ROYAL GOVERNMENT OF BHUTAN
DEPARTMENT OF FORESTS AND PARK SERVICES
OFFICE OF THE CHIEF FORESTRY OFFICER
TRASHIGANG FOREST DIVISION
"Walking the Extra Mile".

MANAGEMENT PLAN
FOR
KHALING KHARUNGLA
FOREST MANAGEMENT UNIT

TRASHIGANG DZONGKHAG

(1st January 2020 to 31st December, 2029)

Plan Prepared by:

Tenzin Wangdi (Sr. Forestry Officer, Territorial Division, Trashigang)
Tashi Norbu Waiba (Sr. Forestry Officer, FRMD)
Lhab Tshering (Forestry Officer, FRMD)
October 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 to 31st December 2029**

AUTHORITY FOR PREPARATION, REVIEW AND APPROVAL

The authority for preparation of Forest Management Plan for Forest Management Unit has been delegated to Territorial Division, Trashigang, by the Department of Forests and Park Services, Ministry of Agriculture and Forests, Royal Government of Bhutan, vide No. FRMD/MPS/1(e)/2014-2015/701 dated December 1, 2014.

PROVISION FOR REVISIONS AND CHANGES

This Forest Management Plan may be revised during the plan period when it is in effect. If major changes occur in the Forest Management Unit or if new information becomes available that may have significant implication on the effective implementation of the plan sustainably, the Director of DoFPS has the authority to revise an approved the plan. The CFO, Territorial Division Office, Trashigang, may be advised to prepare revisions and changes to the Plan for submission to the Director of DoFPS.

APPROVAL

This plan was examined by a wide section of user groups, clients and organizations. The proposed plan has been reviewed by FRMD of the DoFPs. The final version of the Plan was furthered reviewed and technically cleared by the Technical Advisory Committee of the DoFPs, and an environmental clearance was obtained from the Secretariat of the National Environment Commission. The Director, Department of Forest and Park Services (DoFPS), after further review forwarded with his recommendation for approval to Ministry of Agriculture and Forests for approval.

Submitted for approval:

Chief Forestry Officer
Forest Resources Management Division
Department of Forests and Park Services

Recommended for approval:

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

Recommended for Approval:

Secretary,
Ministry of Agriculture and Forest
Date:.....

APPROVED

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

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

NECS/EACD/Dzo-Tgang/3817/2020/103 January 16, 2020

ENVIRONMENTAL CLEARANCE

In accordance with Section 34.1 of the Environmental Assessment Act 2000 this Environmental Clearance (EC) is hereby issued to Forest Resources Management Division (FRMD), Department of Forests and Park Services for the operation and management Khaling-Kharungla Forest Management Unit (FMU) measuring an area of 17569.91 hectares at Brekha, Kurchillo, Bephu and Khaling under Tashigang 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;
2. ensure that the operation and management of FMU is in line with Environmental Impact Assessment and Management Plan submitted for EC;
3. ensure that Annual Allowable Cut is fixed to 1,400 m^3 (One Thousand Four Hundred Meter cube);
4. ensure that the harvesting of the timbers are done as per the requirement of the market from the commercial area and as per the public requirement from the rural;
5. ensure that no extraction of timber is carried out at the critical watershed;
6. 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;
7. restore the damage to any public or private properties caused by the operation and management of FMU;
8. 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
9. 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:

NEC, PO Box 466, Thimphu, Bhutan
Tel: (975-2) 323384/325856/324323/326993 Fax: (975-2) 323385
www.nec.gov.bt

Ensure that import and use ODS are in line with the Revised Regulation on the Control of ODS 2008.

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 30 meter or 100 feet buffer is maintained from the water resources at all times.

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.

VI. Management of excavated materials and run-off

The holder shall:

1. dispose excess excavated materials generated during construction of access 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.

IX. 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.

X. Monitoring and reporting

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;

XI. 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 is issued with valid from January 16, 2020 until January 15, 2025.

(Phento Tshering)
DIRECTOR

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

Copy to;
1. The Director, Department of Forests and Park Services, Ministry of Agriculture and Forests, Thimphu for kind information.
2. The Regional Manager, Natural Resource Development Corporation Limited, Tashigang for necessary action.
3. The Dzongkhag Environment Officer, Tashigang Dzongkhag for necessary action.
4. Guard File, (Dzo-Tashigang/3813/2020/) for record.

ACKNOWLEDGEMENT

I owe many thanks to a great many people who helped and supported me during the writing of this Management Plan. Preparation of this plan would not have been possible without hard work of many people and agencies involved all throughout planning process.

My deep sense of gratitude goes to the Mr. Keazang Penjor, Unit In-charge, Khaling-Kharungla Forest Management Unit, Womrong and Mr. Pema Tenzin, Forest Ranger II, Dongdichu Forest Management Unit, Trashi Yangtse for their professional and technical support in preparing Forest Function Mapping. Without them, it would have been very difficult for me to bring out this plan with all required Function mappings.

I also owe many thanks to the team from FRMD for their hard work in carrying out the resources assessment and result analysis from FRMD.

In addition thanks and appreciation to the Gup and the people of Khaling and Lumang Gewog for having provided me with important feedback and various information during the Public Consultation Meeting in two Gewog. without their participation, a holistic plan as this one may not have been possible.

Lastly, I also extend my heart felt acknowledgement for the support and guidance of Mr. Dendup Tshering, Chief Forestry Officer, Trashigang Forest Division and all staff under whose leadership and support, this plan was successfully prepared.

