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Royal Government of Bhutan
Ministry of Agriculture and Forests
Department of Forests and Park Services
Divisional Forest Office
Bumthang

Forest Management Plan
for
Karshong Forest Management Unit

[1st January, 2020- 31st December, 2029]

Prepared by:
Lhab Tshering, Forestry Officer, FRMD
Tashi Norbu Waiba, Sr. Forestry Officer, FRMD
Sonam Tashi, Forestry Officer, Bumthang Forest Division.
November, 2019

AUTHORITY FOR PREPARATION, REVISION AND APPROVAL

PERIOD OF THE PLAN

This Plan is valid for the period of 10 years from 1st January, 2020 – 31st December, 2029.

AUTHORITY FOR PREPARATION, REVIEW AND APPROVAL

The authority for preparation of this Plan was given to the Divisional Forest Office (DFO), Bumthang, Department of Forests and Park Services (DoFPS), 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. The Director, DoFPS has the authority to revise and approve Plan 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. The CFO, Bumthang may be requested to prepare revisions and changes to the Plan for submission to the Director, DoFPS.

APPROVAL

This Plan was examined by a wide section of user groups, clients and organizations. The final version of the Plan was reviewed and technically cleared by the Head, FRMD and an environmental clearance was obtained from National Environment Commission Secretariat. It was then submitted to the Director, DoFPS, who, after further review and amendments, forwarded 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

Recommended for Approval:

Director
Department of Forests and Park Services
Date:.....

Recommended for Approval:

Secretary
Ministry of Agriculture and Forests
Date:.....

APPROVED

Minister
Ministry of Agriculture and Forests
Date:.....

ACKNOWLEDGEMENT

We would like to express our gratitude and appreciation to all the people who are involved in making this plan writing process a success. An immense appreciation goes to the Unit staffs (both Territorial and NRDCL counterpart) of Karshong Forest Management Unit for their assistance and support during data collection and information gathering. In particular, the Planners would like to thank Mr. Tsheten Wangchuk, Unit In-charge of Karshong FMU for his active participation and contribution during the course of preparation of this management plan.

Special thanks are due to Mr. Kinzang Gyeltshen and Mr. Pankey Drukpa, Chief Forestry Officers, Bumthang for providing immense support and guidance in the process of writing this plan. The technical advices received from the Chief Forestry Officers have helped us make this plan credible and moreover practically applicable in the field.

We also would like to thank the officials of Forest Resources Management Division, particularly Mr. Arun Rai, Deputy Chief Forestry Officer and Mr. Tashi Norbu Waiba, Sr. Forestry Officer for their technical guidance during various stages of plan writing. Immense gratitude is due to the Local Government Officials of Chumey Gewog and local people of Chumey Gewog for their contribution and participation in various consultation meetings while writing this plan.

LIST OF ABBREVIATIONS

%	Percent
AAC	Annual Allowable Cut
CF	Community Forest
KFMU	Karshong Forest Management Unit
CFO	Chief Forestry Officer
CGI	Corrugated Galvanized Iron
cm	Centimeter
DBH	Diameter at Breast Height
DFO	Divisional Forest Office
DoFPS	Department of Forests and Park Services
EIA	Environmental Impact Assessment
FMP	Forest Management Plan
FMU	Forest Management Unit
FNCA	Forest and Nature Conservation Act
FNCRR	Forest and Nature Conservation Rules and Regulation of Bhutan
FRMD	Forest Resources Management Division
GIS	Geographic Information System
Ha	Hectare
km	Kilometer
LULC	Land Use and Land Cover
m	Meter
m^3	Cubic Meter
MC	Management Circle
mm	Millimeter
MoAF	Ministry of Agriculture and Forests
NEC	National Environment Commission
NRDCL	Natural Resources Development Corporation Limited
Nu.	Ngultrum
NWFP	Non-Wood Forest Product(s)
OP	Operational Plan
RGoB	Royal Government of Bhutan
RM	Regional Manager
RME	Reliable Minimum Estimate
RNR	Renewable Natural Resources
sp.	Species
TMB	Tree Marking Book
UIC	Unit-In-Charge
UWICER	Ugyen Wangchuck Institute for Conservation and Environmental Research
WC	Working Circle

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

NECS/EACD/Dzo-Bumthang/3819/2020/463 March 25, 2020

ENVIRONMENTAL CLEARANCE

In accordance with Section 34.1 of the Environmental Assessment Act 2000, this Environmental Clearance (EC) is hereby issued to the Forest Resources Management Division (FRMD), Department of Forests and Park Services for the operation and management of the third phase of the Karshong Forest Management Unit (FMU) along with the construction of 9 km forest road and operation of ropeways in the state reserve forest measuring 6.42 acres at Nangar under Chhumey Gewog, Bumthang 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 2012 (Amendment 2016), The Water Act of Bhutan 2011 and its Regulation 2014;
2. ensure that the operation and management of FMU is in line with Initial Environment Examination document and Forest Management Plan submitted for EC;
3. ensure that Annual Allowable Cut (AAC) is fixed to 7700 m^3 (Seven Thousand Seven Hundred cubic meter);
4. ensure that no extraction of timber is carried out in the Protection Working Circles and Non-Production Working Circles;
5. ensure that local communities, properties and any religious, cultural, historic and ecologically important sites are not adversely affected by the operation and management of FMU;
6. restore the damage to any public or private properties caused by the operation and management of FMU;
7. 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
8. 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 Environmental Standards 2010.

III. Import and use of ODS

The holder shall not use Ozone Depleting Substances as per the Revised Regulation on the Control of ODS 2008.

NEC, PO Box 466, Thimphu, Bhutan
Tel: (975-2) 324747/325856/324323/326993 Fax: (975-2) 323385
www.nec.gov.bt

IV. Protection and management of water resources

The holder shall:

1. ensure that operation and management of FMU does not disrupt the water flow and pollute the water bodies; and
2. ensure that a buffer zone of 100 meters is maintained from the major rivers and local drinking water sources and a buffer zone of 30 meters is maintained from the all the streams and springs present within the FMU.

V. Waste prevention and management

The holder shall manage wastes generated from the project (labour camps, offices, etc.) with the application of 4R (Reduce, Reuse, Recycle, Responsibility) principle and other environmentally friendly methods of waste management as in the manual attached herewith.

VI. Management of excavated materials and run-off

The holder shall:

1. manage and/or dispose excess excavated materials generated during construction of forest road and operation and management of FMU only at the pre-identified approved dumpsite; and
2. put appropriate measures for management of surface run-off 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 as per the reporting format attached herewith.

VIII. Monitoring and reporting

1. The holder shall 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;
2. Maintain information on the generation of wastes on a monthly basis and submit report to NECS annually.

IX. Renewal and modification

The holder shall:

1. ensure that renewal of this EC is processed at least three months prior to its expiry along with a copy of EC and a report on the implementation of its terms and conditions as per the format attached herewith; 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 supersedes EC issued vide letter no. NECS/EACD/Dzo-Bumthang/3819/2020/394 dated March 12, 2020.

This EC is issued with validity from **March 25, 2020** till **March 11, 2025** only for the operation of the Karshong FMU with AAC of 7700 m^3 along with the construction of 9 kms forest road and operations of ropeways.

Thinley Dorji
(Offtg. DIRECTOR)

To,
The Chief Forestry Officer,
Forest Resources Management Division,
Department of Forests and Park Services,
Thimphu.

Copy to;

1. The Dzongkhag Environment Officer, Bumthang, for kind information and necessary compliance monitoring; and
2. Guard File (3819/2020) EACD, NECS for record.

NATIONAL ENVIRONMENT COMMISSION * THIMPHU : BHUTAN *

EXECUTIVE SUMMARY

This is the third Management Plan for Karshong Forest Management Unit. The Plan structure is as per the guidelines on forest management plan reflected in the Forest Management Code of Bhutan, 2004. It comprises of three parts:

PART 1: GENERAL DESCRIPTION AND THE CURRENT SITUATION
PART 2: FUTURE MANAGEMENT
PART 3: IMPLEMEMTATION OF THE PLAN

PART 1: GENERAL DESCRIPTION AND THE CURRENT SITUATION

- The Karshong Forest Management Unit is located in Chumey Gewog of Bumthang Dzongkhags. The Forest Management Unit falls within 90˚42´0.87″ and 90˚47´58.79″ East and 27˚31´39.88″ and 27˚26´10.09″ North. The FMU became operational in 1994.
- The total area of the FMU has been increased to 6,008.54 ha from 4,715.77 ha after extending the area of the FMU for the third plan period.
- The general terrain of KFMU ranges from moderate in most part of the FMU to steep landscape in the eastern part. The elevation of KFMU ranges from 2,563 meters at the valley bottom to 3,930 meters at the ridge top. The average monthly rainfall is approximately 58.04 mm. Precipitation in the form of snowfall occurs in the winter.
- In total, there are ten villages that falls within the FMU, namely Pangtey Goempa, Yamthra, Nangay, Zungyne, Choeninpo, Trakar, Nangar, Choedipan, Ungsang, Throметh. There are 200 households with a total population of 1504 residing within Karshong FMU.
- Forests in Karshong FMU are broadly divided into two types; Blue Pine and Mixed Conifer Forest. Blue Pine occurs in the lower valleys while Mixed Conifer occupies the higher elevations in the FMU. The mixed conifer forest mostly is dominated by Hemlock with some areas mixed with spruce and Blue Pine.
- The AAC of the last Management Plan have been set at 5,035 m^3, of which 3,535 m^3(3,535 m^3 for 6 years and 3,266 m^3 for 4 years) is allotted for commercial extraction ad 1,500 m^3 was allotted to rural extraction.. The total commercial timber harvested for the last 10 years is 20,883.36 m^3 and rural volume is 9,350.96 m^3 in Standing Volume. This shows that commercial extraction is undercut by 39.07% of total AAC for ten years and rural extraction is undercut by 37.66%.
- A total of 21.5 kms of forest road have been constructed in FMU during the last two Plan periods. The forest road passes through Compartment I, II, III and IV of South Block where current operation is being carried out.

PART 2: FUTURE MANAGEMENT

- The overall Goal of the Management Plan is ***"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"***.
- To facilitate the planning, implementation and recording of activities, the Karshong FMU is divided into blocks and compartments. The FMU is broadly divided into two Blocks, namely North Block and South Block. The previous two plans of the FMU have eight compartments (four each in North and South Block). With the extension of FMU area, four compartments were added to the South Block, adding up to a total of eight compartments in South Block.
- Karshong FMU has been divided into three Management Circles using forest function mapping and they are Protection, Production and Non-production Management Circle. The Production Management Circle has been divided further 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 prescribed Silvicultural System for the commercial harvesting is the Group Selection System with natural regeneration in Mixed Conifer Working Circle and Seed Tree System in Blue Pine Working Circle. Group openings will be created in the stand allowing optimum quantity of light to reach the forest floor and creating conductive micro climatic conditions for seed germination and establishment of seedlings. Criteria for opening the groups and laying out annual coupes are given in detail in the Plan. For local use area, single tree selection system will be used.
- Annual Allowable Cut for the previous plan was set at 3,535 $m^3$from the South Block which was designated for commercial harvesting and 1,500 m^3 from North Block designated for rural harvesting. However in this plan, the AAC has been revised to 7700 m^3. The increase in the AAC compared to the previous plan is mainly attributed by the inclusion of more area under the Karshong FMU management regime. Out of the total AAC of 7700 m^3, 6200 m^3 has been allocated to commercial use and 1,500 m^3 has been allocated to local use.
- In the Production Management Circles, two regular Working Circles and one Overlapping Working Circle has been formed in this plan. The two Working Circles in this management plan are Mixed Conifer and Blue Pine Working Circle and one overlapping Working Circle is Non-wood Working Circle.
- In collaboration with the NRDCL, the Divisional Forest Office, Bumthang carried out detailed EIA and its findings are incorporated in preparing the Forest Management Plan. Using a series of environmental criteria outlined in the Environment Assessment Act, 2000 and adopted by the National Environment Commission, the guidelines recommended have been examined to ensure that the practice within KFMU meets the requirement. The Environment Statement includes the effects of previous activities within the FMU along with recommended mitigation measures for future management actions.

- A 10 years financial forecast has been prepared for the FMU summarizing the total cost, revenue and royalties for NRDCL and the treasury (via CFO) 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, Bumthang will be responsible for the implementation of this management plan and he will be assisted by the Forest Management Planner, Unit In-charge and other Unit staffs.
- A rolling biennial Operational Plan will be prepared by the Unit In-charge in consultation with the CFO, Bumthang and NRDCL counterpart to facilitate the timely implementation of this management plan.
- FMU-level Management Committee chaired by CFO, Bumthang 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 management objectives will be discussed in the FMU-level Management Committee meetings.
- The Operational Plan activities will be reviewed annually whereas the mid-term review will take place after five year of plan implementation. The final evaluation shall be carried out during the final year of plan implementation. FRMD will be responsible to initiate evaluation of activities in the FMU.
- Unforeseen circumstances may warrant deviations from Plan prescriptions and in such an event the CFO, Bumthang must obtain prior written approval from the Head of the Department. The reasons for the deviations must be fully justified by the CFO in this respect and such approved deviations entered into the Management Plan during the next scheduled revision.

Actions Required by the FMU Plan	Responsibility
Implementation and Review	
The CFO Bumthang, as the senior territorial officer will be responsible for the implementation of this Management Plan, assisted by Forest Management Planner, Unit-In-charge and other Unit staffs.	CFO
A FMU-level Management Committee chaired by the CFO, will be established to ensure the smooth implementation of the Management Plan.	CFO
The CFO and UIC will ensure that only the silvicultural systems described for each working circle are used for that working circle, and they are implemented thoroughly and correctly.	CFO & FMU UIC
The Head, FRMD, will ensure that the Plan is reviewed five years after implementation (mid-term review), and at the end of the plan period (end-of term review)	Head, FRMD
Monitoring and Evaluation	
The CFO will ensure that monitoring is carried out on an annual basis according to the guidelines issued by FRMD	CFO
The Head FRMD will ensure that evaluation is carried out at five year intervals, based on the information collected by annual monitoring and other necessary information.	Head, FRMD
Operational Planning	
A bi-annual Operational Plan will be prepared by the CFO to facilitatethe timely implementation of this Management Plan, and should be submitted to FRMD by 1st November every year, before the start of operating year.	CFO RM, NRDCL
The budget in the operational plan should be jointly developed by the CFO and RM, NRDCL and agreed by both.	CFO RM, NRDCL
The UIC will determine the location and extent of cable lines in theCompartment to be harvested annually, in consultation with NRDCL staff, as prescribed in the Operational Plan.	FMU UIC
The CFO and the RM, NRDCL will cooperate and coordinate to ensure that the logging operation and log out turn are conducted smoothly and in accordance with local and other demands.	CFO RM, NRDCL
The FMU UIC will ensure that stocking regeneration surveys are conducted as and when required.	FMU UIC
Enrichment planting, if necessary, will be carried out by NRDCL.	NRDCL RM
Fencing or other action to protect regeneration will be carried out by NRDCL, in consultation with the FMU UIC.	NRDCL RM
The FMU UIC will inspect the coupes when harvesting is completed and will issue a Coupe Clearance Certificate only if all aspects of the operation are satisfactory.	FMU UIC
Road survey, design and construction will be carried out by NRDCL.	NRDCL
NRDCL road engineers must follow acceptable standards, designs, estimates and provide supervision during construction to ensure that the standards are met.	NRDCL staff
Regular inspection will be conducted by the FMU staff to detect and report any pest and disease outbreaks to enable earliest possible remedial orpreventive measures to be initiated.	FMU staff
Participatory Forest Management	
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 Bumthang.	FMU UIC
Timber and non-wood products, including fuel wood, Daphne bark, and bamboo, can be allotted to *bona fide* local villagers.	FMU UIC, via Operational Plan
The views of stakeholder groups will be incorporated into the operational plans through the inclusion of stakeholder representatives in the FMU-level Management Committee.	CFO

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LINE NO:62
YEAR:2016

PART 1: GENERAL DESCRIPTION AND THE CURRENT SITUATION

1. LOCATION, AREA, BACKGROUND AND STATUS

1.1 Location and Extend

Karshong Forest Management Unit is located in Chumey Gewog under the administrative Dzongkhag of Bumthang between longitudes 90^{o} 42'0.87"East and 90^{o} 47'58.79" East, and latitudes 27^{o} 26'10.09"North and 27^{o} 31'39.88" North. The East-West lateral highway passes right through the middle of the Forest Management Unit. Roadside settlements of Chumey and Nangar fall within the FMU.

1.2 Area Statement

As per the Land Use and Land Cover map (LULC) classification, majority of the FMU area is covered by forest (Map 2). Over 59.34% of the land is covered by Blue Pine forest followed by approximately 33.35% by mixed conifer forest. The build-up area only forms over 0.36% of the total land cover (Figure 1).

Table 1: Area Statements by Land Use

Land Use	Area (ha)	Percentage Cover (%)
Blue Pine Forest	3,565.29	59.34
Broadleaf Forest	10.21	0.17
Mixed Conifer Forest	2,003.82	33.35
Fir Forest	0.07	0.00
Shrubs	217.98	3.63
Meadows	16.13	0.27
Build-up	21.54	0.36
Cultivation Land	173.5	2.89
Total	**6,008.54**	**100%**

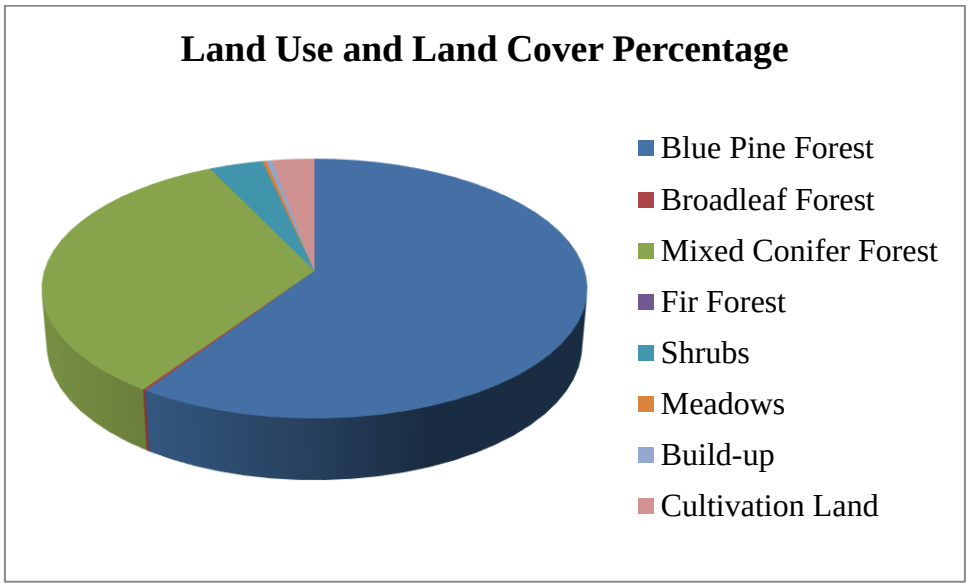
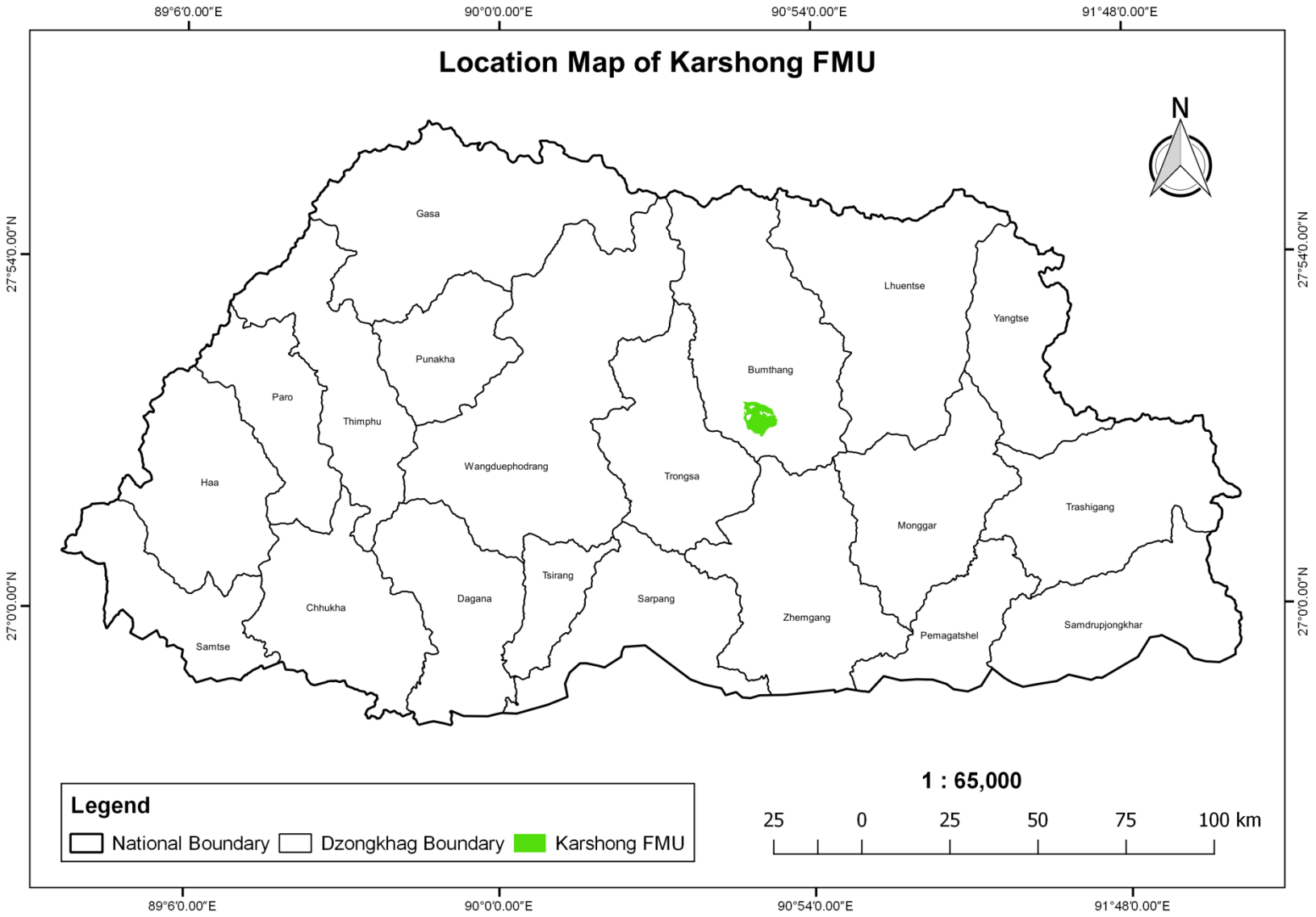
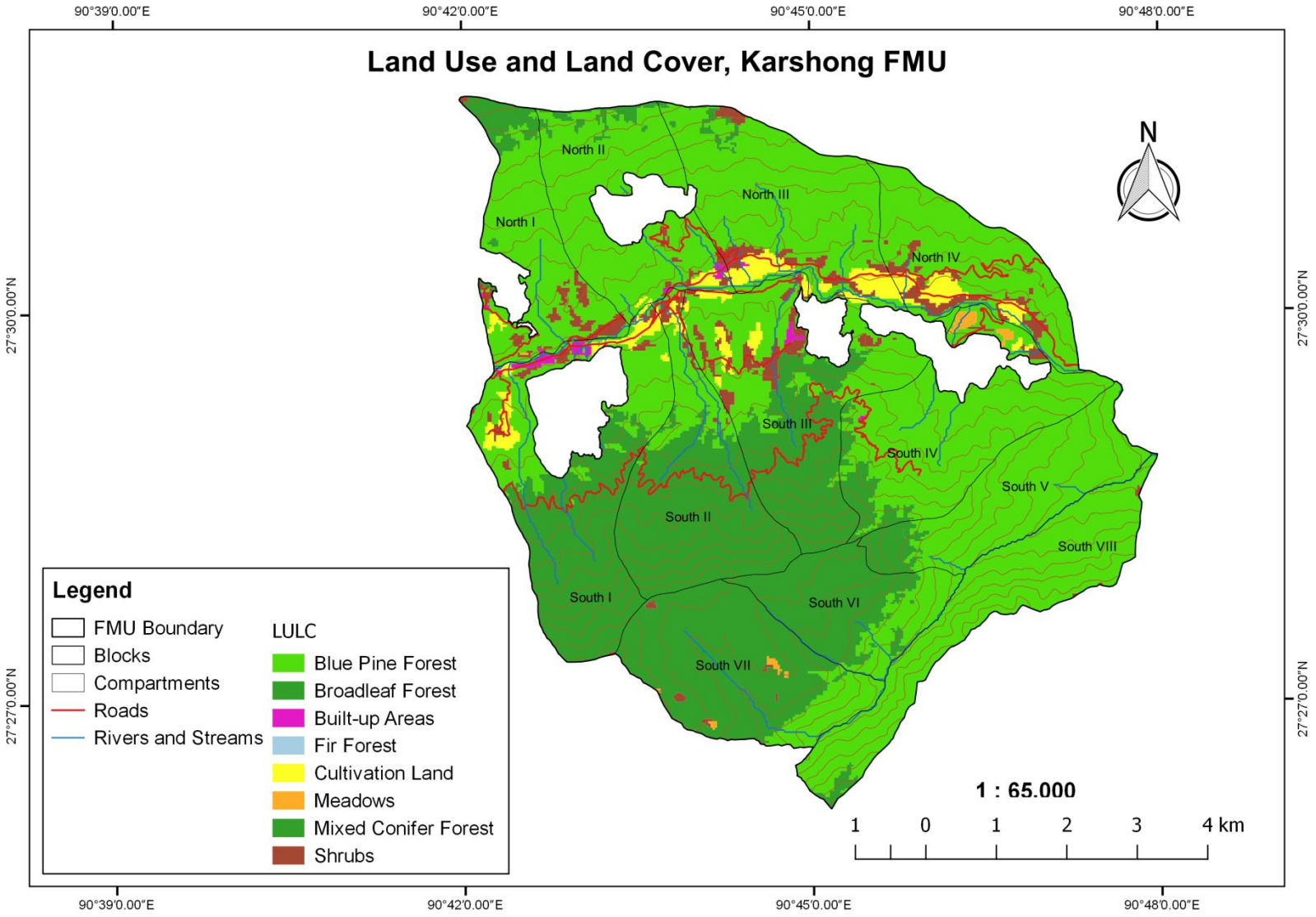


Figure 1: Figure Showing Land use by Percentage

Map 1: Location of Karshong FMU



Map 2: Land-use and Land Cover



1.3 Historical Background

Historical background was obtained through semi-structured interviews and informal conversations with the elderly and key informants of the FMU, and reviewing the previous management plans and forest records.

Before the creation of Department of Forests in mid 1950's, people within the FMU had unlimited access to the forest for their timber and firewood requirement. Harvesting of timber on commercial scale had been on limited scale within the Karshong FMU except firewood collected by the villagers.

However some areas near the settlement have been degraded because the local people have been collecting firewood as well as construction timber requirements from these easily accessible areas. There was no Forest Management Plan, and as such, whatever timber was marked for the local villagers by the Divisional Forest Office in Thimphu was purely on an ad-hoc basis. The Bumthang Forest Division was created only in 1985, before that it was looked by Thimphu Division.

The Forest Management Plan was prepared by Forest Resources Development Division in 1994 and since then harvesting on commercial scale had started. The first forest management plan was operational from 1994-2004, and in-between four operational plans carried out under Department of Forest's directive as per the provisions for deviation from Management plan. During the first management plan 10.5Km was constructed.

The second plan was operational from 2009-2019, in which the total commercial timber harvested for the last 10 years is 20,883.36 m^3 and rural volume is 8,454.68 m^3 in Standing Volume. This shows that commercial extraction is undercut by 39.07% of total AAC for ten years and rural extraction exceeded by 43.64% as per the plan. In the second plan almost 21.5 Km of forest road was constructed. All the harvesting operation was to be carried out by using cable crane logging system.

1.4 Forest Condition

Karshong FMU was under commercial harvesting since 1994 for the last twenty years and with scientific silvicultural systems used over the period of time, the final evaluation report from FRMD, 2019 has found that the forest condition in the KFMU is in good state. The forest stock which consists of Blue pine, Spruce, Hemlock and Fir stand in majority has good regeneration over the period which can be attributed to good soil condition even though disturbance through timber harvest is being carried out. Blue pine is the strong colonizer among the tree species. Blue Pine colonization could also be spotted in the lower valleys of the FMU and is covering the open grasslands which were once used as grazing ground by the locals. As the natural regeneration was profuse, no artificial regeneration in the form of plantation was carried out in the past operated areas.

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 Tsamdo (grazing land) or Sokshing (woodlot for collection of leaf litter)".*** All such areas are considered as Government Reserved Forest and the entire KFMU falls within this category of reserved forest, except for a some part of land classified as cultivations and some build-up areas which are privately owned.

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 mold 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 Forestry Officials and royalty has been paid. Hunting wild animals is completely prohibited in the forest.

1.5.3 Grazing Rights

The people living within the Karshong FMU heavily depend on the livestock and their products. Till the second plan, There are approximately 400 hectares of *tsamdo* within the Karshong FMU registered in the name of the local villagers. However, as per the new regulation regarding *Tsamdo* and *Sokshing*, it has been taken over as government reserve forest land and should be subsequently leased for use.

1.5.4 Water Rights

Local population within the FMU has traditional rights to use water from rivers and perennial streams for domestic purpose, such as consumption, irrigation and other uses. There are 26 streams and springs which the local people residing in the FMU get their drinking and irrigation water supply.

1.5.5 Historical Monuments and Monasteries

Within the FMU, there are two Dratsang, seven Lhakhang, one Goenpa and one significant religious. The Dratsangs are Chudipang Dratsang and Nimalung Dratsang and Lhakhangs are: Zungyne Lhakhang, Thrometh Lhakhang, Nangar Lhakhang, Yangrel Lhakhang Trakar Lhakhang, Unsang Lhakhang and Choeten Ningpo Lhakhang. The other is Dorten Goenpa and Terdho (Significant stone). A buffer of 100 meters in all the Lhakhang, Dratsang, Goenpas and religious sites has been delineated. Beside these, there are various *Gney* (sacred sites) located in the high rocky outcrops which falls within the soil protection circle.

1.5.6 Proximity to Protected Areas

Karshong FMU does not share any boundaries with protected area. But there are two National Parks which is quite near to the FMU: Wangchuck Centennial National Park to the North and Phrumsengla National Park towards south of KFMU.

