions. Areas for commercial and rural forestry activities are those that are left after areas for other critical functions were identified and mapped out, using GIS and inventory information. The functions that take precedence over commercial and rural forestry activities are:

- Riparian buffers and zones
- High altitude zones (above 4000 m msl)
- Soil protection areas (slopes greater than 100%)
- Biodiversity areas (wildlife protection)
- Religious site protection
- Agricultural uses
- Road buffers

13.3 Organisation into Management Circles and Working Circles

Function mapping was used to delineate three different Management Circles; these are large areas where the management objectives differ as listed in Section 11.3. Management Circles in the CHFMU will be Protection, Production and Non-Production. Protection Management

Circle includes soil protection, wildlife protection, religious areas and stream and road buffers (Map 9). Production Management Circle includes all areas where harvesting can occur (Map 6).This Management Circle includes the Working Circles where harvesting will take place. The objectives for each Working Circle are listed in Tables 13.3 to 13.5. Non-Production area is all the remaining area in the FMU, including private and cultivated land, non-forest areas (Map 6).

Table 13.1Area Statement for Management Circles

Protection Management Circle	Area Ha
Soil Protection	155.10
Buffers	204.65
Wildlife Protection	352.76
Ecological reserve	50.94
Aesthetic protection	476.18
Catchment areas	1022.39
Non-Production Management Circle	
Non-forest area (blanks and grassland)	67.63
Private/Cultivated Land	77.44
Production Management Circle	
Blue Pine Working Circle	343.91
Mixed Conifer Working Circle	1757.78
Total	4508.78

13.4 Management Circles

13.4.1 Protection Management Circle

This area will be managed to give total protection to natural environment. The Protection Management Circle is relatively small, comprising of alpine area, local water supply areas, soil protection and religious sites. Stream buffers are also included in this Management Circle and are mapped to the best of our ability, however it is necessary to identify streams in the field during the Operational Inventory and treat them accordingly.

Table 13.2 Protection Management Circle

Management Objectives	Management Options	Responsibility
• To conserve and enhance wildlife habitats and biodiversity.	• Regenerate local water supply areas • Avoid disturbance • Promote research	• Territorial • All parties • Territorial
• To conserve the water catchment functions.	• Minimal intervention	• All parties

Management Objectives	Management Options	Responsibility
• To meet local needs for NWFPs, sustainably, from alpine areas.	• Provide licensing for local residents • Resource assessment	• Territorial • Territorial
• To protect the forest from grazing, fire and illegal activities.	• Involve local people in mitigating impact	• Territorial
• To raise awareness of the important biodiversity areas.	• Public meetings/Field visits • Literature • Research	• Territorial • Territorial • Territorial
• To respect the sanctity of religious places.	• Non-intervention	• All parties

Dialogue is required within the FMU Level Management Committee to decide on activities that will achieve these objectives. These activities will be decided and budgeted for the Operational Plan.

Removal of trees may be permitted in the Protection management Circle to deal with outbreaks of pest and diseases and Silviculture operations may be carried out to improve stocking and reforest degraded area.

13.4.2 Non-production Management Circle

This management circle includes inaccessible land, private land, Sokshing and tsamdos. This area will be managed to promote the use of forest, other than timber harvesting, while maintaining the biodiversity and watershed values.

Table 13.3 Non-Production Management Circle

Management Objectives	Management Options	Responsibility
• To meet local needs for collection of NWFP	• Promote Community Monitoring	• Territorial
• To maintain and improve the forest condition	• Regenerate • Silviculture operation	• NRDCL/Territorial • NRDCL/ Territorial
• To manage grazing for livestock	• Fodder tree plantation and local involvement	• Territorial/ CFO/ Gup
• Environmental conservation	• Environmental concern are to be taken into consideration while activities are implemented	• NRDCL/ territorial

Removal of trees may be permitted in the Non-Production Management Circle to deal with the outbreak of pest and disease and Silviculture operation may be carried out to improve the existing forest stand.

13.4.3 Production Management Circle

This area contains commercially important species where timber harvesting will take place. However, due to lack of any potential production area and properly established natural regenerations in previously harvested cable lines, no commercial harvesting shall take place during the current plan period.

This Management Circle is comprised of following working circles;

- ⇨ Mixed Conifer Working Circle
- ⇨ Blue Pine Working Circle
- ⇨ Non-Wood Forest Products Working Circle (overlapping)

Table 13.4 Production Management Circle

Management Objectives	Management Options	Responsibility
• To meet local need for timber and other forest produce on sustainable basis	• Priority must be given to local people	• Territorial
• Enhance and improve forest condition and productivity	• Suitable silvicultural operation • Plant degraded area	• NRDCL/ Territorial • NRDCL/ Territorial
• Create employment	• Involve local people	• NRDCL/ Territorial
• Maintain Biodiversity within production area	• Field visit • Research	• Territorial

13.5 Management of Working Circles

Production Management Circle has been divided into two regular working circles and one overlapping working circle. The activities of each working circles to meet the objectives differs. The objectives, management options, responsibilities, monitoring and evaluation and silvicultural systems specific to each working circle is given in the following table:

13.5.1 Non-Wood Working Circle (Overlapping Circle)

Non-Wood Forest Products (NWFP) is an important, but underestimated (in earlier plans) part of the economy of many countries. Non-Wood Forest Products (NWFP) was formally known as minor forest products or non-timber forest products because of their contribution in the country and the forest revenue.

Over the years, NWFP has been given priority and more communities are encouraged to participate in the care, collection and trade of NWFP species. It is studied that if NWFP is taken good care and managed sustainably, not only it will aid in alleviating poverty but also

gradually aid in forest and wildlife conservation, as they are found in different niches and micro climates that determine the edaphic factors for better growth of forests. Hence, the need to meaningfully and genuinely integrate NWFP Working Circle in this Forest Management Plan appears to be necessary.

Abundance of NWFP species especially Mushroom,*Aconitum Spp, Neopicrorhiza scrophulariiflora, Satuwa and Gastroda elata*are prominent at Chamgang Helela Forest Management Unit,andas NWFP is an income generating source to these people,the communities should start managing these resources with formation of NWFP groupsfor proper resource assessment and technical assistance from the Department.

13.6 Organization into working circles

Production forests have been classified into different Working Circles for easy management of the forests. The production Working Circle include all the areas where harvesting can occur, Production Working Circles consist of the following Sub-Working Circles;

Management of the Sub Working Circles

Working Circles are created on the consideration of stands requiring similar Silviculture treatment and rotation age. The production Working circle has been divided into two major sub working circles.

i. Mixed conifer Working Circle
ii. Blue pine Working Circle

All Working Circles address the goal and objectives for Production Management Circle given above. However, the activities for each Working Circle to meet the Objectives differ.

Since there is no available commercial timber harvesting areas and forest in some parts had been degraded due to rural timber extraction the production working circle shall be managed to built up the potential for future timber production. Past operated areas should be thoroughly surveyed and areas with little or no established natural regeneration should be planted immediately. Plantation survival survey should be carried out on regular interval and failed plantations should be immediately refilled.

Other activities like collection of firewood, sand and boulder can be carried out with proper field verification by the unit in charge. In case of bark beetle epidemic FRMD should be informed by the CFO, Thimphu Territorial Division and further activity can be prescribed with field verification. Thinning in young blue pine forest if necessary can be carried out on need basis.

Blue pine working circle falling within the rural use area will be managed under single tree selection system with proper field verification by the Unit In-charge.

13.6 Implementing Working Circle Management

Forest function planning concept has been used in this plan to allocate land use among forest in the FMU, so that strategic planning for restocking of the lost forest areas can be carried out. Albeit problem of implementation of prescriptions remainin the field.

Later sections indicate that this will be done through an operational planning process, whereby information that is more detailed is collected through inventory and discussions with stakeholders, local communities and NRDCL. However, even when more detailed data is collected, requirement remains to locate individual Forest Functions on the ground so that prescriptions and objectives can be implemented. Although maps have been prepared indicating the boundaries of Forest Functions, locations on the ground can be complex. In addition, experience in the field indicates that the base from which all maps are derived, the 1: 50,000 topographic maps, are often inaccurate and difficult to use for implementing operational plans.

Therefore, the Unit In-Charge will have to use the maps provided to the best of his/her ability. Areas would be observed on forest functions maps prior to going into the field. Once in the field visual observation within the areas should be able to provide the required information. For example, stream buffers will occur on all streams and steep slopes should be measured and observed for soil protection or conservation. The forest function map will be updated accordingly as per the field observations.

14. YIELD REGULATION AND HARVESTING

14.1 Determination of AAC

Principle of Sustainability, the backbone of Forest Management is an accepted norm in forest management and forms the core principle of organized forestry. The concept has evolved from the basic consideration that the later generation may derive from the forest at least as much of the benefits as the present generations. The principle of sustained yield ensures the stability and continuous supply of raw materials to the industries, and meets the social and domestic needs of the people.

Sustained Yield management allows harvesting of forest resources in a way by which annual cut and other losses of timber do not exceed the average annual growth and assures continuity of harvest, indefinitely, without impairment of the productivity of the soil. Sustain Yield Calculation is expressed as Annual Allowable Cut (AAC).

It is now understood that AACs calculated for the older FMUs, particularly in western Bhutan, were too high and unsustainable.

Reasons for AACs being above a sustainable level can be summarised as:

1. FMU inventories over-estimated mature standing volume. Reasons may include variable quality of early fieldwork, volume function problems, bias in systematic sample location, data processing problems and certainly, incorrect post survey stratification.

2. Assumed rotation lengths being optimistic and not accounting for long regeneration periods.
3. Fir dieback and spruce bark beetle may have gradually reduced the utilisable standing volume.
4. The gross operable area was overestimated in the Management Plan.
5. No or insufficient allowance was made for portions of operable stands being inaccessible or inoperable due to small terrain features. *Gross* area was not reduced to a workable *net* area.

With these problems with the AAC, ecological conditions of certain areas of Chamgang Helela forests are not in a good state.Currently the pressing issue is perhaps not environmental but economic sustainability. A sustainable forest policy had somewhat been compromised right from the very first plan by overestimation of the AAC and far more area had been covered. This had led to drastic reduction of AAC in the second management plan.

The Chamgang Helela AAC calculated for the previous (1993-2002 and 2003-2013) management plans was based on an AAC derived separately for each of the four Working Groups.

$$\text{For the three main conifer groups AAC} = \frac{\text{Net operable area}}{\text{Rotation}} \text{ x average standing vol./ha}$$

14.1.1 Increment Based AAC's

In theory, with a prefect structured normal forest it should be possible to sustainably cut the annual increment each year. Some calculation methods rely heavily on increment. Unfortunately, data on growth rate is still limited for Chamgang Helela FMU and Bhutan in general, and it will take some time before valuable data from permanent plots are available. In addition, forest in Bhutan are not perfectly structured, they vary really in natural growth, some of the stock particularly the Fir zone had negative increment rate as decay exceeds new growth. In the long term, increment should increase as over mature stands are replaced by younger stocks, but it will be many decades before this second growth is available for harvest. In the meantime there is over-mature growing stock and too little and unreliable increment data to use in determining AAC, therefore increment based AAC's are currently unsuitable for Bhutan.

14.1.2 The Most Appropriate AAC Method

A very wide range of formulae and calculation approaches are available, advantages and disadvantages can be argued for each. Whilst it is difficult to define a clear *best* method for Bhutan, there is a strong case for standardisation around a fairly simple and robust single

methodology. However, for the past two management plans of Chamgang Helela FMU, the following calculation is used for calculating the AAC:

$$\text{AAC per Working Group} = \frac{\text{Net operable area}}{\text{Rotation}} \times \text{Average standing Vol./Ha}$$

This calculation is performed for each working circle, providing an AAC per working circle. These are summed together, to provide the total AAC.

14.1.3 The Calculation of AAC for Chamgang Helela FMU

a) **Net operable Area**

The operable area for the FMU identified through mapping and GIS is the *Gross operable area*. Majority of the FMU area had been harvested and small pockets of unmapped areas such as minor terrain, rocks, water, and other conservation areas needs to be considered.

Therefore, for Chamgang Helela FMU, it is surmised that about 25% is inoperable.

Table 14.1 Net Operable Area

Working Circle	Gross Operable Area (ha)	Calculation -25%	Net Operable area (ha)
Blue Pine	343.76	25%	257.82
Mixed Conifer Pine	1758.04	25%	1318.52
Total	**2101.8**		**1576.34**

b) Rotation and regeneration period

Species rotation is an imprecise concept in silvicultural system other than clear cutting and replanting. Given that reliable increment data is still very limited, assumed rotation lengths need to be cautious. The rotation ages used in the previous management plan are considered good tentative rotation ages. Two issues need considering. Firstly, as the 2003-2013 management plan stated, the rotation ages are tentative, and should be revised as more information is obtained. Secondly, the rotation ages do *not* consider regeneration periods. An optimistic regeneration period, from completion of harvesting to restocking with viable regeneration may be 10 years for Blue Pine and 20 years for Fir, Spruce and Hemlock. This has been added to the rotation length in this management plan. The rotation lengths used for the AAC calculation are:

- **Mixed conifer working circle: 160 yrs rotation**
- **Blue pine working circle: 120 yrs rotation .**

Therefore, after considering all the elements mentioned above, the Annual Allowable Cut would be calculated using the following formula:

AAC per Working Circle = Net operable area x Average standing volume/ha.

Rotation

c) Average Standing Volume

Mature Standing Volume is taken from the inventory information that is calculated using <PLOT> data processing software developed especially for FRMD. Owing to the high sampling error, the range of possible standing volumes at the 95% probability level is large, meaning that there is a high level of uncertainty with these figures. The sampling error and RME for each stratum is given in the following table.

Table 14.2 Average Standing Volume

Strata	Average Standing Volume (m^3/ha)	Sampling error % (at P=0.95)	Reliable minimum estimate (m^3/ha)
Blue Pine (Combined)	216.16	49.676	108.78
Mixed Conifer (Combined)	241.244	20.715	191.27

d) AAC for each working circle

The AAC for each working circle, based on the above is:

Table 14.3 AAC for Working Circles

Strata	Gross operable area (ha)	Net operable area (ha)	Rotation (Years)	RME of mature standing volume (m^3/ha)	AAC (m^3/year)	Clear cut equivalent (ha)
Blue Pine	343.76	257.82	120	108.78	233.71	No clear cutting
Mixed Conifer	1758.04	1318.52	160	191.27	1576.22	No clear cutting
Total	2,101.80				1809.93	No clear cutting

Note: Final Net production area for calculation ofAACs had been reduced by 25% from the initial gross production area because the whole area had been under timber extraction for the past many decades and also considering small patches of unmapped blank areas and steep areas.

Table 4. AAC contribution from different size classes

CONIFERS (DBH CLASS)	Percent contribution
10-30cm	5.25
31-60cm	29.40
61-90cm	29.06
91-180cm	36.29
Total	100.00

Since the calculated AAC comes at around 1809.93 m³ standing volume.***Therefore, the AAC fixedfor Chamgang Helela FMU is 1800m³.***

e) AAC

It is permissible to vary the AAC by plus or minus 10% in individual years, but the volume cut in each five year period must be no more than five times the AAC. No Commercial AAC has been prescribed for the next ten years. However in an event of timber requirement for commercial purposes such as Lhakhang and Dzong constructions and other time bound projects, timber shall be allocated on single tree selection basis within the prescribed AAC.

14.2 Recording and Accounting for AAC

AAC will be monitored through the records of trees marked (Tree Marking Register) for local use in all Working Circles. AAC has been calculated as gross bole volume, this is the measure that should be totalled on an annual basis from the Tree Marking Register. Since no AAC for commercial harvest had been prescribed, trees marked for sanitation logging needs to be maintained separate and properly. A digital computer record keeping needs to be maintained for harvesting and other activities in the FMU.

Proper record of timber extraction done for the sanitation purpose, if any needs to be maintained both with the FMU and NRDCL Unit office which is missing currently.

14.3 Allocation of AAC

AAC has been allocated for rural use (within the FMU) and the current plan shall not prescribe any commercial AAC instead the focus of NRDCL or the Department should be on restocking and restoration of the past operated/degraded areas.

According to the evaluation report of the past plan (Rural AAC of 1350 m^3) timber supply should not exceed 13500 m^3 in 10 years. However, rural timber supplied was 22,131m^3 in the last ten years exceeding the actual prescribed rural AAC. Although the actual demand within Dagala gewog is low, the allocation exceeded with high demands from outside the gewog and*ad hoc* timber supplies to lhakhangs and dzong renovations.

In spite of the demand, current AAC has come down due to high extraction rate in the past and lack of fully stocked and matured forests.

Therefore, during the current plan Chamgang Helela FMU should first cater to the needs of people living within the FMU and rural timber demand from outside Dagala gewog should be diverted to areas outside the FMU's or allocate within the prescribed AAC. The FMU should be left to regenerate naturally as well as plantation needs to be initiated to restock the felled areas.

14.4 Distribution of the cut

Blue pine stands covers large areas within rural use area of the FMU and has the greatest potential for rapid increment and growth. Pine forests must be managed more intensively and with a view to increase future potential. Currently, annual increment is about 1.9 m^3/ha/yr. This must be improved through thinning and improving the density of trees in others.

This ten year management plan involves a lot of re-structuring: moving away from a logging-centred approach, exploiting the existing old-growth forests; towards a forest *development* approach, involving thinning, plantation and involvement of stakeholders.

A restoration plan needs to be included within the Operational plan for the next ten years in specific compartments listed in the annexure. This plan should be loosely based in order to schedule plantation activities while leaving room for changes that may occur due to pest and disease. Areas within the CHFMU had become scarce and a restoration plan would aid the UIC in decision making and implementation.

15. SILVICULTURAL SYSTEMS

15.1 Past Silvicultural Treatment

Starting from the first Management Plan period (1993-2002), Group Selection System was prescribed based on forest type and mode of regeneration. Group Selection System is considered as an appropriate silvicultural system for managing temperate Mixed Conifer forests, as it promotes natural regeneration and requires no treatment to induce natural regeneration (Moktan, 2003). Single Tree Selection System was prescribed in local use forests areas for rural marking.

No commercial harvesting activities shall take place in the FMU during the current management plan, except during bark beetle incidences and other natural calamities.Silviculture systems that shall be followed during the current plan period is single tree selection system, thinning and salvage harvesting. However, thinning and salvage harvesting can be done on priority basis with technical assistance from FRMD.

15.1.2 Thinning

Young blue pine stands will be worked under thinning, with positive selection to stabilize structure and to increase quality of the stands. This type of thinning will be to direct growth potential of the stand and site to most promising individuals of tree populations to maximize volume and quality production. Stands to be thinned will be identified from Blue Pine Working Circle by field visit. Marking of trees will depend on the number of stems per hectare,

age or size class and spatial distribution. Pole crop stands should have a target of 400 trees per hectare (5 m spacing). Spacing can increase or decrease with the size class. Dead, dying, malformed and diseased trees will be thinned on priority basis. Large opening must not be created.

15.2 Silvicultural research findings 2014(RNR-RDC Yusipang) for general reference

Silvicultural systems prescribed in this management plan are as per the research findings recommended for Forest Management Code of Bhutan, compiled by RNR-RDC Yusipang dated 11 November 2014.

Silviculture is an art and science of cultivating forest crops (caring, tending, harvesting) based on the study of the life history and general characteristics of forest tree in combination with specific site and social factors.

A. Blue pine (*Pinus wallichiana*)

Table 15.1 Silvicultural Management Recommendation for Blue pine

Sl no.	Sites	Silvicultural System
1	No pests	• Single tree system • Small group opening
2	Mistletoe infected stands	• Clear cutting of infected trees

General recommendations

Blue pine stands usually have a tendency to occur in dense stockingwhich leads to high mortality and instability. Therefore, conducting periodic thinning in blue pine stands is of paramount importance.

Thinning

- Stand density regulation/spacing should be carried out early at top height of 5 m or an age of 10 years.
- Spacing should be of 2 m with a resulting stand density of 2500 trees/ha.
- When the stand reaches crown closure (1/3 of rotation age or 12-15 m top height), plus trees should be selected and marked depending on the diameter requirement.
- Stand with Cham size trees(50-90 years) with a target DBH of 40 cm, an optimum spacing of 6-6.5 m needs to be maintained which will result in 260 stems/ha.
- Stand with drashing size trees(90-130 years) with a target DBH of 50 cm, an optimum spacing of 7 m needs to be maintained which will result in 200 stems/ha.