Tenzin wangdi

Sr. Forestry Officer

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LIST OF ABBREVIATIONS

KKFMU	-	Khaling-Kharungla Forest Management Unit
FMU	-	Forest Management Unit
FRMD	-	Forest Resources Management Division
QGIS	-	Quantum Geographical Information System
NTFP	-	Non-timber Forest Products
DoFPS	-	Department of Forest and Park Services
CF	-	Community Forest
NWFP	-	Non-wood Forest Products
RGoB	-	Royal Government of Bhutan
RNR	-	Renewable Natural Resources
FNCA	-	Forest and Nature Conservation Act
NRDCL	-	Natural Resources Development Corporation
AAC	-	Annual Allowable Cut
FMCB	-	Forest Management Code of Bhutan
UIC	-	Unit Incharge
FYP	-	Five Year Plan
RNR-RC	-	Renewable Natural Resources Research Centre
CFO	-	Chief Forestry Officer
DBH	-	Diameter at Brest Height
Ha/ha	-	Hectare
M	-	Metre
M^3	-	Cube metre
NEC	-	National Environmental Commission
EIA	-	Environmental Impact Assessment
Km	-	Kilometer
SFD	-	Social Forestry Division
RM	-	Regional Manager
PRA	-	Participatory Rural Approach
OP	-	Operational Plan
FMP	-	Forest Management Plan
GPS	-	Geographical position System

EXECUTIVE SUMMERY

This is the third ten-year management prepared by Trashigang Forest division. The structure of this management of this plan is as per the guidelines reflected in the FMCB,2004. It consists of three parts:

PART 1: GENERAL DESCRIPTION AND THE CURRENT SITUATION

PART 2: FUTURE MANAGEMENT

PART 3: IMPLEMENTATION OF THE PALN

PART 1: GENERAL DESCRIPTION AND THE CURRENT SITUATION

- Khaling Kharungla Forest management Unit (KKFMU) lies within Khaling and Lumang Gewogs under Trashigang Dzongkhag. It is located between 27°20'04" to 27°20'60" North latitudes and 91°64'2" to 91°64'7" East longitude under Trashigang Dzongkhag. The Highway between Sumdrupjongkhar and Trashigang traverses the FMU.

- The total area of FMU is 7110.30 hectare with ground elevation ranging from 1120 to 3120 masl. The general terrain ranges from steep to moderate. Almost entire area of Kharungla block fall within very steep area with slop more than 45 degree.

- In total, there are 1138 households with total population of 12494 within the FMU. The FMU falls within the administrative boundary of Khaling and Lumang Gewogs under Trashigang Dzongkhag. Animal Husbandry and Agricultural farming are the main livelihood activities of people living nearby FMU.

- The dominant forest type found in Khaling Kharungla FMU is Warm Broadleaved Forest which covers an area of approximately 5522.55 hectares. There is also a small patch of Mixed Conifer Forest towards the northern part of the FMU covering an area of approximately 25.07 hectares and Chirpine Forest towards to the Southern part of the FMU covering an area of approximately 6.06 hectares. About 564.14 hectares is under Scrub Forest. The dominant species found in the Broadleaved Forest are *Quercus* spp, *Castanopsis* spp, *Persia* spp, *Acer* spp and etc. Bamboo of different species are also very abundant in almost entire of FMU.

- The AAC of the last Management Plan (2009 – 2019) was set at 2706 m^3 out of which 1009 m^3 (standing volume) has been allotted for Rural use and 1697 m3 (standing volume) has been allotted for Commercial use. The total commercial timber harvested for the last ten years (2009 to 2019) is 16576 m^3 and rural timber extracted is 6338 m^3 in standing volume. To this, it was observed that the commercial and rural timber extraction has remained within the prescribed AAC for the plan period.

- A total of 6.25 km of forest road have been constructed by NRDCL in the FMU during the last plan period (2009 to 2019). The road network has benefitted the communities of Khaling village/settlement besides extraction of commercial and rural timbers from the FMU.

- FMU provides grazing ground for cattle of communities both within and outside of the Forest Management unit.

PART 2. FUTURE MANAGEMENT

1. The overall Goal of the management plan is to:

Manage the Khaling-Kharungla FMU on multiple use, sustained yield basis for the production of timber, fuel wood and other forest products for watershed and environmental protection.

The Khaling Kharungla FMU has been organized into Management Circles and Working Cirlces. This organization is for the smooth implementation of the plan. Three Management Circles have been identified viz **Protection**, **Production** and **Non-Production** including **Non Wood Forest produce (overlapping)** with all other Management Circles. Production Management circle have been further refined into Broadleaf working circle. This allows different areas to be managed and evaluated separately. Some of the objectives may overlap in all the Working Circles mainly due to multiple functions occurring in the Management Circles. However, the Non Wood Forest produce Managenment Circle shall overlap with all other Management Circles, including Protection and Non-Production Management Circles, which constitute the entire FMU area. The overall objective of this Managenment Circle is to manage the NWFPs in Khaling Kharungla FMU on sustainable basis and monitor low impact collection.

2. Management Based on Forest Function.

Management based on different forest functions will also be adopted as per the prescriptions in the Plan. Following forest functions and management options with restrictions have been described in detail. To facilitate better organisation of management activities during the implementation of the plan and better field orientation within the FMU, the area has been sub-divided into Blocks and Compartments.

Code	Function Group	Code	Function Group
S	**Soil Protection and Conservation**	**N**	**Nature Conservation**
SC	*Soil Conservation*	***NWP***	*Wildlife Protection*
SP	*Soil Protection*	***NWC***	*Wildlife Conservation*
W	**Water and Watershed Conservation**	**SoC**	**Social Function**
	Riparian Reserve Protection	***SoCL***	*Social (Local use only)*
WRR	*Watershed Conservation*	***SoCRs***	*Social (Religious Site Protection)*
WSH	*Local Water Supply Protection*		
WLS			

Table 1: Code of function Groups

3. AAC for Production Management Circle in standing volume.

Production Management Circle for Khaling Kharungla FMU has been divided into only one working circle.i.e, Broadleaf working circle for this plan period. The AAC for Broadleaf working circles is as indicated below:

Table 2: Annual Allowable Cut for Working Circles in standing volume.

Strata	Net operable area (ha)	Rotation (Year)	RME of Average Standing Volume (m3/ha)	AAC (m3/year)
Broadleaf forest	1812.58	120	87.14	1316.23
Total	1812.58	120	87.14	1316.23

Based on the inventory data and net operable forest area available, the Annual Allowable Cut (AAC) for this plan period has been fixed at **1300 m^3** in standing volume per year.

4. Allocation of AAC

Local Use - 400 m^3	Allocated to local users (local villages, general public and *adhoc*). The volume of cham, tsim, dangchung, etc. from operations will be included in this allocation. The territorial DFO, Trashigang will be responsible for allocating this volume.
Commercial -900 m^3	Allocated to NRDCL to meet commercial demand.