2. PERMANENT SITE FACTORS

2.1 Topography and Slope

As in most parts of Bhutan, the terrain in Karshong FMU is mountainous – from moderate to steep. However, the slopes are gentle compared to other parts of Bhutan. The valleys are not very steep. Rocky outcrop is present on the ridge top of the South Block. The elevation ranges from 2,563 meters at the valley bottom to 3,930 meters at the ridge top. The terrain is also dissected by many small rivulets, which flows into the main Chumey River. The lower slopes are moderately gentle. Flatter areas have been converted to agricultural land.

Major part of FMU falls below 25˚ slope. Slope classification was done with the help of Quantum GIS by using terrain analysis. 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.

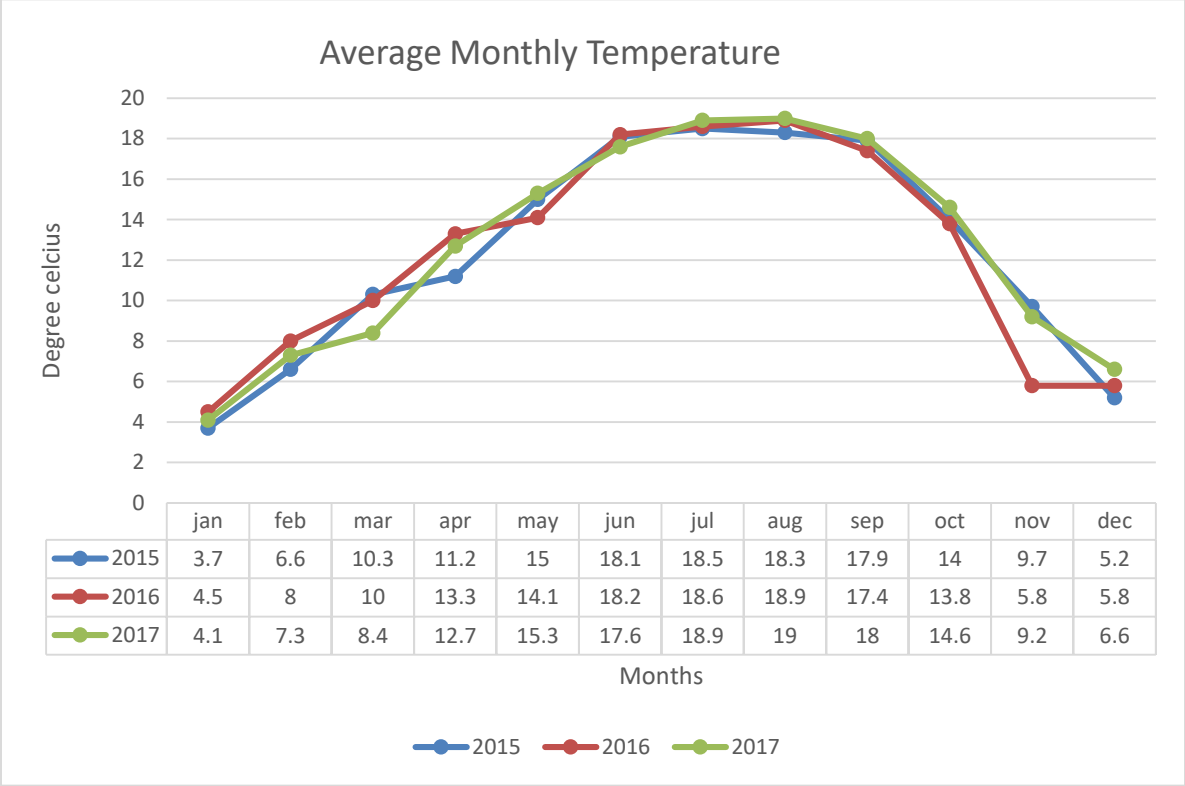
2.2 Climate

2.2.1 Meteorological Station

Meteorology Unit of HydroMet Services Division of Ministry of Trade and Industry has a climatological station at Gyetse near the FMU. They have collected data since 1985. The compiled data for temperature and rainfall is retrieved from Bumthang Dzongkhag website (www.bumthang.gov.bt) which is published by Wheather and climate Division, National Center for Hydrology and Meteorology, MoEA, Thimphu.

2.2.2 Temperature

The monthly average temperature for last three years is given in the following tables and graph.



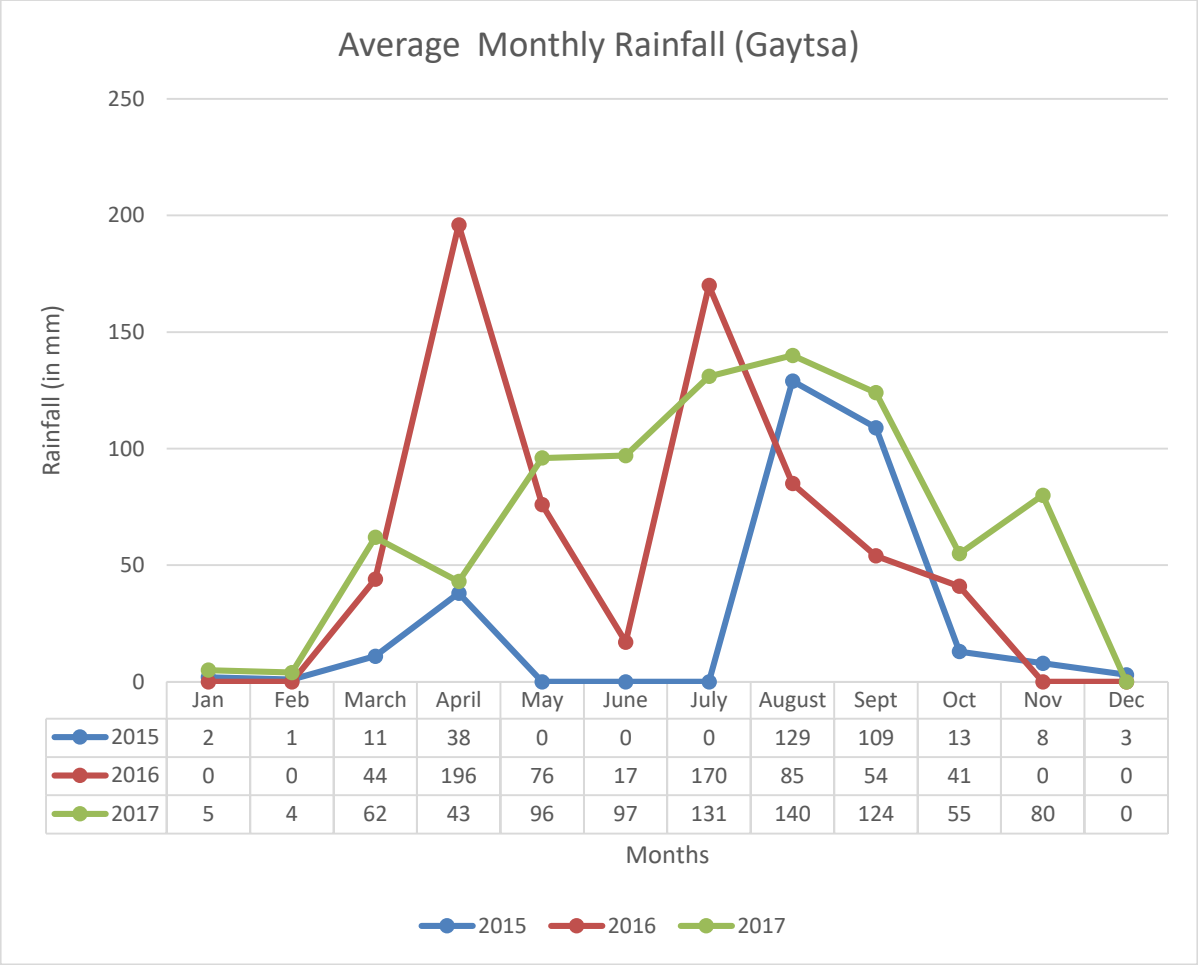
	jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec
2015	3.7	6.6	10.3	11.2	15	18.1	18.5	18.3	17.9	14	9.7	5.2
2016	4.5	8	10	13.3	14.1	18.2	18.6	18.9	17.4	13.8	5.8	5.8
2017	4.1	7.3	8.4	12.7	15.3	17.6	18.9	19	18	14.6	9.2	6.6

Figure 2: Graph showing Average Temperature for 2015-2017

The highest average temperature was recorded during the month of August in past years. November, December, January and February are very cold months with temperature dropping below freezing point. The lowest average temperature was recorded during the month of January. Working condition during these cold months is extremely difficult.The months of July and August are generally the warmest months. The temperature starts dropping from the month of September. However, the temperature during the summer does not pose any working difficulty.

2.2.3 Precipitation

The precipitation of Karshong FMU is expressed in the following graph for three years 2015-2017. During the monsoon, the rainfall can impact the commercial harvesting and transportation of timber to depot if the road is not maintained properly. 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 KFMU difficult.



	Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	Dec
2015	2	1	11	38	0	0	0	129	109	13	8	3
2016	0	0	44	196	76	17	170	85	54	41	0	0
2017	5	4	62	43	96	97	131	140	124	55	80	0

Figure 3: Graph Showing Average Monthly Rainfall of 2015-2017

2.3 Geology and Soil

The rocks are basically of central gneiss complex. The formation is also known as Thimphu Gneissic complex. This formation is characterized by migmatites and biotite-granite gneisses with thin beds of quartzite, quartz- mica schist, calc-silicate rocks and some marbles. (Atlas of Mineral Resources of the Escap Region, vol.8, UNDP).

2.4 Hydrology

The FMU have two main rivers flowing between two valleys; namely Chumey chuu as major and Bashibi Khoe as a secondary perennial stream. These two rivers ultimately joins the main river of Chamkhar Chuu. The Chumey chuu also used in mini-hydroelectric power established near Zhuney village inside the FMU. Beside these rivers, there are numerous perennial streams draining ultimately into the main river.

3. VARIABLE SITE FACTORS

3.1 Population and Demography

Karshong FMU is located in Chumey Gewog of Bumthang Dzongkhag. In total there are 17 villages belonging to three Chiwogs falling within the FMU. There are 255 households with a total population of 2,171 residing within Karshong FMU. Out of the 2,171 total populations, 1,081 are male and 1,090 are female.

Table 2: Chiwog wise population and number of households

Sl. No.	Name of Chiwog	Number of Villages	Number of Household	Population		
				Male	Female	Total
1	Phurgoen	4	81	323	338	661
2	Zungnyer	7	137	571	572	1,143
3	Chungphel	6	37	187	180	367
	TOTAL	**17**	**255**	**1,081**	**1,090**	**2,171**

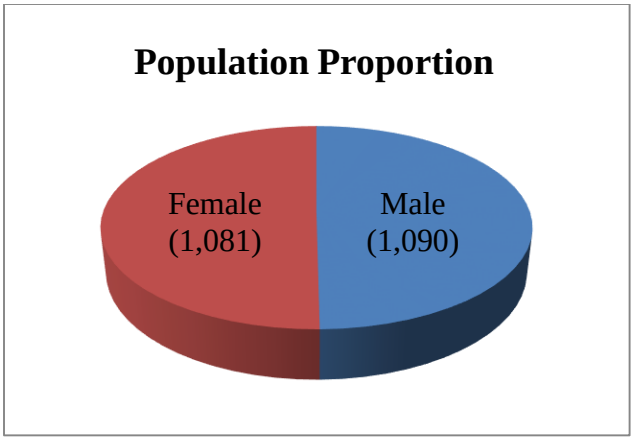


Figure 4: Sex Composition

3.2 Agriculture and Farming System

Most of the farmers practice subsistence farming and cash cropping, depending mainly of crop like buckwheat, barley, wheat and turnip (mainly for cattle feed). The main cash crops is potato. The cultivation method adopted by the farmers living in and around the Karshong FMU is generally permanent dry land cultivation. Previously, keeping the land fallow for few years to regain its fertility is quite common in the area which is also called as *Pang zhing*, however, now the trend of *Pang zhing* is not very common in the area.

3.3 Traditional Use of Forest

Main traditional uses of forests consist of collection of fuel wood, harvesting of construction timber and grazing of domestic animals in the forests.The non-wood forest products collection is a minor traditional forest use in a conifer forest. The usual non-wood forest products are bamboo, Betula and Acer burr for making wooden cups and plates, and collection of some medicinal plants.

3.3.1 Fuel wood: All the people living in the Karshong FMU depend on the nearby forest for their fuel wood requirement. In the last plan period, a total of 5348 m^3 of firewood have been extracted from the FMU (Table 9).The fuel wood collected by the villagers is used locally for their domestic purposes. About two trees' permit per household are being obtained by the villagers. In the absence of any other trees in the vicinity of the villages the Blue Pine, other trees are also marked for firewood.

3.3.2 Rural Timber: All the timber required for house construction, *shingleps* and house repairs of communities of Karshong FMU are harvested within the FMU. The detail data is shown in Table 9.

3.4 Grazing

From the socio-economic survey and information from the Gewog RNR Office, it was found that the locals residing within the FMU rear various types of livestock (Table 5). As per the data, the number of high yielding livestock like Jersey and Mithun is significantly high compared to the local breed. The shift of local breed of cattle to the high yielding breed is an indication that the open grazing in the forest has substantially reduced. However, the grazing pressure to the nearby forest cannot be undermined. In order to reduce the grazing pressure on forest, introduction of improved varieties of livestock and awareness to the people should be continued by relevant agencies.

Table 3: Livestock Information

Sl. No	Type	Nos.	Remarks
1.	Jersey	1,161	
2.	Local cattle	573	
3.	Mithun	1,378	Crossed
4.	Yak	469	
5.	Sheep	246	
6.	Goat	3	
7.	Poultry	278	Local
8.	Poultry	137	Improved
9.	Horse	265	Local
10.	Horse	84	Improved
11.	Mule	6	
12.	Donkey	1	

(Gewog RNR Livestock Extension Office, 2017)(Gewog RNR Livestock Extension Office, 2017)

3.5 Wildlife

Along with the forest resources inventory carried out in 2018, wildlife survey (direct and indirect sighting) was also recorded by the inventory crews. In the indirect sighting method, the scats, pugmarks, shredded antlers and territory markings were observed and recorded. Frying signs on the trees and digging of roots indicates the presence of enough wild boars. Droppings of Barking

Deer and Sambar was also sighted during the transect walk in the forest. During the transect walk, pugmarks of Tiger and small cats were observed. Footprints of Himalayan Black Bears were also present in abundance.

People residing within the FMU mentioned that the Himalayan Black Bears is abundant and there are incidences of its attack on humans as well as domestic animals. Moreover, there are frequent incidences of wild boar damaging the crops. The FMU staffs and logging laborers also mentioned about spotting Red Panda within the FMU.

3.6 Forest Fire

During the previous plan period, there were no records of forest fire incidence in Karshong FMU. However, due to the composition of forest being Blue Pine and mixed conifer, fire hazards cannot be waved off. Therefore, periodic awareness programs should be initiated in order to educate the local people about the risk of forest fire.

3.7 Pest and Diseases

Pest and diseases in reality are always present in any type of forest. However, CFMU being under commercial harvesting for last twenty years, there is no record of any pest and disease that has caused havoc in the forest.

3.8 Non-wood Forest Product

The main non-wood forest products extracted from KFMU are bamboo, Daphne, Mushroom, *Paris polyphylla*, *Rubia cordifolia* besides boulders and sand. Bamboo growth is mostly found in the moist sites within mixed conifer forest. It is predominantly found along the perennial streams and damp sites. Due to gregarious flowering of the bamboo, the entire bamboo within the FMU died. However, new growth can be seen and the regenerations are abundant. The bamboo will be available for harvest in few years' time. Bamboo is one of the NWFP in the FMU which can be explored commercially in order to uplift the livelihood of the local people.

Karshong FMU has number of herbs that can be collected for medicinal purposes but so far, its extraction is not at a commercial scale.

Table 4: NWFPs found in this area

Name of the NWFP	Uses
Bamboo	For making bamboo mats, fencing, construction of houses and livestock shed
Daphne	Daphne is generally used for paper making. However, Daphne is not collected in Karshong FMU for paper making purposes. In future, such uses can be further explored to uplift the livelihood of the local people residing within the FMU.
Mushroom (Jili namcho)	Mushroom commonly known as Jili namcho in local terms is collected by the locals and is consumed as food. It is collected

	mostly for self consumption.
Rubia cordyfloria	The plant is collected for preparation of dye and is traditionally used to dye threads for weaving It is also used as dye for coloring floor of traditional houses.
Paris polyphylla (Satuwa)	Paris polyphylla is a medicinal herb commonly known as Satuwa. It is collected for commercial purposes. However, illegal collection of Paris polyphylla is quite rampant in the FMU and vicinity forest areas.
Sand and Boulders	Besides other NWFPs, sand and boulders are also collected for both domestic and commercial purposes from the FMU.

Table 5: NWFP extracted from FMU from 2010 to 2018

Year	Stone/ Boulder (T/L)	Sand (T/L)	Gravel (T/L)	Soil/Mud (T/L)	Bamboo (Nos)	Total Royalty Collected
2010	57.5	105.62	7	0	500	6,844.80
2011	42	42	17	0	10,500	4,880.00
2012	158.5	48.5	9	0	1,400	8,752.00
2013	285	229	75	3	500	23,720.00
2014	68	6	0	1	0	3,000.00
2015	95.5	57	8	0	0	6,420.00
2016	95	72	0	3	0	6,800.00
2017	18	21	0	0	0	1,560.00
2018	26	5	20	0	200	991
Total	**845.5**	**586.12**	**136**	**7**	**13,100**	**62,967.80**

**From 2014 the bamboo have started dying and they regenerated from 2018.*

3.9 Mineral Extraction

No record of mineral extraction from the FMU has been found.

4. ECOLOGY

4.1 Floral Association

Karshong FMU basically falls in the Temperate zone of the country and the predominant forest type in the FMU is Blue Pine Forest and Mixed Conifer forest. The Blue Pine Forest is found in the lower valley whereas the mixed conifer forest is mostly confined to the higher ridges. The Blue Pine forest near to settlements and roads are mostly young and immature. The undergrowth are mostly Daphne and Rhododendron in few areas. Above the Pure Blue Pine forest, Hemlock and Spruce can be found in association with Blue Pine trees. The Hemlock occupies moist slopes whereas spruce can be found in the drier slopes. Bamboo occupies the moist sites and on either sides of perennial streams in the mixed conifer forest. Scattered growth of *Taxus baccata* can also be observed in the mixed conifer forest. Along with Hemlock and Spruce, broadleaved species like Betula and Acer is also found scattered in the mixed conifer forest.

4.2 Fauna

Karshong FMU, due to its location in vicinity of protected areas, forms habitat for many wildlife. The following mammals and large birds have been recorded in the Karshong FMU during the inventories and reconnaissance visits:

Table 6: List of Wildlife

Common Name	Scientific Name
Sambar Deer	*Cervus unicolor*
Barking Deer	*Muntiacus mutjak*
Goral	*Nemorhaedus goral*
Sumatran Serow	*Capricornis sumatraensis*
Rodent	*Niviventereha sp.*
Wild Boar	*Sus scrofa*
Red Panda	*Ailurus fulgens*
Himalayan Black Bear	*Ursus thibetanus*
Musk Deer	*Moschus chrysogaster*

Table 7: List of Birds

Common Name	Scientific Name
Common Myna	*Acridotheres tristis*
Rufous-fronted Tit	*Aegithalos iouschistos*
Brown-bush Warbler	*Bradypterus luteoventris*
Grey-sided Bush Warbler	*Cettia brunnifrons*
White-capped Redstart	*Chaimarrornis leucocephalus*
Brown Dipper	*Cinclus pallasii*
Rock Dove	*Columba livia*
Large-billed Crow	*Corvus macrorhynchos*
Pale Blue Flycatcher	*Cyornis unicolor*
Common Kestrel	*Falco tinnunculus*
Blood Pheasant	*Ithaginis cruentus*
Plain Mountain Finch	*Leucosticte nemoricola*
Himalayan Monal	*Lophophorus impejanus*
Blue Whistling Thrush	*Myophonus caeruleus*
Spotted Nutcracker	*Nucifraga caryocatactes*
Coal Tit	*Parus ater*
Grey Crested Tit	*Parus dichrous*
Green-backed Tit	*Parus monticolus*
Russet Sparrow	*Passer rutilans*
Long-tailed Minivet	*Pericrocotus ethologus*

Willow Warbler	*Phylloscopus trochiloides*
Eurasian Magpie	*Pica pica*
Alpine Accentor	*Prunella collaris*
Alpine Chough	*Pyrrhocorax graculus*
Red-billed Chough	*Pyrrhocorax pyrrhocorax*
Plumbeous Water Redstart	*Rhyacornis fuliginosus*
Grey Bush Chat	*Saxicola ferrea*
White-throated Bush Chat	*Saxicola insignis*
Rufous-throated Wren-babbler	*Spelaeornis caudatus*
Broad-billed Warbler	*Tickellia hodgsoni*
Crimson Horned Pheasant	*Tragopan satyra*
Yellow-billed Blue Magpie	*Urocissa flavirostris*
Whiskered Yuhina	*Yuhina flavicollis*
Rufous-vented Yuhina	*Yuhina occipitalis*

5. SILVICULTURAL ASSESSMENT

5.1 Present Forest Types

The main forest types of Karshong FMU are;

Blue Pine

Blue Pine is mostly found in the lower valley and cover the major portion of the FMU. The Blue Pine forests in the vicinity of the settlements are mostly young and are in pole stage. The different land use and land cover map of the FMU shows a general trend of movement of blue pine forest into the mixed conifer forest. In the higher elevation, the blue pine is usually found mixed with spruce on the drier slopes and hemlock in the relatively moist slopes. The Blue Pine trees in North Block are mostly mid-age between 30-40 years.

Mixed Conifer

Mixed conifer forest occupies the higher elevations of Karshong FMU. This forest type is dominated by Hemlock with some areas mixed with Spruce and Blue Pine. Hemlock mostly occurs in the moist part of the forest whereas Spruce occupies dried slopes. *Taxus baccata* is often found scattered in the Mixed Conifer forest. High altitude broadleaved species like Acer and Betula are also found in the mixed conifer forest.

5.2 Past Silvicultural Treatment

Two regular working circles were established in the previous management plan and they are:

1. Blue Pine Working Circle (830 ha)
2. Mixed Conifer Working Circle (781 ha)

Group Selection System was prescribed for all the Working Groups. The Group Selection System has been introduced in preference to Single Tree Selection System in the mixed conifer stands as an effective way of regenerating the major coniferous species. This system was also applied to Blue Pine stands in preference to single tree system for environmental and aesthetic reasons.

Under the Group Selection System small openings were created in the stand allowing light to reach the forest floor and create micro climatic conditions conducive for seed germination and establishment of seedlings. It was prescribed that the openings should be no larger than one tree length in the Hemlock and Mixed Conifer Working Groups and one and half tree length in Blue Pine Working Group, (but not exceeding 50 meters), assuming that the average tree height would be 35 meters. All the commercial harvesting operations were to be carried out using cable crane logging system. In local use areas, single tree selection system was prescribed. The AAC prescribed for the last management plan was 5,035 m^3 of which 3,535 m^3 was allocated to commercial harvesting by NRDCL and remaining 1,500 m^3 rural harvesting.

5.3 Plantations

As the natural regeneration was abundant in the past operated areas, supplementation of stock through artificial regeneration was found unnecessary. Therefore, during the second plan period, no artificial regeneration in the form of plantation was carried out in the harvested area. Thick growth of Hemlock saplings could be seen in the past operated cable lines.

6. SOCIO-ECONOMICS

6.1 Common Source of Income

Chumig Gewog is divided into Upper Chumig and Lower Chummy. Main livelihood of the people living in Upper Chumig is Agriculture and for the people of Lower Chumig, it is Yathra weaving. There are two Yathra factories in Chumig Gewog at Nanger village. Yathras are hand woven cloth piece made out of wool and are mainly used for making bags, jackets, seat covers, table clothes, scarfs and etc. Other livelihood includes livestock rearing. The food crops produced in Chumig Gewog are wheat, barley, sweet buckwheat and the Cash crop produced are mainly potatoes.

7. CURRENT TIMBER DEMAND AND SUPPLY

The timber need for the rural communities residing within the FMU is being met from the Unit. The timber needs are mainly for rural house construction, renovation of rural house, cattle shed construction, fencing of farm lands and flag poles. Even the rural firewood demand for the locals is being met from the FMU.

Table 8: Rural Supply

Year	Quantity Supplied in Standing Form										Total Quantity Supplied (m^3)
	Drashing		Cham		Tsim / Fencing post		Dangchung / Flag		Firewood		
	Nos	m^3	Nos.	m^3	Nos.	m^3	Nos.	m^3	Nos.	m^3	
2010	-	-	-	-	-	-	-	-	-	-	-
2011	105	209.94	1,038	414.97	380	37.98	383	38.28	242	642	1,343.17
2012	36	71.98	286	114.33	592	59.17	60	6	113	300	551.48
2013	155	307.78	230	96.14	30	1.69	50	3.03	420	1,120	1,528.64
2014	40	79.27	232	92.77	142	70.27	112	43.36	73	284	569.67
2015	77	154	626	250.32	620	61.98	791	218.74	344	724	1,409.04
2016	20	40	186	74.37	628	62.78	426	21.23	348	928	1,126.38
2017	0	0	0	0	802	80.17	139	6.92	300	900	987.09
2018	292	498.77	10	3.99	2480	256.4	270	23.02	351	934	1,725.18
2019	0	0	0	0	170	16.99	187	9.32	31	84	110.31
TOTAL	**725**	**1,361.74**	**2,608**	**1,046.89**	**5,844**	**647.43**	**2,418**	**369.9**	**2,222**	**5,916**	**9,350.96**

When it comes to timber for commercial purposes, NRDCL is the sole agency which harvest timber from the cable lines and ad-hoc activities for commercial supply.

Table 9: Commercial Timber Supply

Year	Quantity harvested from Planned OP activities (m3)					Quantity supplied from Unplanned activities (m3)					
	Standing Vol. (m3) (a)	Log vol. (m3)	Firewood (m3)	Wood - chips (m3)	Others (m3)	Standing Vol. (m3) (b)	Log vol. (m3)	Firewood (m3)	Wood - chips (m3)	Others (m3)	Total standing vol. (m3) (a)+(b)
2010	3,443.25	2,356.75	184.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2,540.75
2011	3,080.87	1,849.61	248.00	0.00	0.00	642.00	0.00	642.00	0.00	0.00	2,739.61
2012	2,841.70	1,857.27	296.00	0.00	101.53	101.53	101.53	0.00	0.00	0.00	2,356.33
2013	3,350.00	1,079.83	72.00	0.00	0.00	1120.00	0.00	1120.00	0.00	0.00	2,271.83
2014	2,851.84	1,365.05	528.00	0.00	0.00	284.00	0.00	284.00	0.00	0.00	2,177.05
2015	2,419.64	2,395.34	296.00	0.00	52.11	604.51	331.79	140.00	0.00	0.00	3,215.24
2016	2,595.42	1,659.81	64.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1,723.81
2017	3,034.70	776.22	96.00	0.00	291.51	597.06	319.27	272.00	0.00	5.79	1,760.79
2018	2,754.52	883.08	400.00	0.00	0.00	271.43	271.43	0.00	0.00	0.00	1,554.51
2019	3,055.09	479.32	0.00	0.00	0.00	64.12	64.12	0.00	0.00	0.00	543.44
Total	**29,427.03**	**14,702.28**	**2,184.00**	**0.00**	**445.15**	**3,684.65**	**1,088.14**	**2,458.00**	**0.00**	**5.79**	**20,883.36**

8. ORGANIZATION AND ADMINISTRATION

8.1 Organization

Karshong FMU falls within the jurisdiction of Bumthang Forest Division and is directly administered by CFO, Bumthang. A Unit In-charge has been assigned to look after daily activities in Karshong FMU. Under him, there are two Foresters who assist him in the implementation of the management plan.

8.2 Health and Safety

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 risks involved in the forestry operations are during:

a. Harvesting and
b. Transportation

Actions can be initiated with little or no expenditure to ensure health and safety of the field staffs. Following are the few recommendations to minimize hazards in the field:

- Ensure chain saws equipped with full functioning chain breaks
- Always ensure feller to keep two tree lengths apart while felling.
- Deploy only trained power chain saw operators for felling operations.
- Explain the dangers of falling timbers and overhead cable lines.
- Stack timbers in the same direction and not to stack the logs too high.
- Never approach or climb the log pile from the bottom of the slope.
- Always dismantle a stack from the top rather than from the bottom.

It is recommended that NRDCL should initiate long term safety measures and ensure its improvement which would one day become mandatory at any costs.

8.3 Record Keeping

Maintenance of record in the FMU office has substantially improved over the years. Although, the records from initial year of the second plan were identified as a concern, the Unit had made an effort to improve the record keeping in the FMU. The record keeping, however, can be further improved so that no details are lost in the process of the plan implementation. Unit Office shall continue to maintain the records of all the activities within the FMU as per the record-keeping format reflected in the Forest Management Code of Bhutan, 2004 and other guidelines/format developed by the Department from time to time.

9. INFRASTRUCTURE, TRANSPORT AND EQUIPMENT

9.1 Road

The Thimphu-Bumthang National Highway passes through Karshong FMU dividing the FMU into two halves. A total length of 17.5 kms of forest road was constructed during the first plan period. The road passes through South Block, Compartment I, II and III. During the second plan period, a total additional road length of 4 kms was constructed which passes through South Block, Compartment III and IV. The construction of forest road has facilitated in extraction and transportation of commercial timber as well as rural timber. Compared to other FMUs, the forest road condition is relatively better. This has facilitated the smooth transportation of logs from the cable lines to Depot. Although, the roads are pliable, side drains and culverts in certain sections of the roads are missing, leading to accumulation of water on the surface of the road.

9.2 Buildings

Karshong FMU does not have a building specifically for the FMU for carrying out daily activities. Currently, the Unit office is a temporary shade (log house) which was built during Integrated Forest Development Project (IFDP) in Domkhar and it is not in good shape. Besides FMU office, the temporary shade is also used as forest check post.

9.3 Transport

Due to the lack of budget, Division has not provided any kind of locomotives for the Unit staffs. Unit In-charge and the staffs owned their personal vehicles which they use to travel to the production site and other areas for monitoring the activities.

9.4 Equipment

The office is well equipped with all the necessary equipment that is required to carry out their duty. Through the funding support from RGoB, the office equipment and electronics were procured and distributed.