B. Spruce (*Picea spinulosa*)

Table 15.2 Silvicultural Management Recommendation for Spruce

Sl no.	Site conditions	Understory conditions	Management type	
			FMUs, WS, Leased SRF	CF, PF, SRF outside FMUs, PA
1	Moist sites (mostly northern aspects, valleys)	Bamboos and under story competitors	• Group selection (0.1-0.25 ha) • Single tree selection	Group selection (0.1 ha) Single-tree selection
		Herbaceous understory, no major competitors	• Group selection (0.25-0.35 ha) • Single tree selection	Group selection (0.1 ha) Single-tree selection
2	Dry sites (mostly southern aspects, ridges)	Bamboos and understory competitors	Slit cut (0.1 ha:20 m *50 m) Group selection (0.1 ha)	Group selection (0.1 ha) Single-tree selection
		Herbaceous understory, no major competitors	Slit cut (0.125 ha:25 m *50 m) Group selection (0.1 - 0.15 ha)	Group selection (0.1 ha) Single-tree selection

General Recommendations

- Thinning and tending needs to be carried out to avoid thin unstable trees
- Create small openings on dry sits with bamboos/rhododendron to reduce bark-beetle attack
- Directional felling is recommended on sites with bamboo/rhododendron to reduce these species
- Sanitation needs to be required to avoid bark beetle attack
- Maintain rotten logs and woody debris as seed beds for regeneration as shown below

Table 15.3 Opening size coarse wood debris relation.

Sl. No	Opening Size (Ha)	Coarse wood debris (CWD)
1	0.15	0.6 -1.3 m^3
2	0.20	0.8-1.8 m^3
3	0.30	1.0-2.3 m^3
4	0.35	1.4-3.2 m^3

C. Hemlock (*Tsuga dumosa*)

Table 15.4 Silvicultural Management Recommendation for Hemlock

Sl. no.	Site conditions	Understory conditions	Management type	
			FMUs, WS, Leased SRF	CF, PF, SRF outside FMUs, PA
1	Moist sites (mostly northern aspects, valleys)	Bamboos and under story competitors	• Group selection (0.1-0.25 ha) • Single tree selection	Group selection (0.1 ha) Single-tree selection
		Herbaceous understory, no major competitors	• Group selection (0.25-0.3 ha) • Single tree selection	Group selection (0.1 ha) Single-tree selection
2	Dry sites (mostly southern aspects, ridges)	Bamboos and understory competitors	Slit cut (0.1 ha:20 m *50 m) Group selection (0.1 -0.15 ha)	Group selection (0.1 ha) Single-tree selection
		Herbaceous understory, no major competitors	Slit cut (0.125 ha:25 m *50 m) Group selection (0.1 - 0.2 ha)	Group selection (0.1 ha) Single-tree selection

General Recommendations

- Hemlock strongly depends on moisture in the substrate. Therefore, should maintain large size coarse woody debris (rotten logs), or intact timber, in case if rotten logs are not available (10 m^3 * ha^{-1}).
- On sites dominated by dense bamboo understory, prescribed cattle grazing is beneficial to reduce bamboo height and for successful tree regeneration.
- Directional felling is recommended on sites with bamboo/rhododendron to reduce these species.

D. Fir (*Abies densa*)

Table 15.5 Silvicultural Management Recommendation for Fir

Recommendation for group selection system for Fir

Sl no.	Understory conditions	Management type	
		FMUs, WS, Leased SRF	CF, PF, SRF outside FMUs, PA
1	Bamboo/large rhododendron understory	Group selection (0.01 ha) created around saplings/poles Single tree selection	Single tree selection Group selection (0.01 ha) created around saplings/poles
2	Herbaceous/moss understory, no major competitors	Group selection (0.25 ha) Single tree selection	Single tree selection Group selection (0.25 ha)

- Restrict size opening below 0.1 ha to avoid dominance of bamboos and other competitors.
- Create oval-shaped openings perpendicular to the slope for partial shading by the surrounding trees and to avoid direct sunlight which dries up the seed bed (e.g. moss pads)

General recommendations

- Avoid harvest in wet sites on slopes greater than 70%
- Retain good shaped, over-sized trees to serve as mother trees
- Fir is a shade tolerant species, major competitors are *Rhododendron hodgsonii*, *Y microphylla*, *A. Racemosa*, and *Betula utilis*
- Directional felling is recommended on sites with bamboo/rhododendron to reduce these species.
- If openings become dominated by bamboo, apply moderate cattle grazing to promote regeneration however, phase out grazing once seedling reach bamboo height
- Bamboo flowering may provide a window opening for regeneration of Firs
- Similar to Hemlock Fir also strongly depends on moisture in the substrate therefore, should maintain large size coarse woody debris (rotten logs), or intact timber, in case if rotten logs are not available

E. Brown oak (*Quercus semecarpifolia*)

Table 15.6 Silvicultural Management of Brown oak

Sl. No.	Sites	Silvicultural system
1	Sustainable management of oaks near human settlements	Pollarding at a height of 2 m and above and allowing to coppice
2	Old growth oak forest above 2800 m	Protected for the conservation of biodiversity and watershed

16. FOREST PROTECTION

16.1 Fire

Till dateforest fire has not been a major disturbance in Chamgang Helela FMU. However, during the winter dry season when forest fire risk is high, constant observations must be maintained to avoid severe negative impacts to the FMU and surrounding areas.

Therefore, the CFO and the Unit In-charge will need to review forest fire protection programs at regular intervals in close consultation with local people and various contractors/labourers involved with the FMU activities. The local people must be informed and made aware of the dangers of burning agriculture debris during the dry season.

16.2 Pests and Diseases Management

The forest will be periodically monitored to detect any outbreak of pests or diseases. Regular inspection will be conducted by the FMU staff to detect and report any pest and disease outbreaks to enable earliest possible remedial or preventive measures to be initiated. Reports should be made to the CFO and the relevant research specialist(s) contacted.

- The initial marking should be guided by an experienced forester to identify affected trees.
- Freshly attacked trees should be removed on a priority basis.
- Felling, debarking and crosscutting of attacked trees, immediately after an infestation is noted.
- All bark, wood dust and beetles collected, using gunny bags or tarpaulins spread under logs before debarking should be burnt in case adult beetles are still in the infected tree.

Dwarf Mistletoe (*Arceuthobium minutissimum*) has also been noted in Blue Pine stands within Chamgang Helela FMU. Clear cutting is one of the recommended preventative measures but this is not permissible within the CHFMU, so the control measure will have to be implemented as follows:

- Infected trees will have to be felled for local use on a thinning basis.
- Pruning and disposing of infected branches should take place where ever possible.
- If the whole stand is infected clear felling is recommended.

16.3 Grazing

In line with the multiple-use objectives of forest and as provided in the National Forest Policy of Bhutan, grazing will be allowed to continue in the Unit. However, management objectives for Protected Management Circle state that grazing should be minimised in these areas and focus should be moved to the Non-Production Management Circle.

Grazing has been identified by the territorial staff as *one of the main constraints to the regeneration of the past harvested areas*. This issue needs to be addressed during the tenure of this management plan. It is not a case of telling the local people to move their cattle but to discuss with them, how the objectives of regeneration can be achieved – with their help. It is essential that the local people understand the necessity of regeneration for continued supply of timber and participatory approaches need to be achieved for the production forest to be sustainable. No solutions are evident but several approaches to grazing issue are listed below. These will need to be discussed with the FMU Level Management Committee to decide if these or other options are feasible and whether the budget for such activities can be made available in the Operational Plan.

- Consultation with local people to see if other areas are available for grazing for the first five years of the regeneration of a harvested area
- Excluding grazing from regeneration areas
- Develop improved pastures near villages or cowsheds
- Plant fodder trees near villages and cowsheds
- Promote stall feeding and improved breeds of cattle
- As artificial regeneration of grazed harvested areas costs money, there is possibility of diverting funds to the local people, so that they can manage the area for regeneration. This could mean that with compensation they are more likely to graze their cattle elsewhere.

These are only suggestions and need to be discussed, as stated above. If the forest is to continue to be productive for timber in future, regeneration must be protected and allowed to establish. Grazing can be reinstated to harvested areas once regeneration has reached a height that will ensure its survival.

16.4 Plantation

Most important management regime during the current management plan is plantation. NRDCL along with Thimphu Territorial division should focus on plantation programme in the FMU. Regeneration establishment survey of the past operated cable lines needs to be carried out. Cable lines with failed natural regeneration and clear felled areas due to sanitation logging have to be planted immediately.

17. ENVIRONMENTAL STATEMENT FOR ENVIRONMENTAL IMPACT ASSESSMENT

17.1 Introduction

The goal of Chamgang Helela Forest Management Unit (FMU) is to manage the forest on a multiple use, sustained yield basis, for livestock grazing, timber and fuel wood, watershed and wildlife protection.

The Environment Assessment Act 2000 requires that all development proposals in Bhutan meet a series of environment criteria, outlined in section 18, chapter III. For the implementation, the National Environment Commission has prepared Forestry Sectoral Guidelines that recommend more specific sets of criteria. These guidelines have been examined to ensure that the practice within Chamgang Helela FMU meet these requirement.

Chamgang Helela FMU was under commercial harvesting for last twenty years since the forest was brought under scientific management in early nineties. A forest road of length 33.16 km had been already constructed to facilitate transportation of harvested timbers. The road construction showed some negative impact on the environment which needs immediate mitigation measures.

This Environmental Statement will act as a review of past management and mitigating measures that have been implemented along with the future mitigating measures that will be put in place in the 2017-2026 management plan.

17.2 Method and project Summary

This environmental statement is based on an EIA conducted between October and December 2015, as a part of ground truthing and information gathering for the plan. It is based on personal observation by the evaluator, interviewed with key personal and stakeholders and a detailed review of existing management plan. The forestry environmental parameter checklist developed by NEC was completed, identifying environmental effects and mitigating measures.

17.3. Environment performance of the FMU

- To improve forest and other vegetative cover of the area
- To sustainably supply timber and fuel wood to local population for all times to come
- To supply timber and fuel wood to wood based industries and to various Government Organizations as and when required.
- To regenerate the areas either naturally or supplemented by artificial regeneration of those forest areas currently not satisfactorily regenerated
- To improve the productivity of natural forest by appropriate silvicultural systems.
- To improve the immature stands through scientific thinning methods.
- To ensure the improvement of the presently degraded forest areas
- To protect the watershed values of the FMU

- ❖ To protect and conserve the environment and ensure preservation of genetic diversity, wildlife habitat and the aesthetic value of the area
- ❖ To satisfy the needs of local population for other forest products and grazing through their involvement in all phases of the implementation of this plan.

Many of these objectives relate directly to environmental performances of the FMU, and to satisfactorily meet these objectives, mitigation measures have been stated. These are discussed below.

17.4 Checklist of Environmental Parameters for Forestry Projects

The initial stage of EIA involved compilation of the checklist to identify areas where there will be significant effects. The scoring reflects the potential for effect, as the FMU is operating for the third time.

In general, operation of CHFMU will have no adverse effect on the environment. Potentially critical areas such as reduction in water quantity and quality are closely linked and erosion control is taken care. Even during the monsoon, water leaving catchment area contains low sediments. Hence there is no evidence reflecting erosion and water quality/quantity reduction. The environmental functions of the watershed and the FMU will remain intact. Since there will be no commercial operations involving laying out of cable lines, therefore no roads will be constructed in this management plan.

Table 17.1 Summary of environmental statement from previous plans & review of effectiveness of mitigating measures

Predicted adverse impact	Predicted magnitude & significance of impact	Mitigating measures identified	Effectiveness of mitigating measures
Damage to soil & vegetation resulting from harvesting	Minimal negative impact if mitigating measures followed	Single tree selection and dragging to cause minimal damage to soil and vegetation.	Log rolling by local people had caused damage to soil and regenerations such actions shall be strictly monitored and prohibited.
Damage to soil & vegetation resulting from road construction	Extent of road construction predicted as negligible	Proper drainage and culvert construction ensures undisturbed stream flow.	33.16 km of road had already been constructed during the past two plans. No new road construction shall be done during this plan period. Proper Road maintenance standardswill reduce the impact.

Predicted adverse impact	Predicted magnitude & significance of impact	Mitigating measures identified	Effectiveness of mitigating measures
Stream flow & water quality deterioration due to road construction	Low impact if mitigation measure implemented	Protection of vegetation on 30 m wide buffer and proper drainage and culvert maintenance.	Stream flow obstructed due to poor side drains and unmaintained culverts. Maintenance of side drains and culverts shall minimize the impact. Water quality not assessed
Stream flow & water quality deterioration due to harvesting activities	Deterioration due to harvesting activities	No skid trails, harvesting by cable crane, small openings in canopy, buffer strips along water courses	Water flow in some areas obstructed due to wood debris along the stream course. Removal of wood debris will minimize the impact. Water quality not assessed
Interruption of nutrient cycle	Insignificant due to small scale of annual harvest	None required	Not applicable
Wind throw resulting from gaps in canopy	Gaps too large to have disastrous effect	Closing of gaps by plantations	Plantation to fill up the gaps will minimize the impact.
Regeneration	Change of species composition	Use of natural regeneration to ensure restocking with same species mix as that harvested	Some change of species composition favouring blue pine in previously spruce/MC forest types
Road construction; disturbance to wildlife	Minimal; fragmentation of forest by roads not significant	Non identified	Not applicable

Predicted adverse impact	Predicted magnitude & significance of impact	Mitigating measures identified	Effectiveness of mitigating measures
Harmful effect of pesticides on flora & fauna	Minimal/none	No pesticides to be used except in case of epidemics	No pesticides used
Impact of harvest on wildlife habitat	No adverse effect; wildlife in the FMU are not location specific & wildlife corridors are not disturbed	None required. Dead tree habitat available in protection forest & growing stock always left behind in production forest. Understorey habitat always present.	Not applicable
Species change due to reforestation	No adverse effect although blue pine monoculture will initially be established on barren lands	None identified (blue pine monocultures will create favourable conditions for other species)	Not applicable
Grazing impact on soil & water yield	Little impact	None identified	Not applicable
Grazing impact on water quality	High potential for increased faecal coliform & other bacteria	Buffer strip serves as filter	Not assessed
Grazing impact on regeneration	Could be significant	Constant monitoring by regeneration survey, artificial regeneration if necessary	Constant monitoring with fencing and species selection will minimize the impact.

Environmental statement for activities within the FMU

A. Environmental Considerations Regarding Project Sighting

- ***Watershed Areas – siltation & water quality***: **No significant Effect**, the whole Forest Management Unit is designated as watershed area of Dagala geog and Babesa city area. Appropriate buffers for all streams were kept protected and local water source is protected. Since no commercial harvest is prescribed during the current plan, impact on watershed areas from harvesting will be insignificant. **Proposed Mitigating Measures**: CFO and the staffs concerned should understand the objectives of the plan and act as directed. This will ensure that the operations should occur with best available techniques and any deviation from the plan objectives will be dealt and acted upon immediately.

- ***Relation to other dedicated land uses – conservation areas – impaired ecological and recreational opportunities:*** **No significant Effect**, environmentally or socially critical areas within the Forest Management Unit was designated as 'protection areas' and riparian reserve in the plan. **Proposed Mitigating Measures**: Areas that are deemed 'protected' should undergo thorough investigation before any plan to check their status is initiated.

- ***Traditional forest uses – impaired beneficial uses:*** **Small Effect**, much of the watershed was used as grazing areas. In the past harvesting and regeneration activities have affected the grazing possibilities of the local population and the grazing inversely has affected the regeneration of these areas. Reforestation being the main focus during this plan, a high possibility of conflict with grazing. **Proposed Mitigating Measures**: With the establishment of Forest Management Committee at local level, issues such as this can be discussed between the various stakeholders and compromises can be reached.

B. Considerations Regarding Planning and Design

- ***Operations and maintenance – diminished project efficiency and objectives if lack of funds:*** **Significant Effect**, as with any project, lack of funds would mean cutting corners and reverting to poor forest practice techniques. Low budget for road maintenance had deteriorated the road conditions in the past.**Proposed Mitigating Measures**: The CFO/Territorial staffs should work closely with NRDCL staffs so that budgets that are set can, and will be followed. Room must be made within the budget for development activities that are prescribed in the plan, these prescriptions are written to ensure that future operations are profitable and that proper forest structure and health is maintained.

- ***Database for decision-making:*** **Small Effect**, decision making must be based on scientific practice, learned knowledge and observations in the field. Activities must be recorded in order to ensure proper management for future. Proper record keeping

needs to be initiated and maintained properly. **Proposed Mitigating Measures**: Records of all activities will have to be enforced along with further recommendations within appropriate sections of the Plan.

- ***Road network design – erosion, siltation & water quality – downstream economic losses:*** No s**ignificant Effect**, proper road design is very important for mitigating environmental impacts. Forest road of 33.16 km length had been constructed during the last 20 years of operation and roads were constructed initially as seasonal roads. Some parts of the road were eroded and culverts blocked. Existing functional road catering to CHFMU is also under poor condition. Since, roads will not be constructed during this plan period no new significant environmental impact is forecast. However, mitigation measures for the past years need to be initiated. **Proposed Mitigating Measures**: Considering the watershed has many users including communities that rely on the water for drinking and it is essential that the culverts be upgraded to good quality standards and Hume pipes be installed and maintained in each stream crossings and sections were excess water is apparent.

- ***Design of logging activities – unnecessary damage to residual stand:*** **Small Effect**, No significant impact is forecast in this plan from felling. The felling techniques in the past were good and cable lines were properly surveyed and laid. But neglected and wind fallen trees can be still seen in few cable lines and rural areas which had become breeding grounds for bark beetles.**Proposed Mitigating Measures**: monitoring should be effectively done in all cable lines and rural marked areas after the operation to make sure that proper sanitation is maintained. Since only thinning, rural timber and sanitation logging (if necessary)are prescribed in the current plan therefore, proper forest sanitation must be adhered to by Territorial staffs.

C. Considerations Regarding Project Operations

- ***Felling – siltation & water quality – downstream economic losses / loss of beneficial uses:*** **No significant Effect**, as cable lines are laid as per the guidelines harvesting activities has not been observed along the stream buffers in the past. Quality/quantity of streams and siltation is negligible till now. Further, with no commercial harvest in the FMU for the next 10 years the impact will be insignificant. **Proposed Mitigating Measures**: Layout of cable lines must follow plan guidelines and no further activities will take place within the stream buffers.

- ***Logging in riparian zones – degradation of waterways/fisheries:***Insignificant, Insignificant impact due to no commercial harvest prescribed during the plan.**Proposed Mitigating Measures**: All activities within the buffer zones must be in line with the plan prescriptions.

II. Reforestation/Afforestation

A. Considerations Regarding Project Sighting

- ***History of forest abuse – Negation of project objectives if not effectively controlled:*** **Significant Effect**, Records of illegal felling within the Forest Management Unit had been booked and many undetected. Timber overharvest from the prescribed AAC for rural people has created large openings in the previously forested area. **Proposed Mitigating Measures**: More intense monitoring of illegal activities, this will require an increase in staff and staff mobility/transport. Awareness campaign among the local residents should be initiated.FMU Unit in-charge should strictly adhere to the prescribed AAC. Plantation of the degraded forests is the focus of the current plan.

B. Considerations Regarding Planning and Design

- ***Allocation of benefits to locals – training:*** **Small Effect**, dissemination of knowledge with regards to regeneration and grazing issues, illegal activities and general forest/human relationships would benefit local people and the forest industry alike. **Proposed Mitigating Measures**: Increase social activities within the local communities to increase the public's knowledge on forest issues.

- ***Operations and maintenance – diminished project efficiency and objectives if lack of funds:*** **Small Effect**, as harvesting activities would be affected by lack of funds so would silvicultural activities and maintenance of infrastructures like roads. **Proposed Mitigating Measures**: It is essential that all NRDCL activities should directly contribute to the long-term development of the forest.

- ***Database for decision-making:*** **Small effect**, as stated 'decision making must be based on 'best practice' and observations in the field.' This not only applies to the AAC but also to silvicultural activities and afforestation. Activities must be recorded in order to ensure proper management for the future. **Proposed Mitigating Measures**: Recording of all activities will be enforced immediately.