5. Silvicultural Systems

The prescribed Silvicultural System for the commercial harvesting for Broadleaf Forest is Patch Clear-cut System for Broadleaf. lear cut patches of suitable sizes shall be created in the stand allowing optimum quantity of light to reach the forest floor and creating conducive micro climatic conditions for seed germination and establishment of seedlings. Criteria for patch openings and laying out annual coupes are given in detail in the plan.

For rural marking, Single Tree Selection System will be applied.

6. Environmental Assessment

A team from DFO Trashigang in consultation with NRDCL carried out detailed EIA and its findings are incorporated in preparing the Forest Management Plan. Checklist of Environment Parameters for Forestry projects as per NEC guidelines and Forest Management Code of Bhutan has been followed and the following activities were taken into consideration in this Management Plan.

1. FMU Planning and Zoning
2. Road Construction and Maintenance
3. Harvesting and Extraction
4. Regeneration and Post-harvesting Treatment
5. Riparian Zone Protection
6. Biodiversity Conservation within the FMU
7. Local use forest area

PART 3. IMPLEMENTATION OF THE PLAN

1. The CFO, Trashigang assisted by Unit Incharge and other supporting staff of Khaling Kharungla FMU will be the implementing agency. Determining of cutting cycles, annual coupes, harvesting, reforestation, road construction, etc. will be done as per prescriptions in this plan. Annual planning will be facilitated through Operational Planning. Record keeping and Monitoring will be done by the CFO on annual basis as per the format. FRMD in collaboration with CFO Trashigang will conduct mid-term and final evaluation of the FMU as per the timeline outlined in this plan.

2. FMU Level Management Committee chaired by the CFO, Trashigang has been established to assist in objective setting and ensuring the smooth implementation of the plan. The committee comprises of the stakeholders of the FMU and each member has

equal say in recommendation for management and implementation of the FMU. Plan activities to achieve the FMU objectives will be discussed in the FMU Level Management Committee.

3. Unforeseen circumstances may warrant deviation from plan prescriptions and in such an event the CFO Trashigang must obtain prior written approval from the Head of the Department. The reasons for the deviation must be fully justified by the CFO in writing in this respect and such approved deviations entered into the Management Plan during the next scheduled planning priod and plan revision.