The equipment and instruments of the Karshong FMU Office includes;

- Computer (Desktop) set- 3
- Printer- 3
- Xerox Machine- 1
- Laptop- 1
- Clinometer- 2
- Diameter tape- 2
- Measuring tape- 3
- Compass- 2
- GPS Garmin- 2
- Walkie Talkie Sets- 2

10. EVALUATION OF PREVIOUS PLAN (2009-2019)

The past harvesting activities and other associated activities in Karshong Forest Management Unit was guided by the Forest Management Plan prepared in line with the Forest Management Code of Bhutan, 2004 and all the operations are based on the scientific forest management principles. However, it is mandatory to review the activities carried out during the last plan period to assess whether the activities are in line with the prescriptions of the previous plan or not. Moreover, it is important to review whether or not the goals and objectives of the previous plan have been achieved. The review will also highlight the areas of improvement and will subsequently help address those issues in the future.

This review process will look at the Goals and Objectives, Harvesting operations and AAC prescription, road building and reforestation activities. These reviews should be referred by the implementers so that such short comings are not repeated in the future operations. This review is based on the management plan from 2009 to 2019.

10.1 Review of Goals and Objectives

The Karshong Forest Management Plan was written considering its importance to various stakeholders and most importantly to maintain healthy forest through extraction of resources on sustainable basis. Although, the operations within the FMU were carried out as per theprovisions

of the Forest Management Code of Bhutan, 2004, many areas of improvements were seen in the field.

The Forest Management Unit of Karshong has undergone series of changes especially when it comes to area coverage. The total area of the FMU until the approval of second management plan was fixed at 4,715.77 ha. During the course of implementation of second management plan, around five community forests were established within the Forest Management Unit. This has led to significant reduction in the overall area as well as the production area of the FMU. On the other hand, laying of shorter cable lines besides availability of area to extend the lines lead to early exhaustion of the production area in the FMU. These two factors combined have lead to exhaustion of future production areas from where commercial harvesting of timber can be carried out.

In the 6th year of second management plan implementation, the Nangar Chuithuen Community Forest was established in the production area of the FMU. This has led to reduction in the total operable area of the FMU which in turn resulted in reduction in the commercial AAC from 3,535 m^3 to 3,266 m^3.While planning for third management plan of the FMU, there was a serious concern regarding unavailability of production area to sustain for next 10 more years. This has compelled the Division to propose for extension of the FMU area by approximately 2,000 ha so that the FMU can be operated on sustainable principle for coming years. Upon extending the FMU area, four more compartments were created in the South Block which will be subject to commercial harvesting from third plan onwards. The Third Management Plan should relook into these management and implementation problems and try to address such issues in the future.

A brief review of the Goals and Objectives from the last management plan is given below. The review will highlight on areas which were neglected during the implementation of last plan period.

Goal

To manage the Karshong FMU in a sustainable and multiple use basis for production of timber and NWFPs to meet the requirements of the country/locality as well as for conservation of forests and environment.

Although, the goal of managing the FMU on a sustainable and multiple use basis for production of timber and NWFPs was not achieved completely, the activities implemented in the last plan period was geared towards achieving this. As the goal is usually considered as a long-term objective of the management, it is unlikely to consider that it should be achieved in the short period of time. The sustainability aspect of the goal has been taken care properly while implementing the activities in the FMU. However, prescription mentioned in the scientific forest management plan need to be strictly implemented in order to derive benefits for all times to come.

Objectives

To meet the local requirements, as priority, for timber, fuel wood and other forest products on a sustainable basis.

For Karshong Forest Management Unit, not only commercial harvest through scientific sivliculture system, catering to the need of local people residing within the FMU through supply of rural timbers, fuel wood and other forest produce is one of the priority to regulate the allotment for sustainability. Till date there is not much issue in meeting the requirement of local communities, however, accessibility of required size timber like Drashing and Cham is getting further from settlement. This is quite the recent scenario, so perhaps this third plan might take care as we have increased the local use area which is quite accessible. Therefore, this objective is fully achieved and this forth plan will resolve further if any local requirement issue arises any in this plan period.

To manage the commercial timber production on sustainable basis.

As per the Management Plan of Karshong FMU, the total volume of rural and commercial timber that could be extracted is 49,274 m^3 from 2010 to 2019. However, about 30,234.32 m^3 or 61.36% of timber was actually extracted for rural and commercial purposes. Over all, the FMU has an undercut volume of 19,039.68 m^3 or 38.64%. To specify further, about 20,883.36m^3 commercial timbers has been extracted in standing form against the FMU total AAC of 34,274 m^3 [(6 X 3,535) + (4 X 3,266)]. Similarly, 9,350.96 m^3 rural timbers have been extracted against the total ten years volume target of 15,000 m^3 (10 X 1500). The target set in management plan is less by 113,390.64 m^3 or 39.07 % of the commercial AAC and less by 5,649.04 m^3 or 37.66% of the rural AAC of the FMU. The AAC target set in the management plan has not been achieved by 38.64 %. However, the management of FMU is not over harvested during the last plan period.

To maintain and improve the forest conditions for conservation of wildlife habitats, water catchment functions and biodiversity.

The FMU was divided into three working circles based on the nature of topography and stock density. The protection working circle is mainly being managed to improve the forest condition for use by wildlife and to enhance water catchment functions. It was found that the protection working circle was not disturbed by the commercial harvesting and has been kept exclusively for wildlife and watershed protection function. Also, interlines were well maintained which support uninterrupted movement of wild animals in the FMU. However, when it comes to improving the forest conditions, no interventions were carried out specifically to improve wildlife habitats.

To regulate grazing in sustainable manner to benefit the local people.

Free grazing has decreased due to increase in stall feeding, but free grazing system still exists in the FMU whereby the people leave the cattle to graze openly in the forest area. However, there is

no major impact has resulted due to grazing during the past plan period. Some local people, also attributes in shrinking of grazing land due to colonization by Blue Pine. Even though the area of tree cover has increased due to this phenomenon, it has led to decrease in grazing grounds for cattle and hence they are freely left in the forest areas to graze. The improved varieties of livestock were also being reared by the local people and these varieties of livestock are being stall-fed, resulting in lower grazing pressure in the forest.

To involve local people in the management of forest by providing employment opportunities and raising awareness programs.

Although, all the technical works are being contracted to the eligible business firms, the firms hire the local people as laborer to carry out the works within the FMU. This way, it helps in creating employment opportunity for the local people and the social mandate of the FMU is also being achieved. Moreover, three community forests were also established within the FMU which is aimed at giving opportunity to the local people to manage resources for themselves and also to carry out interventions to improve the forest cover and conditions. More so the community has benefited immensely through employment opportunities through FMU road maintenance, constructions and timber extractions. The local people were also involved in the management of FMU through FMU level meetings in which their opinions and suggestions are being incorporated for proper management of the Unit.

To protect the forest from fire and illegal activities.

Within the plan period, the division and unit office has initiated several awareness programs annually to sensitize the local people on importance of preventing forest fire and other illegal forestry activities. In the past decade there was no forest fire reported from the FMU area, whereas, the number of illegal activities within the FMU is on rise. Therefore, we can safely conclude that objective to protect the forest from fire is achieved, but curbing illegal logging is a continued effort, thus more attention is required in reducing any illegal activity in the FMU henceforth.

10.2 Review of Harvesting Activities

The commercial harvesting of timber in the FMU is carried out by skyline cable system. This system has helped in transportation of logs from the cable corridors without causing major disturbance to existing regeneration and ground cover. Further, the technique has helped extract the logs within limited timeframe and therefore, reducing the chances of timber damage at site.

However, some issue has been recorded within the production areas which need to be addressed in the future so that the operation is as per the standard set in the Forest Management Code of Bhutan, 2004. Firstly, the residue in the form of lops and tops which are left after extraction of logs are not being disposed properly. It was also reported in the final evaluation that the lops and tops are found lying at the road site as well as in the cable line corridor and it is not converted into firewood for supply on commercial basis. These residue needs to be disposed immediately

so that outbreak of pest and diseases is prevented. Not to major issue but the width of the cable corridors need to be maintained specifically of 4 m which has been prescribed in the management plan. This is to reduce clear cut area and eventually avoid undesirable precedence.

10.3 Review of Road Construction Activities

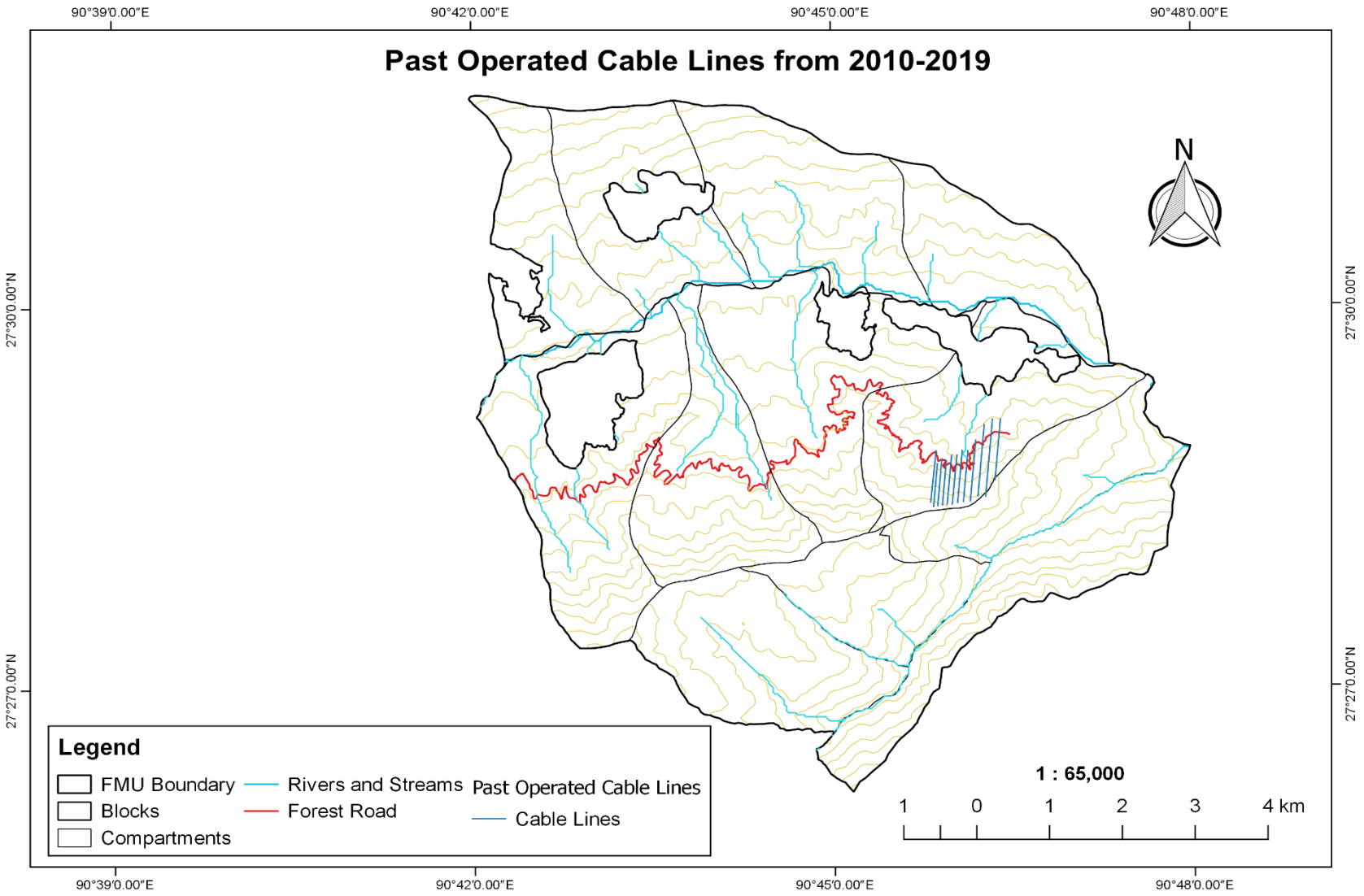
A total length of 17.5 kms of forest road was constructed during the first plan period. The road passes through South Block, Compartment I, II and III. During the second plan period, a total additional road length of 4 kms was constructed which passes through South Block, Compartment III and IV (Table 11). In total till date 21.5 kms of road was constructed. The construction of forest road has facilitated in extraction and transportation of commercial timber as well as rural timber. Compared to other FMUs, the forest road condition is relatively better. This has facilitated the smooth transportation of logs from the cable lines to Depot. Although, the roads are pliable, side drains and culverts in certain sections of the roads are missing, leading to accumulation of water on the surface of the road.

Table 10: Road Construction Information

Block/Compartment	Year of Construction	Road Constructed (km)
South Compt. III	2010	0
South Compt. III	2011	1
South Compt. III & IV	2012	1
South Compt. IV	2013	0
South Compt. IV	2014	0
South Compt. IV	2015	1
South Compt. IV	2016	0
South Compt. IV	2017	1
South Compt. IV	2018	0
South Compt. IV	2019	0
TOTAL		**4**

Source: Karshong FMU Office

Map 3: Past Operated Cable Lines from 2010-2019



10.4 Review of Reforestation

Regeneration surveys are carried out by the Unit every year to check the need to reforest the areas through artificial means. The regeneration survey report mentioned that the regenerations in the past operated cable corridors and groups are adequate. Dense regenerations, particularly of Hemlock species, are coming up along the forest road and past operated cable lines. As the established regenerations in the past operated lines are adequate, artificial regeneration in the form of plantations was not carried out. However, it was observed by the Final Evaluation committee members that the regeneration of bamboo is coming up in most open and operated areas. Therefore, this needs to be managed so that regeneration of desired species is not affected in the future. In order to overcome this issue, NRDCL is required to carry out periodic clearing of bamboo if it has severely impacted the process of regeneration of desired species. Further, care should be taken to manage bamboo for allotment to locals who depend on these resources. In the lower elevations of the FMU, regeneration of Blue Pine species is found abundant and it has also established in the open/barren areas within the FMU.

10.5 Annual Allowable Cut

The Annual Allowable Cut (AAC) of the last management plan is less than the current management plan. Due to the inclusion of the additional areas into Karshong FMU (approximately 1,800 ha), the overall volume per hectare of the FMU has increased compared to the previous management plans.

PART 2: FUTURE MANAGEMENT

11. INTRODUCTION

The Constitution of Bhutan has the provision to maintain 60% of the total land as forest (Royal Government of Bhutan, 2008). This is reflected in the National Forest Policy, 2011 and also forms an important aspect of the developmental process of the country. This constitutional provision can be fulfilled by following scientific sustainable forest management practices which not only help us manage and utilize the forest, but also look into fulfilling the social, economic, ecological and cultural needs of present and future generations.

11.1 Forest Policy

Over the years, there has been increasing pressure on the environment and the natural resources, the alarming consequences of which are becoming evident in the increasing propositions. The National Forest Policy of Bhutan, 2011 consists of a long term goal, major policy objectives and specific statements to enable various aspects of forest production, use and management (Royal Government of Bhutan, 2011). It has five guiding principles i.e. equity and justice in terms of

access, poverty alleviation through integrated approach, deregulation and devolution, integration of science and indigenous knowledge, and allowing import of logs and sawn timber(Department of Forests and Park Services, 2011).

According to the FNCA (1995) and FNCRR (2017), Management Plan needs to be prepared for all Protected Areas and for all forests where commercial logging is to be undertaken and needs to be approved before implementation (Department of Forests and Park Services, 2017). FNCA (1995) provides the legislative framework for the community participation in the forest management and streamline the preparation of supporting forest rules and regulations. The regulation lay out the best practices that apply nationwide. This plan has been prepared in line with the Act and the Forest and Nature Conservation Rules and Regulations of Bhutan.

11.2 Goals

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 Karshong FMU were framed based on the different management circles identified to ease the implementation of the plan. The three management circles identified are Protection, Production and Non-production Management Circles. As different management circles are managed for different purposes, framing separate objectives can help manage, monitor and evaluate the areas with ease. However, there are instances where different management circles share similar objectives. The objectives for management of the three management circles are listed below:

Protection Management Circle

- To conserve and enhance wildlife habitats and biodiversity.
- To conserve and improve the health of the watershed.
- To meet the local demand for NWFP on sustainable basis in order to improve socio-economic status of the people.
- To prevent negative impacts due to forest resource use on religious sites and water quality.

Non-Production Management Circle

- To maintain and improve the forest condition.
- To meet the local demand for NWFP on sustainable basis in order to improve socio-economic status of the people.
- To ensure regulated grazing for livestock in the FMU.
- To conserve the water catchment function.

Production Management Circle

- To meet local requirements, as priority, for timber, fuel wood and other forest produce on a sustainable basis.

- To manage and harvest commercial timber on sustainable basis.
- To protect the forest from fire, illegal activities and grazing in regeneration areas.
- To create employment opportunities for local people.
- To maintain and improve health and safety measures during operation.
- To prevent negative impacts due to forest resource use on watershed functions and water quality.
- To conserve and enhance biodiversity within production areas.

11.4 Management Based on Forest Function

11.4.1 Introduction

Forest function mapping is the term used for grouping the different potential uses of the forest. The different forest potential includes soil conservation, watershed conservation, habitat for flora and fauna and resource based for many kinds of human needs. Forest function, in general, are not based only on subjective human demands, they are significantly and objectively limited by site condition of forest stand. For this reason, categorization of every forest stand into different forest function is mainly based on the dominant site, forest type, accessibility, slope, flora and fauna present. However, some forest function represents certain exception to this rule and these functions are designated on the basis of social importance (Forest Resources Development Division, 2004).

Forest function defines all the ecological, environmental and social function within the FMU, so as to balance the often diverging interest of commercial logging. Alongside it identifies areas of Production forest, Limited production forest and Protected Areas. It also provides the UIC with firsthand information on the location of different forest functions in order to enable him/her to specify the required management prescriptions and to control its implementation.

11.4.2 The main objectives of Forest Function Mapping are:

- To define different environmental and social functions of the forest and depict them on the map.
- To identify Production, Non-production and Protection area within the FMU.
- To provide a tool for the management planner for balancing the requirement of nature conservation, environment protection, social forestry, commercial timber production and also to provide spatial information required to compute the sustainable AAC (Forest Resources Development Division, 2004).
- To provide the Unit In-charge with information on the location of different forest function in order to specify the required management prescriptions on the ground and to control its implementation.

11.4.2 Function Groups

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

Table 11: Different Forest Function used in the Plan

Soil Conservation	Water and Watershed Conservation	Nature Conservation	Social Function	Road Buffer
SP **Soil Protection**	**WRR** Riparian Reserve Protection	**NWP** Wildlife Protection	**SocRS** Religious Sites Protection	**RB** Road Buffer
SC **Soil Conservation**	**WLS** Local Water Supply Protection	**NWC** Wildlife Conservation	**SocL** Social (Local Use Only)	
	WSh Watershed Conservation			

11.4.3 Mapping Forest Functions

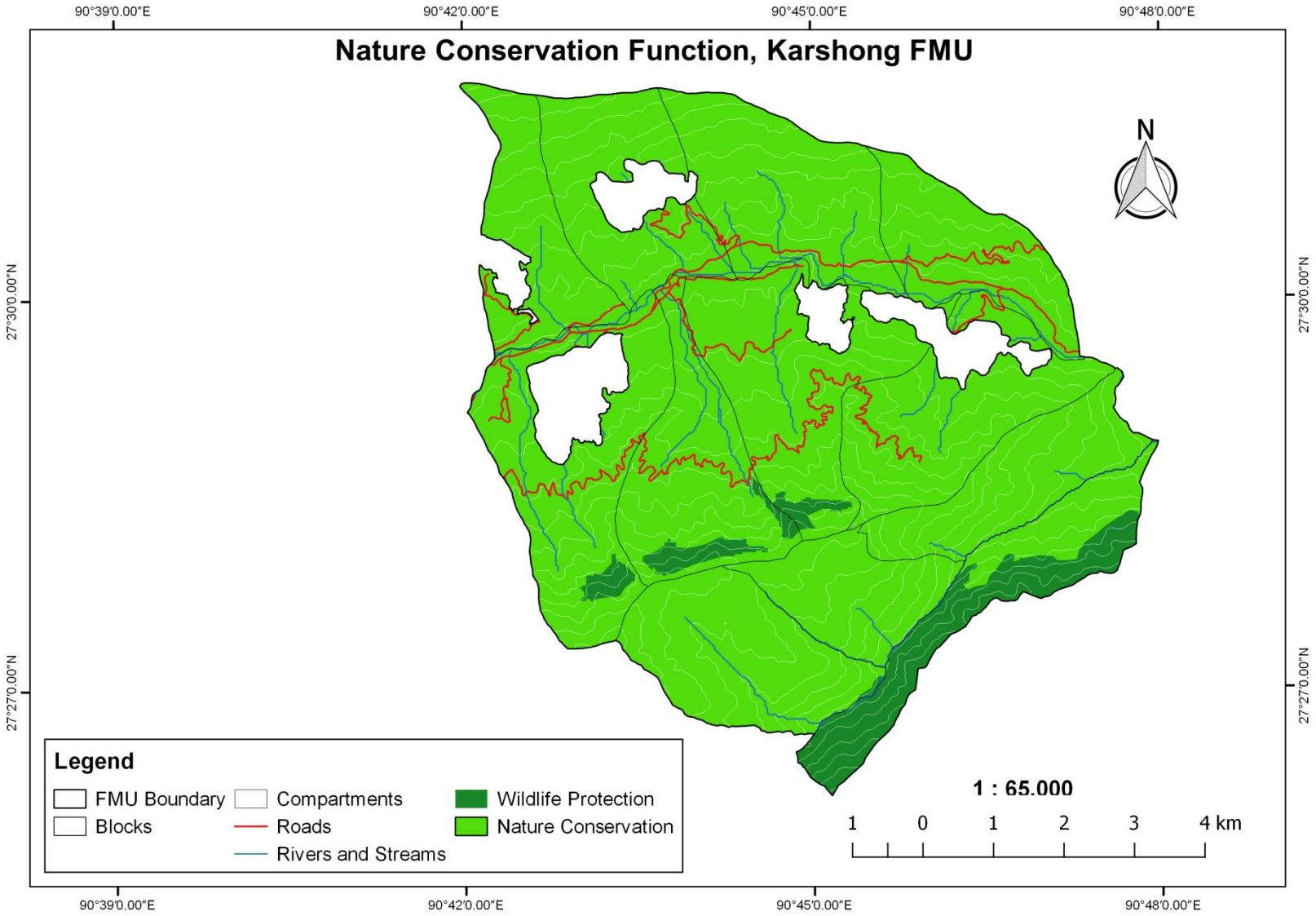
The forest function mapping was carried out to differentiate the forest area based on the function it caters. The mapping is carried out as per the criteria set for mapping based on the function groups. The details of criteria used to prepare forest function map for Karshong FMU is given in Table 13. 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 12: Criteria for Mapping Forest Functions

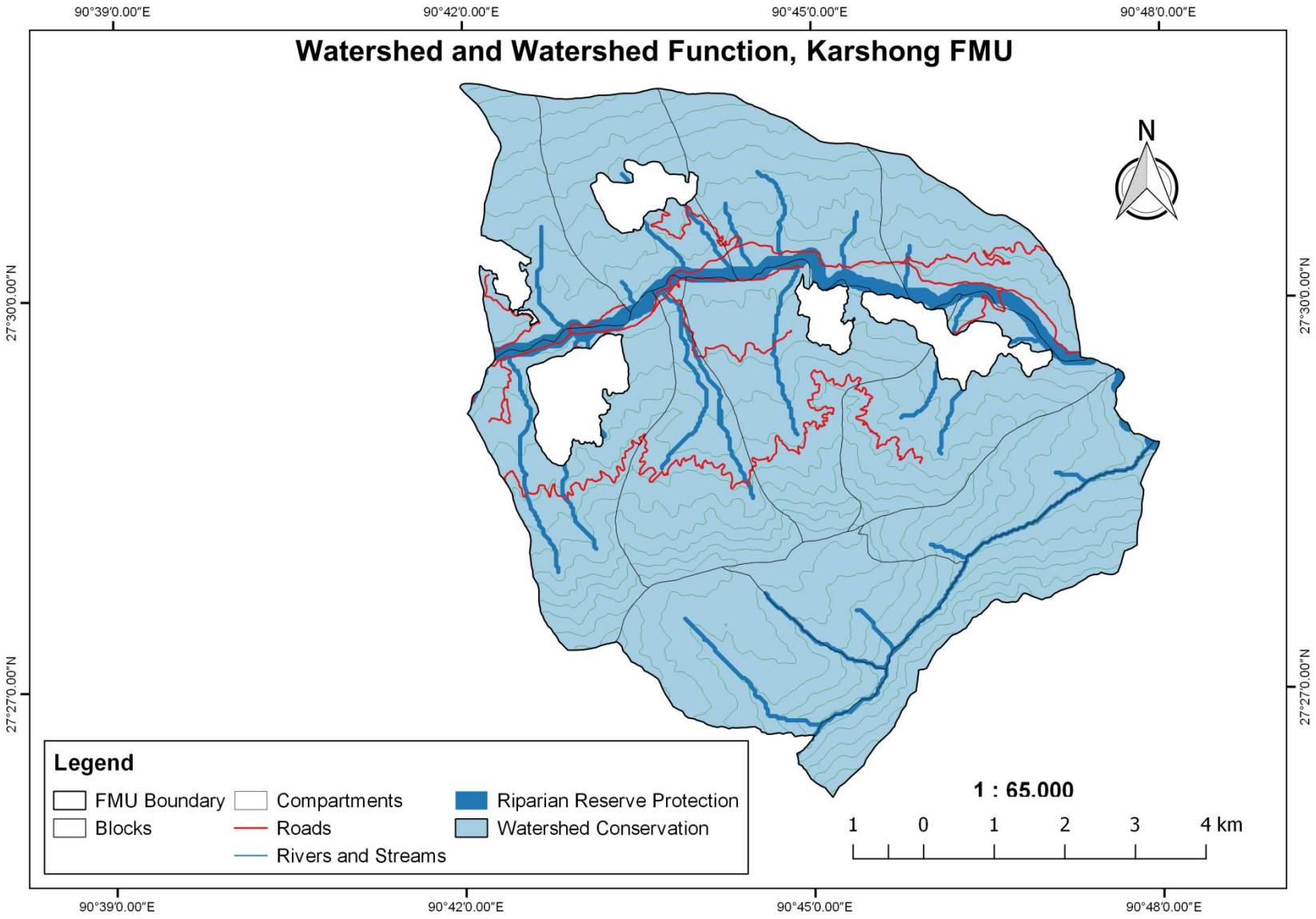
Function Group and Codes	Criteria for Mapping
Soil Conservation	**SP:** Very steep areas (slopes of greater than 100%), *areas with indication of slight to moderate erosion*. **SC:** Steep or sensitive areas (slopes of 76-100%)
Water and Watershed Conservation	**WSh:** Catchment areas of water courses, water retention areas. **WRR:** Areas within 30m 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, Red Panda territory, *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:** 200m uphill and 100m downhill for motorable public road, 30m uphill and 10m downhill for unstable forest road.