C. Consideration Regarding Project Operations

- ***Soil conservation benefits – erosion:*** **Moderate Effect**, with the use of cable harvesting systems and narrow corridors with small group openings, the erosion of soils in commercial area is insignificant. However, lack of proper road maintenance and log rolling by local people had led to soil erosion in small pockets. Areas, which may be sensitive to soil erosion or have slopes 76 - 100%, were labelled protection area and any activities in these areas will maximize impacts to the soil and under storey vegetation.

- ***Socio-economic benefits – employment opportunities:*** **Small Effect**, according to the socio-economic study the Forest Management Unit provides employment for some of the local people for firewood and harvesting contractors in the area. With

afforestation being the focus during this plan involvement of local people in plantation programs will benefit the local communities.

- ***Socio-economic benefits – fuel wood:*** **Small Effect**, although fuel wood is not allotted by marking for local use it is available through the collection of lops and tops from harvesting practices for local consumption.

The following sections of this environmental statement address specific forestry-related issues in more detail, examining how environmental effects have been considered and minimized.

D. Road Maintenance

These impacts on environment due to road maintenance will be minimized and rectified as soon as possible using the following tactics:

- Stream crossings will be reviewed and action will be taken.
- Sections were excess water is apparent will have cross-drains or culverts installed.
- Maintenance of roads will be budgeted from NRDCL/Gewog development grants or other means that the department deems apposite.

E. Harvesting and Extraction

I. Review of the past harvesting and extraction

The Annual Allowable Cut (AAC) of the CHFMU prescribed in the Management Plan is 2000 m^3 in standing volume (commercial 650 m^3 and rural 1350 m^3). The total Rural AAC for 10 years, works out to 13500 m^3. The volume extracted in 10 years by the rural people was recorded as 23,119 m3 against the total AAC of 13500 m^3. This is above the prescribed Rural AAC. Hence, no point was given on this criterion indicating that timber is over extracted and future sustainability of timber production is at stake. Commercial AAC had been closely followed and no significant deviation occurred. The over-harvesting is attributed to heavy pressure for allotment of rural timber. Due to these factors, timber harvesting could not be planned and implemented as per Management Plan. Therefore, there is a need to review this FMU and discuss on the restoration plan for CHFMU.

Mitigation Measures

Proper record of both commercial and local timber extraction (including firewood and woodchips) should be maintained and reviewed. The focus of the current plan is on restoration of the FMU via reforestation program.

a) Methods for harvesting

As far as possible no commercial harvesting activities will take place during the current plan period of 10 years' time. However, if there arise any urgent need for salvage felling of bark beetle infested stands, cable cranes could be used for harvesting and extraction upon approval from DoFPS to minimize potential negative environmental impacts. Sanitation logging has taken place in areas infested with bark beetle in the past, this is implemented to maintain stands

of healthy trees while reducing spread of insects and disease throughout the forest by debarking the logs on site. It is essential that Territorial and NRDCL staffs are aware of the guidelines and that proper monitoring is carried out to ensure compliance.

Power chain saw would be used in place of axe to reduce waste. Harvesting prescription and silvicultural treatment have been taken care of and described in detail in the management plan. No operation would take place during the winter months when snow covers the ground. A further measure to reduce impact on environment is that the logs are cut to the length before they are cabled to landing, helping to further decrease the impact to the soils by reducing the contact of the log lengths with the soil surface. This reduces any gulling effect that may be caused by open corridors. Clear felling during the salvage operation will expose the soil to high risk of soil erosion. Therefore, immediate reforestation activities will be carried out. Logs and stumps have to be debarked and burnt.

Harvesting methods used in this Forest Management Unit are restricted to slopes that do not exceed 100%. This is to ensure that unstable or steep slopes are left untouched and no unnecessary damage, such as landslides or soil erosion, results from these activities.

Impact from harvesting methods in this Forest Management Unit is minimal and has been assessed for the purpose of this environmental statement. The method of harvesting and extraction coupled with slope restrictions is the most suitable and least detrimental impact for environment in Bhutan.

b)Regeneration and Post Harvesting Treatments

NRDCL had done plantations of 14.89 ha in already operated cable lines and along the road side which is far below the prescribed target of 10 ha per year in the previous plan.

Mitigation measures

If natural regeneration does not thrive within three years, artificial planting of the principal and local species should be initiated. This would be crucial as future forest condition will depend on the status of regeneration and their establishment. Regular maintenance of the plantation must be done and the Unit In-charge shall evaluate the plantation at the end of three years. If the survival percentage is lower than 70-80% immediate beating up shall be carried out with the same species by the NRDCL or the Department. NRDCL should clear up all remaining lops and tops along the openings made which will hinder the natural regenerations to come up.

c) Stream and Riparian Zone Protection

Any harvesting activities should be carried out to ensure the best practice possible with utmost care, keeping in mind the protected areas kept aside for water source, as the FMU watershed acts as main source of drinking water met by nearby communities and thromde areas of Babesa and Semtokha. Therefore, it is very important that activities within the watershed are conducted to ensure the best practice possible.

d) Biodiversity Conservation

Conservation of flora and fauna is an important objective and a challenge to a logging agency. Low impact silvicultural technique with small group openings will let to change in microclimate and greater biodiversity. The various group openings also provide a matrix of age classes on a landscape level. This means that there will always be mature forest represented as well as pioneer species present.

All flora and fauna that appear on the list in the Forest and Nature Conservation Act (1995) will be protected in the Forest Management Unit during harvesting activities. There is no evidence that any of the wildlife found in the area would warrant special consideration or would be a constraint on the level of management although the general policy on wildlife conservation and protection will be observed.

As a apart of biodiversity conservation and research (in future) on the impacts of logging and to maintain more areas under protection working circle, a separate area has been set aside as Ecological Reserve within the FMU.

e) Landscape/Aesthetic Considerations

Landscape of Chamgang-Helela Forest Management should be conserved as the whole FMU is very sensitive and now directly visible from Thimphu. Aesthetic view of the FMU needs to be restored through reforestation program.

Table 17.2 CHECKLIST OF ENVIRONMENTAL PARAMETERS FOR FORESTRY PROJECTS

	Adverse Environmental Impacts	Preliminary Evaluation			
		No Significant Effect	Small Effect	Moderate Effect	Major Effect
I. COMMERCIAL LOGGING					
A. Environmental Considerations Regarding Project Siting					
1. Watershed Areas					
a) erosion	*a) downstream economic losses*	✓			
b) siltation	*b) downstream economic losses*	✓			
c) hydrology	*c) increased peak and flood flows*	✓			
d) water quality	*d) loss of downstream beneficial uses*	✓			
2. Relation to other dedicated land uses					

	Adverse Environmental Impacts	Preliminary Evaluation			
		No Significant Effect	Small Effect	Moderate Effect	Major Effect
a) conservation areas	*a) impaired ecological and recreational opportunities*	✓			
b) economic ventures	*b) possible economic loss*	✓			
3. Traditional forest uses	3. Impaired beneficial uses		✓		
4. Re-habitation	4. Social problems	✓			
5. Relation to regional/ national forestry plans	5. Possible conflicts with established management policies	✓			
6. Critical environmental areas	6. Downstream economic losses	NA			
a) erosion	*a) downstream economic losses*	✓			
b) siltation	*b) downstream economic losses*	✓			
c) hydrology	*c) increased peak and flood flows*	✓			
d) water quality	*d) loss of downstream beneficial uses*	✓			
7. Precious ecology	7. Loss of ecological values	NA			
B. Considerations Regarding Planning and Design					
1. Cost/benefit analysis		✓			
2. Operations and maintenance	2. Diminished project efficiency and objectives if lack of funds				✓
3. Data base for decision making			✓		
4. Road network design		✓			

	Adverse Environmental Impacts	Preliminary Evaluation			
		No Significant Effect	Small Effect	Moderate Effect	Major Effect
a) erosion	*a) downstream economic losses*			✓	
b) siltation	*b) downstream economic losses*		✓		
c) hydrology	*c) increased peak and flood flows*		✓		
d) water quality	*d) loss of downstream beneficial uses*		✓		
5. Design of logging activities	5. Unnecessary damage to residual stand		✓		
6. Critical environmental areas		NA			
a) erosion	*a) downstream economic losses*				
b) siltation	*b) downstream economic losses*				
c) hydrology	*c) increased peak and flood flows*				
d) water quality	*d) loss of downstream beneficial uses*				
7. Precious ecology	7. Loss of ecological values	NA			
8. Appropriate technology	8. Diminished project objectives if inappropriate				
C. Considerations Regarding Project Operations					
1. Road construction					
a) erosion	*a) downstream economic losses*				
b) siltation	*b) downstream economic losses*				
c) hydrology	*c) increased peak and flood flows*				
d) water quality	*d) loss of downstream beneficial uses*				

	Adverse Environmental Impacts	Preliminary Evaluation			
		No Significant Effect	Small Effect	Moderate Effect	Major Effect
2. Felling					
a) erosion	*a) downstream economic losses*	✓			
b) siltation	*b) downstream economic losses*	✓			
c) hydrology	*c) increased peak and flood flows*	✓			
d) water quality	*d) loss of downstream beneficial uses*	✓			
3. Log conveyance and allocation					
a) erosion	*a) downstream economic losses*				
b) soil compaction	*b) increased runoff*				
c) log floatation	*c) impede navigation*	N.A.			
d) allocation	*d) less than optimum economic benefits*	✓			
4. Logging in riparian zones	4. Degradation of waterways/fisheries		✓		
5. Socio-economics					
a) employment opportunities			✓		
b) loss of traditional forest use	*b) economic and cultural losses*		✓		
D. Considerations Regarding Post-Project Activities					
1. Rehabilitation and conservation			✓		
2. Road shutdown				✓	
II. REFORESTATION/AFFORESTATION					
A. Considerations Regarding Project Siting					
1. History of forest abuse	1. Negation of project goals if not effectively controlled				✓

	Adverse Environmental Impacts	Preliminary Evaluation			
		No Significant Effect	Small Effect	Moderate Effect	Major Effect
2. Relation to other dedicated land uses					
a) conservation areas					
b) economic ventures	*b) Interference with more profitable ventures*				
c) regional/national forestry plans		✓			
3. Rehabilitation	3. Social Problems	✓			
4. Siting in degraded forest	4. Possible unnecessary loss of ecological values	✓			
B. Considerations Regarding Planning and Design					
1. Cost/benefit analysis		✓			
2. Selection of tree species	2. Diminished project objectives				
3. Precious ecology		NA			
a) wildlife					
b) fisheries					
c) plants					
d) soil and water					
4. Allocation of benefits to locals			✓		
a) employment opportunities	*a) social conflict if local people not significantly involved*		✓		
b) training			✓		

	Adverse Environmental Impacts	Preliminary Evaluation			
		No Significant Effect	Small Effect	Moderate Effect	Major Effect
c) non-wood products		✓			
5. Operations and maintenance	5. Diminished project efficiency and objectives if lack of funds		✓		
6. Data base for decision making			✓		
7. Project financing and reservoirs		NA			
8. Appropriate technology	8. Diminished project objectives if inappropriate	✓			
9. Relation to other dedicated land uses	9. Potential social and economic conflicts	✓			
a) extensive land use modification		✓			
10. Road network design	10. Increased erosion	✓			
11. Use of grasslands		✓			
C. Consideration Regarding Project Operations					
1. Commercial logging	1. Same as in Commercial Logging A and B				
2. Reduced water supplies	2. Socioeconomic losses	✓			
3. Chemicals and fertilizers	3. Impaired fisheries and aquatic systems	NA			
4. First-year operations	4. Increased erosion due to soil disturbance	NA			

	Adverse Environmental Impacts	Preliminary Evaluation			
		No Significant Effect	Small Effect	Moderate Effect	Major Effect
5. Soil conservation benefits					
a) erosion				✓	
b) sedimentation		✓			
c) soil capacity		✓			
d) soil surface moisture		✓			
e) soil nutrients		✓			
6. Socioeconomic benefits					
a) employment opportunities			✓		
b) fuel-wood			✓		
c) enhanced fisheries		✓			
d) enhanced recreation/ tourism		✓			
7. Water resources benefits					
a) minimized overland flows		✓			
b) reduced flood peaks		✓			
c) water quality		✓			

Source: ADB (1987) and Forestry Sectoral Guidelines NEC(1999)

18. Financial and economic appraisal

A 10-year financial forecast (cash flow) and economic appraisal has been developed for the CHFMU. This is intended to identify revenue to NRDCL and the Treasury (via royalties) and the costs and royalties paid by NRDCL. Overhead costs to NRDCL are not included. Some of the figures are estimates based on the assumptions listed and the information made available to the planner. The assumptions for the forecast are listed in Table 18.1. A summary of the forecast is presented in Table 18.2 and the forecast itself in Table 18.3.

Table 18.1 Assumptions Used for the Financial Forecast

Assumptions	
m^3 to cft	35.31
Recover Volume NRDCL (%/AAC)	60
Length of proposed new road (km)	0
Length of existing road (km)	33.16
Road maintenance (Nu/km/yr)	12000
Distance to Depot (km)	15.0
Royalty from Rural Allotment is paid by DBH. However an average was used for this calculation (Nu/yr) (Based on previous plan and adjusted for the new AAC allotment)	11520
Rural Allotment (m3)	1800
Regeneration maintenance (for cable lines) (Nu/ha)	3000
Hectares of cable lines that require planting per year (approximate)	5
Coupe regeneration establishment	19000
Creation of plantations (Nu/ha) (including cable line regeneration)	19000
Plantation maintenance (Nu/ha) (for first five years of plantation only)	3500
Hectares of existing plantations in the FMU	14.89

This forecast is for ten-year period of the plan, therefore does not include profitability of the FMU for the rotation length. The potential income from the investment in regeneration is not represented in this forecast. However, it is important to remember that all development activities within the FMU will be beneficial in the future. It is also important to understand that the income generated from previous plan period would have been much higher (due to the AAC and the minimal amount of money spent on regeneration of harvested cable lines) and should be kept in mind when dealing with expenses during this plan period.

Table 18.2 Summary of Financial Forecast

Financial Summary for Plan Period	
Total Revenue NRDCL	0
Total Costs NRDCL	492920
Total Royalty NRDCL	0
Total Revenue less Royalty less Costs NRDCL	0
Total Revenue of FMU (All Revenue and Royalties)	Rural x 10 years.

Note: It was assumed that there will be no commercial harvest and revenue generated form sanitation logging is not accounted.

This financial forecast is based on indicative figures and is a projection of a possible cash flow scenario. This is financial forecast should only be used as a guide.

	AAC (m3)	Rec. Vol (m3)	Nu/c ft	Nu/m 3	2017 Nu	2018 Nu	2019 Nu	2020 Nu	2021 NU	2022 Nu	2023 Nu	2024 Nu	2025 Nu	**2026** Nu	**2027** Nu	10 years Total (Nu)
Revenue:NRDCL																
Timber-Commercial	0	0	107.3	0	0	0	0	0	0	0	0	0	0	0	0	0
Timber-Rural	1800															
Total Revenue: RDCL					0	0	0	0	0	0	0	0	0	0	0	0
Costs: NRDCL																
Bridge construction																0
Road construction					0	0	0	0	0	0	0	0	0	0	0	0
Road maintenance					397920	397920	397920	397920	397920	397920	397920	397920	397920	397920	397920	3979200
Marking cost					0	0	0	0	0	0	0	0	0	0	0	0
Inventory cost			**0.08**	2.83	0	0	0	0	0	0	0	0	0	0	0	0
Felling and crosscutting cost			**2.49**	87.9	0	0	0	0	0	0	0	0	0	0	0	0
Debarking			**0.45**	15.9	0	0	0	0	0	0	0	0	0	0	0	0
Cable craning			**10.01**	353	0	0	0	0	0	0	0	0	0	0	0	0
Transportation to depot			**7**	247	0	0	0	0	0	0	0	0	0	0	0	0
Stand tending (spacing etc.)																

	AAC (m3)	Rec. Vol (m3)	Nu/c ft	Nu/m 3	2017 Nu	2018 Nu	2019 Nu	2020 Nu	2021 NU	2022 Nu	2023 Nu	2024 Nu	2025 Nu	**2026** Nu	**2027** Nu	10 years Total (Nu)
Regeneration maintenance(Nu/ha)		Nu 3000/ha														
Creation of plantation		Nu 19000/ha			190000	190000	190000	190000	190000	190000	190000	190000	190000	190000	190000	1900000
Plantation maintenance		Nu 3500/ha			52115	52115	52115	52115	52115	52115	52115	52115	52115	52115	52115	521150
Total Cost: NRDCL																
Total revenue less Total cost: NRDCL					-640035	-640035	-640035	-640035	-640035	-640035	-640035	-640035	-640035	-640035	-640035	-6400350
Royalty-commercial			9.8	346	0	0	0	0	0	0	0	0	0	0	0	0

Note:

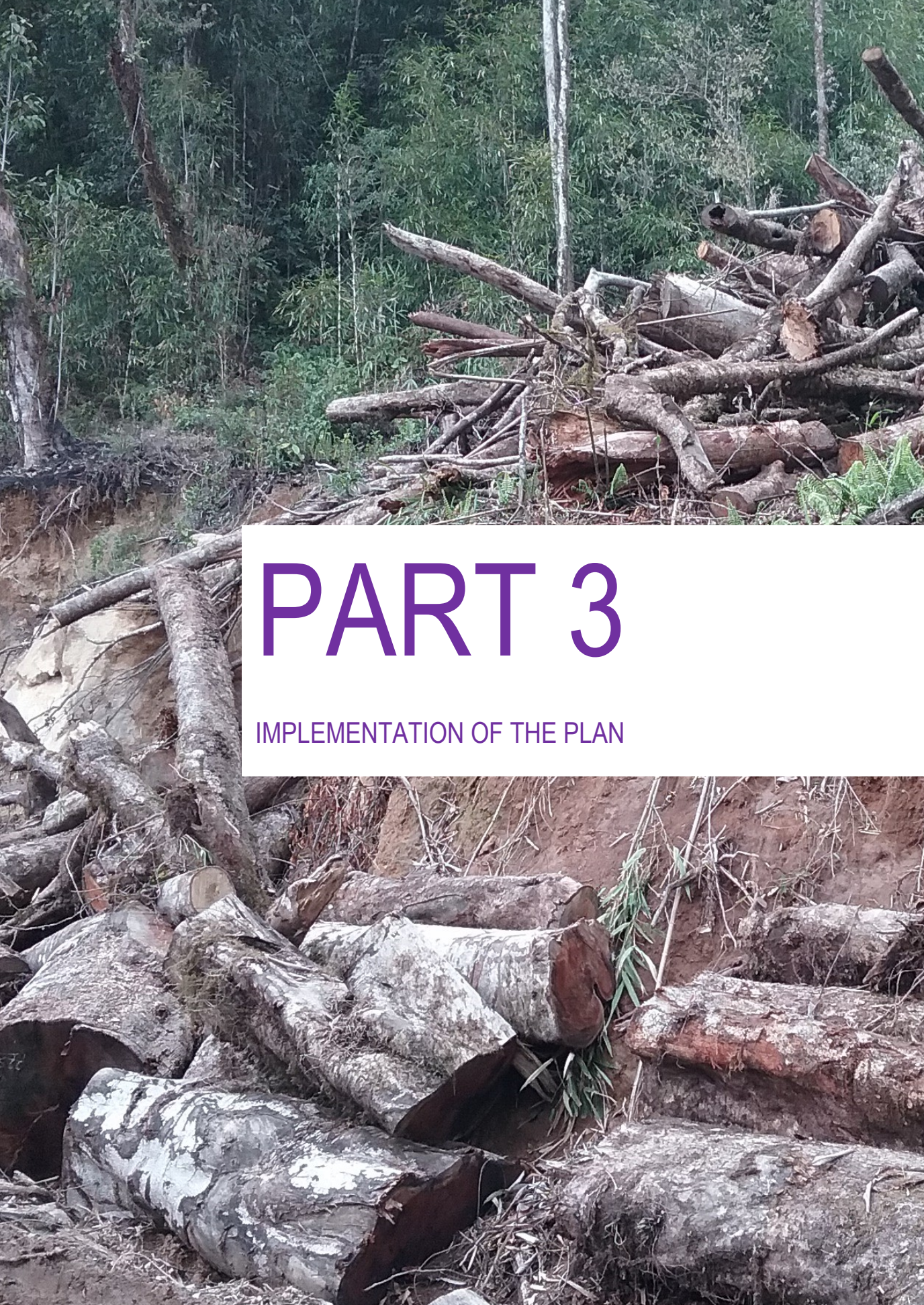
- *It was assumed that there will be no commercial harvest and revenue generated form sanitation logging is not accounted*
- *It is recommended that a contingency fund be established for these activities due to the uncertainty of the occurrence of bark beetle during the plan*
- *The area of plantation is for both old cable lines without natural regeneration and other potential plantation areas*

19. RESEARCH

Research programs needs to be implemented in collaboration with UWICE. The FMU Level Management Committee for the CHFMU will discuss, during the yearly meeting, and decide what research is deemed necessary in the FMU for the coming year.