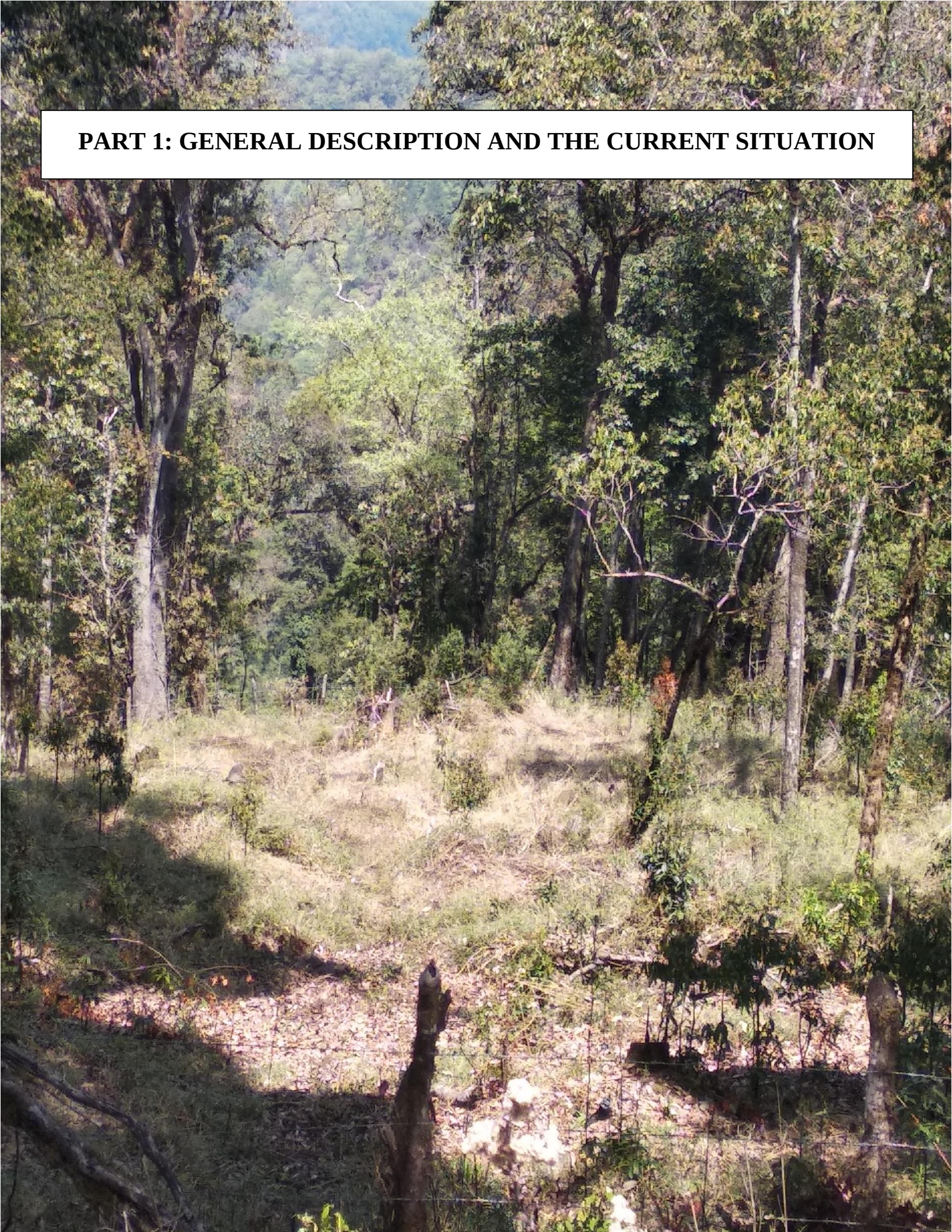
Table 3: Actions and responsibilities

Actions required by the FMU Plan	Responsibility
1. Implementation and Review	
The CFO Trashigang, Divisional Forest Division will be responsible for the implementation of this Management Plan, assisted by the Unit-In-charge and staff.	CFO
A FMU 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 silvicultural systems prescribed for each working circle are used for that working circle, and they are implemented thoroughly and correctly.	CFO & UIC, FMU
The Head, FRMD, will ensure that the mid-term evaluation and final evaluation of the plan is carried out as per the ToR developed by the Department.	Head, FRMD
2. **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
3. **Operational Planning**	
A bi-annual Operational Plan will be prepared by the CFO to facilitate timely implementation of this Management Plan. The OP be completed and submitted to FRMD by 1st Week of 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 the compartment to be harvested annually in consultation with NRDCL staff as prescribed in the Operational Plan.	UIC, FMU
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 UIC, FMU will ensure that plantation survival surveys are conducted annually to ensure enough restocking of harvested area.	UIC, FMU
Plantation will be carried out by NRDCL.	RM, NRDCL
Tending operation must be done as per the norms and standard of nursery and plantation to facilitate good health of seedlings.	RM, NRDCL
The UIC, FMU will inspect the coupes post completion of Operations in a cable line and will issue a Coupe Clearance Certificate only upon fulfillment of the criteria set for issuance of coupe clearance.	UIC, FMU
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 or preventive measures to be initiated.	FMU staff
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 UIC, FMU and furnished monthly to the CFO Trashigang.	UIC, FMU
Timber and Non-Wood Forest Products can be allotted to bonafide local villagers.	UIC, FMU as per Operational Plan
4. **Participatory Forest Management**	
The views of stakeholder groups will be incorporated into the operational plans through the inclusion of stakeholder representatives on the FMU level Management Committee.	CFO

Table of Contents

PART 1: GENERAL DESCRIPTION AND THE CURRENT SITUATION



PART 1: GENERAL DESCRIPTION AND THE CURRENT SITUATION

1. LOCATION, AREA, BACKGROUND AND STATUS

1.1 Location and extent

KhalingKharungla Forest management Unit (KKFMU) lies within Khaling ang Lumang Gewog under Trashigang Dzongkhag. It is located between 27°20'04" North latitudes and 91°64'7" East longitutes under Trashigang Dzongkhag. The FMU has a total area of 7110.30 hectare. Ground elevation in the FMU ranges from 1120 to 2987 masl. The Highway between Sumdrupjongkhar and Trashigang traverse the FMU.

1.2. Historical Background

The first Forest Management plan for KKFMU was developed by Third Forestry Development project (TFDP), Project Facilitation office based at Khangma in the year 1996. The first management plan expired in 2005. The second forest Management Plan was prepared by Forest Resources Management Division (FRMD) which will expire by 31st October, 2019. During the past two plan periods, Kurchilo and Khaling blocks were commercially logged. The forest area of these Blocks has broadleaf species such as *Quercus, Persia, Acer, Michaelia, Cinnamomum, Symplocus, Castanopsis, Betula, Rododendron, Exbuklandia* and *Linderea* species. Besides, commercial harvesting, rural timber was also allocated to the local population to meet their local demands and they still have access to the forest resources from Bayphu and Brekha rural blocks. Re-forestation of harvested areas was also carried out through NRDCL. The silviculture system that was adopted in first management plan was strip cutting system. The plantations carried out within some of the strip cut areas is heavily taken over by bamboo *(Chimonabambusa* spp). Patch clear cut system was adopted during the second phase of management plan.

1.3 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 77.67% of the land is covered by Broadleaf forest followed by approximately 0.35% Mixed Conifer forest and 0.09% Chirpine Forest. The build-up area cover about 1.82% of the total land cover (Table .?).

Land Use	Area (ha)	%
Broadleaf	5522.55	77.67
Built up	129.40	1.82
Chhuzhing	2.76	0.04
Chirpine	6.06	0.09
Kamzhing	612.68	8.62
Landslides	5.71	0.08

Meadows	241.53	3.40
Mixed conifer	25.07	0.35
Rivers	0.38	0.01
Shrubs	564.14	7.93
Grand Total	7110.30	100.00

Table 3:Area statement by Land Use

Table : Area statement by Land Use

1.4. Forest Condition

The forest type within KKFMU is essentially warm broadleaved forest with *Quercus*, *Persia* and *Acer* as most dominant tree species. The majority of forest crop within the FMU are mature. The young trees are seen along the streams and within eroded area. Different species of bamboo too can be seen within FMU ranging from lower elevation to the higher elevation. A patch of mixed conifer forest and chirpine fores also occurs within FMU, however these forest falls either in protection or within improvement the stand.