(Forest Resources Development Division, 2004)

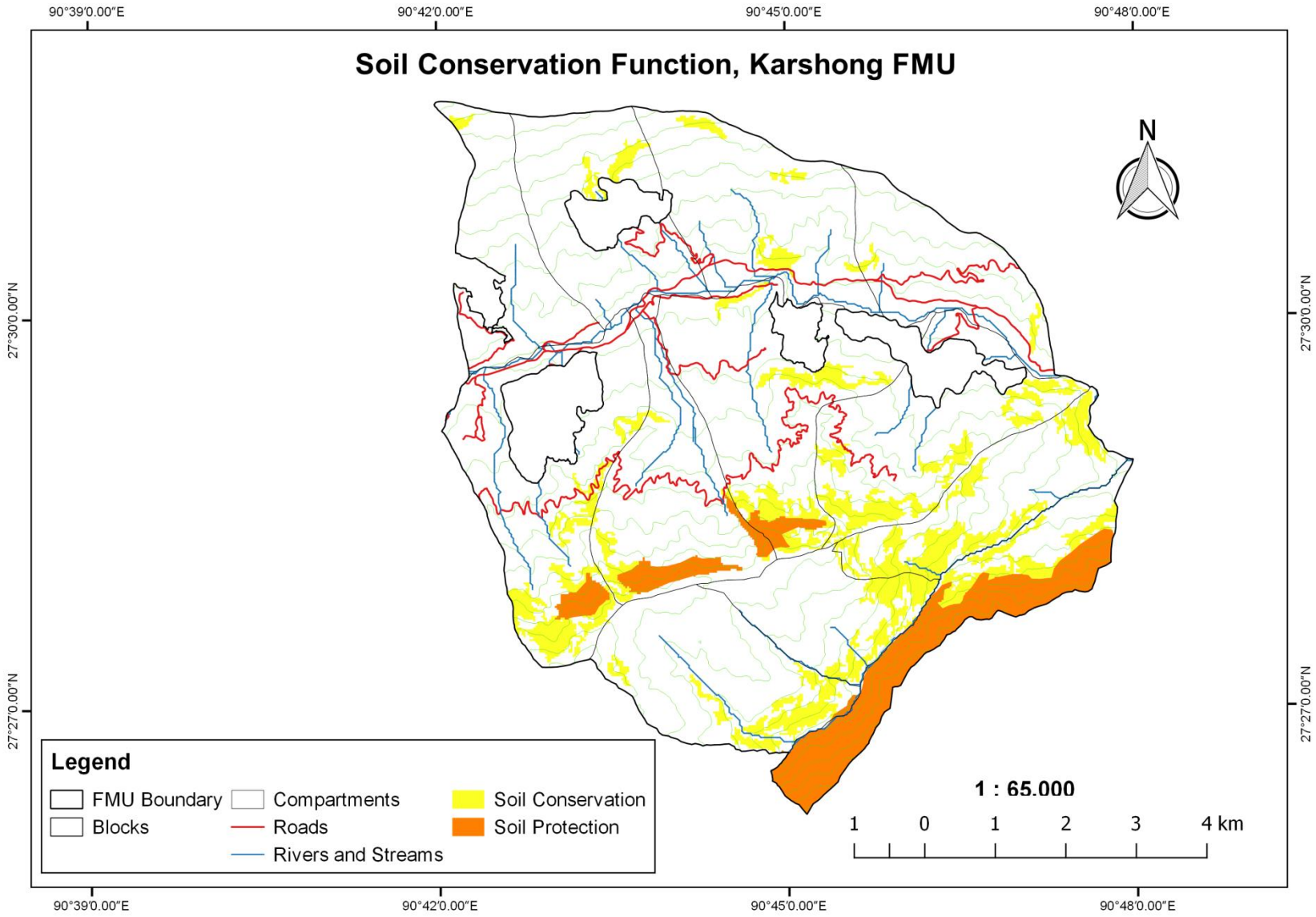
Map 4: Nature Conservation Function



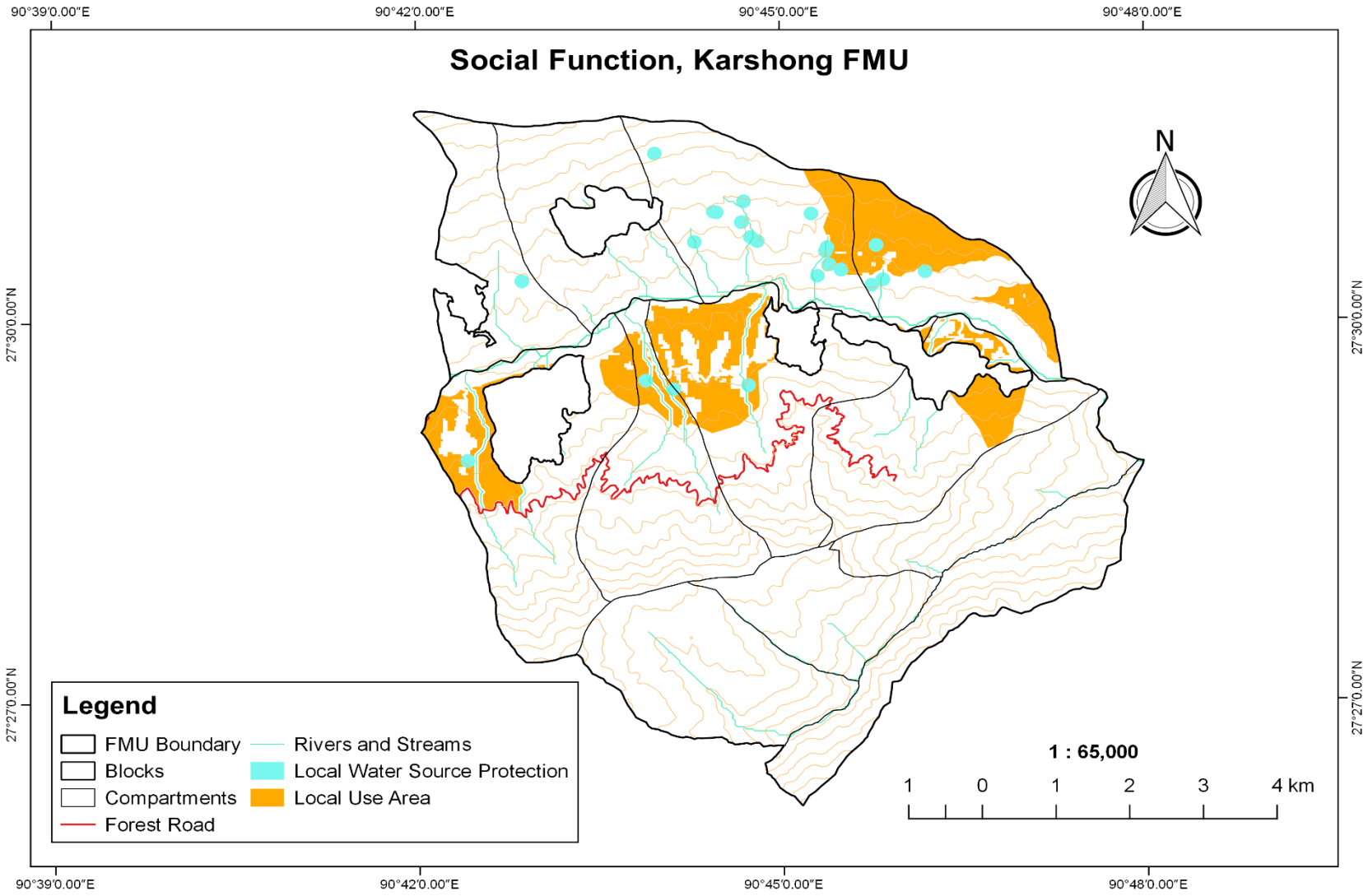
Map 5: Water and Watershed Conservation Function



Map 6: Soil Conservation Function



Map 7: Social Function



11.4.4 Restrictions of Forest Functions

The specific restriction to be applied to forest in the various function categories are summarized in table below:

Table 13: Forest Function Restrictions

Sl. No.	Code	Function	Restriction on Commercial Use	Restriction on Local Use
1	SP	Soil Protection	No commercial use	No tree felling, minimize human interference
2	WRR	Riparian Reserve Protection	No commercial use	Only collection of NWFP; no *tsamdrog*; no *sokshing*
3	RB	Road Buffer	No commercial use	No tree felling
4	NWP	Wildlife Protection	No commercial use	Restriction to activities that do not change habitat quality and disturb wildlife
5	WLS	Local Water Supply Protection	No commercial use	Low impact use only; no cattle grazing
6	SocRS	Religious Site Protection	No commercial use	Only uses which do not disturb the sanctity of the place
7	SocL	Social (Local Use Only)	No commercial use	No restriction
8	SC	Soil Conservation	No clear cutting; no conversion into plantation; extension of rejuvenation periods	Low impact local use; no intensive cattle grazing
9	WSh	Watershed Conservation	No clear cutting; no conversion into plantation; minimize disturbance to understory vegetation	No intensive cattle grazing; low impact local use
10	NWC	Wildlife Conservation	No clear cutting; no conversion into plantation; leave snags; leave some undisturbed patches; minimize disturbance to understory vegetation (bamboo)	Low impact local use
11		Production	No restriction	No restriction

(Forest Resources Development Division, 2004)

12. QUANTITATIVE RESOURCE ASSESSMENT

12.1 Forest Management Inventory

Inventory Design of Karshong Forest Management Unit

The forest management inventory of Karshong FMU was conducted in 2018 for the preparation of the third management plan. The standard FMU inventory technique was used, with data being collected for trees >10 cm DBH (OB). A total of 634 plots were laid within the FMU at a more practical spacing of 300 m × 300 m, thus a plot representing an area of 9.48 ha. The inventory was designed with target sampling error of +/- 10% at 90% confidence level using the coefficient variation of 98.8%. All inventory plots are designated as special plots in which both height and diameter of the trees were measured.

The general objective of the inventory was to make available essential background information for preparation of Management Plan. The inventory was carried out to provide accurate overview of the growing stock and regeneration potential of the natural forest in the area, according to major forest types. Further, it was also intended to provide an overview of the general characteristics of the natural forest, indication of timber quantity and furnish essential data on tree height to generate local volume table for main species.

12.2 Forest Management Inventory Result

The data obtained from the forest management inventory was analyzed using statistical software called 'R'. As per the forest management inventory of the FMU carried out in the year 2018, the average standing volume per hectare was found to be 299.68 m^3/ha with a sampling error of 7.26%. The average number of trees per hectare in the FMU was estimated at 186.52 with a standard error of 5.73%. The basal area per hectare was estimated to be around 27.76 m^2 with a standard error of 6.17%. The summary of the inventory results is shown in the table below:

Table 14: Summary of Inventory Results for overall FMU area

Parameters	Estimates	Sampling Error (%)	Lower value	Upper value
Total Volume in FMU (m^3)	2,074,148.49	7.26	1,923,574.54	2,224,722.45
Total Volume per Hectare (m^3)	299.68	7.26	277.92	321.44
Total Tree Count in FMU (Nos.)	1,290,912.23	5.73	1,217,000.23	1,364,824.23
Total Trees per Hectare (Nos.)	186.52	5.73	175.84	197.19
Total Basal Area of FMU (m^2)	192,105.99	6.17	180,254.23	203,957.75
Total Basal Area per Hectare (m^2)	27.76	6.17	26.04	29.47

13. AREA ORGANIZATION

13.1 Spatial Organization

The strategy for forest resource management begins with the formation of working circle and miscellaneous regulation. Therefore, the formation of working circle is an important step in planning process. The working circle is further divided into Blocks, Compartments and Sub-compartments. The Blocks have been demarcated according to natural drainage and terrain features whenever possible. The composition of the blocks, compartments and sub-compartments is given in Table 16:

Table 15: Block, Compartments and Sub-compartment Information

Block	Block Area (ha)	Compartment	Compartment Area (ha)
North	1,824.66	I	372.11
		II	458.92
		III	592.63
		IV	401
South	4,183.88	I	671.17
		II	530.45
		III	661.94
		IV	546.94
		V	408.27
		VI	332.14
		VII	547.28
		VIII	485.69
Total	**6,008.54**		**6,008.54**

Cable lines are usually aligned along the stable, well-stocked ridges and slopes and away from environmentally sensitive gullies and valley bottoms. According to the Forest Act, the felling of trees along the river banks, streams and in steep gullies is not permitted. The block boundary, as far as possible, follows permanent ridges and waterways to a point where a spur easily recognizable on the ground leads to a ridge top. This will facilitate the recording of removals by cable lines and Blocks (Rai, 2007).

During the Forest Function Mapping, the production areas have been separated for local use and commercial use. In the FMU-level Management Committee meeting, it was agreed that demarcation of separate areas will be done, and production forests will be shared. However, preference will always be given to native inhabitants for rural timber and NWFPs.

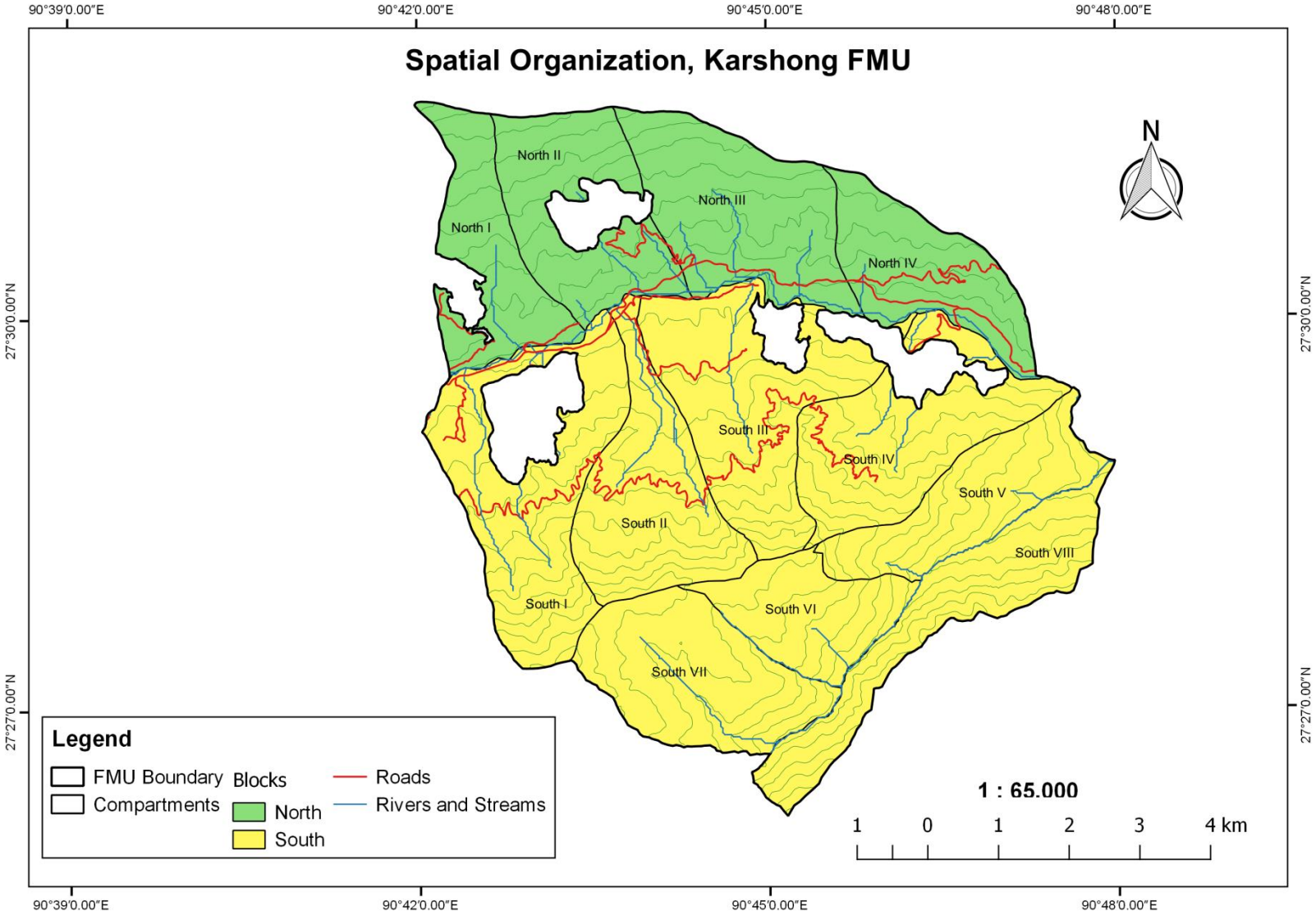
13.2 Determining Operable Area

Forests are managed for multiple purposes. The role of forest in serving people assumes utmost significance. The multiple uses of forests are generally protective, climatic, productive, scientific, recreational, etc. But while managing a unit area of forest, all such purposes cannot be

equally harmonized. One purpose has to take precedence over the other. The area 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:

- Soil protection areas (slopes greater than 100%)
- Soil conservation
- Agricultural uses
- Riparian buffers and zones
- Local water supply protection
- Biodiversity areas (wildlife conservation and protection)
- Religious site protection
- Road buffers.

Map 8: Spatial Organization of Karshong FMU



13.3 Organization into Management Circles and Working Circles

Function mapping was used to delineate three broad management circles for Karshong FMU. The three broad management circles for Karshong FMU are Protection, Production and Non-production Management Circles.

Table 16: Area Statement for Management Circles and Working Circles

Management and Working Circles	Area (ha)
*1.**Protection Management Circle***	1,286.16
2. Non-production Management Circle	160.95
*3.**Production Management Circle***	4,378.43
a. Blue Pine Working Circle	2,609.72
b. Mixed Conifer Working Circle	1,768.71

Note: A total of 183 ha of private registered land was excluded from Production Management Circle (Blue pine Working Circle).

13.4 Management Circles

13.4.1 Protection Management Circle

The Protection Working Circle is the sum of all protection functions; wildlife protection, soil protection, riparian reserve protection, religious site protection, road buffer protection and local water supply protection. Commercial harvesting activities are strictly prohibited in this management circle. The total area under protection management circle is 1,286.16 ha. The removal of trees may be permitted in the Protection Management Circle to deal with outbreaks of pest and diseases. The outline of management objectives and options of the protection management circle are given below.

Table 17: Protection Management Circle

Management Objectives	Management Options	Responsibility
To conserve and enhance wildlife habitats and biodiversity.	• Avoid disturbance • Promote research and habitat improvement activities	All Parties Territorial Division
To conserve and improve the health of the watershed.	• Minimal intervention	All Parties
To meet the local demand for NWFPs on sustainable basis in order to improve socio-economic status of the people.	• Regulate extraction of NWFP on sustainable basis • Carry out resource assessment	Territorial Division
To prevent negative impacts due to forest resource use on religious sites and water quality.	• No interventions	All Parties

13.4.2 Non-production Management Circle

The Non-production Management Circle includes area where production is not economically feasible. It comprises of non-forest areas, build-up areas, agricultural land and rocky outcrops. The total area under non-production management circle is about 160.95 ha.

Table 18: Non-production Management Circle

Management Objectives	Management Options	Responsibility
To maintain and improve the forest condition.	• Silvicultural Operations • Regeneration	Territorial Division NRDCL
To meet the local demand for NWFP on sustainable basis in order to improve socio-economic status of the people.	• Encourage people's participation in resource management and extraction • Promote community monitoring	Territorial Division
To ensure regulated grazing for livestock in the FMU.	• Encourage high yielding livestock varieties • Fodder tree plantation • Involve local communities	Territorial Division and Local Government
To conserve the water catchment function.	• Plantations • Keeping check on over exploitation of resources	Territorial Division, NRDCL and Local Government

13.4.3 Production Management Circle

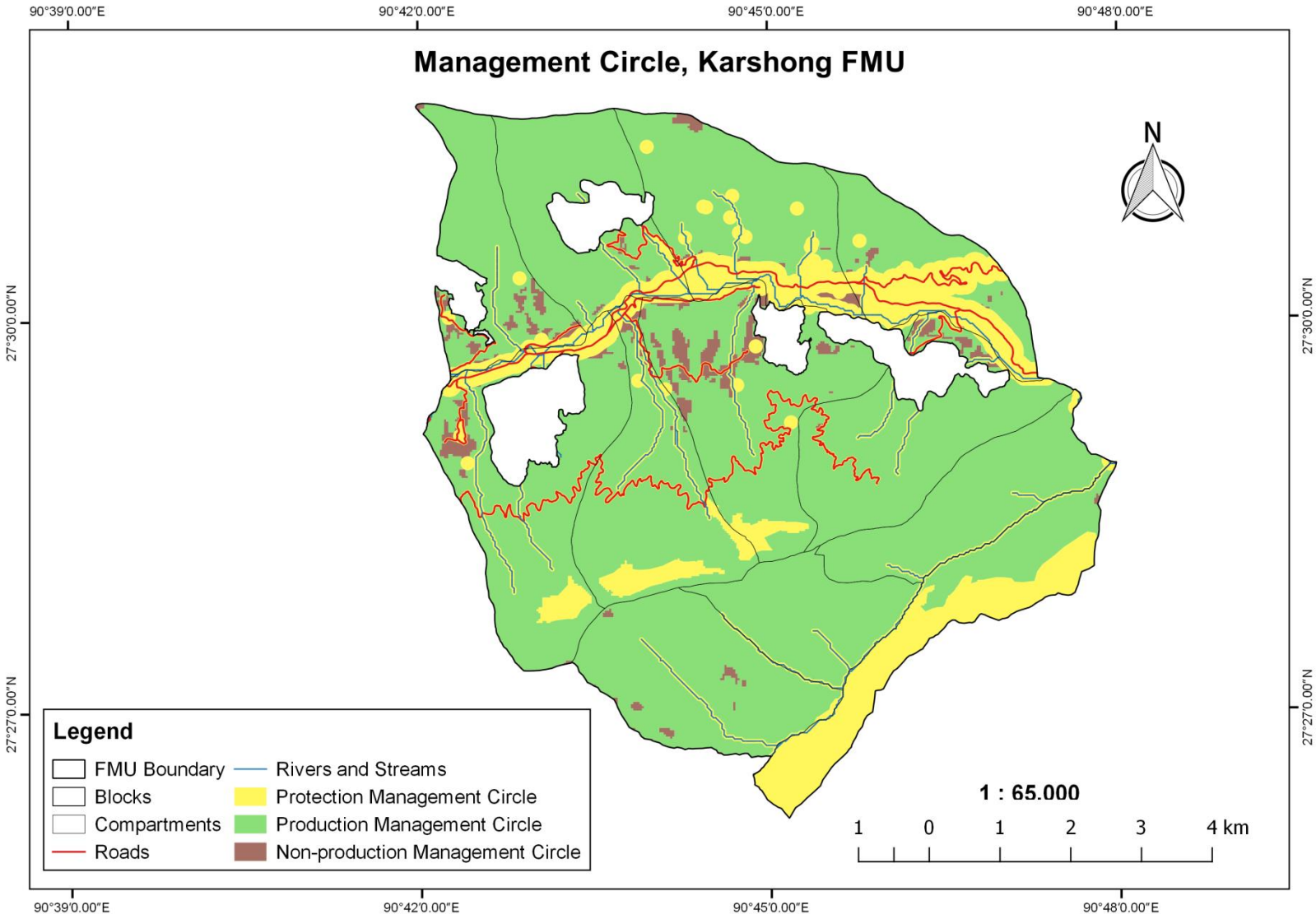
The Production Management Circle comprises of the area that has the potential for harvesting operations. It is the area left after delineation of protection and non-production management circles. This management circle comprises of areas which are well stocked with species which can be harvested on sustainable basis for both local and commercial uses. However, a total of 183 ha of private registered lands falling within the Production area is excluded . Therefore, the total area under this management circle after exclusion of the private registered land is 4,378.43 ha.

Table 19: Production Management Circle

Management Objectives	Management Options	Responsibility
To meet local requirements, as priority, for timber, fuel wood and other forest produce on a sustainable basis.	On the basis of single tree selection system from the identified local use area	Territorial Division
To manage and harvest commercial timber on sustainable basis.	Group selection system in mixed conifer, seed tree system in blue pine working circle and patch-cut system for mixed broadleaf working circle.	Territorial Division and NRDCL
To protect the forest from fire, illegal activities and grazing in regeneration areas.	Surveillance and community monitoring Regulated grazing	Territorial Division and Local Government
To create local employment opportunities for local people.	Involvement of local people in FMU activities	Territorial Division and NRDCL
To maintain and improve health and	Enforce use of safety gears during	NRDCL and

safety measures during operation.	harvesting work and road construction	Logging Contractors
To prevent negative impacts due to forest resource use on watershed functions and water quality	Minimal disturbance and plantation wherever required	Territorial Division and NRDCL
To conserve and enhance biodiversity within production areas.	Monitoring and research activities	Territorial Division

Map 9: Management Circle under Karshong FMU



13.4.4 Non-wood Management Circle (Overlapping)

The final evaluation of the second plan also recommends having prescription for NWFP management, as in the past the allotment has been done based on availability rather than with a sustainable AAC fixed by the plan. Due to limited resources and expertise to measure the stock of NWFP and to provide an AAC in this plan as well, perhaps it's recommended to estimate the quantity during the OP plan within the OP area which can then at least be regulated of its sustainability by its proportion. The NWFP is designed as an overlapping management circle and the harvesting can be carried out as per the sustainable principles from all other management circles. The Territorial Division should monitor the collection and processing of the NWFPs from the FMU on regular basis to ensure its sustainability. As per the provisions of FNCRR, 2017, the communities should form NWFP Management Groups and by-laws should be developed accordingly for sustainable management and harvest of NWFPs. The groups should take full responsibility for managing the resources in close consultation with the Divisional Office. Bamboo deserves an exclusive mention here as the growth of Bamboo is immense at once, which might be imperative to regulate its growth for allotment as well as to minimize its hindrance for regeneration.

Bamboo

One of the most important bamboo species found in the KFMU is *Borinda grossa*(Figure 8). The presence of *Borinda grossa* is mostly concentrated in South Block of KFMU.

Figure 5: Clump of *Borinda grossa*

Plant Profile

Scientific Name: *Borinda grossa*
Common Name: Baa (Dzongkha)
Family: Gramineae
Habitat: Wetter temperate mixed coniferous forests often associated with hemlock, at altitude of 1,800 m to 3,200 m.

Physical Characteristics

This is the clumping and frost-hardy mountain bamboo. It is grown in the temperate zone from 1,800m to 3,200m above the sea level. It is considered to be the largest clump forming bamboo that is found in the temperate forest. It has internode that reaches up to50cm in length. This species is found mostly in association with hemlock. It has dense clumps and they are straight and tough measuring upto 10m in height. Its clump diameter is around 4-5cm. Besides being naturally found in the forest, it is also cultivated within the homestead of the village.

This species grows well in moist depression with sandy loam soil. Though, its growth is gregarious in open and light exposed areas but it get matured with a very small culm diameter. The young shoots develop from March till July (General guidelines for Management of Bamboo in Bhutan). Economically, this bamboo species is very important. This species is usually used for weaving mat and fencing lattices. Some basket and decorative items are also made out of this species.

Management

Very little information on this species regarding the management technique is known. However Mr. Prabhat Kumar Mukhia has collected some of the indigenous method of harvesting and planting technique regarding *Borinda grossa*.

Harvesting

During the months of December to March, matured bamboo is collected by the farmers. Usually the matured culm of around one to two years old bamboo is cut with sharp knife (patang) at about 0.6 to 0.9 meter above the ground level (sometimes even cut 1metre above the ground level). The utilized portion of the bamboo measures only around 4 to 5 meter long and rest of the portion is discarded. The main problem is that the discarded potions of the bamboo are thrown there in the field itself. This negligence of the people might lead to the outbreak of the diseases which will have devastating effect on the healthy clumps. Therefore, Unit In-charge must give some awareness regarding the proper harvesting and sanitation of bamboo.

Planting

As observed in the field, most of the farmers do not plant or cultivate this bamboo since this species is readily available in the wild and to the nearest of 2 to 3 hours walking distance to reach the actual bamboo growing area. Those few farmers, who cultivate, do practice the traditional planting method i.e. rhizome cuttings. The whole rhizome along with 1 to 2 meter height of culm is dig out and planted in the desired site especially during the rainy season.

General Harvesting Guidelines of Bamboos

Harvesting guidelines will differ with species. The following general guidelines may be applied.

- Immature culms less than 1 year old should not be cut.
- Immature culms of 1-2 years have very high water content and shrivel up when cut, which makes them useless for construction. Speed of development depends on the condition of the clumps and the position of the culm: If the clump is vigorous and the culm is in exposed position, it matures much sooner. The culms at the center of the poor clump mature more slowly (Haun et al.-1961 and Storey-1998, written in Bradshaw paper 2001).
- In a clump containing 12 culms or more, at least 6 mature culms over 1 year old should be retained, and in a clumps containing less than 4 mature culms over 1 year old, all mature should be retained during felling. Mature culms should be evenly distributed throughout the clump to provide mechanical support as well as nourishment (Gautam 1988).
- All culms older than 4 years should be removed.
- Culms should never become so overcrowded that they touch one another at the base. There must be sufficient space between them to allow movement of the cutting instrument (Sharma, 1988).
- The culms should not be cut lower than the first node above ground level, to ensure that the rhizome is not damaged and not higher than 30 cm (Gautam, 1988). Thinning the clumps reduces rhizome overcrowding and encourages the production of new culms in the center of the clump (Sharma, 1988).
- Damaged culms, debris and cut branches which may have become infested with shoot-boring moths (family: Pareuplexia) should be removed (Bahadur et al., 1980; Stapleton, 1985a) and burnt (Storey, 1988a), along with all dead and dry culms (Gautam, 1988).
- The culms should be severed by cutting round once with the blade of a patang (or any sharp knife) angled at 45 degrees to the stem, then again with it angled the opposite way to produce a wedge-shaped notch. This avoids splitting the culm (Storey, 1988b).