Some possibilities for research include:

- Soil and water conservation techniques
- Wildlife studies
- Impact of logging on water quality and flow dynamics
- Logging impacts on forest structure and seedling dynamics in the FMU
- Long term effects of clear felling on vegetation dynamics and species diversity in CHFMU
- Natural regeneration dynamics of tree seedlings on log rolling trails and clear felled gaps
- Effects of logging and grazing on understory plant communities in the FMU
- Effects of habitat, cattle grazing and selective logging on seedling survival in cool temperate forests of western Bhutan



PART 3

IMPLEMENTATION OF THE PLAN

20. IMPLEMENTING AGENCY

The Department of Forests and Park Services is charged with the responsibility of protection and management of forest resources in Bhutan. It will discharge this responsibility through the Territorial Divisions. CFO Thimphu will be responsible for implementation of this Management Plan, assisted by the Unit In-charge and other support staff.

Past implementation failure.

In order to achieve the target AAC, during the very first plan cable lines had been laid across the whole length of CHFMU. This resulted in a small operable area during the second plan. During the detailed regeneration establishment survey carried out, it was observed that many cable lines don't have prescribed group openings.

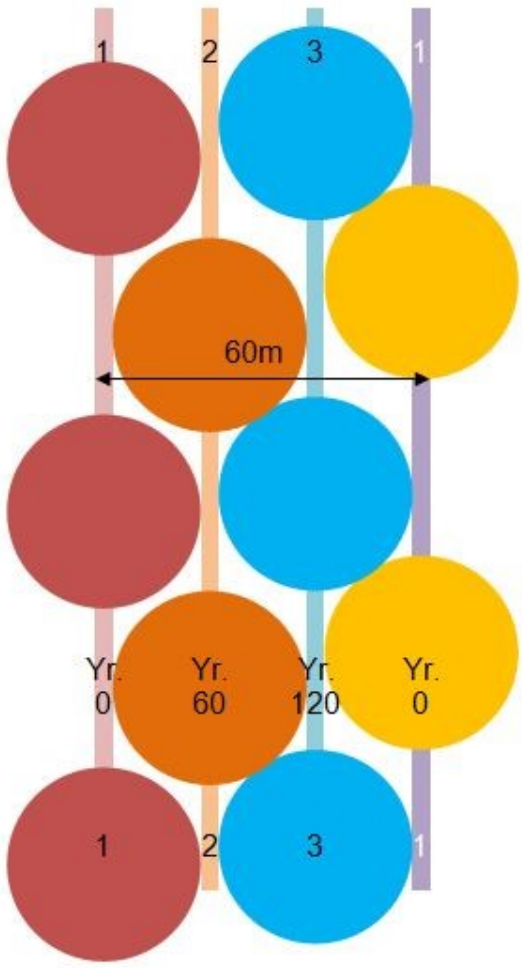


Figure 20.1 Layout for Group

AAC prescribed was exceeded and Interlineswere also compromised to meet exponential rural demand each year resulting in a clear felled area, and lack of or poor regeneration in cable lines were also observed, thus requiring immediate artificial regeneration.

Severe wind fallen stands and unclaimed timbers from rural allotments had also led to the failure of maintaining the prescribed silvicultural systems and inducing regeneration. In future chances of large breeding ground for bark beetles is possible.

There will be no commercial harvesting activities in the FMU during the current plan unless a needfor salvage operation arises. Reforestation of the past harvested areas will be the focus of this plan. Therefore, descriptions on cutting cycle, annual coups, tree marking rules and harvesting guidelines given are given below for strict compliance.

20.1 Cutting Cycles

Past management of Chamgang Helela FMU has not seemed to take into account the need for proper spacing between cable line layouts. Silvicultural systems employed for Mixed Conifer and Fir Working Circles will only be sustainable if cable line spacing is correct so that subsequent passes can be achieved.

Although group size differs for Mixed Conifer and Fir Working Circles, they require the same cable line spacing – 60 meters *minimum*. This is to ensure that two more passes can be made in interlines. Fir Working Circle has a rotation of 180 years, this means that the two cable lines that will be implemented in future are occurring at year 60 and year 120. See Figure 20.1. The original lines will therefore be harvested in year 180. This gives the adjacent areas time to regenerate so as not to cause large, open, blank areas within the forest. The same would apply to the Mixed Conifer Working Circle except that the return to interlines would occur after 53 years.

Blue Pine Working Circle, a seed tree system, requires 90 m spacing between initial cable lines. This would mean that interlines are harvested at year 40 and year 80, with the original line being harvested at year 120.

If any areas are revisited from the last plan it is essential that the cable lines are 60 meters from previously harvested lines, as regeneration is not established.

Terrain in Bhutan poses a problem for layout. The layout in the field must be tailored to suit the terrain. Therefore, some groups may be lost to commercial harvesting in the process. It is up to the Unit In-charge to look ahead and plan accordingly.

Cutting cycle during the current plan

No commercial harvesting will take place during this plan unless if need for salvage operation arise. Sanitation logging operations in the areas infested with bark beetle should be implemented to maintain healthy stands, while reducing the spread of insects and disease throughout the forest by debarking the logs and burning the forest residue with adult beetle on site. It is essential that Territorial and NRDCL staffs are aware of the guidelines and that proper monitoring is carried out to ensure compliance.

20.2 Annual Coupe

During the current plan period no annual coupe will be identified for commercial timber harvesting due to lack of any commercial AAC. However, annual restocking areas must be identified by Unit In-charge for building up the potential for future timber production.

In general the criteria for selecting the annual coupe for harvesting in the operable area will be accessibility, slope, stand condition and environmental considerations. Coupes must comply with the following conditions:

- Based on the Silviculture System for each Working Circle, the annual coupe will follow the required spacing designated, within the limits of the AAC.

- The Unit In-charge will determine the location and extent of cable lines in the Compartment to be harvested annually, in consultation with NRDCL staff. NRDCL will then plan for harvesting operations and the location of cable cranes, alignment of cable lines and designated log landing points. Environmentally sensitive areas designated in the forest function map will be identified, their position indicated and care taken to ensure the appropriate prescriptions/restrictions are followed. Stream buffer strips will be reserved according to the rules given in the Forest Management Code of Bhutan.
- The Unit In-charge will then arrange to mark the trees in the Sub-coupes as prescribed in Section 20.3.
- Cable line layout will be based on safety, stand composition, environment and cost considerations. NRDCL will be permitted, in consultation with the Unit In-charge, to align cable lines diagonally across contour lines in order to avoid environmentally-sensitive sites, identify stable landing points or to secure a sufficient length of cable corridor in order to put the cutting system into effect in a cost efficient manner.
- Cable lines may traverse slopes greater than 100%, but forest on such slopes is not to be harvested.
- Because of constraints imposed by the terrain and other on-site considerations, adjacent cable lines need not be necessarily parallel to one another. The prescribed interval between the sub-coupe cable lines is considered a *minimum* value.

20.3 Tree Marking Rules

In general, the following factors are to be considered when determining the spatial framework and sequential order of the patches selected for harvest:

1. Patches of mature and over-mature trees are selected systematically according to the patch size. Trees within stream buffer strips and on slopes greater than 100% must not be marked.
2. The direction of the tree lean and topography has to be taken into account to prevent large trees being felled on nearby advanced growth.
3. Dead, dying, malformed, or damaged (snags, scars, conk, etc.) trees will be retained in between patches, and in the interline spaces, to safeguard flora and fauna niches or habitats, but not in the harvested patches themselves, where there is the risk of wind-throw and danger to personnel working underneath. Diseased trees (bark beetle, mistletoe) will be removed to protect the quality of the remaining stand.
4. All species listed under Schedule Iof the Forest and Nature Conservation Act (1995) must be protected if encountered.
5. The trees selected will be marked with the authorised marking hammer close to ground level by Unit staff, and diameter measurements, along with estimated total tree height and tree species, will be entered in the Marking Register. The volume of

each tree will be estimated using an appropriate Volume Table. The standing volume marked will be recorded in the Marking Register. Log volumes at the NRDCL Depot will also be recorded.

20.4 Harvesting

In view of generally steep terrain and management objectives set for the Unit, harvesting method to be used will be a skyline cable system*(incase of commercial harvest, but none in this current plan)*.

This system will allow logs to be kept above the forest floor during extraction and will enable logs to be taken across sensitive ecological sites, gullies and riparian filter buffer zones. This system has other advantages:

- minimises soil disturbance and initiation of soil erosion,
- maximises worker safety (if used correctly according to the manufacturer's directions and according to the safety practices in the Code of Logging Practice),
- avoids damage to residual reserve stands,
- avoids disruption to wildlife corridors in valley bottoms,
- minimises noise and dust pollution on any adjacent farmlands and villages, and,
- Eliminates the need for log extraction tracks and feeder road construction.

Harvesting in the Working Circles is to be carried out in accordance with the following prescriptions.

1. The layout of the cable lines should be planned and undertaken well in advance of the harvesting operations after the logging coupe has been demarcated. Suitable log landings should be identified and incorporated into the forest road design. Care should be taken to avoid locating lines in and along gullies and other protected areas, but lines may cross these at an angle. Trees to be felled will be enumerated and marked in time so as not to delay harvesting operations.
2. The cable corridor shall not exceed the prescribed width stated in the Silviculture System for each Working Circle.
3. Trees will be felled, de-limbed, crosscut, extracted on the cable, loaded and hauled to the log depot. Only chainsaws and handsaws will be permitted in felling operations. Trees will be felled, where possible, into natural openings, into harvested openings or in a direction that will not damage residual stands. Damage to soil should be minimised at all times.
4. Axe usage is discouraged except in fuel wood splitting.
5. All Blue Pine and Spruce will be debarked as soon as they are felled to avoid the spread of Bark Beetle.

6. All logs will be measured and recorded in the Log Yard Register. This should be kept up-to-date and made available to inspecting officers as required. A copy of the list of logs/timber entered in the Log Yard Register will be submitted to the CFO every month. This information will be used for royalty calculation and issuance of removal permits. Logs will be transported by private haulage contractors and all deliveries will be made to designated depots and/or sawmills.

7. Records of all trees marked and issued for local use or for conversion within the forest, by Blocks and Compartments will be maintained by the Unit staff and furnished monthly to the CFO Thimphu.

8. The CFO and the Regional Manager, NRDCL will co-operate and co-ordinate to ensure that the logging operation and log outturn are conducted smoothly and in accordance with local and other demands.

9. Fuel wood will be collected from harvesting residues. It is important that all lops and tops for fuel wood are collected along *entire* cable lines, not just the easily accessible areas. It is desirable that the trees to become fuel wood are extracted with the cable line and fuel wood conversion occurs at the designated log landing areas.

10. In case of bark beetle attack with prior approval from FRMD the trees needs to be enumerated and marked and felled immediately before the incubation season of the bark beetle. The trees need to be debarked and the barks and small branches have to be burned under controlled condition. Sanitation of the forest floor in the operated areas should be maintained to prevent further beetle incidences.

Gravity cable systems are the only form of cable harvesting systems used in Bhutan. Although no other harvesting system is being introduced it would be beneficial to investigate other possibilities that would increase production. This would allow more 'less desirable' timber to make it to the landing, promoting utilisation of poorer quality timber and fuel wood residues.

20.5 Reforestation of Harvested Sites

It is crucially important that harvested areas (*including the sanitation operations areas*) are effectively regenerated as soon as possible after harvesting. Natural regeneration is preferred in the FMU, but if natural regeneration fails, either enrichment or complete stocking by planting must be carried out in regular cable corridors and group openings. Generally, natural regeneration in the blue pine dominated forest is not problematic. However, natural regeneration in mixed conifer areas of the FMU does not seem thriving. Therefore, a proper plantation programme needs to be developed for large opened areas. Immediate plantation should be carried out for sanitation areas.

Many factors limit the success of regeneration; grazing pressure, protracted harvesting periods and weed/brush and bamboo colonisation. These problems must be addressed if regeneration is to have a fighting chance. It is recommended to adopt more tending activities, such as

weeding and brushing, so that regeneration will establish. This would also reduce the cost of reforestation as clearing and replanting a failed area would cost much more than the initial tending for natural regeneration.

Since, no new commercial harvesting shall take place in the Chamgang Helela FMU, instead of conducting general regeneration surveys, a regeneration survival survey in the past cable lines needs to be carried out. Immediate plantation needs to be followed in the areas where regeneration had failed to establish.

Although a monitoring process has been adopted in FRMD, it is recommended that regeneration surveys be conducted every three years, until the regeneration has reached a height that will ensure its survival. If the second survey (5^{th}year) indicates poor stocking, remedial action must be taken in the following planting season. FRMD needs to revisit the natural regeneration survey form and develop a new form which can accommodate more valuable information on natural regeneration. Table 20.1lists the sequence of operations in the coupe.

FMU IC will ensure that stocking of natural regeneration is first monitored within three years following completion of the harvesting operation.

Enrichment planting, if necessary, will be carried out by NRDCL or the Department, fencing or other action to protect regeneration will be carried out by NRDCL, in consultation with the FMU In-charge and the FMU Level Management Committee.

It is important that all cable lines that have been harvested in the last ten year plan follow the same guidelines as stated above. Any cable lines over five years old where regeneration is poor must be artificially stocked as soon as possible.

20.6 Sequence of operations relating to the annual coupe

The sequence of operations relating to the annual coupe are given in Table 20.1

Table 20.1 SEQUENCE OF OPERATIONS RELATING TO THE ANNUAL COUPE

Operation Description	Timing (months) (- before felling; + after felling)
Unit In-charge decides on the location and size of annual coupe in accordance with the Biennial Operational Plan	-12
NRDCL and FMU IC prepares an estimate of human, material, equipment and financial resources required	-10
Unit In-charge finalises the annual coupe size, demarcates the coupe and instructs NRDCL to carry out pre-logging planning	-6
NRDCL prepares cable line layout and alignment plan, as well as proposed log depot and log landing points and submits these to Unit In-charge for approval	-3
Unit In-charge marks the carriage corridor trees and the trees to be felled in the first sub-coupe	-2
NRDCL manually fells trees that are in the way of the skyline installation and installs the skyline and cable crane	-1
NRDCL commences systematic harvesting and extraction operations according to the approved sequence in the Biennial Operational Plan	0
NRDCL/Contractor completes harvesting and extraction	When completed
The FMU Unit In-charge will inspect the coupes when harvesting is completed and will issue a Coupe Clearance Certificate only if all aspects of the operation are satisfactory.	When works completed
The FMU unit In-charge assess success of natural regeneration.	As per guidelines
NRDCL completes post harvesting operations.	As per FMU IC instructions

20.7 Road Construction

Road construction in the FMU requires extra precautions to achieve best environmental practice. The basic necessity in forest road construction is to avoid steep and fragile areas, to provide a proper drainage system, especially for safe discharge of run-off water during the monsoon, with enough culverts and cross drains, to have an efficiently draining compacted road surface.

Road survey, design and construction will be carried out by NRDCL. The road is to be located by marking a grade line on the ground. This grade line is then used as a basis for the road design, which will vary the location of the road as necessary to meet the standards mentioned below in terms of bend radius, proportion of cut/fill for various slopes, etc. NRDCL will mark the design centreline in the field so that contractor compliance to it can be monitored effectively. The road design should be part of the contract document.

The **33.16 km** of road in Chamgang Helela FMU have been constructed during 1993-2002 and 2003-2013 management plan period. No roads will be constructed during the current management plan period. However maintenance has to be carried out as usual. Since, there will be no new road construction the road construction standards and guidelines provided is for general reference and information.

Road standards

A set of road standards has been developed by the Forest Engineers of TFDP. These road standards, although developed in the east, address policies that are required throughout Bhutan. These standards will be adopted for FMUs and NRDCL road engineers must follow these standards, given in Annex 2, during designing and estimation and provide supervision during construction to ensure that the standards are met.

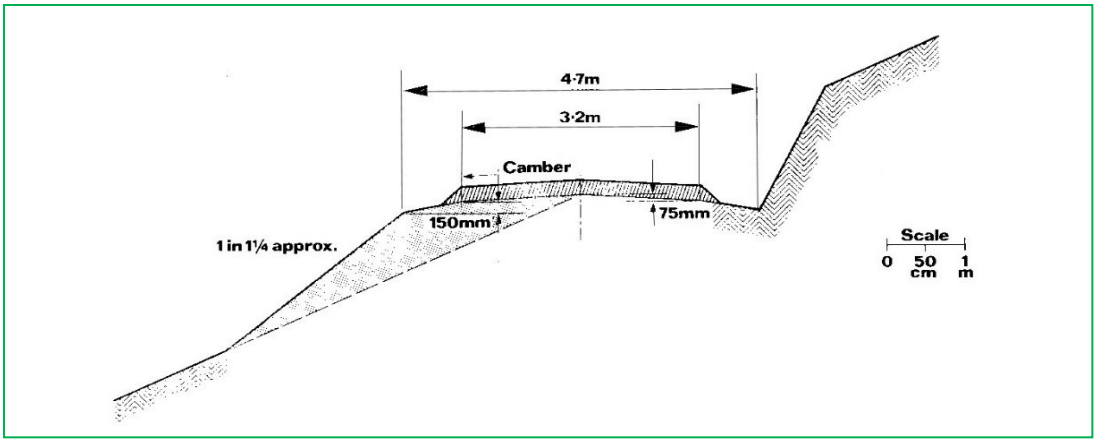


Figure 20.2 Recommended Road Profile

Road design in Chamgang Helela FMU should follow the above recommended road profile in Figure 20.2. Many roads in CHFMU do notadhere to the recommendation; this has caused excessive water pooling leading to rutted road surfaces which inhibit access during monsoon season. Improper drainage may also lead to landslides. Following recommended road design would also decrease maintenance costs for the future.

21. PLANNING

21.1 Operational Plan

Operational Plan will be prepared by the CFO Thimphu and the Unit In-charge to facilitate the timely implementation of this Management Plan. Guidelines for the preparation of the

Operational Plans are available to all territorial Divisions. Operational Plans are meant to be a rolling one, i.e. Operational Plans are prepared annually but the plan period is for two years (see Figure 21.1). Therefore, activities for the second year of the plan are carried forward into the first year of the next plan. This has important implications for budgeting (since it will then be possible to estimate budgets well in advance of the start of the financial planning year) and for participatory processes since these can be carried out a year before the start of the activity. The primary aim in preparing Operational Plans is to determine and co-ordinate the timely input of resources to put the overall Plan into effect in a cost-effective manner and according to the objectives.

Year 1	2	3	4	5	6	…
Detailed	Outline	Detailed	Outline	Detailed	Outline	Etc.
	Detailed	Outline	Detailed	Outline	Detailed	Outline

Figure 21.1 Concept of Rolling Operational Plan

The Operational Plan is also the tool used to provide changes that cannot be foreseen or allowed in the FMU Management Plan, such as insect and disease outbreaks, severe fires, or the like. If and when these occur, the current Operational Plan should be immediately reviewed and areas and /or methods of operation modified to deal most efficiently with possible changes in the sustainable level of harvest.

The Operational Plan will be prepared in consultation with all of the agencies and parties who will be using the forest, represented by the FMU Management Committee. Inclusion of a consultation process with local communities in preparation of the Plan is particularly important so that potential issues concerning communities in the forthcoming operational areas are worked through before the plan is implemented.