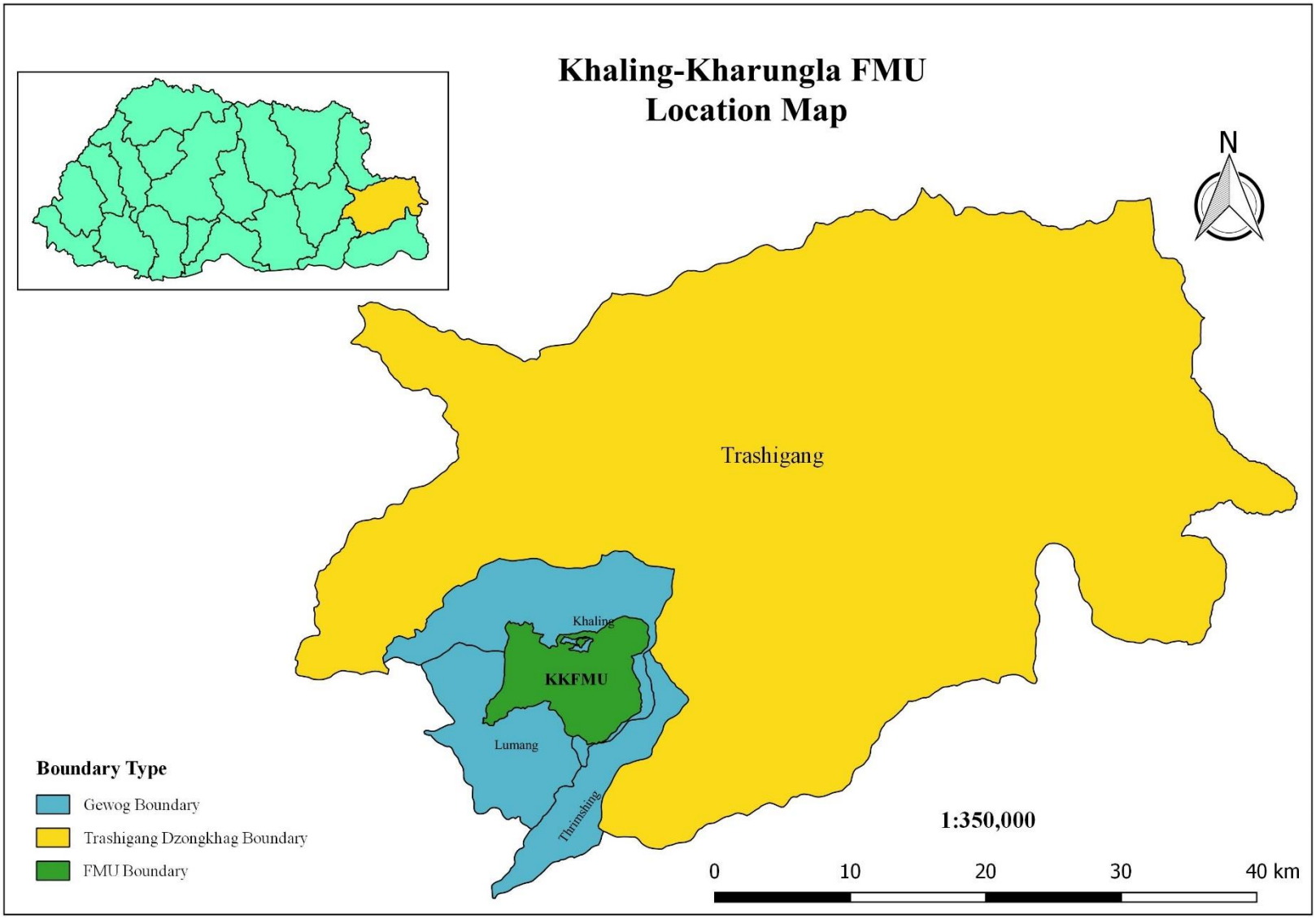
1.5 Legal status

1.5.1 Ownership

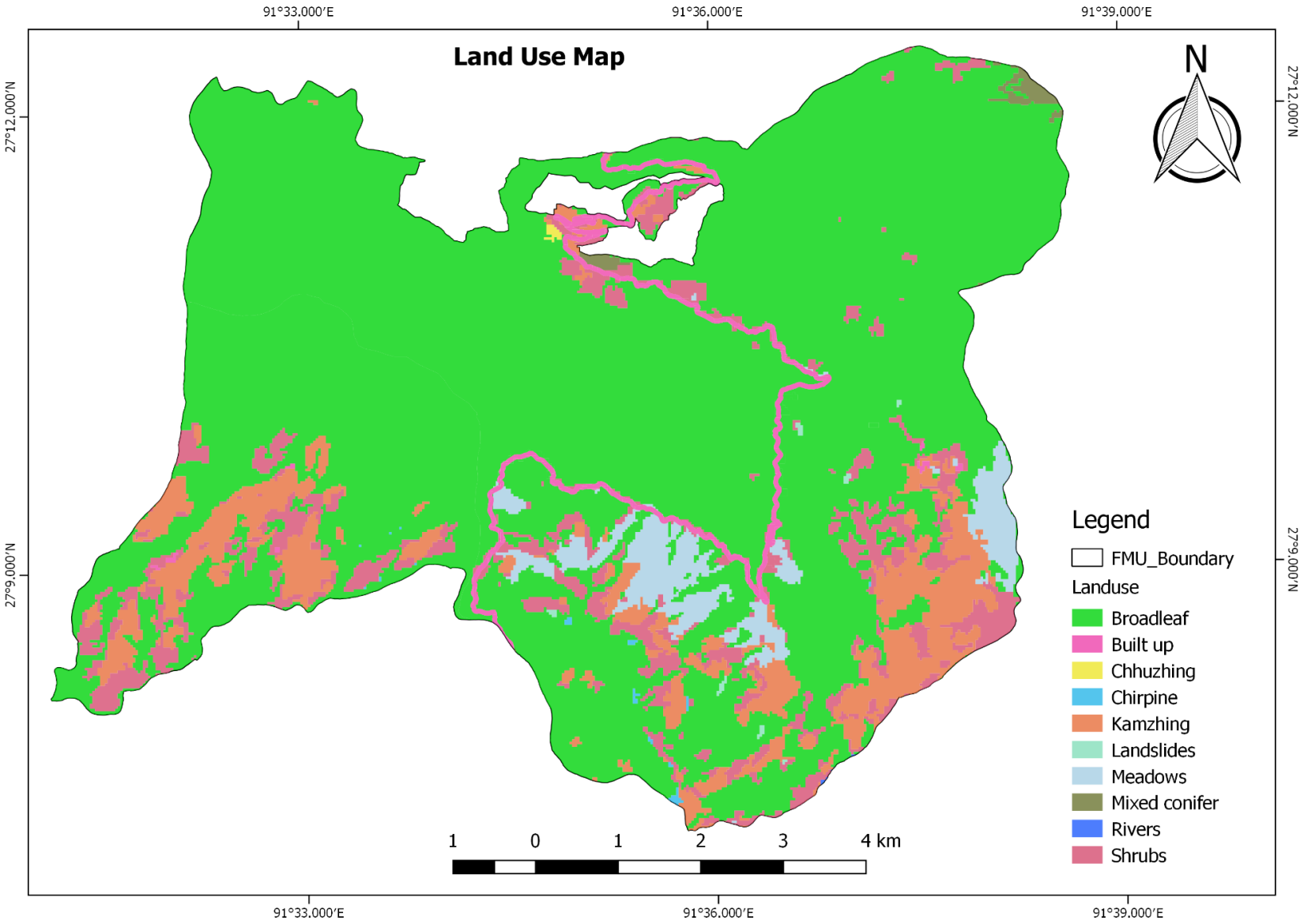
The Forest and Nature Conservation Act 1995, defines forest as "*any land and water body, whether or not under vegetation cover in which no person has acquired a permanent and transferable rights of uses and occupancy, whether such land is lactated insides or outside the forest boundary pillar, and includes land registered in a person's name as tsamdo (Grazing land) or sokshing (woodlot for collection of leaf litter)".* Majority part of KKFMU fall within such area and considered as State Reserve Forest. However, some area of private registered land from Lumang and KhalingGewog also fall within the KKFMU.