13.5 Management of Working Circles

The Production Management Circle has been divided into four regular working circles (Map 10). The prescription in each working circles will differ and need to be adhered to strictly. The basis for formation of different working circle is purely on the forest composition and is grouped accordingly as per similar silvicultural treatments and requirements. The four working circles under the Production Management Circle are:

1. Mixed Conifer Working Circle
2. Blue Pine Working Circle

The objectives, management options, responsibilities, monitoring and evaluation, and silvicultural systems specific to each working circle is given below:

Map 10: Production Management Circle

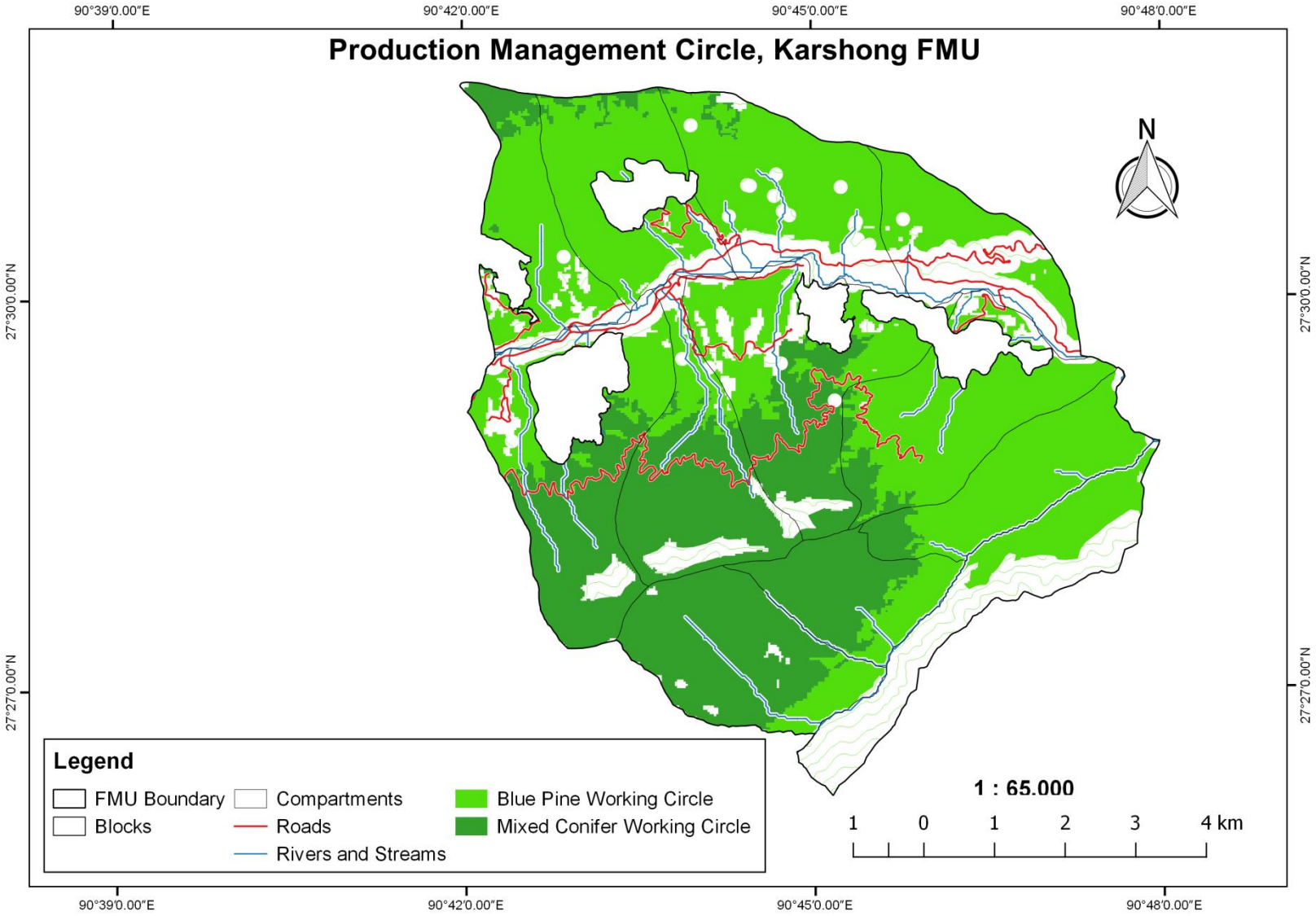


Table 20: Blue Pine Working Circle

WORKING CIRCLE: BLUE PINE				
Management Objectives	**Management Options**	**Responsibility**	**Monitoring**	**Silvicultural Systems**
To meet local requirements, as priority, for timber, fuel wood and other forest produce on a sustainable basis.	1. Controlled marking of trees 2. Systematic thinning	1. Territorial 2. Territorial/ NRDCL	1. Territorial 2. Territorial	***Thinning*** The young Blue Pine stands will be worked under thinning. Marking trees will depend on the number of stem per hectare, age or size class and spatial distribution. The detailed marking guideline for thinning in Blue Pine stand is given in Annexure 3. Dead, dying, malformed and diseased trees will be thinned on priority basis. ***Seed Tree System*** For cable harvesting, felling areas of 1000m × 30m can be logged, leaving 20-25 trees/ha as a seed source. The cable line should be laid to the full length and not to be limited to 1000 m.Harvesting line must not run directly downhill. Lines must be 90m apart to allow two interlines operation. On exposed or sensitive sites harvesting must leave 40-50 trees/ha and all under-story vegetation. Seed tree must be of good form, not over matured and representative of existing stand. In mixed stand, equal distribution of seed tree must be left(Forest Resources Development Division, 2004).
To manage and harvest commercial timber on sustainable basis.	1. Encourage use of small diameter wood 2. Promote commercial harvesting	1. NRDCL 2. NRDCL/ Territorial	1. NRDCL 2. Territorial	
To enhance and improve forest productivity	1. Mark trees for rural use as planned thinning exercise. 2. NRDCL to commercially thin stand. 3. Use appropriate logging and silvicultural methods. 4. Restock logged areas (if natural regeneration fails) or barren areas. 5. Create favorable conditions for regeneration and growth. 6. Involve local communities for planting and restocking activities. 7. Use stand tending techniques, such as bush clearing and spacing. 8. Harvest all areas regardless of financial returns	1.Territorial 2. NRDCL/ Territorial 3. NRDCL 4. NRDCL 5. NRDCL/ Territorial 6. NRDCL/ Territorial 7. NRDCL/ Territorial 8. NRDCL	1. Territorial 2. Territorial 3. Territorial 4. Territorial 5. Territorial 6. Territorial 7. Territorial 8. Territorial	
To maintain biodiversity within the production area	1. Low impact silvicultural system	1. Territorial/ NRDCL	1. Territorial	
To create local employment opportunities	1. Employ local contractors and people. 2. Provide proper training.	1. NRDCL 2. NRDCL/ Territorial	1. NRDCL 2. Territorial	
To protect the forest from overgrazing, fire and illegal activities	1. Control overgrazing, poaching, prevent fire and illegal activities with local participation	1. Territorial	1. Territorial	
To conserve the water catchment functions.	1. Minimal intervention. 2. Abide by stream buffer regulations	1. Territorial 2. NRDCL/ Territorial	1. Territorial 2. Territorial	

Table 21: Mixed Conifer Working Circle

WORKING CIRCLE: MIXED CONIFER				
Management Objectives	**Management Options**	**Responsibility**	**Monitoring**	**Silvicultural Systems**
To manage the commercial timber production on sustainable basis.	1. Use appropriate logging and silviculture method. 2. Ensure cable line layout allows interline logging. 3. Operate entire cable line. 4.Encourage cleaning of entire cable lines.	1. Territorial/ NRDCL 2. Territorial/ NRDCL 3. Territorial/ NRDCL 4. NRDCL	1. Territorial 2. Territorial 3. Territorial 4. Territorial	***Group Selection System*** The coupe sizes recommended by RNR-RDC Yusipang serves as a guideline to follow for each silvicultural system prescribed for each forest type. Cable lines will be laid to their full capacity. Cable corridors will be not more than 4m wide. Group opening will not exceed 0.15 ha. The distance between the cable lines will be 60m and between groups along cable line will not be less than 50m(Forest Resources Development Division, 2004). All merchantable trees >10cm DBH will be felled. Dead, dying, malformed and diseased tree be felled by priority. Opening can be irregular shapes and should be based on terrain features and stand condition. Damage to residual tree must be minimized.
To enhance and improve forest condition and productivity.	1.Ensure that all barren areas are restocked with suitable native species if natural regeneration fails. 2.Use appropriate logging and silvicultural method. 3.Monitor on the attack of pest and disease. 4.Involve local communities.	1.NRDCL/ Territorial 2.NRDCL/ Territorial 3.Territorial 4. NRDCL/ Territorial	1. Territorial 2.Territorial 3.Territorial 4.NRDCL/ Territorial	
To protect the forest from overgrazing, fire, illegal activities and from grazing in regeneration areas.	1.Control over grazing, fire, poaching and other illegal activities through community participation and proper fencing.	1. Territorial/ NRDCL	1. Territorial	
To create local employment.	1.Employ local people. 2.Employ local contractor.	1.NRDCL 2.NRDCL	1.NRDCL 2.NRDCL	
To maintain biodiversity within the production area.	1.Low impact silviculture system.	1. Territorial/ NRDCL	1.Territorial	
To conserve the water catchment functions.	1.Minimal intervention. 2.Abide by stream buffer regulation.	1.Territorial/ NRDCL 2.NRDCL/ Territorial	1.Territorial 2.Territorial	
To continually improve health and safety standards.	1.Provide training to contractors and machine operators. 2.Provide awareness to local community.	1.NRDCL 2.Territorial	1. Territorial 2. Territorial	

13.6 Implementing Working Circle Management

The Forest Function planning has been used in this plan to allocate land use among the forests in the FMU, so that strategic planning for sustainable yield can be carried out. The problem still remains to implement these prescriptions on the ground. Later sections indicate that this will be done through an Operational Planning process whereby more detailed information is collected through inventory and discussions with stakeholders, primarily local communities and NRDCL. However, even when this more detailed data is collected, the requirement remains to locate individual Forest Functions on the ground so that the prescriptions given can be implemented. Although, maps have been prepared indicating the boundaries of Forest Functions, the map indicating all Functions is quite complex. In addition, experience in the field indicates that the bases for all maps are derived, from the 1:50,000 topographic maps, which is often inaccurate and inappropriate for implementing Operational Plans.

Therefore, the Unit In-charge will have to use the provided maps to the best of their ability. Areas should be observed on the forest function maps prior to going to the field. Once in the field, visual observation within the operable areas should be able to provide the needed information. For example, stream buffer will occur in all the perennial streams and steep slopes should be measured and observed for soil protection or conservation. The forest function maps will be updated accordingly as per the field observations.

14. YIELD REGULATIONS AND HARVESTING

14.1 Determination of Annual Allowable Cut (AAC)

14.1.1 Introduction

Forest management based on the principle of sustainability ensures sustainable utilization of forest resources by present as well as future generations. The principle of sustained yield ensures the stability and continuous supply of raw materials to the industries and meets the local needs of the people. The concept of Sustained Yield allows harvesting of forest resources by which annual cut and other losses of timber do not exceed the average annual growth. It also assures continuity of harvest without impairing the productivity of the soil. The calculation of sustained yield is expressed as AAC.

14.1.2 Increment Based AAC

In a perfectly 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 increment is still limited for Karshong FMU and Bhutan in general, and it will be some time before valuable data from permanent plots are available. The forests are not perfectly structured, but have very varied natural growing stock (of different cohorts). In the long term, increment should increase as over matured stands are replaced by younger stocks, but it will be many decades before this second growth is available for harvest. There is an over-matured growing

stock and too little and unreliable increment data to be used in determining AAC. Therefore, increment based AAC is currently unsuitable for Bhutan.

14.1.3 The Most Appropriate AAC Method

Annual Allowable Cut can be calculated using a wide range of formulae but the most suitable formulae used for the purpose of this management plan is the combination of area, rotational age and standing volume of species. The formula used for calculation of AAC for Karshong FMU is given below:

$$AAC\ per\ Working\ Circle = \frac{Net\ Operable\ Area}{Rotation} \times Average\ Standing\ Volume\ per\ Ha$$

This method is applied for calculating AAC for each Working Circle and are added together to calculate the total AAC. Due to different rotation age used for different working circle, it is necessary to calculate the AAC for each working circle first and sum it all to obtain the total AAC of the FMU. However, it should be noted that the AAC for each working circle should not be the basis for annual harvest in the field due to the fact that one cable line may cross more than one working circle if it is laid to the maximum length. This will also enable the implementer to lay the cable lines to the maximum length and make the best use of available production area.

14.1.4 Calculation of AAC for Karshong FMU

Net Operable Area

The total operable area is identified through mapping using GIS technique. But it has been observed that in most of the FMUs, the total operable area cannot be always subjected to harvesting. Within the mapped area there can be small rocky terrain, water bodies and other conservation areas which often prevent harvesting operations. This occurs mainly when the cable lines are being laid out. Beside this, Group Selection System almost inevitably leads to some patches of mature timber being left in later phases due to the presence of new regeneration and the possibility of damage.

In such challenging terrains in Bhutan, exact geometric-shape group layout is rarely possible. Due to the above inevitable fact, around 20% of area from the gross operable area has been reduced to calculate the net operable area in commercial Working Circles. Any deviations from the prescribed cable line layout should be approved by the Department prior to implementation.

Table 22: Calculation of Net Production Area

Forest Types	Gross Operable Area (ha)	Calculation	Net Production Area (ha)
Mixed Conifer	1,768.71	In order to calculate the net production area, 20 % from the gross operable area has been reduced.	1414.97
Blue Pine	2,609.72		2087.78
TOTAL	**4,378.43**		**3502.74**

Rotation and Regeneration Period

The assumed rotation age for Mixed Coniferis 160 years. Consideration of regeneration period while calculating rotation age is very crucial. However, in Karshong FMU, the regeneration of mixed conifer species does not take long time to get established. Therefore, while calculating AAC for Karshong FMU, no regeneration period has been added to the rotation age of Mixed Conifer. The assumed rotation length for Blue Pine which grows at relatively lower altitude is 110 years. Therefore, the rotation age for Blue Pine is kept at 110 years. The assumed rotation lengths for the calculation of AAC in Karshong FMU are:

*Mixed Conifer Working Circle= **160 Years***
*Blue Pine Working Circle= **110 Years***

Average Standing Volume

The mature average standing volume is derived from management forest inventory data statistically analyzed using "R". The sampling error and RME for each stratum is given below (Table 26). The forest management inventory of Karshong FMU is designed based on the entire forest type and not based on individual stratum. Therefore, the average standing volume obtained from the analyzed data is kept the same irrespective of the stratum. Hence, the average standing volume for all the strata is considered as 299.68 m^3/ha with a standard error of 7.26%. The reliable minimum estimate of standing volume thus obtained was 277.92 m^3/ha for all stratum.

AAC for Each Working Circle

The AAC for each working circle is given in the following table (Table 26). Due to different rotation for each stratum, it is necessary to calculate the AAC for each stratum. However, while implementing practically in the field, it is essential to consider that one cable line may pass through more than one stratum. This makes it difficult to totally base the harvest as per individual stratum. Therefore, during implementation, the total AAC (sum total of AAC for each stratum) should be considered instead of AAC for each stratum.

Table 23: AAC for the Working Circles (Standing volume)

Stratum	Net Operable Area (ha)	Rotation (Years)	RME standing volume (m^3/ha)	AAC (m^3/yr)	Clear-cut Equivalent
Blue Pine	2,087.78	110	277.92	5,274.86	18.98
Mixed Conifer	1,414.97	160	277.92	2457.79	8.84
TOTAL	**3502.74**			**7,732.66**	**27.82**

Therefore, the total workable AAC for Karshong FMU is fixed at 7700 m^3 in standing volume. It is permissible to vary the AAC area 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. The AAC prescribed is not solely to be met from the cable lines. The volume obtained from ad-hoc logging and thinning within the FMU should be accounted for.

Compared to the AAC allocation of the second management plan, the third management plan showed a increase in the AAC from 5,353 m^3 to 77,00 m^3. Due to the addition of four compartments in the South Block of the FMU, the volume per hectare has shown substantial increased. The reliable minimum estimate of volume per hectare of the FMU is 277.92 m^3. The other reason which attributed to the increase in AAC is the change in approach for calculation of net production area.

14.2 Recording and Accounting for AAC

Annual Allowable Cut will be monitored through the records of tree marked (Tree Marking Register) for both commercial and local use in all the Working Circles. AAC has been calculated as gross volume and this is the measure that should be totaled on annual basis from the Tree Marking Register.

14.3 Allocation of AAC

The allocation of AAC has taken into account the needs of both rural people (living within and near Karshong FMU) and commercial demands. The AAC for rural use has been allotted based on the demand and the Local Use Area.

Table 24: Allocation of AAC

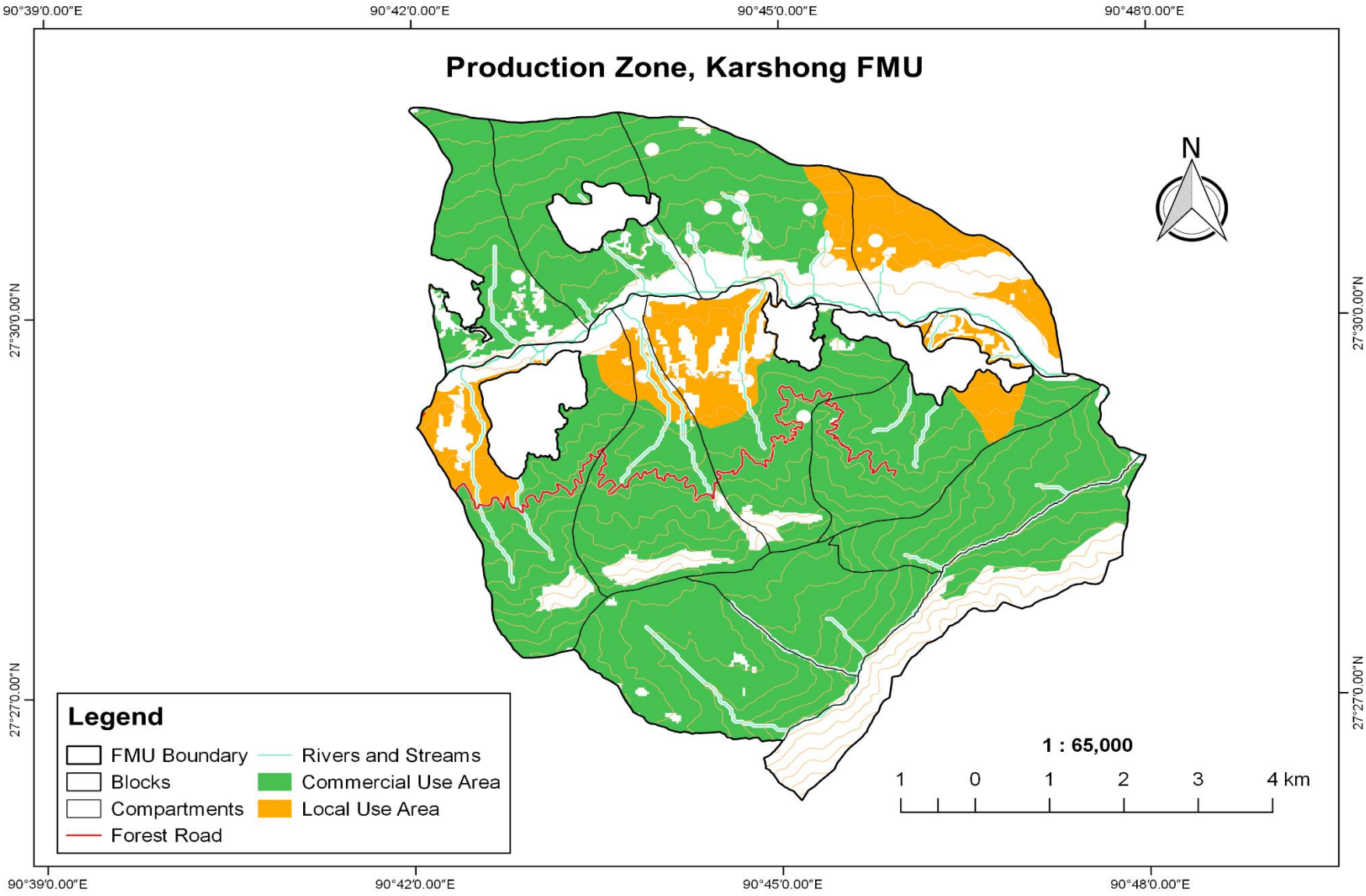
Standing Volume (m^3)	Allotted to
1,500 m^3	Local Use- Allocated to local villages and general public.
6,200 m^3	NRDCL- Allocated for meeting the timber demand in the market.

14.4 Distribution of the Cut

AAC has been calculated by Working Circles. However, during the implementation, it should be noted that the distribution of cut will be considered as the entire FMU and not as individual working circle. If the operation area for a particular area falls completely under one working circle, the sum total of AAC for that year will be removed from this working circle. Therefore,

the AAC for each stratum is mentioned purely for calculation purposes and not to be read as individual cut for each working circle. The number of cable lines to be harvested annually should be mentioned in the Annual Operational Plan.

Map 11: Production Zone



15. SILVICULTURAL SYSTEMS

15.1 Group Selection System

For the Mixed Conifer Working Circle in the FMU, Group Selection is the prescribed Silvicultural System. The particular Silvicultural System has been selected based on the ecosystem and natural regeneration system. Under the Group Selection System, small openings will be created in the stand allowing light to reach the forest floor and creating conducive micro climate for seed germination and establishment of seedlings. The opening will be no longer than one and half tree length in the Hemlock, Spruce and Fir Stand.

The groups will be opened along cable lines. The distance between cable lines will be not less than 60 meters, and between groups along cable line not less than 50 meters. The corridors should not exceed four meter widths. The effective area within the limit of standard cable length is 6 hectares (1000meters x 60 meters), less the area of the corridor 0.40 hectares (1000 meters x 4 meters), thus the one third removal would be equivalent to (1.87 ha) which is the area available for opening groups. Thus, it would be possible to open up around 9 to 10 groups along the standard cable lines, if the average tree height is taken around 35 meters and further the diameter of any opening will not exceed 50 meters.

The individual openings need not be uniform in shape or size and systematically located along cable lines. In most cases the openings will be irregular in shape and systematic location of groups will be almost impossible. Aspect, slope and silvicultural requirement would influence the actual size of the groups. An average of 0.15ha opening is recommended.

Existing opening in the stands which can be expanded, signs of existing windfall in the stands, stands which are mature or diseased, and stands infested with mistletoes should be chosen as groups as priority. In order not to lose the site protection effect of the surrounding trees it is necessary that the specified size for opening should be strictly adhered to. The tree should be felled towards the center of the group opening whenever possible to avoid damage to the unmarked trees. Terrain with steep slope and exposed South and South-West aspects should be avoided, or the opening should be smaller to match with the terrain and site conditions or the selection system should be applied.

In areas where opening cannot be created under Group Selection System (in between two cable lines) such areas should be operated under Single Tree Selection System. However, care should be taken that spatial distribution of the trees are strictly followed and should match with openings created under Group Selection System.

The Group Selection System has the following advantages:

- Regeneration in the small groups under even-aged condition gives better stem form.
- Larger openings in comparison to that under single tree selection system permit the establishment of intolerant species.

- Harvesting is more concentrated, so the logging cost is lower.
- Harvesting in group lower damages to residual stands.
- Intermediate cuts may be made less frequently.
- Aesthetically and environmentally more acceptable than clear cutting system.

Calculating Number of Cable Lines Annually

Assuming the standard cable line length to be 1,000 meters to be installed for extraction of timber by seed tree silvicultural system, the approximate number of cable lines that can be installed to achieve the annual allowable cut is worked out below:

Assuming,

Length of the cable line = 1,000 meters

Total clear felled area per line using seed tree system including cable corridor = 2.6 ha

Total clear-cut equivalent of all Working Circle = 21.72 ha

Therefore, total cable lines that can be installed annually to achieve the AAC is

= (21.72 ha / 2.6 ha)

= 8.35

= 8 cable lines/year

Although, the above projection is done considering the length of the cable line to be 1,000 meters, the length of the cable line while practically planning in the field may vary based on the topography and site conditions. Therefore, this projection should only be used to initially plan the field work during operational plan preparation. The actual number of cable lines to be installed annually will be guided by the operational inventory and cable line survey carried out during preparation of operational plan.

15.2 Single Tree Selection System

The Single Tree Selection System will be applied to Local Use areas in case of rural marking for extraction of rural house building timber and firewood. Single tree selection system follows principles of nature that matured trees are selected and removed to enable regeneration to replace them. The felling should be scattered all over the operational area instead of confining to certain parts of forest. Felling should involve removing of trees or small groups of trees. This system helps to maintain uneven-aged character of the forest crop.

It is observed in most cases that the trees of best economic interest are selected and felled. Instead of following this, Unit In-charge of the particular FMU should judge and familiarize with the forest condition and silvicultural requirement of the species and do the selection with the interest of meeting the objectives of the system. As far as possible, selection of trees to be felled should be done for following categories first especially in young and immature stands.

- Dead, dying, diseased, misshapen or otherwise defective trees which interferes with the growth of neighboring vegetation.
- Trees of undesirable species.
- Immature tree which can be removed by judicious thinning.
- Mature trees above the exploitable diameter, which will leave gaps for regeneration to come up.

15.3 Seed Tree System

Blue Pine Working Circle will be worked under Seed Tree System as Blue Pine regenerate very easily under Seed Tree System. About 20 to 25 seed trees (plus tree or mother tree) per hectare should be retained as seed source. These trees must be of good health and vigorous in growth which would truly serve as good seed source. Slope characteristics, wind firmness and aesthetic value have to be taken into consideration while utilizing this system. Again in applying this system, site condition like aspect must be considered. For cable harvesting, felling areas of 1000m x 30m can be logged, leaving 20-25 trees/ha as seed source. Harvesting lines must not run directly downhill. Lines must be 90m apart, allowing 2 interline operations. Dead, dying, malformed and diseased tree will be cut on priority basis. On exposed or sensitive site, harvesting must leave 40 to 50 trees/ha.

15.4 Thinning

The young Blue Pine stands (Blue Pine Working Circle) will be worked under thinning. The thinning will be done by positive selection with due consideration to stabilize the structure of the stands. This type of thinning will be to direct the growth potential of the stand and site to the most promising individuals of the tree populations to maximize volume and quality production. The stand to be thinned will be identified from the treatment map and field visit. Pruning in the appropriate stands will also improve the value of the forests. Marking of trees will depend on the number of stem per hectare, age or size class and spatial distribution. The detailed marking guideline for thinning in Blue Pine stand is given in Annexure 3. Dead, dying, malformed and diseased tree will be thinned on priority basis. Large opening must not be created. Thinning area should be identified as per this plan and should be carried out annually in order to improve the existing stand. Around 14 hectares of forest area in South Block, Compartment IV (along the new road alignment) will be thinned in addition to other areas that require thinning. The thinning should be well reflected in the operational plan with the total area allocated each year.

16. FOREST PROTECTION

16.1 Fire

There was two incidences reported in the last plan, but in the last decade shows no incidences of forest fire in the FMU as per our official records with the FMU office. However, the forest fire has not been a major threat in the FMU. As the FMU area is mostly covered with mixed conifer and Blue Pine forest, it is essential to take preventive measures to reduce the risk of major forest

fire in the future. The Unit In-charge and the Production In-charge of NRDCL will need to review forest fire protection programs at regular interval in consultation with the local communities and the various stakeholders involved with activities of FMU.

16.2 Pest and Disease Management

Till date, there is no record of any pest and diseases outbreak in Karshong FMU. However, there can be chances of pest and diseases outbreak in the future. Therefore, periodic monitoring of the forests to check any outbreak of pest and diseases will be done. In order to detect and report any outbreak of pest diseases, the FMU staffs will conduct regular inspection to enable the initiation of earliest possible remedial and preventive measures. Report should be submitted to the CFO, Bumthang and also to the Specialist(s) with the Department.

The following are the control measures suggested:

- Regular periodic survey of the forest and removal of deformed trees.
- Regular survey of regenerated areas and burning of infected plants after slashing and debarking.
- Education extension program for the people and the workers in the forest to report symptoms of the disease will be part of the pest and disease management program within the FMU.

The planting stock at any nursery, which will be supplied to the Unit for further plantation, will need to be monitored for pest and diseases. The infected seedlings should not be supplied, instead destroy by burning at the nursery itself.

16.3 Grazing

Grazing has not been much issue in the FMU area, perhaps it can be attributed to the change in rearing method where livestock is mostly kept in vicinity of the settlement for easy milking and feeding purpose rather than grazed freely in forest unlike in past. More so, in line with the multiple-use of the forests and as provided in the National Forest Policy of Bhutan, 2011, grazing will be allowed in some parts of the FMU. Grazing will not be permitted in areas identified as protection areas and light grazing will be permitted in areas identified as conservation areas. Thus, a participatory approach to secure the co-operation of the local communities to manage the grazing land for their cattle will be adopted with high priority.

17. ENVIRONMENTAL STATEMENT

All developmental proposals in Bhutan have to fulfill certain environmental criteria as per the provision of the Environmental Assessment Act, 2000. The Chapter III, Section 18 of the Environmental Assessment Act necessitates obtaining environmental clearance prior to the commencement of the proposed developmental activity. To carry out any forestry activities, the National Environment Commission Secretariat has developed Regulation for Environmental Clearance of Projects in 2002, the procedures of which the applicant should meet. This section of

the plan provides all necessary information required for environmental clearance which includes the perceived threats of the proposed project to the environment and necessary mitigation measures to minimize the impacts resulting from the planned activities. This section, altogether, meets the requirement of the Act to be fulfilled by the applicant concerned.

17.1 Project Description

17.1.1 Introduction

Karshong Forest Management Unit was established in the year 1994 in line with the Department's aspiration to establish one FMU in each Dzongkhag to cater to the timber needs of the people of Bhutan on sustainable basis. The FMU was operational since 1994 till date and it was managed based on the two 10 year plans. Now the FMU will be managed with this plan which is the third one since its inception. During the first plan, the total AAC was 5,300 m^3 of which 3,700 m^3 is for commercial harvest and 1,600 m^3 for rural use and in subsequent second plan the AAC was kept at total of 5,035 m^3 which is bit lower than the first one. In the second plan it was mentioned that, harvest was more in field and data keeping was not strong during that time. However, the second plan has improved when it comes to implementation with strict compliance with the plan and data keeping.

In this plan the Karshong FMU will continue working with the principle of sustainability to meet the timber for commercial as well as *bona fide* rural requirements. The FMU will be managed on the basis of sustainability principles which will ultimately improve the forest stands. A total area of the FMU which sums up to 6,008.54 ha will be managed based on this principle out of which only 4,561.43 ha of forest will be subjected to harvesting operations. The broad objective of this project is to harvest the over matured and matured trees to improve the forest stands and also to make timber available in the market along with generation of revenue for the government. To enable transportation of logs from the forest, a total of approximately 15 kms of road need to be constructed during this plan period of 10 years.

17.1.2 Objectives

- To improve the forest stand of Karshong.
- To ensure sustainable supply of timber, fuel wood and non-wood forest produces.
- To regulate grazing in an organized manner and on sustainable basis.
- To support developmental activities through the construction of forest road.

17.1.3 Project Location and Area

Karshong Forest Management Unit is located in Chumey Gewog under the administrative Dzongkhag of Bumthang between longitudes 90º 42'0.87" East and 90º 47'58.79" East, and latitudes 27º 26'10.09" North and 27º 31'39.88" North. The East-West lateral highway passes right through the middle of the Forest Management Unit. Roadside settlements of Chumey and Nangar fall within the FMU. The total area of Karshong FMU is 6,008.54 ha. The entire area will not be subjected to harvesting. Only about 4,561.43 ha of area will be subjected to timber

harvesting in a scientific and sustained manner. Rest of the area is categorized under various protection and non-production management circles.

As per the Land Use and Land Cover map (LULC) classification, majority of the FMU area is covered by forest (Map 2). Over 59.34% of the land is covered by Blue Pine forest followed by approximately 33.35% by mixed conifer forest. The build-up area only forms over 0.36% of the total land cover (Figure 1).

17.1.4 Benefits

1) *Ecological benefit*: In this plan as the area has been extended, the south block will have more over matured trees which do not put on significant increment. Thus, these over matured stands can be harvested so that it creates space for regeneration to establish. This not only benefits in terms of generating revenues but also help improve the forest conditions.

2*) Monetary benefit:* The plan will benefit in revenue generation for government as well as for NRDCL from logging.

3) *Community benefit*: The FMU activities can contribute towards providing employment opportunities to the local communities. Local people can be involved as unskilled labor during maintenance of road, construction of forest road, extraction of timber and transportation. This will help uplift the livelihood of the people residing in and near by the Forest Management Unit. The existing FMU road and the proposed new roads will benefit the settlements within the FMU when it comes to local extraction as now in this plan, local use is also allocated in south Block which falls above the new proposed road.

17.2 Forest Management Unit: Planning and Zoning

All the Management Plans will have to be prepared based on Forest Management Code of Bhutan, 2004. Very comprehensive and consultative land use planning has to be carried out while preparing the Forest Management Plan. The process is briefly outlined below:

The FMU resource inventory was carried out in 2018 by Division and FRMD Inventory Crew to provide the information about tree stocking, regeneration, timber volumes, site characteristics, wildlife presence and understory species. Consultation with the community was carried out to map out local use areas, drinking water sources, places of religious importance, among others.

Forests zoning is based on above data collected, using the forest function mapping prescribed in the Forest Management Code of Bhutan. The area is divided into different forest type called Working Circle and they are further divided into Blocks and Compartments. The protection areas such as soil protection, wild life protection, rivers and streams buffer protection, etc. are excluded from the net operable area.

The silvicultural system to be implemented is Group Selection System for Mixed Conifer Working Circle. For Blue Pine Working Circle, Seed Tree System and Thinning operations will

be applied. No clear cutting will be permitted and all the trees will be harvested using the skyline cable crane. The opening of the group size can vary between 0.1ha to 0.15ha depending upon the stand composition and condition. The distance between the cable lines will be not less than 60 meters and distance between the groups will be not less than 50 meters.

17.3 Harvesting and Extraction

Fixed volume of timber expressed as Annual Allowable Cut (AAC) is prescribed in this Management Plan. The AAC prescribed is 77,00 m^3 in Standing Volume per year. This means that the maximum volume that can be harvested from Karshong FMU will not exceed 7,700 m^3 per year. Out of 77,00 m^3, 6,200 m^3 will be allotted to NRDCL for commercial harvesting and 1,500 m^3 will be allotted for rural use.