The Operational Plan will be prepared before NRDCLs financial year begins. Before approval, the Operational Plan will be presented to the FMU Management Committee. It is therefore recommended the Operational Plan be prepared in the October before operations are to begin.

Along with the Operational Plan the FMU In-charge will prepare a report reviewing the previous year's activities.

The process for preparing and implementing the Operational Plan is laid out in Table 21.1.

Table 21.1 PREPARATION AND IMPLEMENTATION OF OPERATIONAL PLANS

Activity (Planning Step)	Objective	Output	Responsibility (lead)	Comments
1. Approved FMP				
2. PRAs with local stakeholders	To prepare participatory plans for fire management; grazing control and rural timber To involve relevant stakeholders in planning for activities which have a direct impact in their "interest"	Participatory plan for grazing management; fire management or rural timber harvesting (to be incorporated within the OP)	DoFPS FMU In-charge. CFO PREPARATION AND IMPLEMENTATION OF OPERATIONAL PLANS	First step is to enter into discussions with stakeholders and their representatives Use PRA techniques to prepare a plan Plan costs are included in the OP
3. Operational inventory	To assess the resource availability for the planned harvesting area Calculation of the harvestable volume	a. Site-level inventory data for operational area to be harvested b. Precise estimate of volume to be removed during the coming year.	FMU In-charge NRDCL	For the areas proposed for harvesting during the next 2 years May be combined with Harvesting plan and cable line survey
4. Harvesting plan and cable line survey	To plan for harvesting and extraction activities	a. Agreed extraction and road plan	NRDCL	Within the selected identified harvestable area for the year May be combined with Operational inventory

Activity (Planning Step)	Objective	Output	Responsibility (lead)	Comments
5. Preparation of Operational Plan	To prepare a costed plan for implementation during the next 2 years (involving stakeholder participation for some activities) To formalise local institutional responsibility for planned activities (e.g. grazing, fire management, rural timber distribution)	Approved operational plan with budget Identified responsibilities for each planned activity Calculated costs for each planned activities	FMU In-charge with local stakeholders as required	Activities linked with objectives identified in the FMP and following options and guidelines in the FMP Each activity with identified responsibility for implementation, estimated cost, and site-specific location OP prepared according to standard formats
6. FMU annual report presented to the FMU management committee	To review progress and identify and address any implementation problems To identify any future actions necessary based on issues arising	FMU Annual report endorsed by FMU management committee	FMU In-charge presents to the FMU management committee	During FMU management committee annual meeting Implementation problems need to be addressed before endorsing the new OP
7. OP reviewed by FMU committee and endorsed	For the FMU management committee to endorse the OP (prior to approval by DoFPS) To endorse expenditure estimates for the coming financial year	OP endorsed by FMU management committee	FMU In-charge presents to the FMU management committee	During FMU management committee annual meeting

Activity (Planning Step)	Objective	Output	Responsibility (lead)	Comments
8. NRDCL financial commitment within OP agreed	To ensure that FDC is committed to funding the agreed activities in the OP	Budget estimates for the OP endorsed by NRDCL and FMU management committee	FMU management committee	Meeting needs to take place by November to ensure that budget requirements can be included in the NRDCL APO for the next financial year
9. OP approved by Director DoFPS	To approve the OP for implementation	Approved plan and budget	Approval by FRMD and Director DoFPS	OP approval linked with sanctioned budget for all planned activities
10. OP implementation by NRDCL	To carry out planned activities	Harvested timber; protected area; roads; fuelwood etc	According to responsibilities identified in the operational plan e.g. FMU In-charge, NRDCL, DzFO etc.	Each activity with a specific responsibility and budget
11. Monitoring of activities	To assess the level of achievement of planned activities	Information for FMU annual report	FMU In-charge	DoFPS responsibility is to monitor the implementation of activities carried out by NRDCL Monitoring also has a cost which needs to appear in the OP
12. DoFPS Unit In-charge prepares	To report progress against planned activities	FMU Annual report	FMU In-charge	Prepared annually

Activity (Planning Step)	Objective	Output	Responsibility (lead)	Comments
FMU annual report	To highlight any problems being encountered in implementation			Progress is reported against each FMP objective and the associated activities
13. Prepare the next year's operational plan (steps 2-5)	To prepare the next operational plan taking into account progress over the past year	Operational plan	FMU In-charge	Operational plans may alter in response to FMU Management Committee suggestions and recommendations

21.2 Mid-term Evaluation of the FMU Management Plan

Mid-term evaluation should take place during the last quarter of the fifth year (January, 2022) of the FMU Management Plan period. This mid-term evaluation requires appointment of an Evaluation Team. The CFO responsible for the FMU must initiate this process through FRMD. The evaluation team will be constituted by the Director/Director General, Department of Forests and Park Services, and will comprise of eight team members (minimum five) to include representatives from:

- FRMD (lead agency)
- PPD
- CFO Territorial Division (not from same Division)
- NRDCL Regional Manager (not from same Division)
- UWICE (Research based agency)
- Local Community.

The mid-term evaluation should be preceded in accordance with Part 7 (Monitoring and Evaluation) of Forest Management Code of Bhutan.

The Mid-term evaluation will be discussed with the FMU Level Management Committee.

21.3 FMU Level Management Committee

FMU Level Management Committee chaired by the CFO Thimphu, has been established to ensure the smooth implementation of the Management Plan.

The Committee consists of following members:

- CFO Thimphu (Chairman)
- FMU Unit In-charge, Chamgang Helela FMU (Secretary)
- Regional Manager, WangRegion, NRDCL, Thimphu
- Unit Manager, Chamgang Helela FMU, NRDCL
- Dzongkhag Livestock Officer, Thimphu Dzongkhag
- Gup, Dagala Geog, Thimphu Dzongkhag
- Mamgmi, Dagala Geog, Thimphu Dzongkhag

The Committee can co-opt any person as a member as required, for example, from the local community, from agriculture, NGO or other.

It is important that Gups and Mangmis are included in the Committee as they represent the community that live within the CHFMU boundaries. This will aid in education of the local community and the Committee will benefit greatly from their input.

The Terms of Reference for the FMU Level Management Committee are:

During FMU Management Plan Preparation

- To represent the interests of identified stakeholder groups during the planning process for Forest Management Plan preparation;
- To agree FMU forest management objectives for different parts of the forest, based on national priorities and specific local conditions and needs;
- To consult (along with FRMD) with specific groups of stakeholders likely to be significantly affected by proposed activities such as road construction and timber harvesting and ensure that their interests are effectively accommodated in the final plan.
- To review and endorse the draft forest management plan before it is presented to Director, DoFPS and Minister of Agriculture and Forests for final approval.

This will require up to four FMU Level Management Committee meetings during the year when the forest management plan is being prepared (at least 2 of which should take place "on site")

During Operational Planning, Implementation and Monitoring

- To represent the interests of identified stakeholder groups during planning and review of activities under Operational Plans;
- To review achievements during the past year (based on an annual report submitted by the FMU Unit In-charge) and advise and act on any issues identified;
- To make recommendations for changes in the proposed Operational Plan for the coming year based on the previous years' experience and on the need to achieve agreed objectives in the Forest management Plan;
- To review and endorse the draft Operational Plan before submission to the Director DoFPS for approval;
- To participate in the 5-year mid-term review of the Forest Management Plan;
- To hold any additional meetings as required in response to specific issues arising from FMP and OP implementation.

This will require one annual meeting of the FMU Level Management committee during each year of FMP implementation with the possibility of further meetings to address any urgent matters arising.

21.4 Staff

Chief Forestry Officer, Thimphu Division is the overall controlling Officer of the area. The FMU In-Charge will have direct responsibility in control and management of the FMU. They will be under the administrative control of the Chief Forestry Officer, Thimphu Division.

Chief Forest Officer is the direct representative of DoFPS in the field and as such he is solely responsible for all forestry activities, both technical and administrative, in his jurisdiction.

21.4.1 Responsibility

For the smooth implementation of the plan in the FMU, following staff is the minimum requirement.

Unit In-charge	1
Deputy Ranger	1
Forest Guards	6

The Unit In-charge will be responsible for the day to day implementation of the plan under the overall guidance of the Chief Forest Officer. The Unit In-charge will keep records of all the works, supervise and initiate other silvicultural activities as envisaged in this plan.

21.5 Buildings

Presently Chamgang Helela FMU office is housed separately in Chamgang block, near to Chamgang Middle Secondary School, with office space and UIC's residential quarter. However, in future separate staff quarters need to be constructed, for better monitoring and management of the FMU.

Currently, at the FMU office, the following equipment is available:

1 Bike

1 Clinometer

1 Compass

2 Measuring tapes (50 m)

1 Garmin Etrex GPS

1 Computer

To ensure that all duties can be carried out it is recommended that the following equipment be supplied to the FMU staff:

- 2 Clinometers
- 2 Compasses
- 2 Altimeters
- 2 Diameter Tapes
- 1 Increment Borer
- 1 Printer cum Xerox machine
- 1 Computer

- 1 telephone
- 3 GPS
- 1 Digital Camera
- 1 Binoculars

22. MONITORING AND EVALUATION

The primary focus of the Royal Government of Bhutan's forest policy is to ensure conservation of the environment and, only thereafter, to allow the derivation of economic benefits from the forest.

To ensure that this policy is being carried out in the management of FMUs, a two stage verification process is necessary. The first stage checks that on-ground activities are being carried out as planned in the short term, and the second stage checks that the planned objectives being achieved over the longer term. Monitoring (checking on inputs on a year to year basis) is the term used for the first stage and evaluation (checking achievements against objectives over five year periods) is the second stage.

Standard forms for monitoring and evaluation were prepared and are available from the Forest Management Code of Bhutan. The forms for monitoring were subdivided into Physical, Financial and Environmental sections that contained an exhaustive set of questions and the forms for evaluation were also subdivided into Evaluation form A and Evaluation form B.

22.1 Monitoring

Monitoring is the examination of whether inputs, activities and outputs are successfully supplied according to the planned schedule. CFO Thimphu will ensure that monitoring is carried out on an annual basis (every December/January) according to the guidelines issued by FRMD and as reflected in the Forest Management Code of Bhutan.

The summary of data collection, monitoring and evaluation forms and their use and summary of monitoring and evaluation process are outlined in tables 22.1 and 22.2

Table 22.1 A Summary of Data Collection, Monitoring & Evaluation Forms & Their Use

Form Nos.	Form Name	Purpose of the Form	Who Fills In the Form?	*How Often?*
Form 1 Form 2 Form 3	**Physical & Financial Data – Commercial Activities** **Coupes harvested** **Territorial Activities**	Field data collection & recording of FMU activities	FMU IC	Every Jan, for the previous year (1 Jan to 30 Dec).

Form Nos.	Form Name	Purpose of the Form	Who Fills In the Form?	*How Often?*
Form 4	**Code of Forest Practice Forms: Road Drainage by Culverts**	Field data collection	FMU IC	Every March
Form 5	**Code of Forest Practice Forms: Road Drainage by Side Drains, Batter & Fill Slopes**	Field data collection	FMU IC	Every March
Form 6	**Code of Forest Practice Forms: Stream Crossings**	Field data collection	FMU IC	Every March
Form 7	**Code of Forest Practice Forms: Cable Lines**	Field data collection	FMU IC	Every March
Form 8	**Code of Forest Practice Forms: Interlines**	Field data collection	FMU IC	Every March
	Physical, Financial and Environmental Summary	Summarise Forms 1 to 8	FMU IC	Every Jan for the previous year
Form 9	**Monitoring of Animal Indicator Species**	Field data collection	FMU IC	Every April & October
Form 10	**Monitoring of Plant Indicator Species and Regeneration**	Field data collection	FMU IC	Every April & October
Form 11	**Community Participation RRA Checklist**	Field data collection for 5 year Evaluation	FMU IC	Every 5 Years
Monit-oring Form A	**Annual Monitoring**	Monitoring (*data from Summary form*)	CFO for FMU concerned	Every Year
Evalua-tion Form A	**Five-Year Evaluation**	Evaluation (*data from Form A and Forms 9-11*)	Evaluation Team	Every 5 Years
Evalua-tion Form B	**1st Five-Year Evaluation**	Evaluation (*data from a range of sources directly into the Form*)	Evaluation Team	When 1st 5-year evaluation is done & only rarely thereafter.

Table 22.2 Summary of the Monitoring and Evaluation Process

Stage in the process				
	1.INFORMATION COLLECTION	**2. INFORMATION SUMMARY**	**3. MONITORING**	**4. EVALUATION**
What is happening in each stage?	**INFORMATION COLLECTION AND SELF MONITORING AT FIELD FMU LEVEL**	**SUMMARY OF INFORMATION FOR USE AT DIVISIONAL AND HIGHER LEVELS**	**MONITORING AT DIVISIONAL LEVEL**	**EVALUATION AT DIVISIONAL AND NATIONAL LEVEL**
Type of form used in the process	Physical and Financial Forms 1-3 Environmental Forms 4-10	Physical, Financial and Environmental (P,F & E) Summary Form	Monitoring Form A	Evaluation Forms A and B
Forms filled in by:	Physical and Financial Forms 1-3 filled in by FMU IC in July, assisted by RM NRDCL Environmental Forms 4-10 filled in by FMU IC in March, assisted by RM NRDCL	Filled in by FMU IC in Jan every year.	Filled in by CFO in Jan. every year, using Summary Form	Filled in by CFO in Jan. every five years Environmental Form 11 (RRA) used for data collection every five years
Location for storage of Forms	Forms stored in FMU Office	Forms sent to CFO	P,F & E Summary Form and Monitoring Form A forwarded to FRMD and NEC Secretariat	Evaluation Forms A and B forwarded to FRMD and NEC Secretariat
Who should act on what the forms indicate?	FMU IC should correct deficiencies indicated by the forms	CFO should ensure that action is taken by the FMU IC	CFO should take action necessary to correct deficiencies indicated by the forms	FRMD, CFO should take action necessary to correct deficiencies indicated by the forms

22.2 Evaluation

Evaluation is the examination of whether objectives are being achieved. In the context of FMU evaluation, sufficient time has to elapse before a realistic assessment can be made of progress towards fulfilling objectives (Incoll, 1999). Evaluation should be carried out at five year intervals, based on the information collected by annual monitoring.

CFO, FRMD will ensure that evaluation is carried out at five year intervals, based on the information collected by annual monitoring and other necessary information.

Corrective action, if it is necessary, may require changes to a range of inputs or to implementation methodology. The evaluation will be carried out by staffs that are independent of field implementation activities.

The Evaluation Team for the FMU will be appointed by the Director/Director General, DoFPS and the members of the Evaluation Team will be as outlined in section 21.2.

23. CONSTRAINTS AND RISKS

Constraints and risks to forest management are:

- Inadequate funds for implementation of forest management plan,
- Uncertainty of natural regeneration, due to excessive grazing, bush competition etc.,
- Insufficient trained manpower and limited capacity for resource assessment and management planning,
- Inadequate monitoring to determine whether objectives are being achieved,
- Poor communication between field and office staff and between involved parties,
- Lack of research information.

To implement and monitor this Management Plan, it is essential that the CFO Thimphu be provided with sufficient staff and funds. The risk of failure of regeneration can be minimised by close monitoring, control of grazing and brush competition and planting.

24. DEVIATIONS FROM PLAN PRESCRIPTIONS

Unforeseen circumstances may warrant deviation from the Plan prescriptions. In such an event, the CFO Thimphu must obtain prior written approval from the Director General, DoFPS. Any such request for Plan deviation(s) must be fully justified and such approved deviation(s) entered into the Management Plan during its next scheduled revision.

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ANNEXURE I: Compartment Review and Prescription

Chamgang Helela Forest Management Unit is divided into Three Blocks viz. Chamgang, Helela and Tauding. The blocks are further divided into compartment and sub-compartments based on prominent natural features and similar stand conditions.

Note: No harvesting related to commercial activities shall take place within the plan period in the FMU except during an urgent and unavoidable need for sanitation and thinning of pole size trees. Further rural timber shall only be allotted after proper field verification and in accordance with the Forest and Nature Conservation Rules, 2006. This is because marking in the restricted areas along the FMU road and Interlines had occurred in the past.

1. Block : Chamgang COMPARTMENT : I SUBCOMP : 1

- Altitude:2628 m– 3931 m
- Topography: Gentle to very steep.
- Total area: 267.028 ha
- Protection: 154.314 ha
- Non-production: 5.343 ha
- Forest cover: BP 63.793 ha and MC 41.692 ha
- Area reduced by Community Forest 2.048 ha

Past management:

Rural allotment areaand markings were done on single tree selection basis. Reduction of FMU area is observed due to formation of Community forest in the sub-compartment.

Future management prescription:

Rural timber allotment can be catered based on single tree selection system and in the lower part of the sub-compartment Thinning should be carried out for better growth and increment of the forest stands.

2. Block: Chamgang COMPARTMENT : I SUBCOMP: 2

- Altitude: 2723 m -2815 m
- Topography: Gentle to moderately steep
- Total area: 41.637 ha
- Protection: 22.354 ha
- Forest cover: BP 4.866 ha and MC 13.32 ha.

Past management:

Non- production area.

Future management prescription:

The entire sub-compartment falls under registered land of Royal Bhutan Police, hence no production in this area.

3. Block: Chamgang COMPARTMENT : II SUBCOMP: 1

- Altitude: 2976 m -3128 m
- Topography: Gentle slope
- Total area: 7.41ha
- Protection: 7.41 ha

Past management:

Area has been under Protection Working circle and designated as local water supply area.

Future management prescription:

The area still needs to be managed under Protection working circle as it is an important source for water supply to the local residents within the FMU.

4. Block: Chamgang COMPARTMENT : II SUBCOMP: 2

- Altitude: 2941m - 3188m
- Topography: Moderately gentle to very steep
- Total area: 259.009 ha
- Protection: 11.89ha
- Area reduced by Community Forest: 116.074
- Forest cover: MC- 113.941 ha, BP- 15.299 ha
- Non-production 1.275 ha

Past management:

Designated as rural allotment area in the past plan, however, more than half of the area has been demarcated as Community Forest, with major portion of vegetation under the CF.

Future management prescription:

The remaining half of the area should be conserved and rural markings can be carried out on thinning basis.

5. Block: Chamgang COMPARTMENT : III SUBCOMP: 1

- Altitude: 2976 m – 3128 m
- Topography: Moderate slope

- Total area: 39.657 ha
- Protection: 5.186 ha
- Forest cover: MC- 33.542 ha
- Non- production : 0.93 ha

Past management:

Rural harvest had been carried out.

Future management prescription:

The western portion of the sub-compartment can cater rural marking on selection basis, while the eastern ridge is dominated by bamboo with no feasibility of rural allotment.

6. Block: Chamgang COMPARTMENT: III SUBCOMP: 2

- Altitude: 3234 m– 3436m
- Topography: Moderately steep to steep
- Total area: 9.77 ha
- Protection: 4.57 ha
- Production: 5.20 ha
- Forest cover: MC 4.58 ha,

Past management:

Production and protection

Future management prescription: Marking should be done carefully since 50% area of the compartment falls within protection management circle.

7. Block: Chamgang COMPARTMENT: III SUBCOMP: 3

- Altitude: 3270m-3370 m
- Topography: Gentle steep to steep
- Total area: 35.16 ha
- Protection: 35.16 ha

Past management:

Protection working circle for local water supply

Future management prescription:

Stands of the sub-compartment should be preserved for continuous water supply for local people residing in the FMU.

8. Block: Chamgang COMPARTMENT : IV SUBCOMP: 1

- Altitude: 3318 m-3495m
- Topography: Steep to very steep
- Total area: 87.685 ha
- Protection: 2.242 ha
- Non-production : 3.676 ha
- Forest cover: MC- 81.734 ha.

Past management:

Had been designated as Production Management circle but no harvesting was prescribed in the past plan.

Future management prescription:

Since majority of the sub-compartment was not harvested in the past plan period, rural markings can be done in the sub-compartment with retention of elite mother trees and thinning of poles if required can be done.

9. Block: Chamgang COMPARTMENT : IV SUBCOMP: 2

- Altitude: 3402 m–3710 m
- Topography: Moderate steep to steep
- Total area: 102.205 ha
- Protection: 45.872 ha
- Forest cover: MC- 55.029 ha
- Non-Production: 1.249 ha

Past management:

The entire block had been designated as local water supply under Protection Management circle.