1.5.2 Rights and privileges

The Forest and Nature Conservation Act, 1995 and National Forest policy 2011 protects rights and privileges of the local inhabitants with regard to the use of forest for grazing, collection of firewood, fodder, leaf litters, leaf mold and non-timber Forest Products (NTFP) for domestic use, either free or on payment of Royalty. Timber for *bona fide* rural use were also issued based on the recommendation from Dzongkhag/gewog concerned and payment of royalty. Hunting and fishing is restricted unless with proper permit issued by Department of Forest and Parks Services (DoFPS)



Map 1 : Location Map of Khaling Kharungla FMU



Map 2 : Land Use Map

1.5.3 Grazing rights

Since from times immemorial, the local communities of Khaling and Lumang Gewog have traditional rights for grazing their cattle in the forest within the unit. The FMU is also summer grazing grounds for Migratory cattle from Merak and Sakteng. The Forest Management Units was established only from 2009. However, the land Act of Bhutan, 2007 under Chapter 10, Section 235, states that *all Tsamdro land has been deleted from Thram and reverted and maintained as Government.* Therefore all Tsamdros within FMU is reverted to State Reserve Forest unless it is leased with leasehold Thram . Further, the Forest and Nature conservation Act, 1995, Chapter No. VIII, Section No. 30 (a) (c) has the provision to regulate grazing in the in State Reserved Forest.

1.5.4 Water rights

The local population has traditional rights to use water from rivers and stream flowing from FMU for their domestic purposes, such as home consumption, irrigation and other uses. The main rivers are JiridazaRi, Ngesigangnang Ri, Phochu, Mo chu, BaephuRi and Darung Ri. Besides, there are several perennial and seasonal streams and creeks in FMU that serve as water source for the communities.

1.5.5 Historical Monuments and Monasteries

Three Goenpas have been identified under KKFMU namely, Kharphu, Bephuthang and Brekha Gongpa.

2. PERMANEMT SITES FACTORS OF FMU

2.1. Topography

The general terrain of KhalingKharungla Forest Management Unit ranges from very steep to moderate. The slopes are basically steep towards higher elevation with highest proportion of steep area within Kharungla block. Altitude of KKFMU ranges from 1120m towards extreme end of Kurchilo block below Derna village to 3880m in Kharungla block at the highest point.

2.2. Slope

KKFMU has wide range of slope ranging from 0° to 45° and above. Slope classification was done using Digital Elevation Model with 30m x 30m resolution. The areas above 100% slope were delineated as SPP- *Soil Protection* where any sort of activities including timber harvesting are restricted within the area. Slope that ranged from 76-100% are classified as SC – *Soil Conservation* where limited forestry activities with proper plan can take place. Slopes are usually steep at higher elevations above 4000m and gentle at the bottom of the valley.

2.3 Climate

2.3.1 Meteorological Station.

There is no meteorological station both at Khaling and Womrong. Therefore all meteorological data have been derived from Meteorology Station, Hydro-met Services Division, Department of Energy, Ministry of Economic Affairs, Thimphu, Bhutan.

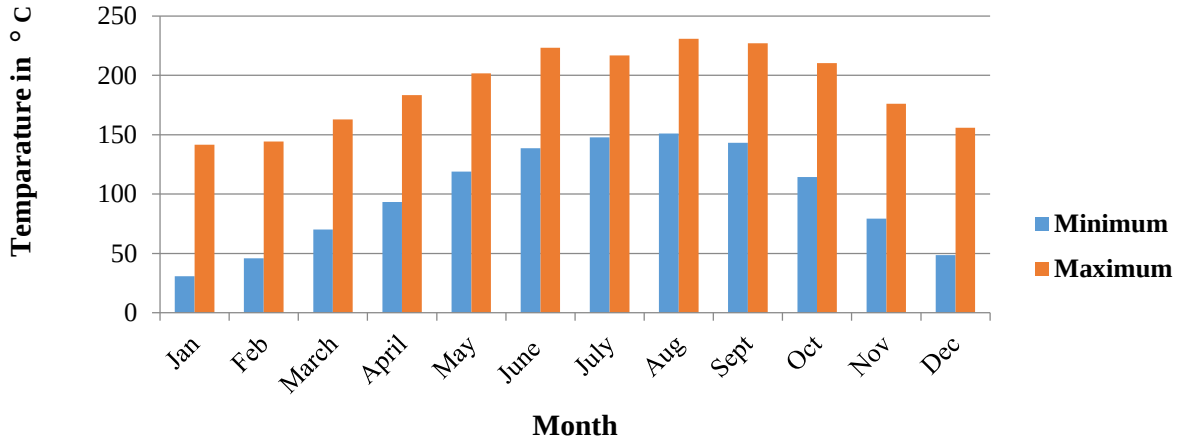
2.3.2 Temperature

2.3.2.1 Maximum and Minimum temperature

The maximum temperature in the last 10 years in KKFMU was recorded in August and minimum in January. Specifically July & August of 2010 had the highest temperature with 16.55°C and January of 2016 had the lowest temperature with (-) 0.24°C.

Figure 1: Monthly maximum and minimum average temperature for last 10 years

(2008-2017)



2.3.2.2 Annual average temperature

The maximum annual average temperature for last 10 years was recorded in 2008 and similarly minimum annual temperature was recorded in 2012 in KKFMU.