However, mitigating measures will be employed during harvesting and extraction to minimize potential negative environmental impacts. Cable cranes would be used for harvesting operation and no manual logging would be permitted in the laid cable lines. Power chain saws would be used in place of the axe to reduce waste. The harvesting prescription and silvicultural treatment have been taken care of and described in detail in the Management Plan.

17.4 Road Construction and Maintenance

For the extraction of timber from the production site, it is necessary to construct all season road to transport the logs and firewood to the timber depot. The physical assessment for the road construction in Karshong FMU was carried out by the team comprising of Planner, Engineer from NRDCL, Unit staffs both from NRDCL and Bumthang Territorial Division. During the assessment, two options were identified (Map 12). These two access road options are mentioned below:

Proposed Road Alignment 1: *Road extension from existing 21.5 kms forest road in South Block, Compartment IV (approximately 2 kms).*

Proposed Road Alignment 2: *Construction of new forest road from the newly constructed bridge at Nangar-Pharbi connecting Compartment V and VI (approximately 7 kms).*

The forest road construction in Karshong FMU is aimed at minimum negative environmental impacts. The proposed road has been aligned in such a way that none of the drinking water sources and settlement is affected. For stream crossings, culverts, side drains and hume pipe have been designed to minimize the pollution of the stream. NRDCL will be able to use the bridge constructed by Chumey Gewog Administration in order to connect to the new production area in Compartment V. It is proposed that the construction of forest road in South Block, Compartment IV will commence first and simultaneously, the construction of road towards South Block, Compartment V will began. This will help complete the proposed road within stipulated time and also contribute towards operating the area without having to wait for the completion of road construction towards Compartment V. The takeoff point of the road and the

alignment has been agreed by the general public of Nangar Village and the Local Government Leaders of Chumey Gewog during the consultation meeting.

During road construction, the NRDCL engineers will supervise and no deviation from the proposed road alignment should take place. As general rules, excavators will be deployed. Bulldozers shall not be permitted for use. Road Standards recommended by FRMD and the general principles and practices to be followed during forest road construction as identified by NEC Forestry Sectoral Guidelines will be followed. These will ensure that the road construction within the FMU will meet the recommendations and also ensure that any erosion or other negative impacts will be minimized or eliminated. Complete Road Standard is given in annex 4.

17.5 Regeneration and Post Harvesting Treatments

It is prescribed in the Management Plan that harvesting will be followed by natural regeneration. If the natural regeneration fails, artificial planting will be carried out with immediate fencing. 1,600 seedlings per hectare should be planted. Thereafter, weeding and tending operations should be carried out every year till the regeneration gets established. Regeneration is considered successful only if >80% of 1600 seedlings planted gets established. Therefore, establishment of a forest nursery of principal species by NRDCL is recommended in this Plan period. Besides, regular maintenance of the plantation will be done by NRDCL. CFO, Bumthang TD shall monitor establishment of regeneration in harvested areas at the end of first year. If the survival percentage is lower than the above prescribed number, immediate beating up will be carried out with the same local species. The established regeneration should be evenly distributed in the operated area and not concentrated in one particular place. Fencing could be removed once the regeneration gets established.

17.6 Existing Environment

17.6.1 Topography and Geology

The general terrain of KFMU ranges from moderate to steep landscape. The lower slopes are moderately gentle and the upper slopes are slightly steeper. Most of the flattened area in the valley bottom are private registered land and has been converted to agriculture land. The terrain is moderate in most of the compartments however; compartment VIII is generally steep and rocky. The elevation of KFMU ranges from 2,563 meters at the valley bottom to 3,930 meters at the ridge top. The Chumey River divides the FMU into North and South Block.

Major part of FMU falls below 25˚ slope. Slope classification was done with the help of Quantum GIS by using terrain analysis. 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.

17.6.2 Hydrology

The FMU have two main rivers flowing between two valleys; namely Chumey chuu as major and Bashibi Khoe as a secondary perennial stream. These two rivers ultimately joins the main river of Chamkhar Chuu. The Chumey chhu also used in mini-hydroelectric power established near Zhuney village inside the FMU. Beside these rivers, there are numerous perennial streams draining ultimately into the main river.

The residents of the FMU are dependent heavily upon these water sources for drinking and cultivation. These smaller streams are also the source of water for the livestock.

17.6.3 Air Quality and Noise

The quality of air within the FMU is very good as the pollution is negligible. Due to higher percentage of forest cover within the FMU, the quality of air is comparatively better. As the FMU currently does not have any quarry and other major projects, the noise pollution is almost absent.

17.6.4 Plant, Animal Species and Habitat

Multi-resource inventory was carried out by FRMD inventory crew in 2018 in the entire FMU for the preparation of the third Management Plan. Karshong FMU is dominated by Blue Pine and Mixed Conifer forest. However, few broadleaved species could be found mixed with the conifer forest. The FMU has good floral diversity, due to its altitudinal variation, aspects and different forest composition. Red Panda, Himalayan Black Bear and other small cat species have been recorded within the FMU which are enlisted in endangered and threatened category.

17.6.5 Scenic Qualities

Due to the temperate forest type in the FMU, especially Blue Pine forest, the FMU is known to have added advantage when it comes to scenic beauty. However, the area has no particular popular sites with scenic beauty.

17.6.6 Cultural Significant Sites

Within the FMU, there are two Dratsang, seven Lhakhang, one Goenpa and one significant religious. The Dratsangs are Chudipang Dratsang and Nimalung Dratsang and Lhakhangs are: Zungyne Lhakhang, Thrometh Lhakhang, Nangar Lhakhang, Yangrel Lhakhang Trakar Lhakhang, Unsang Lhakhang and Choeten Ningpo Lhakhang. The other is Dorten Goenpa and Terdho (Significant stone). A buffer of 100 meters in all the Lhakhang, Dratsang, Goenpas and religious sites has been delineated.

17.7 Assessment of Impacts and Mitigating Measures

17.7.1 Impact on Water

Pollution

The FMU has a number of perennial streams, large and smaller ones. While carrying out the planned activities in the FMU, there are higher chances of polluting the water bodies within the

FMU with garbage by workers engaged in road constructions and harvesting operations. Some harmful pollutants might include oil spills from vehicles and machineries.

Drying up of water source

Karshong FMU forms the source of water for most of the major rivers and streams in the area. Any disturbance in the area by human intervention will adversely affect the water sources, increasing the probability of the streams and water sources drying up. The new proposed roads are aligned in such a way that no water source is being affected by the construction. However, it is essential to acknowledge the impact it has on the surrounding vegetation and device appropriate mitigation measures. Proper harvesting of timber as per the prescription of the management plan needs to be prioritized in order to minimize the impact of harvesting operations on water sources.

Mitigations

A buffer of 30 meters on the either of the main river, drinking water source and other perennial streams has to be maintained. The forested area where the drinking water source is located will not be subjected to commercial harvesting. The coupe will be laid in such a way that they are located away from the streams and rivers. Proper pit latrines and garbage disposal should be in place and the camp sites are at least 100m away from the main streams.

During the road construction, NRDCL site engineer will monitor the construction activities. Moreover, the bulldozer will be replaced by excavator in order to avoid the blockage of river and streams from wind throw. At few places, forest road passes through streams and rivers sources but to mitigate the impacts, 100 meters buffer have been kept to prevent damage to the water source. Water pipes will be replaced, if damaged during road construction.

17.7.2 Impact on Forest Resources

As the timber harvesting operation is the main activity in the FMU, it is evident that there will be impact on forest resources. Although, prescribed silvicultural systems are encouraged during harvesting operations, it will result in reduction of the forest cover within the FMU. Mixed conifer will be worked under Group Selection System while the Blue Pine Working Circle will be worked under Seed Tree System. The opening of corridors and groups during the harvesting operation might open the area for grazing with less regeneration of principle timber species. This could result in exposing the site to various environmental and climatic conditions and thus affect the ecological processes in place. In certain forest type, openings can lead to increased undergrowth and hence regeneration of commercial native species will be affected.

Employment of untrained personnel during harvesting operations might lead to wastage of resources while felling trees such as increased number of splitting, breaking and other sorts of felling damages. Excessive collection of NWFPs may also lead to unsustainable harvesting of such resources in the future.

Mitigations

The management plan for the FMU is prepared for a period of ten years and before the commencement of harvesting operations. The harvesting will not exceed the prescribed AAC, nor will the size of the opening be larger than that prescribed in the management plan. If the natural regeneration fails to establish then the area will be planted with local principle timber species. However, natural regeneration is preferred over artificial regeneration considering its ecological as well as economic importance. The introduction of exotic species will not be allowed. For proper planning, implementation and monitoring of activities in the Forest Management Unit, a full time dedicated staff for the FMU will be required from both DoFPS and NRDCL. Only trained power chain saw operators will be allowed to carry out the felling and harvesting operations to reduce the felling damage within the FMU.

17.7.3 Impacts on the Faunal Diversity

Habitat fragmentation and disturbance to wildlife is one of the major threats as a result of operation in the FMU. Activities such as road construction and timber extraction will cause disturbance in the wildlife habitat and thereby increasing the chances of reduction in wildlife population. Construction of roads will also affect the movement of animals from one niche to another. Harvesting operations will adversely impact the prey base and may create imbalance in the food chain.

Mitigations

Certain areas within the FMU have been designated as wildlife protection areas while the remaining areas are designated as nature conservation areas. No harvesting operations will be allowed in area designated as wildlife protection function. As all forest areas are not subjected to harvesting operations, enough areas have been kept for free movement of wild animals. Sufficient number of snag trees and fruit bearing trees will be retained to provide enough food for survival and reproduction of wild animals. Moreover, as certain portion of biological corridors also falls within the Forest Management Unit, these areas are excluded from commercial harvesting to enable movement of wildlife from one protected area to another.

In the interest of wildlife, clear felling of large stretch of forest will be avoided so that sufficient forest is retained for forage, shelter and cover. In operated areas, if natural regeneration fails to establish, artificial regeneration by native trees will be undertaken and subsequently fenced to avoid grazing by domestic as well as wild animals. Regular monitoring and patrolling of the forest area will be carried out in order to minimize poaching and other illegal activities within the FMU.

17.7.4 Impacts on Ecology (Flora)

One of the possible impacts of harvesting operations within the FMU is the change in present forest composition. There are higher possibilities of the harvested areas being invaded by non-native species of plants if proper monitoring of the area from time to time is not undertaken.

Moreover, colonization of mixed conifer areas and natural grassland by Blue Pine is one of the perceived threats.

Mitigations

In order to retain the original forest composition in the harvested areas, the operation should follow the prescriptions strictly. Opening along the cable lines should be maintained as per the prescribed silvicultural systems so that it creates conducive environment for desired species to regenerate. Larger openings will be avoided in the mixed conifer stand in order to avoid its colonization by blue pine species. To ensure adequate regeneration of desired species, mother trees will be retained in sufficient numbers as a source of seed. Forest roads have been aligned in such a way that it does not pass through sensitive and critical areas. Proper monitoring should be ensured while constructing new forest roads to ascertain minimal damage to nearby vegetation.

17.8 Monitoring and Evaluation

The Management Plan, which is for the period of ten years, will be prepared by Territorial Divisional Office of Bumthang. It will be approved by the Minister, Ministry of Agriculture and Forests. The Plan will be implemented by CFO, Bumthang Forest Division, who will be engaging NRDCL for harvesting timber. Annual Operational Plans will be prepared by Bumthang Forest Division in consultation with the stakeholders, based on the Management Plan. The Operational Plan will be approved by the Head of the Department. Annual monitoring will be carried out by Bumthang Forest Division (CFO and Unit In-charge). A report will be submitted to FRMD, DoFPS, Ministry of Agriculture and Forests, Thimphu, based on the annual monitoring forms. FRMD will also monitor the implementation of the activities. Mid-term evaluation will be done during the last quarter of the fifth year of the Plan period and final evaluation during the last quarter of the ninth year of the Plan period.

Table 25: Checklist of Environmental Parameters for Forestry Projects

	Adverse Environmental Impact	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					
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. Rehabitation	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				
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	*			
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 based for decision making		*			
4. Road network design					
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					
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	*			
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	*			
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) siltation	b) increased runoff	*			
c) hydrology	c) impede navigation	*			
d) water quality	d) less than optimum economic benefits		*		
4. Logging in riparian zones	4. Degradation of waterways/fisheries	**N.A**			
5. Socio-economic		*			
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			*	
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					
a) wildlife		*			
b) fisheries		*			
c) plants		*			
d) soil and water		*			
4. Allocation of benefits to locals		*			
a) employment opportunities		*			
b) training		*			
c) non-wood products		*			
5. Operation and maintenance	5. Diminished project efficiency and objectives if lack of funds			*	
6. Data base for decision making		*			
7. Project financing and reservoirs		*			

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. Considerations Regarding Project Operations					
1. Commercial logging	1. Same as in Commercial Logging A and B	*			
2. Reduced water supplies	2. Socioeconomic losses	*			
3. Chemical and fertilizers	3. Impaired fisheries and aquatic systems	*			
4. First-year operations	4. Increased erosion due to soil disturbance		*		
5. Soil conservation benefits					
a) erosion			*		
b) sedimentation		*			
c) soil capacity		*			
d) soil surface moisture		*			
e) soil nutrients		*			
6. Socio-economic benefits		*			
a) employment opportunities		*			
b) fuel-wood		*			
c) enhanced fisheries		*			
d) enhanced recreational/tourism		*			
7. Water resources benefits		*			
a) minimized overland flows		*			
b) reduced flood peaks		*			
c) water quality		*			

18. FINANCIAL AND ECONOMIC APPRAISAL

Table 26: Assumption used for financial Forecast

Assumptions	Figures
m^3 to cft	35.31
Recovery Volume (%)	60% (Conifers) and 40% (Broadleaf)
Road Construction (Nu/Km)	2,260,000
Length of proposed new road	15
Road maintenance (Nu/km/yr)	12,000
Distance to Depot (km)	21
Cable craning (Nu/cft)	14.2
Rural allotment (m^3)	2,000
Regeneration maintenance (for cable line) (Nu/ha)	3,500
Artificial Plantation (ha)	10
Plantation cost (as per plantation norms and standard, SFED)	50,000

Table 27: Financial Forecast

Financial Forecast- Karshong Forest Management Unit

	AAC (m^3)	Rec. Volume (m^3)	Nu/cft	Nu/m^3	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	10 Years
					Nu	Nu	Nu	Nu	Nu	Nu	Nu	Nu	Nu	Nu	Total (Nu)
Revenue: NRDCL															
Timber- Commercial	4,500	2,700	159.67	5,637.95	25,370,764.65	25,370,764.65	25,370,764.65	25,370,764.65	25,370,764.65	25,370,764.65	25,370,764.65	25,370,764.65	25,370,764.65	25,370,764.65	253,707,646.50
Timber- Rural	1,500														
Total Revenue NRDCL					**25,370,764.65**	**25,370,764.65**	**25,370,764.65**	**25,370,764.65**	**25,370,764.65**	**25,370,764.65**	**25,370,764.65**	**25,370,764.65**	**25,370,764.65**	**25,370,764.65**	**253,707,646.50**
Costs: NRDCL															
Road Construction		2,237,777			4,475,554.00		4,475,554.00		4,475,554.00		4,475,554.00		2,237,777.00		20,139,993.00
Road Maintenance			14,000		301,000.00	329,000.00		28,000.00	28,000.00	56,000.00	56,000.00	84,000.00	644,000.00	98,000.00	1,624,000.00
Marking Cost			0.8	28.25	127,116.00	127,116.00	127,116.00	127,116.00	127,116.00	127,116.00	127,116.00	127,116.00	127,116.00	127,116.00	1,271,160.00
Inventory Costs					30,000.00	30,000.00	30,000.00	30,000.00	30,000.00	30,000.00	30,000.00	30,000.00	30,000.00	30,000.00	300,000.00
Felling and Cross-cutting			3.5	123.585	556,132.50	556,132.50	556,132.50	556,132.50	556,132.50	556,132.50	556,132.50	556,132.50	556,132.50	556,132.50	5,561,325.00
Debarking			0.8	28.248	76,269.60	76,269.60	76,269.60	76,269.60	76,269.60	76,269.60	76,269.60	76,269.60	76,269.60	76,269.60	762,696.00
Cable Craning			19	670.89	3,019,005.00	3,019,005.00	3,019,005.00	3,019,005.00	3,019,005.00	3,019,005.00	3,019,005.00	3,019,005.00	3,019,005.00	3,019,005.00	30,190,050.00
Transportation to Depot					4,766,850.00	4,766,850.00	222,453.00	444,906.00	667,359.00	889,812.00	1,112,265.00	1,334,718.00	1,557,171.00	1,557,171.00	17,319,555.00
Stand Tending (Spacing etc.)															-
Coupe Regeneration															-
Regeneration Maintenance		3,500/ cable line				24,500.00	49,000.00	73,500.00	73,500.00	73,500.00	73,500.00	73,500.00	73,500.00	73,500.00	588,000.00
Creation of Plantation		50,000/ha				50,000.00	50,000.00	50,000.00	50,000.00	50,000.00	50,000.00	50,000.00	50,000.00	50,000.00	450,000.00
Plantation Maintenance		8,000/ha					8,000.00	16,000.00	24,000.00	32,000.00	40,000.00	40,000.00	40,000.00	40,000.00	240,000.00
Total Costs NRDCL					**13,351,927.10**	**8,978,873.10**	**8,613,530.10**	**4,420,929.10**	**9,126,936.10**	**4,909,835.10**	**9,615,842.10**	**5,390,741.10**	**8,410,971.10**	**5,627,194.10**	**78,446,779.00**
Total Revenue less Total Costs NRDCL					**12,018,837.55**	**16,391,891.55**	**16,757,234.55**	**20,949,835.55**	**16,243,828.55**	**20,460,929.55**	**15,754,922.55**	**19,980,023.55**	**16,959,793.55**	**19,743,570.55**	**175,260,867.50**
Royalty															
Royalty- Commercial			18	635.58	1,734,066.00	1,734,066.00	1,734,066.00	1,734,066.00	1,734,066.00	1,734,066.00	1,734,066.00	1,734,066.00	1,734,066.00	1,734,066.00	17,340,660.00
Royalty- Rural															
Total Royalty NRDCL					**1,734,066.00**	**1,734,066.00**	**1,734,066.00**	**1,734,066.00**	**1,734,066.00**	**1,734,066.00**	**1,734,066.00**	**1,734,066.00**	**1,734,066.00**	**1,734,066.00**	**17,340,660.00**
Revenue less Royalties NRDCL															
Timber- Commercial					23,636,698.65	23,636,698.65	23,636,698.65	23,636,698.65	23,636,698.65	23,636,698.65	23,636,698.65	23,636,698.65	23,636,698.65	23,636,698.65	236,366,986.50
Timber-Rural															
Total Revenue less Royalty NRDCL					**23,636,698.65**	**23,636,698.65**	**23,636,698.65**	**23,636,698.65**	**23,636,698.65**	**23,636,698.65**	**23,636,698.65**	**23,636,698.65**	**23,636,698.65**	**23,636,698.65**	**236,366,986.50**
Total Revenue less Royalty Less Costs NRDCL					**10,284,771.55**	**14,657,825.55**	**15,023,168.55**	**19,215,769.55**	**14,509,762.55**	**18,726,863.55**	**14,020,856.55**	**18,245,957.55**	**15,225,727.55**	**18,009,504.55**	**157,920,207.50**

Table 28: Financial Forecast Summary (For this plan period)

Particulars	Amount (Nu.)
Total Revenue NRDCL	253,707.646.50
Total Cost NRDCL	78,446,779.00
Total Royalty NRDCL	17,340,660.00
Total Revenue less Royalty less Costs NRDCL	157,920,207.50

19. RESEARCH

Research programs will be in collaboration with UWICER. The Division and Unit staffs can also collaborate as appropriate. The prioritized areas for research are mentioned below:

- Determination of Annual Allowable harvest of NWFPs in the FMU.
- Colonization studies of Blue Pine Species.
- Light requirement for regeneration in Mixed Broadleaf forest.
- Impact of commercial harvesting on wildlife population.
- Timber recovery rate for particular FMU.
- Forest composition change overtime due to commercial harvesting.
- Human wildlife conflict.

PART 3: IMPLEMENTATION OF THE PLAN

20. IMPLEMENTING AGENCY

The Department of Forests and Park Services is vested with the responsibility of protection and management of forest resources in Bhutan. In the field, the territorial division is mandated by the Department to discharge the responsibility of implementing and monitoring all the activities mentioned in the plan. The Chief Forestry Officer of Bumthang Division will be responsible for implementation of this Management Plan. The Chief Forestry Officer, Bumthang will be assisted by the Unit In-charge and other staffs of the Forest Management Unit.

20.1 Cutting Cycle

For sustainability of the forest resources in the FMU, the cable line spacing must be properly laid to enable subsequent passes in the future. A minimum of 60 meters needs to be kept in between the cable lines so that two passes can be enabled in the future. Mixed Conifer Working Circle has a rotation period of 160 years, which means that the two cable lines that will be implemented in the future are occurring at year 53 and year 106. The original line will therefore, be harvested in year 160 (Figure 9). This gives sufficient time to the adjacent area to regenerate and also prevents the area from large opening.

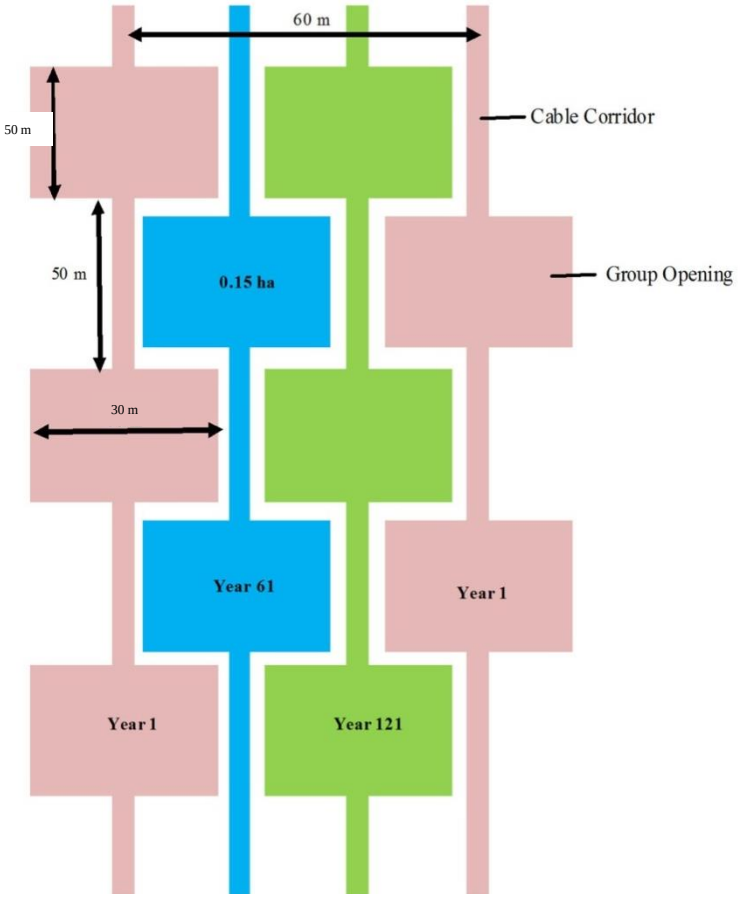


Figure 6: Layouts for Group Selection System

The rough terrains of Bhutan possess challenge while laying cable lines in the field. Therefore, the layout in the field must be aligned to suit the terrain and to the best possible, guidelines must be followed. The Blue Pine Working Circle will be worked under Seed Tree System which requires 90 meters spacing between initial cable lines. Thus, the two interlines in the future will be harvested at year 36 and 72, with original line being harvested at year 110.

For the young stands of Blue Pine, thinning shall be carried out as per the prescription. The thinning will be done by positive selection with due consideration to stabilize the structure of the stand. The thinning will ensure the growth potential of the stand and site to the most promising individual of the tree population to maximize the volume and quality production.

20.2 Annual Coupe

For the selection of annual coupe, accessibility, slope, stand condition and other environmental conditions should be considered. The annual coupe will follow the required spacing designed as per the prescribed silvicultural system of each working circle.

Coupes must comply with the following conditions:

- The Unit In-charge, in consultation with the NRDCL counterpart, will determine the location and extend of the cable lines in the compartment to be harvested annually. All prescription and restriction laid down in the plan must be considered and adhered to completely.
- The cable lines must be laid to the full length if the area is operable in order to avoid unnecessary loss of production area. This practice will also help cut down the expenditure for road construction.
- The Unit In-charge will arrange to mark the trees as per the approved annual Operational Plan.
- Cable line layout will be based on safety, stand composition, environment and cost consideration. This will be done in consultation with the Unit In-charge.
- The cable lines may traverse slopes greater than 100% but extraction is not allowed.

20.3 Tree Marking Guidelines

- Groups of matured and over-matured trees are selected systematically according to the group size given in the plan.
- Trees within stream buffer stripes and on slopes greater than 100% must not be marked.
- The direction of the tree lean and topography has to be taken into account to prevent large tree being felled on nearby advanced growth.
- Some dead, dying, malformed or damaged (snags, scars. conk, etc.) and fruiting trees will be retained in between groups, and in the interline spaces, to safeguard the niches or habitats for the flora and fauna, but not in the harvested group themselves, where there is 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.
- All species listed for protection under the Forest and Nature Conservation Act (1995) must be protected if encountered.
- The trees selected will be marked with the authorized 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 volume at the NRDCL Depot will be recorded.

20.4 Harvesting

To reduce the negative impact to the forest and environment due to extraction, the hauling method for transporting logs from the coupe to road will be done by skyline crane system. 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. Cutting trees 10 cm above the ground level will be strictly followed to avoid the wastage. To maintain the

sanitation and hygienic condition of the forest, the cut over debris must be disposed off and if possible burn in a proper place avoiding forest fire. The skyline cable system has the following advantages:

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

Harvesting in the Working Circle is to be carried out in accordance with the following prescriptions:

- 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 landing site should be identified and incorporated into the forest road design.
- Care should be taken to avoid 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.
- The cable corridor shall not exceed the prescribed width stated in the Silvicultural System for each working circle.
- Trees will be felled, de-limbed, crosscut, extracted on the cable, loaded and hauled to the log depot. Only chain saws and hand saws 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 minimized at all times.
- The use of axes is discouraged except in fuel wood splitting.
- All infected Blue pine and Spruce, if any, will be debarked as soon as they are felled to avoid the spread of bark beetles.
- 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 log/timber entered in the Log yard Register will be submitted to concern 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.
- 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 concern CFO.

- 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.
- 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 be used as fuel wood are extracted with the cable line and fuel wood conversion occurs at the designated log landing areas.

20.5 Reforestation of Harvested Sites

Natural regeneration is the preferred method of reforestation in the harvested areas of the FMU. Natural regeneration is the ecologically and economically viable method to ensure sustainable development of forest resources. Therefore, it is crucial that natural regeneration is given preference over artificial regeneration. It is essential that the harvested areas are effectively regenerated as soon as the harvesting operations are complete. However, if the natural regeneration fails to get established in the harvested sites, restocking by means of artificial regeneration through plantation shall be carried out by NRDCL. It might be evident in some FMUs that the natural regeneration is either very poor or prove to be a complete failure because of site conditions, over grazing, prolonged disturbance due to protracted harvesting operations and overgrowth of weeds and other invasive plant species. These problems must be considered, analyzed and eliminated to successfully regenerate the operated areas.

It is prescribed that periodic tending activities such as weeding, brushing and fencing are carried out to increase the chances of natural regeneration establishment in the FMU. Such interventions will help cut down the plantation cost and ensure higher survival percentage of the forest crops. In case of natural regeneration failure, NRDCL should have a reserve of seedlings of locally viable species which can be done through establishment of forest nurseries. Care should be taken to plant commercially viable local species in the FMU to ensure sustainable harvest in the future. In areas where plantations are carried out, regular maintenance should be done for higher survival percentage. The maintenance of plantation should be carried out as per the Norms for Plantation and Nursery, 2016 and the concern CFO must monitor and evaluate the plantations on annual basis.

The past harvested cable lines should be monitored periodically and regeneration surveys should be conducted every three years until the regeneration has reached the height that will ensure its survival. If the second survey (6^{th} year) indicates poor stocking, remedial actions must be taken in the following plantation season. The Unit In-charge will ensure that stocking of natural regeneration is first monitored within three years following completion of the harvested operation. Enrichment plantation, if necessary, should be carried out by NRDCL. The NRDCL in consultation with the Unit In-charge should keep adequate budget provisions in the Operational Plan to carry out plantation creation and maintenance works.

20.6 Sequence of Operations Relating to the Annual Coupe

The sequence of operation relating to the annual coupe is given in the following table:

Table 29: Sequence of Operations Relating to the Annual Coupe

Operation Description	Timing (months) (- before felling; + after felling)
Unit In-charge describes regarding the location and size of annual coupe in accordance with the Biennial Operation Plan	-12
NRDCL and FMU In-charge prepares an estimate of human, material, equipment and financial resources required.	-10
Unit In-charge finalizes 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, 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 operation according to the approved sequence in the Biennial Operation Plan	0
NRDCL/Contractor completes harvesting and extraction	When completed
The Unit In-charge will inspect the coupe when harvesting is completed and will issue a Coupe Clearance Certificate only if all aspects of the operation are satisfactory.	When works completed
DoFPS assess success of natural regeneration	As per Guidelines
NRDCL completes post harvesting operation	As per the instruction by Unit In-charge

20.7 Road Construction

Despite the negative impact of forest road on forest and environment, still forms an essential part of managed forest estate, both for timber extraction and to provide for forest management and monitoring. Road construction in the FMU requires extra precautions to achieve environmental best practice. The necessity during the 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 efficient draining compacted road surface.

A total length of 17.5 kms of forest road was constructed during the first plan period. The road passes through South Block, Compartment I, II and III. During the second plan period, a total additional road length of 4 kms was constructed which passes through South Block, Compartment III and IV (Table 11). In total till date 21.5 kms of road was constructed. The construction of forest road has facilitated in extraction and transportation of commercial timber

as well as rural timber. Compared to other FMUs, the forest road condition is relatively better. This has facilitated the smooth transportation of logs from the cable lines to Depot.