Future management prescription:

Forest to be preserved for watershed purposes, under Protection Management circle.

10. Block: Chamgang COMPARTMENT : IV SUBCOMP: 3

- Altitude: 3347 m – 3920 m
- Topography: Moderately steep to steep
- Total area: 17.223 ha
- Protection: 17.182 ha
- Non-Production: 0.037 ha

Past management:

Protection working circle.

Future management prescription:

Should be preserved for watershed purposes.

11. Block: Chamgang COMPARTMENT : V

- Altitude: 3022 m– 4012 m
- Topography: Steep to very steep
- Total area: 88.847 ha
- Protection: 86.19 ha
- Production: 2.651ha

Past management:

Protection

Future management prescription:

The sub-compartment should be preserved for watershed conservation AND NO FELLING IN THIS SUBCOMPARTMENT.

12. Block: Chamgang COMPARTMENT : VI

- Altitude: 3122 m–4240 m
- Topography: Steep at the lower part to very steep in the higher elevation
- Total area: 166.086 ha
- Protection: 153.622 ha
- Non-Production: 12.428 ha

Past management:

Protection

Future management prescription:

Chuluna Ridge area is secluded as Watershed, soil and wildlife protection. No operation prescribed in the sub-compartment.

13. Block: Chamgang COMPARTMENT : VII SUBCOMP: 1

- Altitude: 2598m -2739m
- Topography: Moderate steep and flat lands.

- Total area: 27.847 ha
- Protection: 2.996 ha
- Forest cover: MC- 6.056 ha, BP- 0.009 ha
- Non-Production: 18.675 ha

Past management:

Major areas under Non-production MC with minimal rural timber allotments form the BP working circle.

Future management prescription:

The current ground reality sees a lot of new settlements and SRF land leasing, with very little or no areas for further allotment. Therefore, the sub-compartment needs to stop catering timber and look into possibilities of plantation in barren areas.

14. Block: Chamgang COMPARTMENT : VII SUBCOMP: 2

- Altitude: 2747 m–2812 m
- Topography: Moderate slope.
- Total area: 11.296 ha
- Area reduced by CF:1.033 ha
- Total Forest cover: MC- 0.593 ha.
- Non-Production: 9.689 ha
- Local Use Area: 120.35 ha

Past management:

Non-production- cultivated.

Future management prescription:

The whole sub-compartment shall be managed under Non-production area, since majority of the area falls under private property and Community forest.

15. Block: Chamgang COMPARTMENT : VII SUBCOMP: 3

- Altitude: 2732 m-3675 m
- Topography: Steep throughout the compartment.
- Total area: 280.35 ha
- Protection: 147.481 ha
- Area reduced by CF: 36.026 ha
- Non-Production: 19.372 ha

Past management:

Rural allotment.

Future management prescription:

The upper ridges should be preserved with NO FELLINGS for local water supply and the remaining lower portion towards settlements should be managed with single tree selection.

16. Block: Chamgang COMPARTMENT : VII SUBCOMP: 4

- Altitude: 3178 m – 4063 m
- Topography: Moderate steep to very steep.
- Total area: 119.057 ha
- Protection: 116.557 ha
- Non-Production: 2.458 ha

Past management:

Local water supply, Protection management circle

Future management prescription:

Protection MC (Wildlife, water and soil protection).

17. Block: Helela COMPARTMENT : I SUBCOMP: 1

- Altitude: 2392 m – 2571 m
- Topography: Very steep throughout the compartment
- Total area: 38.32 ha
- Protection: 37.401 ha
- Non-Production: 0.875 ha

Past management:

Non-production MC, owing to inaccessibility.

Future management prescription:

Non-production Management Circle for aesthetic value from Thimphu-Wangdue NH and road leading to the FMU.

18. Block: Helela COMPARTMENT : I SUBCOMP: 2

- Altitude: 2693 m-2952 m
- Topography: Moderate slope throughout the compartment
- Total area:139.755 ha
- Protection: 101.888 ha
- Forest cover: BP- 19.213 ha, MC- 18.154 ha
- Non-Production: 0.502 ha

Past management:

Rural timber allotment (BP working circle.)

Future management prescription:

More than half of the area will be under Protection Management circle. Remaining area shall be managed under single tree selection system based on stock availability. Thinning needs to be initiated in young blue pine stands.

19. Block: Helela COMPARTMENT : II

- Altitude:3106m – 3222m
- Topography: Moderate slope to steep slope
- Total area: 485.296 ha
- Protection:139.505 ha
- Forest cover: BP- 17.04 ha, MC- 319.021 ha.
- Non-Production: 9.737 ha

Past management:

Local cum commercial

Future management prescription:

Rural markings should not be done from the interlines and from the western boundary of the FMU as the area is designated under Protection MC. During marking care should be taken to avoid marking in the past old cable lines. Corridor opening and old stumps can be used to identify the past operated cable lines. Forest above road (OLD CABLE LINES) needs immediate restocking and plantation needs to be carried out. Rural area shall be managed under single tree selection system with strict vigilance from the unit in-charge.

20. Block: Helela COMPARTMENT : III

- Altitude: 2923m – 3492m.
- Topography: Moderate slope to steep slope
- Total area: 414.752 ha
- Protection: 250.248 ha
- Forest cover: MC- 156.78 ha
- Non-Production: 7.725 ha

Past management:

No harvesting in the past plan period.

Future management prescription:

The area is designated for rural allotment on single tree selection basis. Marking to be avoided from the western boundary of the FMU, as it is secluded under Protection MC.

21. Block: Helela COMPARTMENT : IV SUBCOMP: 1

- Altitude: 2808 m–2816 m
- Topography: Steep slopes
- Total area:47.554 ha
- Protection: 9.248 ha
- Forest cover: MC- 14.838 ha
- Non-Production: 0.119 ha
- Ecological Reserve: 23.349 ha

Past management:

No harvesting in the past plan period

Future management prescription:

No harvesting in the Ecological Reserve area, but allotment can be done from the Northern boundary of the sub-compartment, below the road.

22. Block: Helela COMPARTMENT : IV SUBCOMP: 2

- Altitude:2864 m –2935 m
- Topography: Gentle slope throughout the sub-compartment.
- Total area: 16.601 ha
- Protection: 1.433 ha
- Forest cover: MC- 3.53 ha.
- Reserve: 11.638 ha

Past management:

No harvesting in the past plan period

Future management prescription:

No harvesting in this plan period

23. Block: Helela COMPARTMENT : IV SUBCOMP: 3

- Altitude: 2877 m-2918 m
- Topography: Gentle slope throughout the sub-compartment
- Total area: 7.35 ha
- Protection: 1.25 ha
- Forest cover: MC- 5.487 ha
- Reserve: 0.613 ha

Past management:

No harvesting in the past plan period.

Future management prescription:

Apart from Reserve and steep slopes (under Protection MC), the remaining area shall be managed under single tree selection system based on stock availability and strict monitoring.

24. Block: Helela COMPARTMENT : V

- Altitude: 2934 m-3756 m.
- Topography: Moderate to steep slope
- Total area: 736.969 ha
- Protection: 503.124 ha
- Forest cover: MC- 228.805 ha
- Non- Production: 4.879 ha

Past management:

Out of the proposed road of 3 km, only 1.5 km was constructed and two cable lines laid, but owing to the declaration of Green Belt zoneno further road was constructed and no operations were carried out.

Future management prescription:

Majority of the sub-compartment falls under Protection MC, and the remaining are designated as rural use area. Local area marking should avoid water buffer and care should be taken to avoid marking in the past old cable lines. Corridor opening and old stumps can be used to identify the past operated cable lines. Rural area shall be managed under single tree selection system with strict vigilance from the unit in-charge.

25. Block: Helela COMPARTMENT : VI SUBCOMP: 1

- Altitude:2862 m –2874 m
- Topography: Moderate slope throughout the sub-compartment
- Total area:6.549 ha
- Protection: 0.814 ha
- Forest cover: MC- 5.645 ha
- Non-Production: 0.09 ha

Past management:

No harvesting in the past plan period.

Future management prescription:

The area should be managed under thinning regimes, to cater flag poles and fencing posts for rural use.

26. Block: Helela COMPARTMENT : VI SUBCOMP: 2

- Altitude:2838 m-2932 m
- Topography: Moderate slope
- Total area: 21.798 ha
- Protection: 1.787 ha
- Forest cover: MC- 20.012 ha

Past management:

No harvesting in the past plan period.

Future management prescription:

Designated as Rural area and shall be managed under single tree selection system with thinning to cater flag poles and fencing posts.

27. Block: Helela COMPARTMENT : VI SUBCOMP: 3

- Altitude: 2929 m - 2944 m
- Topography: Moderate slope
- Total area: 5.509 ha
- Protection: 0.601 ha
- Forest cover: MC- 4.907 ha

Past management:

No harvesting in the past plan period.

Future management prescription:

The area should be managed under thinning regimes, to cater flag poles and fencing posts for rural use.

28. Block: Helela COMPARTMENT : VI SUBCOMP: 4

- Altitude: 2824 m - 2931 m
- Topography: Moderate slope
- Total area: 21.017 ha
- Protection: 6.003 ha
- Forest cover: MC- 15.014 ha

Past management:

No harvesting in the past plan period.

Future management prescription: Designated as Rural area and shall be managed under single tree selection system. However, plantation carried in the past has to be maintained and taken care for future generation.

29. Block: Helela COMPARTMENT : VII SUBCOMP: 1

- Altitude: 2856 m-2884 m
- Topography: Moderately steep slopethroughout the sub-compartment
- Total area: 9.92 ha
- Protection: 0.455 ha
- Forest cover: MC- 9.418 ha
- Non-Production: 0.045 ha

Past management:

No harvesting in the past plan period.

Future management prescription:

Area is secluded for rural allotment but care should be taken not to encroach in plantation carried out in the 1st plan.

30. Block: Helela COMPARTMENT : VII SUBCOMP: 2

- Altitude: 2940 m - 3268 m
- Topography: Moderate slope.
- Total area: 35.219 ha
- Protection: 6.997 ha
- Forest cover: MC- 28.199 ha
- Non-Production: 0.023 ha

Past management:

No harvesting in the past plan period.

Future management prescription:

Designated as rural allotment area.

31. Block: Helela COMPARTMENT : VII SUBCOMP: 3

- Altitude: 2964 m-3832 m
- Topography: Moderately slope near the road and very steep while moving away from the forest road.
- Total area: 462.633 ha
- Protection: 132.835 ha
- Forest cover: MC- 293.236 ha.
- Non-Production: 8.797 ha
- Area reduced by CF: 27.746 ha

Past management:

After road construction in the southern section, Commercial timber extraction was planned. Owing to the declaration of Green Belt zone no roads was constructed and no operations were carried out.

Future management prescription:

The area is designated for rural use. Local area marking should not extend to the southern boundary of the FMU as the area is designated as Wildlife protection, under the Protection Management Circle.

32. Block: Helela COMPARTMENT : VIII SUBCOMP: 1

- Altitude: 2596 m-2793 m
- Topography: Moderately steep slope throughout the sub-compartment
- Total area: 57.823 ha
- Protection: 12.057 ha
- Forest cover: MC- 28.808ha, BP- 5.964
- Non-Production: 10.657 ha
- Area reduced by CF: 0.354

Past management:

Transmission line removals only.

Future management prescription:

Whole sub-compartment is designated as rural area and should be maintained on single tree selection system. The area is bark beetle prone area and if any incidence occurs proper sanitation with immediate plantation should take place.

33. Block: Helela COMPARTMENT : VIII SUBCOMP: 2

- Altitude: 2765m – 2806 m
- Topography: Gentle slope throughout the sub-compartment
- Total area: 35.22 ha
- Forest cover: MC- 30.20 ha
- Non-Production: 5.2 ha

Past management:

Rural timber allotment.

Future management prescription:

As the western portion of the Sub-compartment is colonised by bamboo, few rural demand for flag poles and cham sized trees can be met on the eastern portion below the road.

34. Block: Helela COMPARTMENT : VIII SUBCOMP: 3

- Altitude: 2823 m – 2848 m ft
- Topography: Moderately steep slope throughout the sub-compartment
- Total area: 6.568 ha
- Protection: 1.198 ha
- Forest cover: MC- 4.995
- Non-Production: 0.372 ha

Past management:

No harvesting in the last plan period.

Future management prescription:

Flag poles can be allotted from the sub-compartment on thinning basis and plantation needs to be maintained.

35. Block: Tauding COMPARTMENT : I

- Altitude: 2482 m - 3557m
- Topography: Moderately steep slope throughout the sub-compartment
- Total area: 2011.586 ha
- Protection: 69.834 ha
- Forest cover: MC- 55.022 ha, BP 46.067 ha
- Non-Production: 0.531 ha

Past management:

No harvesting in the last plan period.

Future management prescription:

Firewood markings for VVIP can be met from the North-western boundary, above the road area of the sub-compartment. Rural timber can also be extracted for the area on single tree selection basis.

36. Block: Tauding COMPARTMENT : II

- Altitude: 2382 m–3295 m
- Topography: Moderately steep slope throughout the sub-compartment
- Total area: 358.548 ha
- Protection: 157.281 ha
- Forest cover: MC- 38.567 ha, BP 40.289 ha
- Non-Production: 0.31 ha

Past management:

Commercial and rural allotment from the west side of the sub-compartment.

Future management prescription:

The Eastern portion of the FMU is designated under Protection Working Circle and no felling is prescribed. However, the remaining areas both below and above the road will cater timber requirements for rural as well as commercial.

ANNEXURE II: Compartment Record Sheet

BLOCK: **COMPARTMENT NO:** **Sub-Compartment No.**

Year	Harvesting					Planting		Others	Remarks
	Rural		Commercial		Total	Area(ha)	Species		
	Area (ha)	Vol (m^3)	Area (ha)	Vol (ha)					
2017									
2018									
2019									
2020									
2021									
2022									
2023									
2024									
2025									
2026									
2027									

ANNEXURE III: INVENTORY RESULTS

Basal Area Estimate Per Hectare for Blue pine stratum (Square Meter)	
Estimated basal area of trees per hectare	17.363
Sample variance of total basal area of trees per hectare	205.983
Estimated variance of total basal area of trees per hectare	14.713
Margin of error (%) of total basal area of trees per hectare	39.123
lower limit of basal area of trees per hectare	10.570
upper limit of basal area of trees per hectare	24.156
Percent coefficient of variation	82.659
Standard error percent	22.092
Basal Area Estimate Per Hectare for Mixed Conifer stratum (Square Meter)	
Estimated basal area of trees per hectare	24.438
Sample variance of total basal area of trees per hectare	513.454
Estimated variance of total basal area of trees per hectare	5.642
Margin of error (%) of total basal area of trees per hectare	16.154
lower limit of basal area of trees per hectare	20.490
upper limit of basal area of trees per hectare	28.386
Percent coefficient of variation	92.722
Standard error percent	9.720
Basal Area Estimate Per Hectare for Combined stratum (Mixed Conifer + Blue Pine) (Square Meter)	
Estimated basal area of trees per hectare	23.495
Sample variance of total basal area of trees per hectare	477.223
Estimated variance of total basal area of trees per hectare	4.545
Margin of error (%) of total basal area of trees per hectare	15.059
lower limit of basal area of trees per hectare	19.956
upper limit of basal area of trees per hectare	27.033
Percent coefficient of variation	92.980
Standard error percent	9.074
Number of Trees Estimate per Hectare for Mixed Conifer Stratum (Number)	
Estimated number of trees per hectare	148.132
Sample variance of total number of trees per hectare	7035.915
Estimated variance of total number of trees per hectare	77.318
Margin of error (%) of total number of trees per hectare	9.865
lower limit of number of trees per hectare	133.518
upper limit of number of trees per hectare	162.746
Percent coefficient of variation	56.625
Standard error percent	5.936

Number of Trees Estimate per Hectare for Blue Pine Stratum (Number)	
Estimated number of trees per hectare	155.714
Sample variance of total number of trees per hectare	10841.758
Estimated variance of total number of trees per hectare	774.411
Margin of error (%) of total number of trees per hectare	31.649
lower limit of number of trees per hectare	106.432
upper limit of number of trees per hectare	204.996
Percent coefficient of variation	66.868
Standard error percent	17.871
Number of Trees Estimate per Hectare for Combined Stratum (Mixed Conifer + Blue Pine)	
Estimated number of trees per hectare	149.143
Sample variance of total number of trees per hectare	7476.247
Estimated variance of total number of trees per hectare	71.202
Margin of error (%) of total number of trees per hectare	9.390
lower limit of number of trees per hectare	135.139
upper limit of number of trees per hectare	163.147
Percent coefficient of variation	57.975
Standard error percent	5.658
Volume estimate per Hectare for Mixed Conifer (Cubic meter)	
Estimated total volume per hectare	241.344
Sample variance of total volume per hectare	82349.877
Estimated variance of total volume per hectare	904.944
Margin of error (%) of total volume per hectare	20.715
lower limit of volume per hectare	191.349
upper limit of volume per hectare	291.340
Percent coefficient of variation	118.904
Standard error percent	12.464
Volume estimate per Hectare for Blue Pine (Cubic meter)	
Estimated total volume per hectare	216.160
Sample variance of total volume per hectare	51470.797
Estimated variance of total volume per hectare	3676.485
Margin of error (%) of total volume per hectare	49.676
lower limit of volume per hectare	108.781
upper limit of volume per hectare	323.538
Percent coefficient of variation	104.956
Standard error percent	28.051

Volume estimate per Hectare for Combined stratum (Mixed Conifer + Blue Pine) (Cubic meter)	
Estimated total volume per hectare	279.545
Sample variance of total volume per hectare	81746.187
Estimated variance of total volume per hectare	778.535
Margin of error (%) of total volume per hectare	16.565
lower limit of volume per hectare	233.237
upper limit of volume per hectare	325.853
Percent coefficient of variation	102.278
Standard error percent	9.981

ANNEXURE IV: Road Standards

No new forest road will be constructed during the current plan period however the road standards are given for general reference and information. As stated before, the road standards developed in the east by TFDP will be implemented for design, drainage and construction of all forest roads in the Chamgang Helela FMU. Following are the standards:

Road Design

- Road lengths and density should be minimized, consistent with access requirements to reduce environmental impacts and enhance access economics.
- Where possible locate roads in areas with low side slopes, the maximum side slopes allowed in all areas except rock is 100%.
- Roads must be constructed in such a way that no earth works or soil spill into water courses or watercourse buffer areas. Care should also be taken to ensure that no earth works or soil is allowed to spill onto agricultural land, near houses or main roads.
- Roads should be planned in such a way as to balance cut and fill to minimize transport of construction materials.
- Roads should not be constructed in steep and unstable areas where there is the possibility of landslide. A thorough survey of any area suspected of being unstable should be undertaken prior to work commencing.
- Roads should be kept as narrow as possible to reduce damage to the environment and to reduce costs.
- Where possible, box cuts should be avoided, however they are acceptable for short distances (up to 300 m), if they reduce the length of the road, reduce environmental damage and are properly drained.
- Minimum radius formed by curves or corners should be 15 m and should where possible fit the topography of the land.
- Roads should be located on elevated areas where possible to minimize side cutting, width of clearing and drainage problems.
- Side cutting should be carried out leaving a stepped batter, each step no more than 3 m in vertical height and no more than 100% gradient with a 1.5 m horizontal step.
- Convex road surface should be maintained at all times with the centre line 30 cm higher than the edges.
- Stabilize and re-vegetate cut and fill slopes with shrubs, grasses and legumes as soon as possible after construction.
- Ensure proper maintenance of roads and enforce road use restrictions during critical weather conditions such as monsoon seasons.

Drainage

Road planning should ensure that roads are located in such a way as to minimize stream river crossings.

Roads should not be constructed in areas, which are prone to flooding in the monsoon seasons.

In areas where side slopes of 70% or greater extend for a distance of 100 m or more above the proposed road catch drains should be constructed to divert surface water into culverts. Side drains or table drains should be at least 40 cm deep and 65 cm wide and should drain into culverts of sufficient size and frequency.

All culverts must have stone or concrete aprons at their exit points to prevent erosion by water. These aprons should be of suitable width and design to prevent any erosion, taking place and should extend down the slope for at least the length of the spill. They should divert the water back into the stream if the water came from a stream.