Figure 2: Annual average temperature for last 10 years (2008-2017)

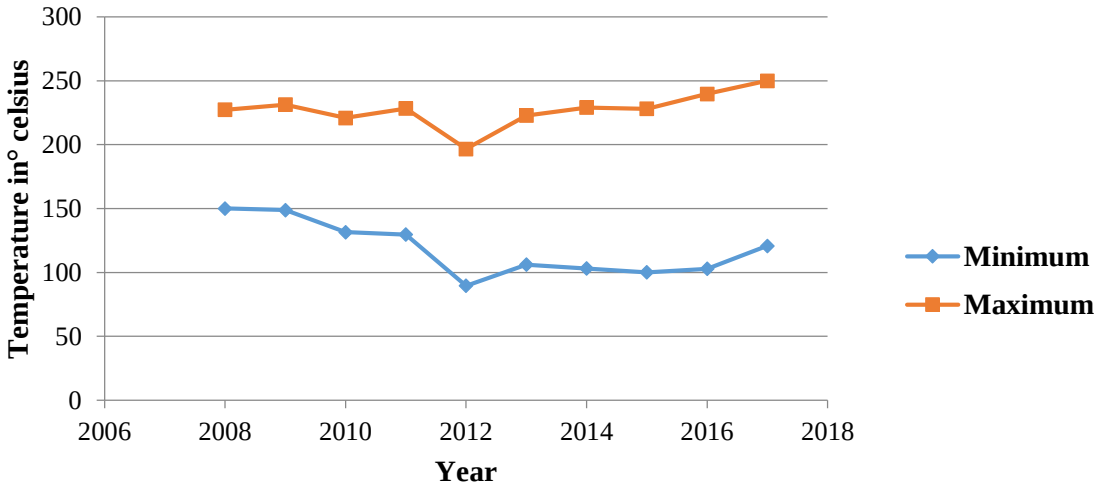


Table 4: Maximum average temperature for last 10 years (2008-2017)

Year	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual max. temp
2008	17.13	15.88	17.6	17.43	20	21.5	17.32	23.65	21.3	21.19	18.83	15.55	**227.38**
2009	14.13	16.79	16.65	18.93	20.23	22.23	22.16	21.65	21.6	23.38	18.47	15.13	**231.35**
2010	15.84	13.32	16.41	18.77	20.48	24.2	19.07	23.32	23.37	13.59	17.33	15.34	**221.04**
2011	14.24	16.04	16.29	18.57	20.74	22.67	22.16	22.33	21.62	22.15	17.33	14.19	**228.33**
2012	10.71	8.07	12.65	14.65	14.73	18.17	20.35	23.35	22.03	20.48	17.4	14.03	**196.62**
2013	13.32	15.93	16.65	17.8	20.4	22.82	22.35	22.1	23.15	19.9	14.7	13.71	**222.83**
2014	13.26	14.13	15.69	19.85	21.34	22.47	23.24	23.01	22.82	21.78	16.57	14.97	**229.13**
2015	14.4	14.63	18.65	17.45	20.61	21.6	22.19	21.95	23	21.78	18.37	13.5	**228.13**
2016	12.61	13.89	17.24	19.82	21.32	22.6	22.62	24.03	23.55	21.97	19.88	20.21	**239.74**
2017	15.98	15.7	15.23	20.12	21.79	25.14	25.29	25.6	24.77	24.21	17.33	19.35	**250.51**
Total	**141.62**	**144.38**	**163.06**	**183.39**	**201.64**	**223.4**	**216.75**	**230.99**	**227.21**	**210.43**	**176.21**	**155.98**	

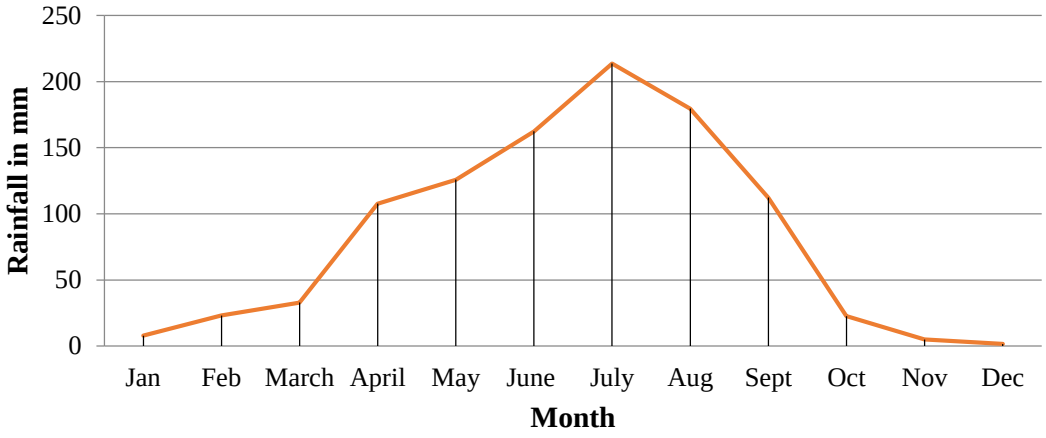
Table 5 : Minimum average temperature for last 10 years (2008-2017)

Year	Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	Dec	Annual temp
2008	7	4.41	8.87	11.67	16.03	15.43	15.13	17.19	16.37	15.45	11.9	10.58	**150.03**
2009	10	10.95	11.61	12.37	14.52	14.07	16.09	16.13	15.9	12.35	8.43	6.45	**148.87**
2010	5.45	5.03	7.38	10.47	12.35	15.03	16.55	16.55	15.65	12.52	8.6	6	**131.58**
2011	2.58	4.36	7.45	10.12	13.65	15.8	16.34	16.03	15.85	12.73	8.57	6.15	**129.63**
2012	1.55	5.49	7.23	5.83	8.73	8.87	9.66	13.82	12.68	8.47	4.62	2.65	**89.6**
2013	0.55	3.63	5.61	8.03	11.35	14.77	14.61	13.85	13.05	10.3	7.6	2.73	**106.08**
2014	0.61	2.52	5.94	8.75	10.87	14.43	15.1	14.35	12.73	8.43	5.73	3.65	**103.11**
2015	1.63	2.39	5.61	7.93	10.95	13.47	14.18	14.1	13.08	9.47	5.82	1.43	**100.06**
2016	-0.24	2.98	5.79	8.95	9.26	13.45	15.13	13.95	13.43	10.38	5.53	4.24	**102.85**
2017	1.69	4.2	4.73	9.22	11.24	13.42	15.16	15.12	14.43	14.39	12.4	4.79	**120.82**
Total	**30.82**	**45.96**	**70.22**	**93.34**	**119**	**138.74**	**148**	**151.09**	**143.17**	**114.5**	**79.2**	**48.67**	

2.3.3 Rainfall

The highest monthly rainfall over the last 10 years in KKFMU was experienced in the month of July and minimum in December.

Figure 3: Average monthly rainfall for last 10 years



2.3.3.1 Annual rainfall

The maximum annual rainfall in KKFMU was experienced in 2015. Similarly the minimum annual rainfall was experienced in 2016 in KKFMU.