Through detailed field survey and consultation with the concerned stakeholders, it was decided that a total of 9 kms of forest road will be constructed during this plan period from 2020-2029. Around 2 kms of new road will be constructed in the South Block, Compartment IV in continuation to the existing 21.5 kms road. As the operation area will be covered with this length of road in South Block Compartment IV, the remaining 7 kms of road will be constructed in the South Block, Compartment IV, V and VI. The existing road should also be maintained on annual basis by NRDCL in order to facilitate safe transportation of logs to depot.

Road Standard

A set of road standards has been developed by 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 Karshong FMU and NRDCL road engineers must follow these standards, given in annexure 2, during designing and estimating, and provide supervision during construction to ensure that the standards are met. Road design in Karshong FMU should follow the recommended road profile given in Figure 10 to avoid excessive water pooling leading to rutted road surfaces that inhibit access during monsoon season. Improper drainage may lead to landslide.

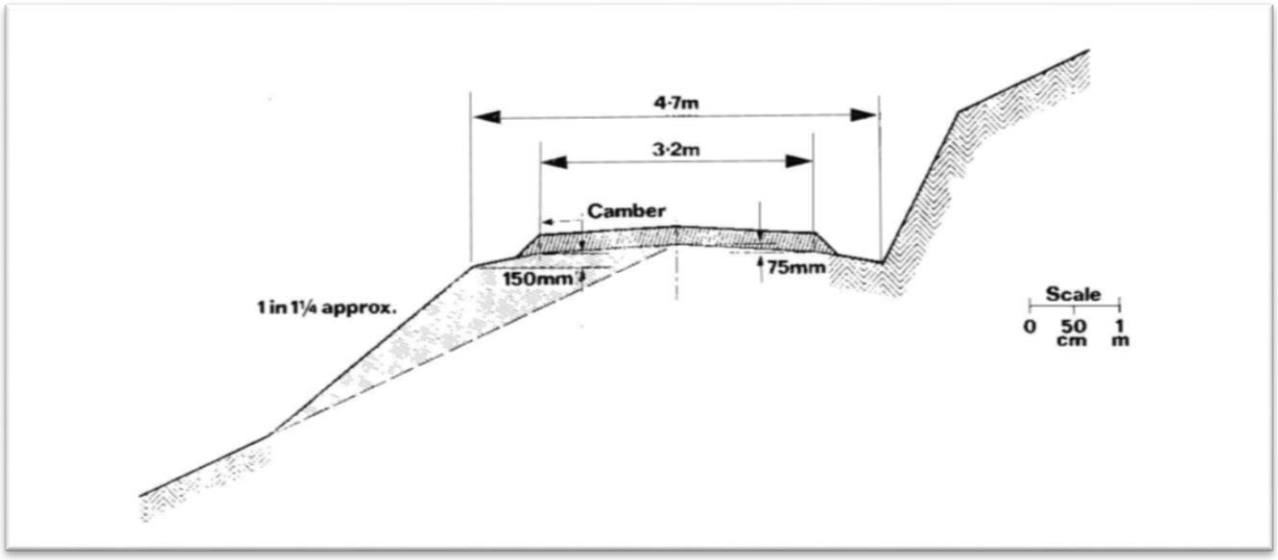
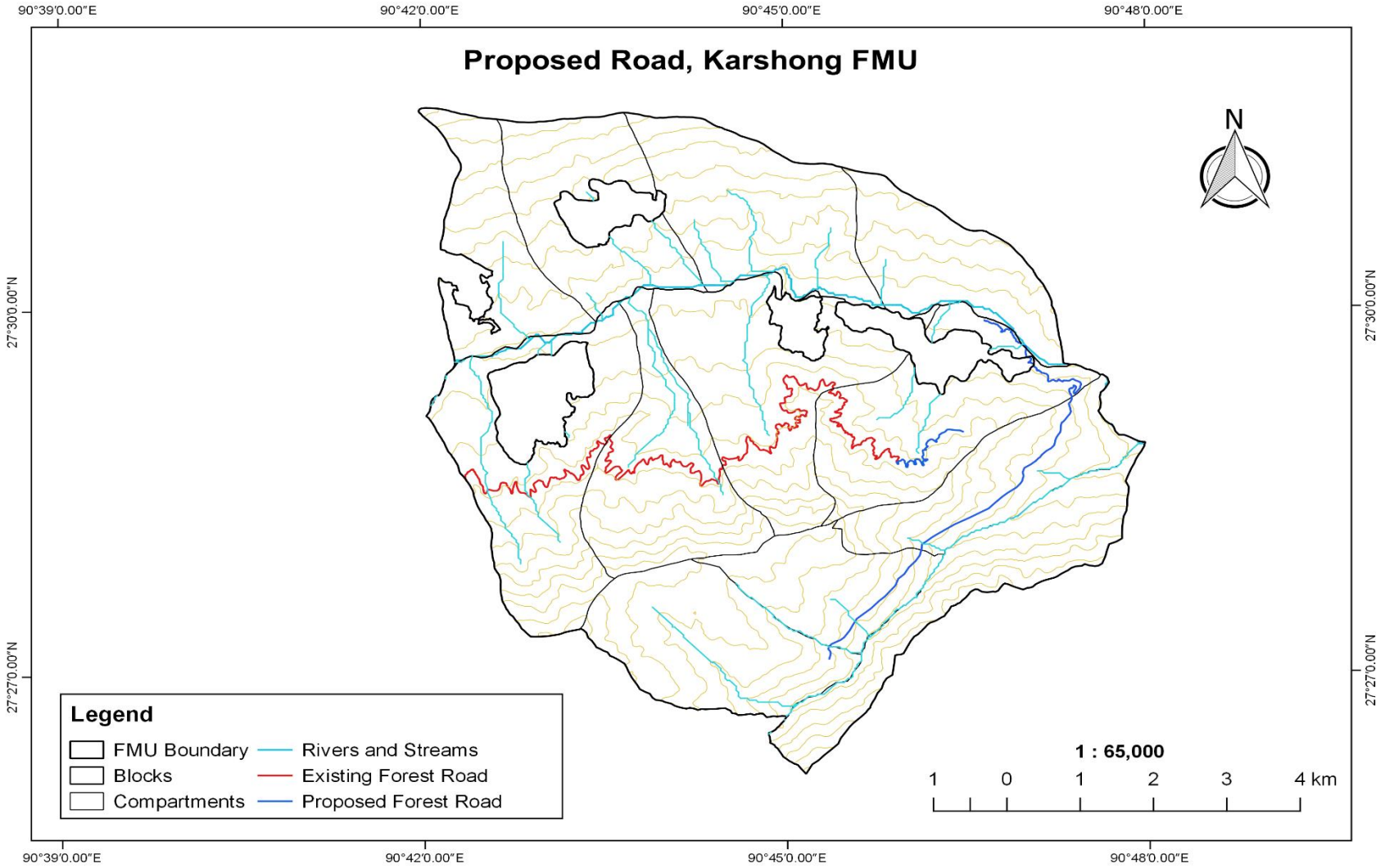


Figure 7: Recommended Road Profile

Map 12: Proposed FMU Road



21. PLANNING

21.1 Operational Plan

For facilitating the timely implementation of the Management Plan, a Biennial Operational Plan will be prepared by the CFO, Bumthang and the Unit In-charge. Guidelines for the preparation of the Operational Plan have been prepared by FRMD (2002) and a copy of each is available to all Territorial Division. The guidelines have been updated and will continue to be so. The Operational Plan is also the tool used to provide for changes that cannot be foreseen or allowed for in the FMU Plan, such as insect and disease outbreaks, severe fire, etc. If and when these occur, the current Operational Plan should be immediately reviewed and the areas and/ or methods of operation modified to deal most effectively with possible changes in the sustainable level of harvest.

The Operational Plan will be prepared in consultation with all the agencies and parties who will be using the forest. Inclusion of a consultation process with local communities in the 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 is meant to be a rolling one, i.e, Operational Plan is prepared annually but the plan period is for two year. Therefore, activities for the second year of the plan are carried forward into the first year of the next plan (Table 33). This has important implication on budgeting (since will then be possible to estimate well in advance of the start of the financial planning year) and for participatory process since these can be carried out a year before the start of activity. The primary aim in preparing the Operational Plan is to determine and co-ordinate the timely input of resources.

Table 30: Concept of Rolling Plan

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

The process for preparing and implementing the Operational Plan is given in the Table 34.

Table 31: Preparation and Implementation of Operational Plan

Activity (Planning Step)	Objective	Output	Responsibility (Lead)	Comments
1. Approved FMP				
2. PRAs with local Stakeholders	To prepare participatory plan for fire management, grazing control and rural timber	Participatory plan for fire management, grazing management and rural timber harvesting (to be incorporated within the OP)	DoFPS/FMU In-charge	First step is to enter into discuss with stakeholders and their representatives
	To involve relevant stakeholders in planning for activities which have a direct impact in their "interest"			Use PRA technique to prepare the plan
				Plan cost are included in the OP
3. Operational inventory	To access the resource availability for the planned harvesting area	Site-level inventory data for the operational area to be harvested	FMU In-charge/ NRDCL	For the areas proposed for harvesting during the next two years
	Calculation of the harvestable volume	Precise estimate of volume to be removed during the coming year		May be combine with harvesting plan and cable line survey
4. Harvesting plan and cable line survey	To plan for harvesting and extraction activities	Agreed extraction and road plan	NRDCL	Within the selected identified harvestable area for the year
5. Preparation of Operational Plan	To prepare a plan for implementation during the next two years (involving stakeholders for some activities)	Approved operational plan with budget	FMU In-charge with stakeholders as required	Activities linked with objectives identified in the FMP and following options and guidelines in the FMP
	To formalize local institutional responsibility for planned activities (e.g. grazing, fire management, rural timber distribution)	Identified responsibilities for each planned activities Calculate cost for each planned activities		Each activity with identified responsibility for implementation, estimated cost, and site-specific location
6. FMU annual report presented to the FMU-level	To review process and identify and address any	FMU Annual report endorsed by FMU-level	FMU Manager presents to the FMU-level	During FMU-level Management Committee

Management Committee	implementation problems	Management Committee	Management Committee	meeting
	To identify any future actions necessary based on issues arising			Implementation problems need to be addressed before endorsing the new OP
7. OP review by FMU-level Management Committee and endorsed	For the FMU-level Management Committee to endorse the OP (prior to approval by DoFPS)	OP endorsed by FMU-level Management Committee	FMU Manager presents to the FMU Level Management Committee	During FMU Level Management Committee meeting
	To endorse expenditure estimates for the coming financial year			
8. NRDCL financial commitment within OP agreed	To ensure that NRDCL is committed to funding the agreed activities in the OP	Budget estimates for the OP endorsed by NRDCL and FMU-level Management Committee	FMU-level 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 OP for implementation	Approved plan and budget	Approved by FRMD and Director, DoFPS	OP approved linked with sanctioned budget for all planned activities
10. OP implementation by NRDCL	To carry out planned activities	Harvested timber; protected area; roads; fuel wood, etc.	According to responsibilities identified in the OP e.g. FMU In-charge, NRDCL, etc.	Each activity with specific responsibility and budget
11. Monitoring of activities	To access the level of achievement for planned activities	Information for FMU annual report	FMU In-charge	DoFPS responsibility is to monitor the implementation of activities carried out by NRDCL
				Monitoring cost need to appear in the OP
12. DoFPS, Unit In-charge prepares FMU annual report	To report progress against planned activities	FMU annual report	FMU In-charge	Prepared annually

	To highlight any problems being encountered in implementation			Progress is reported against each FMP objective and the associated activities
13. Prepare the next years' OP (step 2-5)	To prepare the next OP taking into account progress over the past year	Operational Plan	FMU In-charge	OP may alter in response to FMU management committee suggestions and recommendations

21.2 Mid-term Evaluation of FMP

Based on the information collected by the annual monitoring and from other sources, the Chief Forestry Officer, FRMD, will ensure that the plan is evaluated at the interval of five years after the implementation. The results of mid-term review should be discussed with the FMU-level Management Committee.

21.3 FMU-level Management Committee

The FMU-level Management Committee will be established to ensure smooth implementation of the management plan. The committee will be chaired by CFO, Bumthang.

The committee shall consist of the following members:

- Chief Forestry Officer, Bumthang (Chairman)
- Regional Manager, Jakar Region, NRDCL
- Unit In-charge, Karshong FMU
- Production In-Charge, NRDCL, Karshong FMU
- Gup/Mangmi, Chumey Gewog
- Tshogpa, Phurgoen, Nangar, Zungnyer and Bithang Chiwog
- FRMD Representative (if possible)

The Terms of Reference for the FMU-level Management Committee are:

During FMU Management Plan Preparation:

- To support the interest 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 priority and specific local condition 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 ensuring that their interest 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.

During the Operational Planning, Implementation and Monitoring:

- To represent the interests of identified stakeholders group during planning and review of activities under Operational Plans.
- To review achievements during the past year (based on annual report submitted by the FMU Unit In-charge) and advice and act on any issue identified.
- To make recommendation for changes in the proposed Operational Plan for the coming year based on previous years' experience and on the need to achieve the 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 forest management plan.
- To hold any additional meeting as required in response to specific issue arising from Forest Management Plan and Operational Plan.

21.4 Staff

The Chief Forestry Officer, Bumthang is the overall controlling Officer of the area. The controlling and management of Karshong FMU will be looked after by the FMU In-charge. They will be under the administrative control of the Chief Forestry Officer, Bumthang Division. The Chief Forestry 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 within his jurisdiction.

21.4.1 Responsibility

For the smooth monitoring and implementation of the plan in the FMU, following staff will be required (Table 35). It is also being recommended by the Organizational Development Exercise by Royal Civil Service Commission.

Table 32: Staff requirement in the FMU

Sl. No.	Designation	Numbers
1	Unit In-charge (Sr. Range Officer/ Forestry Officer)	1
2	Forest Ranger II/ Sr. Forester/ Forester	4

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

Forest Ranger II will be responsible for carrying out operational inventory, help to prepare the operational plan, supervise road construction and maintenance and keep the track of regeneration of the harvested areas. Forest Ranger II will also be responsible for supervising the tree marking and felling, timber extraction, transport of logs to depot and reporting the coupe clearance. He

will be responsible for marking of thinning, fire prevention and monitoring pest/diseases outbreak. The Forester will be assigned to help the Unit In-charge and the Forest Ranger.

21.5 Buildings

Karshong Forest Management Unit has been operational since 1994, i.e. for more than 20 years. Although the operation started many years ago, the unit does not have a building specifically for the FMU for carrying out daily activities. Currently, the Unit office is a temporary shade (log house) which was build during Integrated Forest Development Project (IFDP) in Domkhar and it is not in good shape. Besides FMU office, the temporary shade is also used as forest check post. A proper FMU office is also essential for a proper function of the FMU and also for effective coordination with NRDCL. If the funds are available, it would be appropriate to construct a new office building along with staff quarter to accommodate the unit staffs.

21.6 Vehicles and Equipment

The FMU is currently equipped with the following equipment and instruments:

- Computer (Desktop) set- 3
- Printer- 3
- Xerox Machine- 1
- Laptop- 1
- Clinometer- 2
- Diameter tape- 2
- Measuring tape- 3
- Compass- 2
- GPS Garmin- 2
- Walkie Talkie Sets- 2

In order to ensure proper implementation of this plan, the Unit must be equipped with additional equipment as mentioned below:

- Two wheeler- 1 number
- Additional Garmin GPS- 1 numbers
- Laptop- 1 number
- Hypsometer- 2 numbers
- Crown densitometer- 2 numbers
- Bark gauge- 2 numbers

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 (such as commercial timber production) 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, the second checks that the objectives of the plan are being achieved over the longer term. Monitoring (checking on inputs on year to year basis) is the term used for 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 sub-divided into Evaluation form A and Evaluation form B.

22.1 Monitoring

Monitoring is the continuous/periodic review undertaken by management at every level of implementation of an activity to ensure that input deliveries, work schedules, targeted output and other required actions are proceeding according to the plan. The CFO, Bumthang will ensure that monitoring is carried out on an annual basis according to the guidelines issued by FRMD.

22.2 Evaluation

Evaluation is the examination of whether objectives are being achieved. In the context to 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 the intervals of five year, based on the information collected by annual monitoring.

The Head, FRMD will ensure that evaluation is carried out at five-year intervals, based on the information collected by annual monitoring and other necessary information. Copies of necessary forms can be collected from FRMD. Corrective actions, if 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 the field implementation activities. The evaluation team will be appointed by the Director, DoFPS.

23. CONSTRAINTS AND RISKS

Constraint of forest conservation and management planning are:

- Lack of locomotives for field staffs, leading to an inability of the staff to supervise any management activities in the FMU.
- No regular training for field staffs on preparation of operational plans and other related surveys.
- Inadequately trained Unit staffs to carry out cable line profiling.
- Insufficient technical staff in the FMU.
- Increased illegal activities within the FMU.
- Financial feasibility for commercial extraction by NRDCL.
- Lack of research.

24. DEVIATION FROM PLAN PRESCRIPTIONS

The annual harvested area should be managed to allow for unforeseen situation. For these and other *bona fide* reasons, the annual coupe may vary +/- 10%. However, the total volume harvested over successive five-year period must be no more than five times the ACC volume.

Unforeseen circumstances may warrant deviation from the Plan prescription. In such an event, the CFO, Bumthang must obtain prior written approval from the Director, 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. The NEC Secretariat must be informed of the plan deviations approved by the Head of the Department if any. (Tshering , 2018)

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ANNEXURES

ANNEXURE 1: COMPARTMENT DESCRIPTION AND PRESCRIPTIONS

Block: South, Compartment I

Altitude: 2,757 m – 3,925 m
Aspect: North and North-East
Terrain: Moderate to steep
Total Area: 671.17 ha
Protection: 148.35 ha
Non-production: 20.59 ha
Production: 502.23 ha

Past Management

The Compartment I of the South Block was commercial harvested during the first management plan period. Cable lines were laid for extraction of timber.

Forest Description

The higher ridges of the compartment have mixed conifer forest dominated by Hemlock species. The lower half of the compartment has predominantly Blue Pine. The compartment also has few private registered lands which are used for agricultural purposes and settlement.

Prescription for Future Management

As commercial harvesting was also carried out in this compartment, it is prescribed that thinning operations should be carried out in areas where blue pine regeneration is dense. Moreover, the past operated lines should be monitored periodically to ensure that adequate regeneration occurs in the harvested lines. Grazing should be minimized in this compartment to ensure proper establishment of regenerations in the operated sites.

Block: South, Compartment II

Altitude: 2,767 m – 3,753 m
Aspect: North
Terrain: Moderate
Total Area: 530.45 ha
Protection: 124.27 ha
Non-production: 5.03 ha
Production: 401.15 ha

Past Management

The Compartment II of the South Block was commercial harvested during the first management plan period. Cable lines were laid for extraction of timber.

Forest Description

The major forest type in this compartment is Mixed Conifer dominated by Hemlock species. The Blue Pine forest is mostly confined to the lower valleys. The compartment has very good regeneration of Hemlock species, especially on either side of the forest road and past operated cable lines.

Prescription for Future Management

The commercial harvesting was carried out in this compartment during the first management plan period. Moreover, the past operated lines should be monitored periodically to ensure that adequate regeneration occurs in the harvested lines. Grazing should be minimized in this compartment to ensure proper establishment of regenerations in the operated sites.

Block: South, Compartment III

Altitude: 2,700 m – 3,678 m
Aspect: North
Terrain: Moderate to Steep
Total Area: 661.94 ha
Protection: 100.17 ha
Non-production: 59.56 ha
Production: 502.21 ha

Past Management

The Compartment III of the South Block was commercial harvested during the first and second management plan period. Cable lines were laid for extraction of timber.

Forest Description

The major forest type in this compartment is Mixed Conifer dominated by Hemlock species. The Blue Pine forest is mostly confined to the lower valleys. The compartment has very good regeneration of Hemlock species, especially on either side of the forest road and past operated cable lines.

Prescription for Future Management

The commercial harvesting was carried out in this compartment during the first and second management plan period. Moreover, the past operated lines should be monitored periodically to ensure that adequate regeneration occurs in the harvested lines. Grazing should be minimized in this compartment to ensure proper establishment of regenerations in the operated sites.

Block: South, Compartment IV

Altitude: 2,625 m – 3,620 m
Aspect: North and North-East
Terrain: Moderate to Steep

Total Area: 546.94 ha
Protection: 49.53 ha
Non-production: 13.42 ha
Production: 483.99 ha

Past Management

The compartment was commercially harvested during the second management plan period. Cable lines were installed for extraction of timber by NRDCL.

Forest Description

Major part of the compartment has Blue Pine forest type with small pocket of mixed conifer forest occupying the upper ridges of the compartment. The compartment has matured trees which can be commercially harvested. The associated species that can be found in the compartment are *Betula* sp., *Acer* sp. and *Taxus buccata*. *Borinda* species could be found in the compartment as the undergrowth.

Prescription for Future Management

The compartment was under commercial harvesting during the second plan period. Moreover, the commercial harvesting will be continued in the third management plan period also. Approximately 2 kms of new road will be constructed in continuation to the existing forest road to facilitate transportation of timber. As the forest type in the new operation area is mostly Blue Pine Forest, seed tree system will be used to operate the area.

Block: South, Compartment V

Altitude: 2,563 m – 3,615 m
Aspect: South-West
Terrain: Gentle to Moderate
Total Area: 408.27 ha
Protection: 20.48 ha
Non-production: 0 ha
Production: 387.79 ha

Past Management

This compartment was not the part of Karshong FMU during the first and second management plan period. The extension of the FMU area resulted in the creation of this compartment. Commercial harvesting was not carried out in this compartment.

Forest Description

Major part of the compartment is covered with Blue Pine Forest except a small portion of the area being occupied by matured mixed conifer forest. The undergrowth in Blue Pine forest is

mostly Daphne species and Rhododendron species in the moist areas. However, the associated species in the mixed conifer forest area *Rhododendron* sp., *Acer* sp., *Betula* sp. and *Taxus buccata*. The Blue Pine stand is relatively younger in the lower elevation and gradually becomes matured on the upper ridges. In the mixed conifer forest, clean bole spruce and hemlock trees could be found.

Prescription for Future Management

The compartment will be subjected to commercial harvesting during this plan period. Cable lines will be laid in order to extract the timber. As the forest type in this compartment is Blue Pine Forest, seed tree system will be the prescribed silvicultural system. In order to facilitate extraction of the timber, new forest road will be constructed through this compartment.

Block: South, Compartment VI

Altitude: 2,950 m – 3,722 m
Aspect: South-West
Terrain: Gentle to Moderate
Total Area: 332.14 ha
Protection: 18.44 ha
Non-production: 0 ha
Production: 313.70 ha

Past Management

This compartment was not the part of Karshong FMU during the first and second management plan period. The extension of the FMU area resulted in the creation of this compartment. Commercial harvesting was not carried out in this compartment.

Forest Description

Mixed conifer forest is the dominant forest type in this compartment and occupies mostly the upper ridges. The lower elevation areas are occupied by Blue Pine Forest. The undergrowth is mostly *Rhododendron* and *Borinda* species. The compartment consists of generally matured trees which could be commercially harvested.

Prescription for Future Management

The compartment will be subjected to commercial harvesting during this plan period. Cable lines will be laid in order to extract the timber. As the forest type in this compartment is Blue Pine Forest, seed tree system will be the prescribed silvicultural system. In order to facilitate extraction of the timber, new forest road will be constructed through this compartment.

Block: South, Compartment VII

Altitude: 3,141 m – 3,930 m

Aspect: South-West
Terrain: Gentle to Moderate
Total Area: 547.28 ha
Protection: 28.09 ha
Non-production: 10.33 ha
Production: 508.86 ha

Past Management

This compartment was not the part of Karshong FMU during the first and second management plan period. The extension of the FMU area resulted in the creation of this compartment. Commercial harvesting was not carried out in this compartment.

Forest Description

The compartment consists of Blue Pine Forest in the lower elevation, mixed conifer forest in the mid elevation and Fir forest in the upper elevation. *Rhododendron* species and *Borinda* species forms the undergrowth in mixed conifer and fir forest. The compartment has matured trees in the mixed conifer forest. Over matured trees are also present in the fir forest.

Prescription for Future Management

The compartment will be subjected to commercial harvesting during this plan period. Cable lines will be laid in order to extract the timber. As the forest type in this compartment is Blue Pine Forest, seed tree system will be the prescribed silvicultural system. In order to facilitate extraction of the timber, new forest road will be constructed through this compartment.

Block: South, Compartment VIII

Altitude: 2,565 m – 3,705 m
Aspect: North and North-East
Terrain: Steep
Total Area: 485.69 ha
Protection: 331.05 ha
Non-production: 0.94 ha
Production: 153.70 ha

Past Management

This compartment was not the part of Karshong FMU during the first and second management plan period. The extension of the FMU area resulted in the creation of this compartment. Commercial harvesting was not carried out in this compartment.

Forest Description

The compartment has Blue Pine and Mixed Conifer forest. The undergrowth is covered densely by *Borinda* species. Although, matured trees are found in the compartment, majority of the compartment has steep terrain and commercial harvesting cannot be carried out.

Prescription for Future Management

As most part of this compartment has steep slopes, commercial harvesting is not possible in major part of the compartment. The areas with steep slopes are mapped as protection management circle and no interventions will be carried out unless specified in the management plan. However, commercial harvesting can be carried out in western part of the compartment through installation of cable lines.

Block: North, Compartment I

Altitude: 2,765 m – 3,735 m
Aspect: South
Terrain: Gentle to Moderate
Total Area: 372.11 ha
Protection: 47.11 ha
Non-production: 27.33 ha
Production: 297.67 ha

Past Management

The Compartment was solely demarcated as local use area in the second management plan. Rural timber, poles and firewood were extracted from this Compartment by the local people. No commercial harvesting was prescribed in this Compartment during the previous management plan.

Forest Description

The forest type in this compartment is predominantly Blue Pine Forest. As most of the matured trees are removed for the rural allotment to local communities in the previous years, mostly of the remaining trees are immature and young. The average age of the Blue Pine trees in the compartment is around 30-40 years. The lower valley of the compartment has agricultural land as well as settlements.

Prescription for Future Management

Commercial harvesting is not feasible as the crop is of relatively young age. Improvement operations such as thinning could be carried out in areas where blue pine regeneration is dense.

Block: North, Compartment II

Altitude: 2,725 m – 3,567 m
Aspect: South

Terrain: Gentle to Moderate
Total Area: 458.92 ha
Protection: 58.83 ha
Non-production: 4.04 ha
Production: 396.05 ha

Past Management

The Compartment was solely demarcated as local use area in the second management plan. Rural timber, poles and firewood were extracted from this Compartment by the local people. No commercial harvesting was prescribed in this Compartment during the previous management plan.

Forest Description

The forest type in this compartment is predominantly Blue Pine Forest. As most of the matured trees are removed for the rural allotment to local communities in the previous years, mostly of the remaining trees are immature and young. The average age of the Blue Pine trees in the compartment is around 30-40 years. The lower valley of the compartment has agricultural land as well as settlements.

Prescription for Future Management

Commercial harvesting is not feasible as the crop is of relatively young age. Improvement operations such as thinning could be carried out in areas where blue pine regeneration is dense.

Block: North, Compartment III

Altitude: 2,647 m – 3,428 m
Aspect: South
Terrain: Gentle to Moderate
Total Area: 592.63 ha
Protection: 163.58 ha
Non-production: 14.28 ha
Production: 414.77 ha

Past Management

The Compartment was solely demarcated as local use area in the second management plan. Rural timber, poles and firewood were extracted from this Compartment by the local people. No commercial harvesting was prescribed in this Compartment during the previous management plan.

Forest Description

The forest type in this compartment is predominantly Blue Pine Forest. As most of the matured trees are removed for the rural allotment to local communities in the previous years, mostly of the remaining trees are immature and young. The average age of the Blue Pine trees in the compartment is around 30-40 years. The lower valley of the compartment has agricultural land as well as settlements.

Prescription for Future Management

Commercial harvesting is not feasible as the crop is of relatively young age. Improvement operations such as thinning could be carried out in areas where blue pine regeneration is dense.

Block: North, Compartment IV

Altitude: 2,619 m – 3,105 m
Aspect: South
Terrain: Gentle to Moderate
Total Area: 401 ha
Protection: 196.26 ha
Non-production: 5.43 ha
Production: 199.31 ha

Past Management

The Compartment was solely demarcated as local use area in the second management plan. Rural timber, poles and firewood were extracted from this Compartment by the local people. No commercial harvesting was prescribed in this Compartment during the previous management plan.

Forest Description

The forest type in this compartment is predominantly Blue Pine Forest. As most of the matured trees are removed for the rural allotment to local communities in the previous years, mostly of the remaining trees are immature and young. The average age of the Blue Pine trees in the compartment is around 30-40 years. The lower valley of the compartment has agricultural land as well as settlements.

Prescription for Future Management

Commercial harvesting is not feasible as the crop is of relatively young age. Improvement operations such as thinning could be carried out in areas where blue pine regeneration is dense.

ANNEXURE 2: ROAD STANDARDS

The road standards developed in the east by TFDP will be implemented for design, drainage and construction of all forest roads in Karshong FMU.

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 that the cut and fill are balanced 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 construction.
- 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 15m 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 3m in vertical height and no more than 100% gradient with a 1.5m horizontal step.
- Convex road surface should be maintained at all times with the centre line 30cm 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 and avoid areas which are prone to floods during monsoon.
- In areas where side slopes of 70% or greater extend for a distance of 100m 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 40cm deep and 65cm 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 30cm) 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 erodable material then the distance between the culverts must be reduced by 50%.

Road Gradient (%)	Distance Between Culverts (m)
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 700mm 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 from reaching the road.
- Drains should not be allowed to directly enter a watercourse but should be diverted into surrounding vegetation at least 50m before a watercourse.
- Sumps or silt traps should be places in drains every 50m in erodable soils and must be cleaned regularly.

Road Construction

- All timbers above 30cm 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 stabilize the slopes.
- Where side slopes of 70% or more extend more than 100m 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 300m if this substantially reduces road length. Following this incline, a minimum distance of 100m of grades of 10% or less must be maintained.
- The favorable gradient should not exceed 12%. However, grades of up to 15% for distances of up to 300m will be allowed if this substantially reduces road length. These grades should be followed by grades of less than 10% for distances of 100m or more.

ANNEXURE 3: TREE MARKING GUIDELINES

Marking Guidelines for Group Selection System

The Group Selection System aims to 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 10cm DBH.
- The group will be located along extraction lines.
- The distance between the extraction lines will be no less than 60m.
- The distance between the groups, along the extraction lines, will be less than 50m.
- 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; 2-4m in the Fir stands and no wider than 4m in the Spruce and Hemlock 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 economic value will not be harvested; it will be left for preserving biodiversity.