Culverts of appropriate diameter (not less than 30 cm) should be placed at regular intervals along the road. The following table gives the minimum spacing required according to road gradient. Should the roadside drain be composed of erodible material then the distance between the culverts must by reduced by 50%.

Road gradient %	Distance between culverts (metres)
4	110
5-8	90
9-10	80
11-15	60

Culverts should be laid at 2 to 5 % gradient across the road to enable water to flow but should not exceed 6 % as damage from erosion will result.

Culverts pipes (Hume pipe) should be buried a minimum of 700 mm below the surface of the road.

In areas of high seasonal rainfall, catch drains should be constructed above the road to collect surface runoff and prevent it reaching the road.

Drains should not be allowed to directly enter a watercourse but should be diverted into surrounding vegetation at least 50 m before a watercourse.

Sumps or silt traps should be places in drains every 50 m in erodible soils and must be cleaned regularly.

Road Construction

All timbers above 30 cm diameter must be felled and removed from the road alignment, the remaining timber should be cut and burnt (no organic material should be used as fill).

Primary excavation should be done in such a manner as to remove the topsoil and place it on the downward slope of the road. This will allow vegetation to regenerate and stabilise the slopes.

Where side slopes of 70% or more extend more than 100 m downhill no side casting of spoil should be allowed. In this situation end haul methods must be used.

Forest roads should only be constructed on stable soil types where there is no possibility of slippage.

All road construction on side slopes of over 50% or difficult terrain, such as boulder fields, must be carried out using excavators.

Batter and fill slopes should not exceed 100%

Where road construction is carried out on side slopes of over 90% rock or concrete wall should be built to support both batter and fill (this is not required in solid rocks).

On side slopes of over 70% all of the load carrying surface of the road must be built on stable ground. The road should not be supported by fill.

The adverse gradient should not exceed 10%. However, grades of up to 12% will be allowed for distances of up to 300 m if this substantially reduces road length. Following this incline a minimum distance of 100 m of grades of 10% or less must be maintained.

The favourable gradient should not exceed 12%. However, grades of up to 15% for distances of up to 300 m will be allowed if this substantially reduces road length. These grades should be followed by grades of less than 10% for distances of 100 m or more.

ANNEXURE V: Marking guidelines

Marking guidelines for the group selection system

Although no commercial harvesting will take place during the current plan period the guidelines were given for general reference and information.

The group selection system aims secure natural regeneration by imitating nature in the creation of small opening in the forest stand; thus allowing light to reach the forest floor and creating favorable microclimatic condition for seed germination and seedling establishment. It is important to avoid damage to the remaining stand by selecting only trees that will fall into the opening and ensuring that accurate felling is carried out.

- Small groups spaced at specified interval will be harvested removing all tress over 10 cm DBH.
- The group will be located along extraction lines
- The distance between the extraction lines will be no less than 60 m.
- The distance between the groups, along the extraction lines, will be less than 50 m.
- The shape of the harvested groups can be irregular, according to the site and terrain conditions.
- Existing opening in the stand having already established regeneration should be used as a nucleus for marking the groups.
- Signs of existing wind fall in the stand should form the basis of the opening. In such a case, opening boundaries should correspond to changes in soil moisture that is often the cause of the windfall.
- Wind firm trees must surround the selection groups. This could be achieved by leaving intermediate height trees along the edge of the opening.
- The trees will be marked for harvesting along the extraction corridors.
- The extraction corridors must be as narrow as possible; 2-4 m in the fir stands and no wider than 4 m in the Spruce and mixed stands.
- The maximum size of the groups will be on an average less than 0.15 hectares depending on the sites characteristics and stand condition.
- Diseased, dead and malformed tress will be marked on the priority basis and should be used as a nucleus for creating as opening.
- Boundaries of opening should, where possible corresponds to change in slope. An opening should not end in the middle of a steep slope since tree will slide into the remaining stand during logging.
- Care must be taken in choosing the boundary of the opening. Trees, which can be expected to fall into the opening, should be marked while trees leaning out of the proposed opening must be left standing so as to minimize damage to the remaining stand.
- Trees damaged during harvesting will be cut and removed in the subsequent cleaning operations.
- Fruiting trees and some hollow trees which will have less economical value will not be harvested; it will be left for preserving biodiversity.

Marking guidelines for the single-tree selection system

Felling under the single-tree selection system should be done in accordance with the following guidelines:

- Trees marked for harvesting will be evenly distributed throughout the stand.
- Diseased, malformed, dead and decaying trees will be marked on a priority basis; especially these are hampering the better ones (unless objectives of biodiversity conservation dictate otherwise). These trees can be marked even if below the set diameter limit of 50 cm. however, care should be taken that no large openings are created in the stand by marking these trees.
- Trees of exploitable size should be marked, particularly if defective or lacking in vigor; mature and over-mature trees over 50 cm DBH outside bark to be marked.
- No more than one third of the stand volume should be marked for harvesting.
- In mixed stands, an even and suitable distribution of species should be left standing.
- Fruiting trees and some hollow trees which will have less economical value will not be harvested; it will be left for preserving biodiversity.

Marking Guidelines for Blue pine under Seed Tree System

- The seed tree system is used in pure pine stands or missed stands consisting of mixture of pine and Spruce with pine predominating.
- The Seed Tree System will be used in the above stands only on suitable sites.
- The system will not be used on steep and exposed, South or South -West sites.
- In mixed stands an equal distribution of pine and Spruce will be left standing
- Slope characteristics, wind firmness and aesthetic value will be considered.
- About 20 to 25 trees per hectare (i.e. approximately 22 to 26 meters apart) will be left standing.
- Diseased, malformed and dying trees will be cut on priority basis.
- Trees left standing will not be oldest or tallest in the stand. Over mature trees will be cut on priority basis.
- Trees left standing will be of good health and form to ensure good seed source.
- The shape of the area chosen for the seed tree can be irregular.
- Maximum size of a contiguous area harvested using this system should not exceed one hectare.
- Fruiting trees and some hollow trees which will have less economical value will not be harvested; it will be left for preserving biodiversity.

Marking Guidelines for Thinning in Blue pine Stands

Thinning will be carried out in immature stands. The objective of thinning is to increase growth and quality of stands and at the same time provide small dimension. Healthy, vigorous trees will be released by cutting

Considering the fact that there is a great variation in the age, density and condition of the immature stands care has to be taken not to cause damage to the thinned stands. The primary aim is to achieve even spacing of the remaining tress in the stand.

- The stand for thinning will be identified from the forest type maps and verified in the field.
- The stands identified for thinning, if falling within the harvestable limits of cable cranes, will be subjected to thinning.
- Observation and monitoring of dwarf mistletoe infestation on Blue pine; trees infected with mistletoe should be given first priority for felling. Complete burning is needed.
- Mark for thinning 20% of standing volume.
- Marking of trees for thinning will depend on the number of stem per hectare, age or size class, and the spatial distribution.
- Only low thinning will be done in most of the stands, where only dead, dying, suppressed, diseased and defective trees will be marked first.
- In stands less than 10m average height the target spacing should be approx. 4.5x4.5m or about 500 tress per hectare.
- In stand with pole crop (average height 10-20 m) the spacing of tress after the thinning should be no more than 5-6m, or approx. 300-400 trees per hectare.
- In stands which at present have less than desired tree density and spacing; only trees that grow in clusters, very close together and competing for light and nutrient can be removed. Diseased trees, especially those infected with mistletoe can be removed.
- Care must be taken not to create large opening in the thinned stands.
- Diseased, malformed and suppressed trees will be thinned on a priority basis.

Marking for Rural Uses

It is necessary that the marking for rural use whether for timber or fuel wood, should be done under standard Silvicultural system.

Firewood marking when necessary should be done under Single Tree Selection System from Local Use (only) forest area.

Flag posts, fence posts and poles demand should be met by marking for thinning in the pole crop high density stands thereby subjecting the stands to Silvicultural thinning

ANNEXURE VI: Record Keeping Forms

Rural Allotment

Block: Compartment: Sub-compartment:

MC	WC	Date	Name and Address	Permit #	TMB #	Particulars			Volume (m3)			Comments
						Species	Product Type	Amount	Marked	Recovered	Firewood	

Commercial Allotment

Block: Compartment: Sub-compartment:

MC	WC	Year of Activity	Commercial Activities					Volume (m3)				Other Activities	TMB #	Comments (Include detailed description of cable line location in relation to mappable features)
			Cable Lines			Groups/Patches/ Other		Marked		Extracted (FDC)	Firewood (lops/tops)			
			Line #	Length (m)	Azimuth	Total #	Total Area (ha)	# of trees	Vol.					

Stand Tending and Regeneration

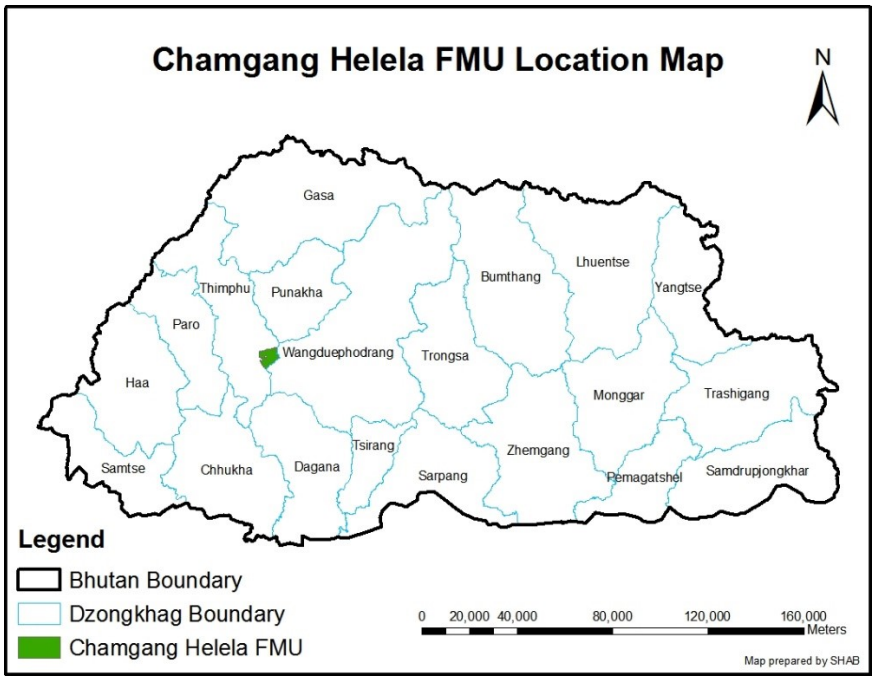
Block: Compartment: Sub-compartment:

MC	WC	Cable line #	Year	Stand Tending		Regeneration						Comments or Other Activities
				Activity	Area (ha)	Natural/ Plantation	Species	Year Surveyed	Area (ha)	Survey Results (stems/ha or survival percent)	Resurvey?	

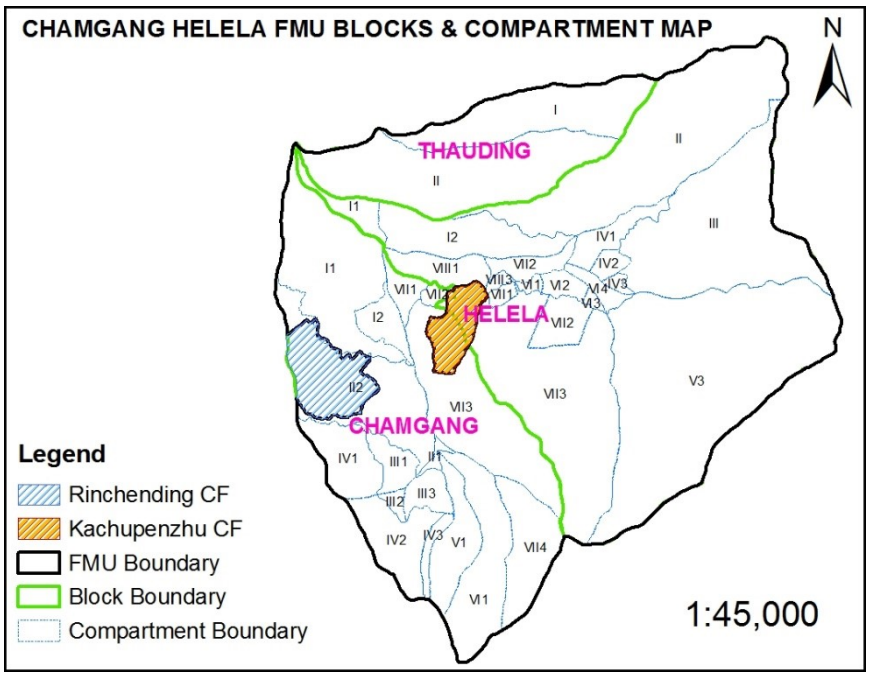
Use for brushing, planting, weeding, and spacing or ground preparation activity

ANNEXURE VII: MAPS

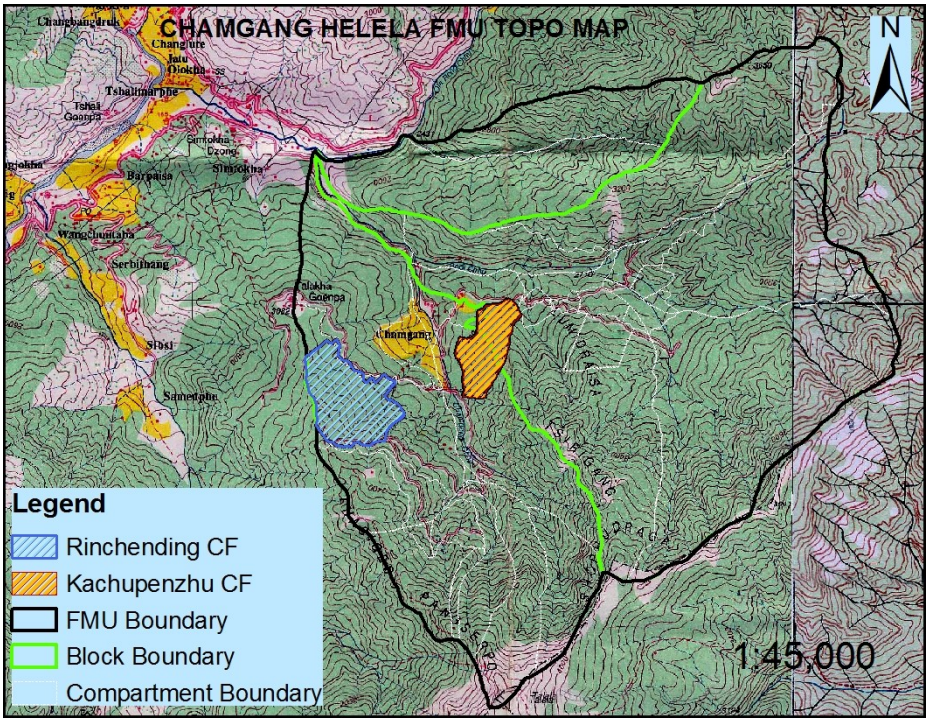
MAP 1



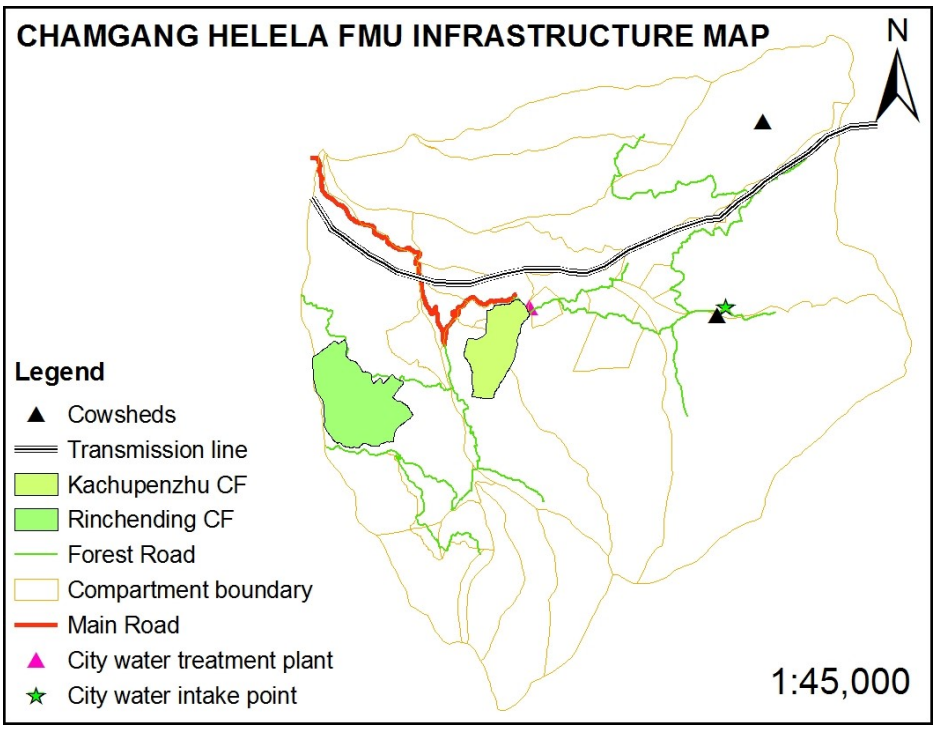
MAP 2



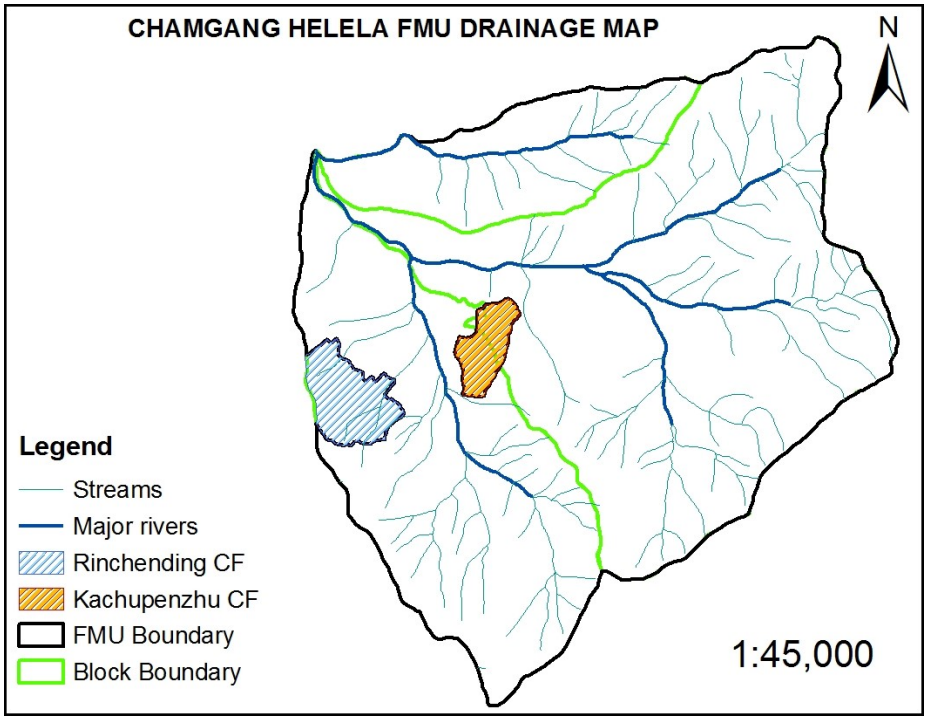
MAP 3


CHAMGANG HELELA FMU TOPO MAP
N
Legend
Rinchending CF
Kachupenzhu CF
FMU Boundary
Block Boundary
Compartment Boundary
1:45,000