Marking guidelines for 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 50cm 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 economic 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 mixed 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 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 economic 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.

Spacing and stand Density Regulation

The spacing of trees should be roughly 2 m and the resulting stand density, approximately 2,500 trees/ha. Preferentially maintain admixed species, unless damaged or malformed. Mean maximum diameters of solitary blue pines provide guidance for optimal size dependent stand density considering a 25% deduction of mean maximum crown dimensions for optimal spacing in closed stands. Trees in closed stands will not develop the crown dimensions of free growing (solitary) trees and at the same time individual tree growth and stand growth have to be optimized. A too severe reduction of stem density (increase of spacing for optimized growth of individual trees) would result in lower standing volume per hectare.

Selection of Plus Trees

Once the stand reaches crown closure at the beginning of pole stage (at top heights of 12-15 m), differentiation between trees in terms of performance and quality will start to become clearly visible in case initial spacing has been carried out. Trees forming part of the stand at time of the final cut (plus trees) have to be selected and marked during this time. A change or supplementary marking of plus trees at a later stage are not possible.

The number of plus trees depends on the target diameter during the final harvest. Considering crown dimensions with a target DBH of 50 cm at rotation period of 100-130 years, selection of 200 plus trees per hectare resulting in a spacing of 7 m between plus trees is recommended. In case the target production for the stand is 40 cm DBH at final harvest, optimal spacing is 6-6.5 m resulting in 260 stems per hectare(Darabant, Rai, Eckmullner, Gratzer, & Gyeltshen, 2012).

In case of doubt, stability should have priority before quality. In locations where suitable trees are lacking, no plus tree should be selected. While carrying out thinning operations, special care should be given to plus trees in order to protect them from damage. In case initial spacing has not been carried out, stands reaching pole stage are densely stocked and differentiation between trees in terms of vitality and quality is not clearly visible. Marking of plus trees at this stage is not meaningful. Therefore, a series of low-intensity thinning entries should be completed before trees are differentiated enough in terms of stability and quality criteria so that selection of plus trees can be carried out(Darabant, Rai, Eckmullner, Gratzer, & Gyeltshen, 2012).

- For each plus tree, mark the one or two (maximum three) strongest competitors for removal in order to provide it enough growing space. Ideally, the total volume removed should be around 25% corresponding to moderate thinning intensity.
- Paint plus trees with yellow band to signalize their importance and for ease of marking in subsequent entries. Trees with such a yellow band should be protected throughout the stand development as they represent the final crop.

- The remaining stand may optionally be thinned, but this is not an essential requirement. In case of thinning the remaining stand, concentrate on removal of malformed and diseased trees.
- In case the favored tree (plus tree or other) has a crown ratio below half or an asymmetric crown, remove maximum one competitor in order not to jeopardize stability.
- Remove trees affected by dwarf mistletoe on a top priority basis.
- The stems of forked trees belong to the same vegetative individual and have to be treated together- if you remove one, you have to remove both.
- Remove malformed trees and trees with other diseases than dwarf mistletoe.
- Marking should not result in creation of gaps in the canopy.
- Focus on maintaining a well-structured stand.
- Focus on promoting a mixed-species stand.
- Do not blaze trees in the remaining stand. Blazing wounds weaken the trees and provide entry point for pathogens, devaluating the most valuable first log of the tree.
- Remove wolf trees (large emergent trees remaining from an earlier cohort) in a priority basis and do not consider their volume within the target of 25% volume removal.
- Do not worry about having to induce regeneration in the course of thinning.
- Thinning is primarily about stand improvement and is not a regeneration cut(Darabant, Rai, Eckmullner, Gratzer, & Gyeltshen, 2012).

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 area only.
- Flag posts, fence posts and poles demand should be met by marking for thinning in the pole crop high density stands thereby subjec(Weather and Climate Serice Division, 2018)(Wangchuk, 2009)ting the stands to Silvicultural thinning.

ANNEXURE 4: Dzongkhag Administrative Approval

Royal Government of Bhutan
Dzongkhag Administration, Bumthang
"Towards Beautiful Bumthang"

JKD/ENV-8/2019-20/ 885

September 16, 2019

Dzongkhag Administrative Approval

In exercise of the powers delegated under the National Environment Protection Act, 2007 of the National Environment Comission Secretariat, Section 47, which manates the Dzongkhag Environment Committee (DEC) as on eof the Competent Authorities in making recommendations to the concerned Ministries, Local Governments and /or the Secretatieat concerning any measures that need to be taken to protect the quality of the Environment. Also , Dxongkhag Administration is mandated to issue the Dzongkhag Administrative approval as per ht Section , 3.10 of Application of the Environmental Clearances Guideline, the Dzongkhag Administrative Approval is hereby accorded in favour of Divisional Forest Office, Bumthang for operation of the revised FMU of Karshong at Nangar, Chumay Gewog with the following terms and conditions:

1. The applicants to execute the work as per the The Land Act, 2007.
2. The Applicant to execute the work as per The Waste Prevention and Management Act (2009) : Regulation (2012) and the Amendments, 2016.
3. The applicant to execute the work as per The Water Act, 2011 and Its Regulation, 2014.
4. The Dzongkhag Administrative Approval is **accorded only for obtaining the Environmental Clearance** and does not include the Social Clearance, Forestry Clearance , if required thereof.
5. The Dzongkhag Administrative Approval for the said activity is within the jurisdiction of the Bumthang Dzongkhag.
6. The Dzongkhag Administrative Approval will stand valid till obtaining the environmental clearance from the competent authority.

(Pasang Dorji)
Chairman
Dzongkhag Environment Committee

CC:
1. Gup, Chumey Gewog, for kind information
2. Office Copy

PABX-03631200 DZONGDAG-Ext 132 (O) Fax # 03-631806 DZONGRAB-Ext 119 (O) Fax # 03-631461
Website: http://www.bumthang.gov.bt

ANNEXURE 5: GEWOG ADMINISTRATIVE CLEARANCE

དཔལ་ལྡན་འབྲུག་གཞུང་།

རྒེད་འོག་བདག་སྐྱོང་།

ROYAL GOVERNMENT OF BHUTAN
GEOG ADMINISTRATION
CHUMIG : BUMTHANG

CGA/Adm-I 15)2019-2020/ 72 Dated: 02/10/2019

ཡིག་ཚང་/ རྟེན་ ( ) ༢༠༡༩ - ༢༠༢༠/ ཉིན་རེས

ADMINISTRATIVE CLEARANCE

With references to your letter no BFD/RMS/04/2018-2019/306 dated 19/09/2019 the Gewog Administration, Chumig is issuing this administrative clearance for construction of forest road from new bridge at Dangpharbi. This road will not only benefit your project but it will benefit the community residing at that place. We found that there is no negative impact on the community and public property.

Thus we have no objection if the forestry construct forest road from Dandpharbi Bridge.

Jampel
(Thrizin)
ཀཱ་ངོ
རྫོང་གཅོད་འོག

Cc:

1. Office copy

ANNEXURE 6: MINUTES OF THE PUBLIC CONSULTATION MEETING

Consultation Meeting on Karshong FMU Plan Revision
(14/06/2018)

Date: 14th June, 2018
Venue: Multi-purpose Hall, Zungnyer Primary School

The consultation meeting was done between the Bumthang Forest Division and communities from Nangar Pangtey Goempa, Yamthra, Nangay, Zungnyer, Choeninpo, Trakar, Nangar, Choedipan, Ungsang and Thrometh villages which falls within the Karshong FMU. The consultation meeting also involved the Gup of the Gewog, staffs of the Chumey range, Karshong FMU and divisional staffs.

Opening Address by Chief Forestry Officer, Bumthang Forest Division

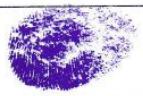
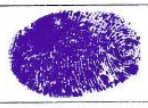
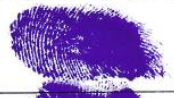
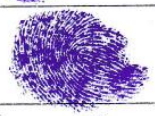
CFO welcomed and thanked the communities and Chumey Gup for their presence in the meeting. The CFO highlighted the importance of the meeting and requested the local people to participate actively in the meeting in order to come-up with a revised forest management plan that will benefit the government as well as the local residence when it comes to timber allocation and extraction. CFO presented the agenda for the consultation meeting which were:

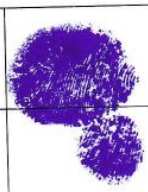
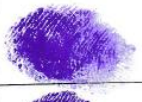
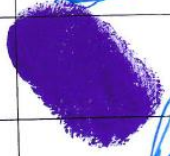
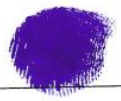
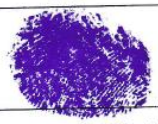
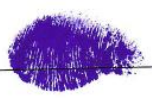
1. Presentation on Review of second management plan of Karshong FMU
2. Extension of FMU area
3. Karshong FMU forest road proposal
4. Issues from the communities

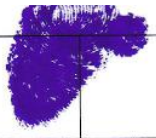
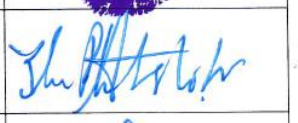
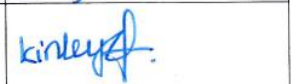
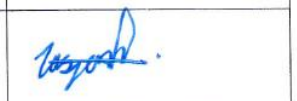
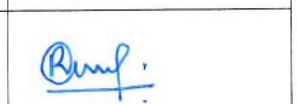
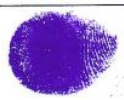
Sl. No.	Agenda	Discussion	Resolution
1	Presentation on review of second management plan of Karshong FMU	Lhab Tshering, Forestry Officer presented the past FMU operation and the current scenario. The commercial and rural timber extracted from the FMU till date was also presented to the local people. CFO also complemented on the presentation regarding the commercial allotment and the rural allotment and issues faced by the Division during the allocation.	
2	Issues during implementation of second forest management plan of Karshong FMU.	One of the main issue during the implementation of the second management plan was the reduction in production area due to following: • Community Forests within the FMU • Huge area of private registered land within the FMU • Illegal harvesting of timber • Revision of community forest area due to enrollment of new members	• The issues presented in the meeting will be addressed by the revised management plan. • The community forest within the FMU will be mapped and excluded from the overall FMU area. • The new production area will be connected with a new road in order to ease the accessibility and shorten the overall length of the road for

		• Huge spillover cable lines due to mechanical failure • Continuous maintenance of FMU road in order to carry out timber extraction throughout the year • Increased length of the FMU road resulting in higher expenses during transportation of timber and firewood.	timber transportation. • As the Division does not have access to the cadastral map of private registered land within the FMU, the planner will not be able to map out the registered land during function mapping.
3	Extension of FMU area	As the existing production area will not be enough for operation for next ten years, the Division office has proposed to the Department for extension of the FMU area.	• The Division upon receipt of approval for FMU area extension, the FMU area will be increased so that the production area will be available for operation in upcoming ten years period. The inventory will also be carried out upon approval to assess the timber stock.
4	Karshong FMU forest road proposal	Lhab Tshering also presented on the forest road proposal which will be constructed in the next management plan (2020-2029) should the extension of FMU area is approved by the Department. The opinion on the new road proposal was gathered from the general public of the Gewog. The take-off point of proposed road will start from Dangpharibi bridge which is currently being constructed by the Gewog administration for the private land which is on the other side of the Chumey river. The division considered the proposed road to be feasible from Dangpharibi because after the area extension of FMU in coming plan, it will be economically feasible for extraction and transportation. If we continue from the existing road, then it will be very long for transporting the timber as it will have more than 21.5 Km.	• The Chumey Gup also expressed the opinion that the proposed road will benefit not only NRDCL for extraction of timber but also benefit the communities in utilizing the road. • Few villagers also expressed their agreement on the construction of forest road from the proposed alignment. • The Planner will work on the detailed road alignment as agreed in the meeting in consultation with the Engineers from NRDCL.
5	Issues from the communities	One villager raised the concern on unavailability of bigger sized timber for their house construction.	The CFO responded to the concern of unavailability of bigger sized timber, stating that in the coming plan local use area to be carefully allocated in the FMU in consultation with Gewog and the local people.

Consultation Meeting on Revision of Karshong Forest Management Plan
(Previous Plan Progress Reporting to Local Stakeholders)

Sl. No.	Name of the Participants	Village	Signature
1.	Tashi Paldan	Nangar	
2.	Pema	11	
3.	Jamyang	11	
4.	Thinley chodan	11	
5.	Dechen	Usang	
6.	Uhamo Yudan	11	
7.	Deki	11	
8.	Namgang Dema	11	
9.	Ugyen Wangmo	Chumeypang	
10.	Namgay Dema	Zungaye	
11.	Ugyen Wangmo	11	
12.	Pema Uhamo	11	
13.	Sangay Dema	11	
14.	Leki Yangchen	11	
15.	Kelzang chodan	11	

16.	karma Tshomo	Zungaye	
17.	Sonam Pema	11	
18.	Jangchuk	11	
19.	karma Wangmo	11	
20.	Dorji	Takar	
21.	karma Tshering	Zungaye	
22.	Tharpola	11	
23.	Yeshi Nidup	11	
24.	Yuden	Zungaye	
25.	Sangay choden	Belhang	
26.	choki Dema	11	
27.	Tashi Dema	11	
28.	Passang Dema	11	
29.	Tshewang Penjor	11	
30.	Sonam choden	11	
31.	Yangchen Lhamo	11	

32.	Tshering Lekey	Bellang	
33.	Karma	11	
34.	Yeshi Seldon	11	
35.	Nima Dorji	11	
36.	Yeshi Phuntsho	11	
37.	Kinley Zangmo	Takar	
38.	Tashi Wangmo	11	
39.	Rinzin chodon	11	
40	Sangay Wangmo	11	
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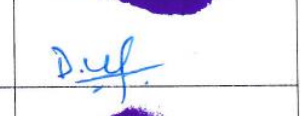
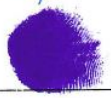
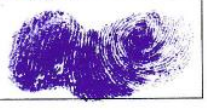
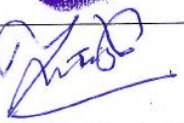
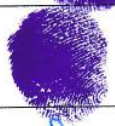
42.	Jamyang Dema	11	
43.	Choki Wangmo	11	
44.	Sonam Deki	Zungaye	
45.	Deki Lhamo	Takar	
46.	Chimi Lhamo	11	
47.	Daji Lhazom	Bellang	

48.	Damchoe Wangmo	Belhang	
49.	Yeshi Wangmo	11	
50	Khadem Wangmo	Takar	
51.	Ugyen Tshomo	Belhang	
52	Tshering Drukpa	11	
53.	Phurpa Zangmo	Chumey pang	
54.	Yeshi Wangmo	11	
55	Dorji Dema	11	
56	Chingzom	Takar	
57	Dopola	11	
58.	Dorji Dema	Chumey Pang	
59.	Tshering Pema	11	
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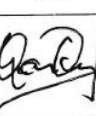
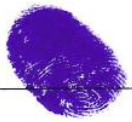
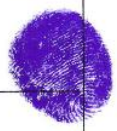
61	Damcho Wangdi	Nangar	
62	Thinley	Nangar	
63.	Ugyen Wangmo	Nangar	

64	Karma Pauchan	Naper.	
65	Sherab Dorji.	"	
66	Sonam Wangmo	"	
67	Tashi Sonam.	"	
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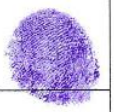
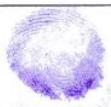
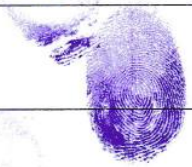
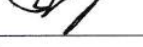
69	Pema Dema.	"	
70	Jamchuk Thinley	"	
71	Karma Sonam.	"	
72	Tashi Pelzom.	"	
73	Dekki Wangmo	"	
74	Yeden.	"	
75	Pema Wangmo.	"	
76	Tashi Dorji.	Yonthsah.	
77	Pema Yangzom	Naper.	
78	Wangmo.	"	
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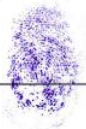
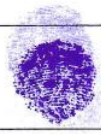
881	Tandin Wangmo.	Yanthrak	
882	Rinchen Dema.	Yanthak.	
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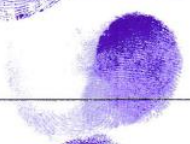
886	Pema Thamo.	"	
887	Phuntsa.	"	
888	Kezang.	Yanthrak	
889	Pem Dem.	"	
890	Nepchap.	Zungey.	
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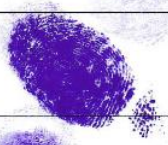
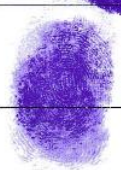
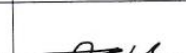
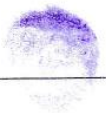
894	Nemola	"	
895	Dechen Wangmo	Nangey.	

96	Yeshi choden.	Nagar.	
97	Zangmo.	Takar.	
98	Jigme Dorji	Nagar.	
99	Tshering Leki	"	
100	Tshering Peldon	"	
101	Tenzin choden	"	
102	Kezangchoden.	Nagar.	
103	Chan Yeden.	Nagar.	
104	Jambay yang	Takar	
105	Tashi Wangdi	"	
106	Tshewang Dorji	"	
107	Gyenboo Tenzin	"	
108	Ugyen Wangmo.	Zupang.	
109	Sapana.	Nagar.	
110	Nakpheng.	Ungsup.	
111	Tshewala.	Bealing	

ANNEXURE 7: ENVIRONMENTAL IMPACT ASSESSMENT REPORT OF PROPOSED FOREST ROAD

ENVIRONMENTAL IMPACT ASSESSMENT REPORT FOR CONSTRUCTION OF FOREST ROAD AT KARSHONG FMU, BUMTHANG DZONGKHAG

1 **Name of the applicant** : Natural Resources Development Corporation Ltd.

2 **Name of project** : Construction of forest road

3 **Present mailing address** : Chief Executive Officer, NRDCL Thimphu, P.O. Box no. 192, Tel. no. 326749, EPABX no. 00975-02-323834/323868. Fax no. 00975-02-325585. Email: info@nrdcl.bt

4 **Name of environmental focal person** : Mr. Nidup Dorji, Junior Engineer, Forest Resources Division, NRDCL HQ, Thimphu. Tel. no. 02-323834/323868. Email: nidupdorji@nrdcl.bt

5 **Project objectives** : Timber harvesting & afforestation of harvested areas

6 **Relevence to overall planning** : Revision of Forest Management Plan

7 **Funding and costs** : Funded by NRDCL, Thimphu Nu,20,140,000.00

8 **Project description**

8.1 Project location : Karshong FMU (27°"29'52.65"N 90°46'37.05"E) to (27°"26'49.51"N 90°45'00.28"E)

Table 1: Road location details by Dzongkhag and Geog

Road chainage		Dzongkhag	Gewog	Town	Village
From	To				
0 + 000	0 + 9000	Bumthang	Chumey	None	Nangar

8.2 Category of road : Access road

8.3 Road specification Forest Road

Table 2. Road Specification/Quantities (For chaninage 0 + 9000)

Item	Unit	Specification/Quantities
Right of way clearing	m	10.00
Formation Width	m	5.00
Pavement Width including edging	m	3.50
Pavement material (Edging, soling & agttes)	cum	9,045.00
Volume of excavated material		
a) Excavation in soil all type	cum	29,756.70
b) Excavation in rock all type	cum	9,038.43
Average road gradient	%	±7
Maximum road gradient	%	±12
Cross drain	no	NIL
Box/Hume pipe culvert	no	16
V-shaped side drain diamensions		
In soil (horizontal x vertical)	cm	40CM X 30 Cm
In rock (horizontal x vertical)	cm	30 CM X 20 CM
Total length of v-shaped drain	m	8,932.00
Box shaped side drain diamensions (lengthxbreadthxheight)	cm	NIL
Total length of box drain	m	NIL

8.4 Excavated materials : The Excavated material will be managed and disposed off safely at designated locations through the use of excavators and tripper trucks or hydrualic tractor

Page 1

8.5 Explosives Approximate quantity of explosive to be used is as under

Sl.No	Particulars	Quantity	Unit	Remarks
1	Safety fuse	1081	coils	(Approx)
2	Detonator	1891	Nos	(Approx)
3	D-chord	1531	m	(Approx)
4	Jelatine	2431	Kgs	(Approx)

Control single shot blasting techique will be adopted with the engagement of trained and certified blaster

9 Alternatives : NIL

10 Public consultation : Public consultation meeting conducted

11 Project site Physical Environmental details

11.1 Topography and Geology

Table 3: Topography and observations along the road

Chainage(Km 0+000)		distance (m)	Side slope %	Observation on geology & possible problem	Method of slope & terrain stabilization Above & Below road
From	To				
0 + 000	0 + 9000	9000m (Karshong block)	10 -120	Predominantly sandy loam	Normal Bio-engineering + Retaining & Breast wall structure works wherever required.
Total		**9,000.00**			

11.2 Water Course Crossings

Table 4: Details of water courses that will require crossing along the proposed road

Chainage at which road crosses water course	Name of water course	Type of crossing	If bridge, Length of bridge (m)	Down stream water users- details		
				Name of community or individual	House hold (no)	Type of use
0000 + 338	N A	Hume pipe culvert	NIL	Nangar	NONE	NONE
310+ 0687	N A	Hume pipe culvert	NIL	Nangar		
0687+ 0771	NA	Hume pipe culvert	NIL	Nangar		
0771 + 1122	NA	Hume pipe culvert	NIL	Nangar		
1122 + 1249	NA	Hume pipe culvert	NIL	Nangar		
1249 + 1592	NA	Hume pipe culvert	NIL	Nangar		
1592 + 1652	NA	Hume pipe culvert	NIL	Nangar		
1652+ 1755	NA	Hume pipe culvert	NIL	Nangar		
1755 + 1898	NA	Hume pipe culvert	NIL	Nangar		

1898 + 2927	NA	Hume pipe culvert	NIL	Nangar		
2927 + 3199	NA	Hume pipe culvert	NIL	Nangar		
3199 + 3372	NA	Hume pipe culvert	NIL	Nangar		
3372 + 3995	NA	Hume pipe culvert	NIL	Nangar		
3995 + 5068	NA	Hume pipe culvert	NIL	Nangar		
5068 + 7121	NA	Hume pipe culvert	NIL	Nangar		
7121+ 7482	NA	Hume pipe culvert	NIL	Nangar		

12 Project Site Ecological Description

12.1 Land Use/Vegetation

Table 5: Land use and forest clearance required for road construction

Chainage from take off		Land use	Area (M^2)	Tenure	Affected House hold no
From	To				
0 + 000	9000 + 000	Mixed Conifer	100,000.00	10 years	NIL

Table 6: Areas Required for Project Facilities

Facility	Land use	Area (m^2)	Tenure/ownership	Remarks
Labour camp	Mixed Conifer	2000 per annum	Govt. reserve forest	Till project
Others				

12.2. Protected area : The protected areas such as Soil protection, local water supply protection, Reparian protection, Wild life protection etc. shall be indentified where no commercial activities shall be allowed.

13 Project social environment

13.1. Population

Table 7: Project Beneficiaries. Households with possible access <2km either side of the road

Dzongkhag	Gewog	Households (No)
Bumthang	Nangar	30

Loss of Houses, Services, Infrastructure and Cultural Heritage Sites

Type of loss	NOS	Description of disturbance
Service	NIL	NIL
House	NIL	NIL
Infrastructure	NIL	NIL
Cultural sites	NIL	NIL
Heritage	NIL	NIL

13.2 Aesthetics

No aesthetic distrubance is foreseen however, grass seeding & other bio-engineering technique measures shall be applied on the slopes for reclaiming immediately after road construction.

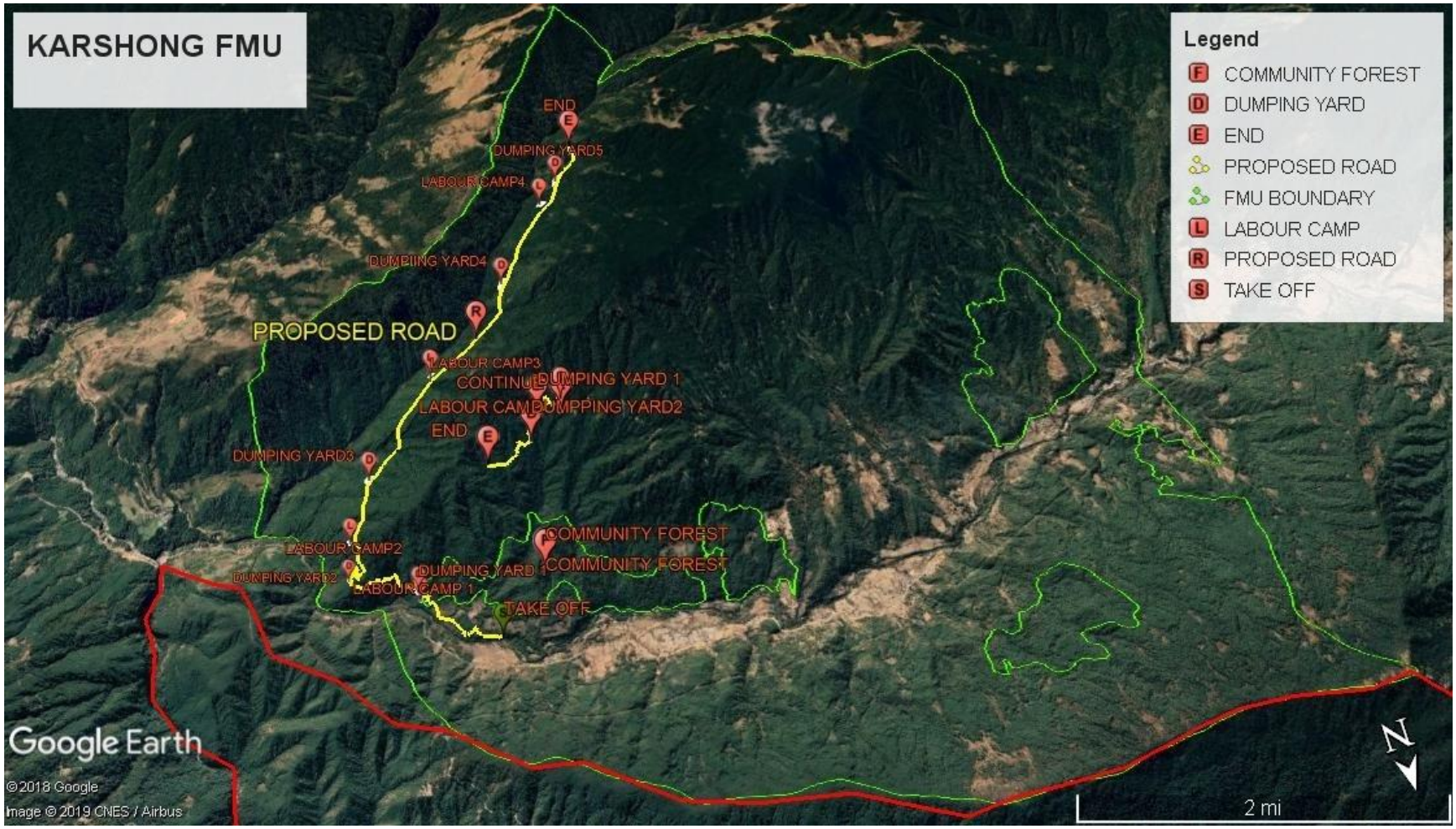
14 Project Impacts and Mitigation Measures

Type of negative impact	Mitigation measures	Estimated metigation costs
Blockage of water canal	Cleaning & maintenance	Nu. 10,000.00 (Lumpsum)
House	NIL	NIL
Infrastructure	NIL	NIL

14.1. Monitoring Program

Monitoring of the construction works will be done by Site supervisor, Karshong Unit, NRDCL, including time to time monitoring by the Unit Manager, Karshong Unit under Jakar Regional Office, Bumthang. The Regional Manager, Jakar Regional Office, NRDCL Bumthang, shall also carry out the frequent monitoring. Also the Engineer from Forest Resource Division, NRDCL HO, shall carry out the monitoring of the construction works as & when required.

Nidup Dorji
Jr. Engineer
Forest Resouce Division,HO,NRDCL


KARSHONG FMU
Legend
COMMUNITY FOREST
DUMPING YARD
END
PROPOSED ROAD
FMU BOUNDARY
LABOUR CAMP
PROPOSED ROAD
TAKE OFF
END
DUMPING YARD5
LABOUR CAMP4
DUMPIING YARD4
PROPOSED ROAD
LABOUR CAMP3
CONTINUE
DUMPING YARD 1
LABOUR CAMP
DUMPPING YARD2
END
DUMPING YARD3
LABOUR CAMP2
DUMPING YARD2
DUMPING YARD
LABOUR CAMP 1
COMMUNITY FOREST
COMMUNITY FOREST
TAKE OFF
Google Earth
©2018 Google
Image © 2019 CNES / Airbus
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ANNEXURE 8: RECORD KEEPING FORMS

Compartment Record Sheet

Block: ……

Compartment: …….

Sub-compartment: ……..

Year	Harvesting		Tending		Planting		Others	Remarks
	Area (ha)	Volume (m^3)	Area (ha)	Volume (m^3)	Area (ha)	Species		
2018								
2019								
2020								
2021								
2022								
2023								
2024								
2025								
2026								
2027								
2028								

Rural Allotment

Block: ……...……
Compartment: …….
Sub-compartment: ……..

MC	WC	Date	Name and Address	Permit No.	TMB No.	Particulars			Volume (m^3)			Comments
						Species	Product Types	Amount	Marked	Recovered	Firewood	

Commercial Allotment

Block: ……
Compartment: ……
Sub-compartment: ……

MC	WC	Year of Activity	Commercial Activities					Volume (m^3)				Other Activities	TMB No.	Comments (Include detailed description of cable line location in relation to mappable features)
			Cable Lines			Groups/ Patches/ Other		Marked		Extracted (NRDCL)	Firewood (lops/ tops)			
			Line No.	Length (m)	Azimuth	Total No.	Total Area (ha)	No. of Trees	Vol.					

Stand Tending and Regeneration[8]

Block: ……...
Compartment: ……
Sub-compartment: ……

MC	WC	Cable Line No.	Year	Stand Tending		Regeneration						Comments or Other Activities
				Activity	Area (ha)	Natural/ Plantation	Species	Year Surveyed	Area (ha)	Survey Results (stems/ha/ survival percent)	Resurvey?	

[8] *Used for brushing, planting, weeding, and spacing or ground preparation activity*

Karshong FMU Inventory Crew (2018)