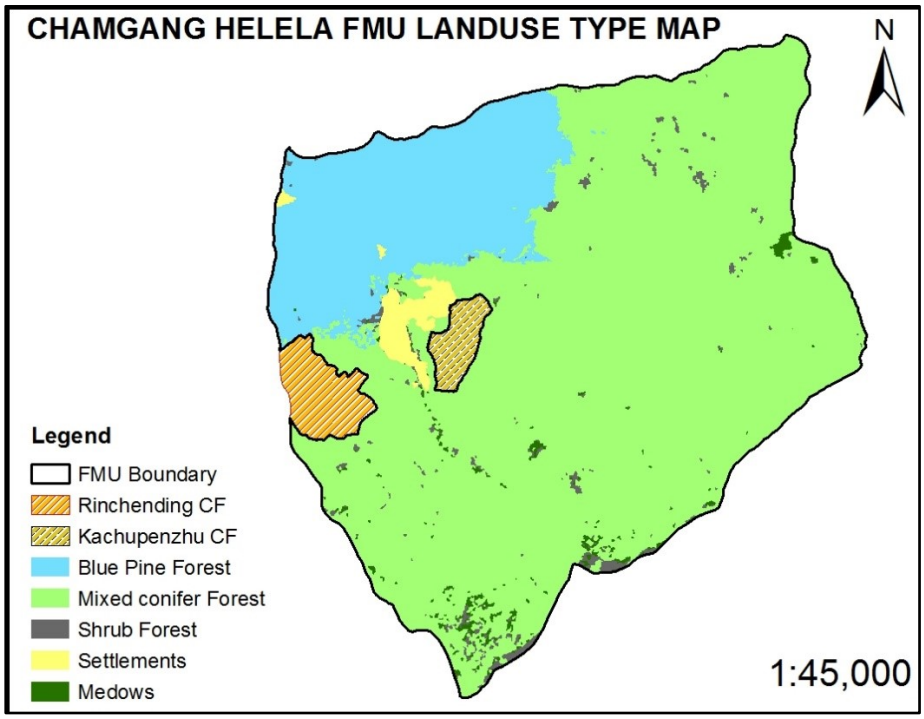
MAP 4


CHAMGANG HELELA FMU INFRASTRUCTURE MAP
N
Legend
Cowsheds
Transmission line
Kachupenzhu CF
Rinchending CF
Forest Road
Compartment boundary
Main Road
City water treatment plant
City water intake point
1:45,000

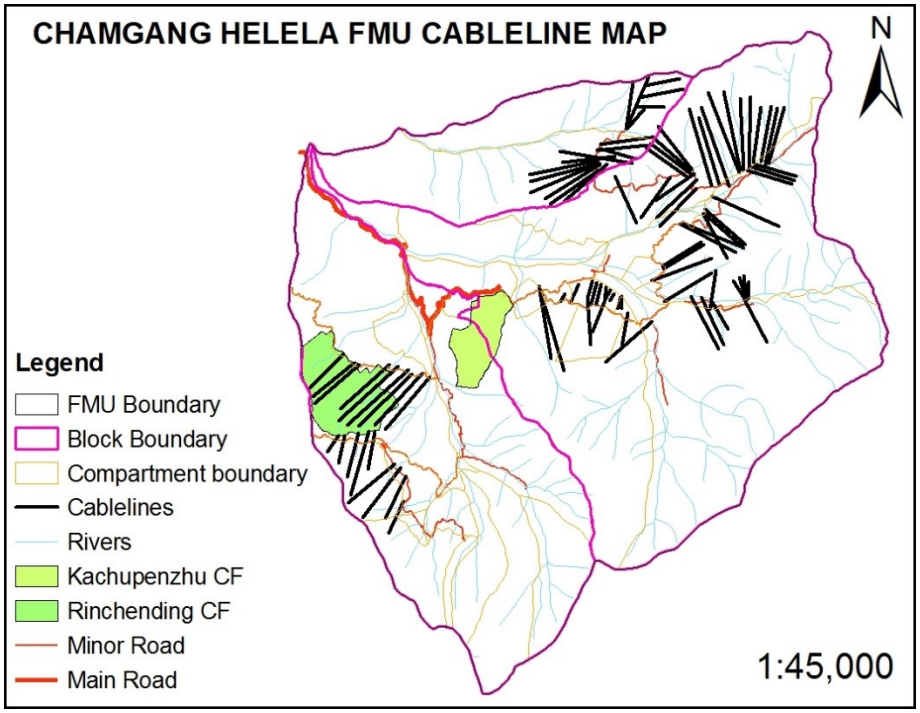
MAP 5


CHAMGANG HELELA FMU DRAINAGE MAP
N
Legend
Streams
Major rivers
Rinchending CF
Kachupenzhu CF
FMU Boundary
Block Boundary
1:45,000

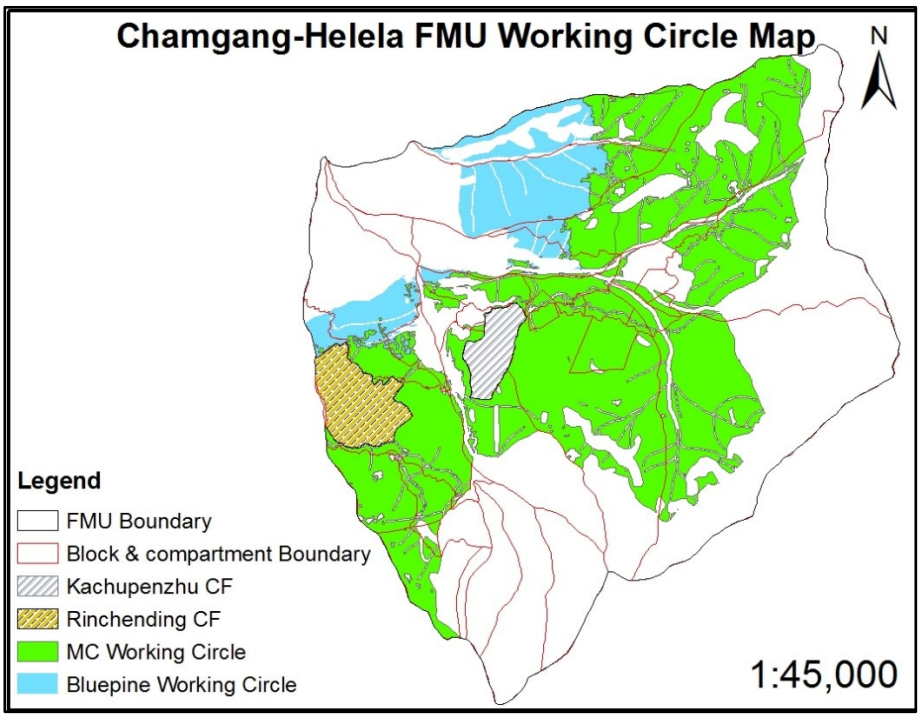
MAP 6


CHAMGANG HELELA FMU LANDUSE TYPE MAP
N
Legend
FMU Boundary
Rinchending CF
Kachupenzhu CF
Blue Pine Forest
Mixed conifer Forest
Shrub Forest
Settlements
Medows
1:45,000

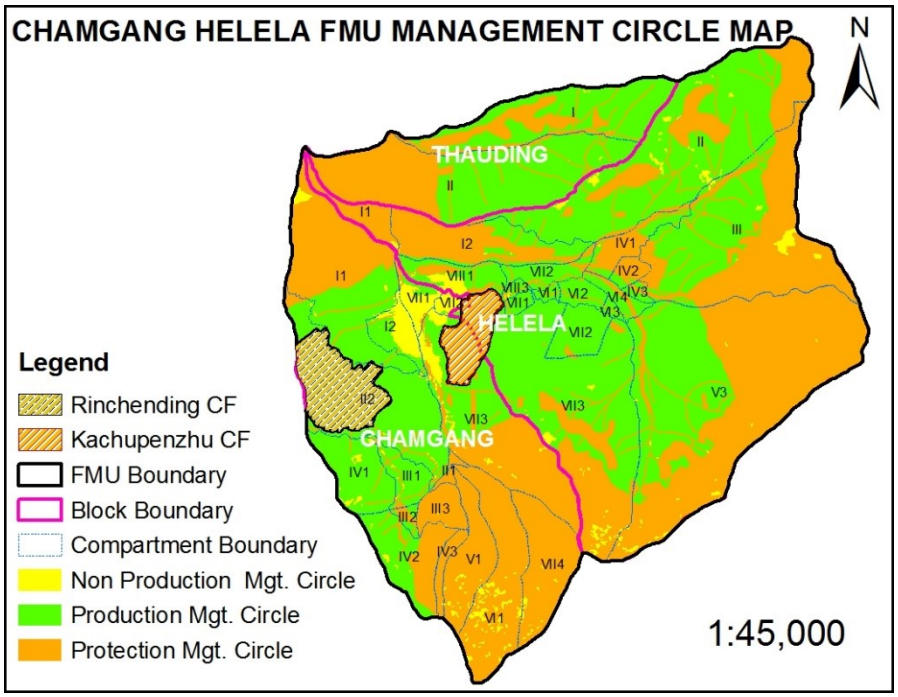
MAP 7


CHAMGANG HELELA FMU CABLELINE MAP
N
Legend
FMU Boundary
Block Boundary
Compartment boundary
Cablelines
Rivers
Kachupenzhu CF
Rinchending CF
Minor Road
Main Road
1:45,000

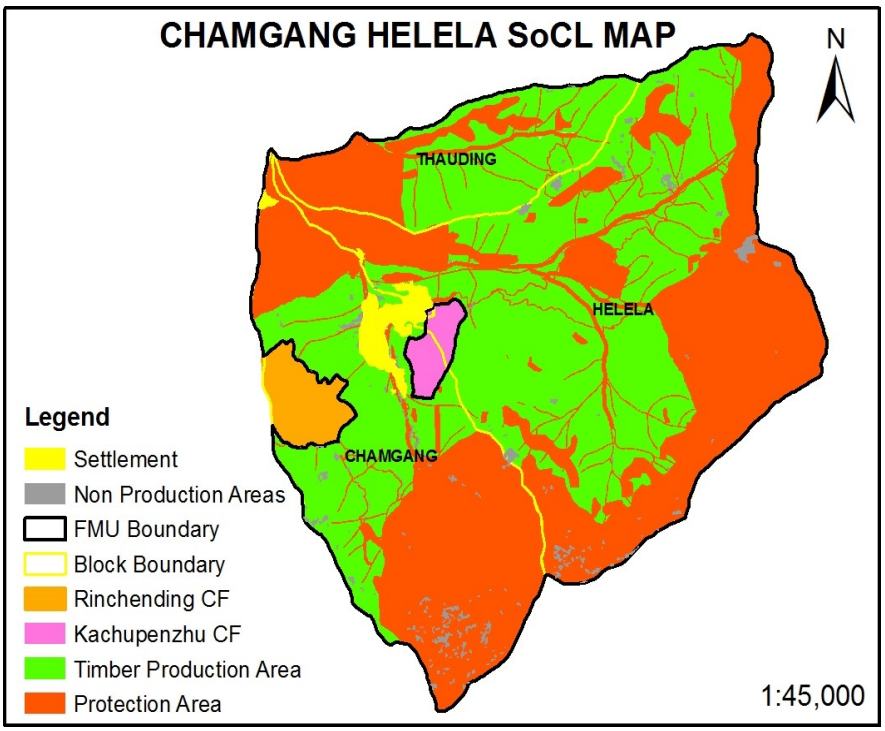
MAP 8


Chamgang-Helela FMU Working Circle Map
N
Legend
FMU Boundary
Block & compartment Boundary
Kachupenzhu CF
Rinchending CF
MC Working Circle
Bluepine Working Circle
1:45,000

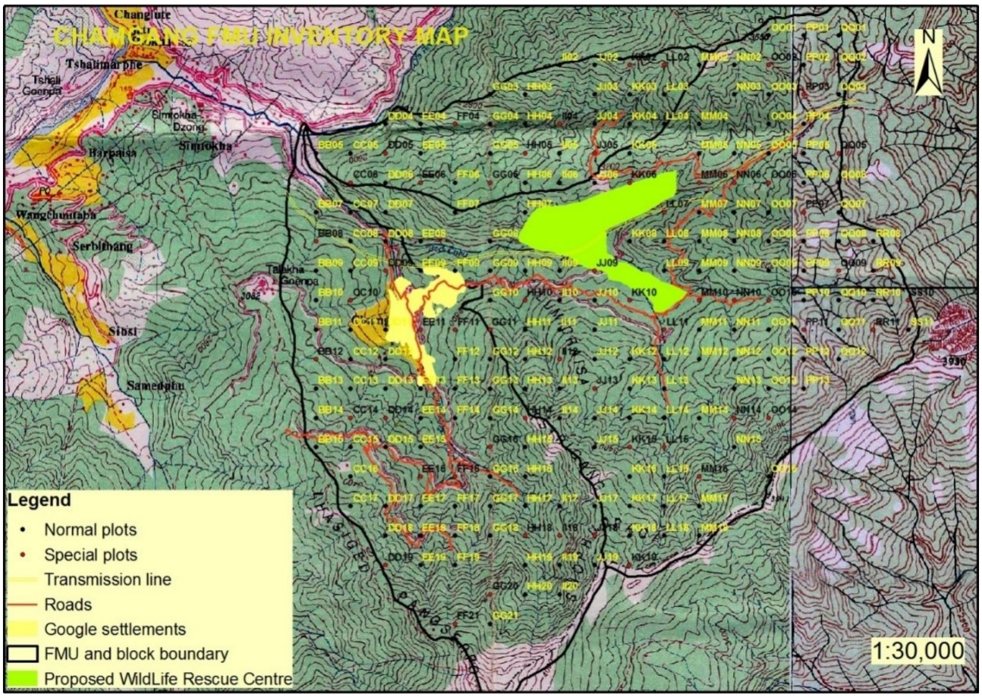
MAP 9


CHAMGANG HELELA FMU MANAGEMENT CIRCLE MAP
N
THAUDING
HELELA
CHAMGANG
Legend
Rinchending CF
Kachupenzhu CF
FMU Boundary
Block Boundary
Compartment Boundary
Non Production Mgt. Circle
Production Mgt. Circle
Protection Mgt. Circle
1:45,000

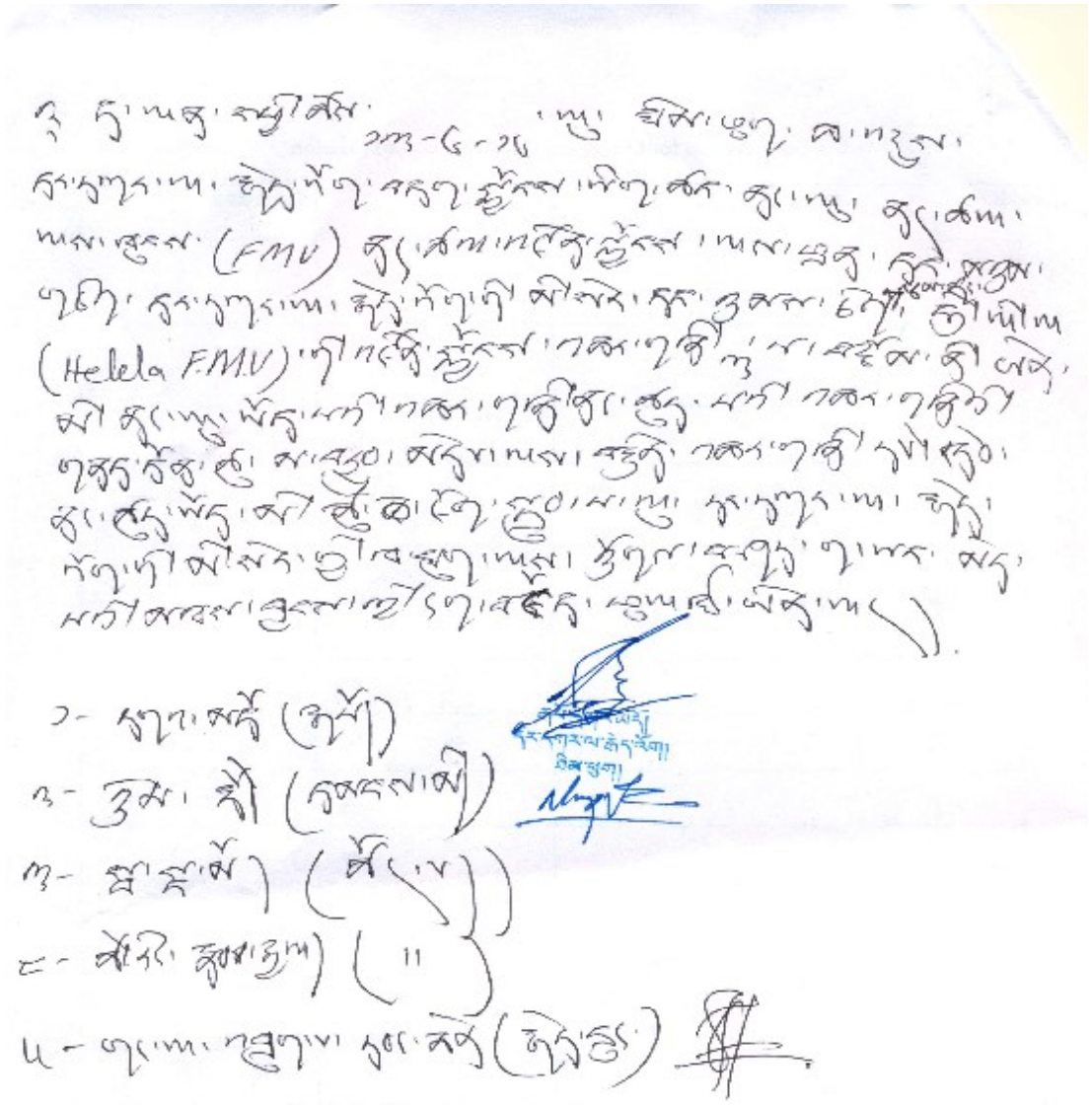
MAP 10


CHAMGANG HELELA SoCL MAP
N
THAUDING
HELELA
CHAMGANG
Legend
Settlement
Non Production Areas
FMU Boundary
Block Boundary
Rinchending CF
Kachupenzhu CF
Timber Production Area
Protection Area
1:45,000

MAP 11


CHAMGANG FMU INVENTORY MAP
N
Legend
Normal plots
Special plots
Transmission line
Roads
Google settlements
FMU and block boundary
Proposed WildLife Rescue Centre
1:30,000

ANNEXURE VIII: No Objection or Minutes of the public consultation meeting



DSA Paid for Public consultation for Chamgang Helela FMU plan revision.

Sl no:	Name	CID NO:	Signature
1)	Gado (Cup)	11403000297	750
2)	Nima Dorji (Mangmi)	11403000132.	500
3)	~~Molam~~ Zangmo.	11506002344	
4)	Gangla Druktpa Wangchen (Caadrung	11403000305	500
5)	Bangam (Tshogpa)	11403000246	300
6)	Tshering Namgay (Tshogpa)	11403000327	300
7)	Kaka	11403000410	215
8)	Tordin Wangchuk	11403000227	215
9)	Pantu	11403000508	215
10	Dothu.	11403000212	215

11)	Gangchu	11403000443
12)	Tandin Dorji	11403000225
13)	Natey	11403000204
14)	Lobzang	11403000138
15)	Chimi Dorji	11403000496
16)	Possang Wangmo	11403000273
17)	Charten Zangpo	115 16001603
18)	Phub Dorji	11403000037
19)	Phub Dorji	11403000126
20)	Dago	11403000446
21)	Soram Dem	11403000
22)	Dawa Denkar	11005001461
23)	Dorji Bidha	11403000317
24)	Ugyen Chamo	11403000274

25)	Tshering Zam	11403000468	215
26)	Kencho	11403000353	215
27)	Namgay	11403000169	215
28)	Kencho gyem.	11403000346	215
29)	Kencho	11403000451	215
30)	Bao	11403000259	215
31)	Ketzang Wangmo.	11403000032.	215
32)	Kado	11403000338	215
33)	Tandin Bidha.	11403000064	215
34)	Pema Wangchuk	11403000409.	215
35)	Rinzin Dorji	11403000378	215
36)	Dimple Thapa	Dy. CRO, FRMD	
37	Tshering Gyelthen	Chamgang FMU	

ANNEXURE IX: PHOTOS

Forest Roads of Chamgang Helela FMU

Non wood forest Products

Paris polyphylla

Balep(Bamboo mat)

Rejected Rural timber

Bamboo colonisation in cable lines

Grazing in the FMU

Left over lops and tops in cable lines

Field work

Inventory team

Wildlife Presence

Tiger Pug mark.

Musk Deer.

Red Panda

Wildlife Depredation.