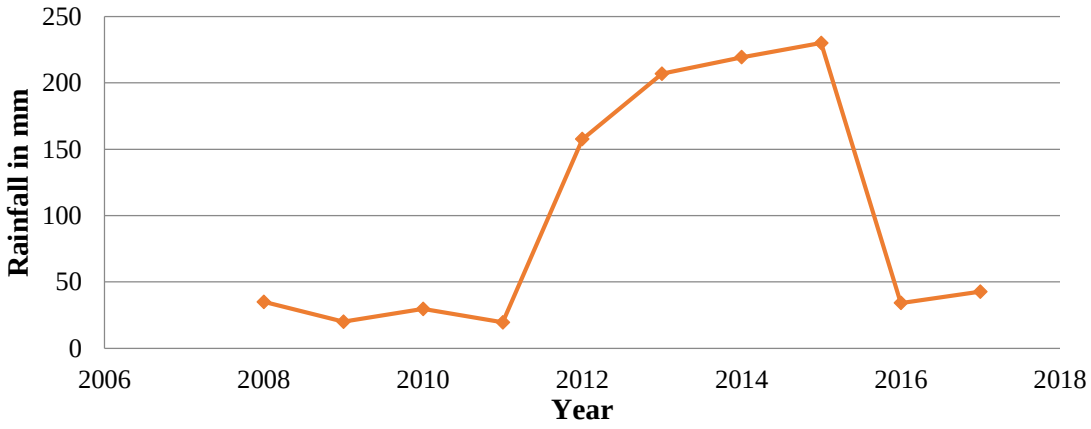


Figure 4: Annual rainfall

Table 6: Rainfall for last 10 years (2008-2017)

Year	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual rainfall
2008	0.22	0.69	1.26	4.7	3.32	6.5	4.1	10.19	2.47	1.16	0	0.32	**34.93**
2009	0	1.43	0.65	1.93	3.55	0.67	4.29	4.52	0	2.23	0.67	0	**19.94**
2010	0	0	2.16	4.9	2.58	3.8	5.42	4.23	4.37	1.35	0.77	0	**29.58**
2011	0.13	0.64	1.03	3.03	3.32	1.63	3.87	2.45	2.52	0	0.7	0.19	**19.51**
2012	0.45	0	0.89	19.25	15.12	32.74	34.31	22.12	31.23	1.01	0	0.48	**157.6**
2013	0.13	12	16.65	32.33	40.68	5.93	49	6.59	31.83	10.74	0.67	0.32	**206.87**
2014	0	0.39	1.53	0	25.74	51.07	57.9	56.12	23.23	1.45	1.57	0.29	**219.29**
2015	6.42	7	5.68	36.1	24.32	46.03	35.55	61.64	5.91	1	0.34	0	**229.99**
2016	0.35	0.34	1.93	3.08	0	4.9	11.67	5.32	4.25	2.18	0	0	**34.02**
2017	0.13	0.6	1.1	2.32	7.24	9.05	7.52	6.37	6.47	1.58	0.28	0	**42.66**
Total	**7.83**	**23.09**	**32.88**	**107.64**	**125.87**	**162.32**	**213.63**	**179.55**	**112.28**	**22.7**	**5**	**1.6**	

2.4 Geology and soil

During the field survey, it was observed that parent rock in KKFMU mainly consist of Quartzite and phyllites, which is formed during Dangling formation(Samtse/Shumar) in Pre-Combrain age. The soil is clayey loam to sandy loam in nature and is moderately fertile. High humus content and well drained sandy loam soil are found in broadleaf forest, while shallow and stony soil covered by pine needles are found in the chirpine forest. It has observed that soil is moderately prone to surface erosion or landslides. The parental rock found within KKFMU indicates that soil is preferred for forestry activities with appropriate silviculture system and management prescription. Therefore, adequate care must be taken not to expose large areas to avert the loss of fertile soil.

Figure 5: Types of rocks in KKFMU

2.5. Hydrology

The entire KKFMU is the watershed for Jiridazza Ri, NgesiganRi, Pho Chhu, Mo Chhu, BephuRi, Dem Ri and DarungRi. There are several perennial and seasonal streams in the FMU that flows into the rivers. The entire area of Kharungla particularly is an important area as it designated as main drinking water source for Wamrong town area. KKFMU is also water source for all residents residing within the FMU area as well people residing outside the FMU.

In general, the water source within FMU are clean. However cattle grazing in these watershed areas needs to be regulated in order to maintain clean drinking water source. In addition to appropriate silvicultural system and harvesting methods, a stream buffer of 30m must be maintained to ensure the quality and quantity of water is not affected due to forest operation.

3. VARIABLE SITE FACTORS

3.1 Population and Demography.

Trashigang Dzongkhag consists of fifteen Gewog with population of 45,518 (source: Population and housing census of Bhutan, 2017). Two gewogs namely Khaling and Lumang Gewog fall within FMU with population of 12494 (source: Gewog Administration). Out of which 6474 are male 6023 are female. On an average, the household size is 10.98 persons. Rural Urban Migration is a common phenomenon in villages located within the FMU. The probable reason includes employment opportunity, marrage and education. However, entire Gewog area do not fall within FMU area.

The Gewog wise distribution of households and population is as tabulated below:

Table 7: Demography of two gewog

Sl. No	Gewog	Nos. of HH	Population		Total population	Remarks
			Male	Female		
1.	Khaling	389	3165	2849	6014	
2.	Lumang	749	3309	3174	6480	
	Total	**1138**	**6474**	**6023**	**12494**	

3.2 Agriculture and Farming Systems.

The people residing within FMU area are mostly engaged in subsistence farming together with rearing of livestock or so called mixed farming. People of two Gewog own both Kamshing and

chhushing. However, the people in the Gewog cannot engage in large scale agricultural activities because of rugged terrain and fragmented land holdings. Potato and maize are their main cash crop. Potato is grown in the 7th month of Bhutanese calendar and harvested in the 5th month. Maize is grown in the 1st month of Bhutanese calendar and harvested in the 9th of month. They also grow other vegetables like cabbage, radish, beans, chilly, garlic and etc. Fruit trees like peach, pear, banana and plum are also grown in the Gewogs.

People in the Gewog also rare cattle like Mithun, horse, pig and poultry. They earn some income through agriculture and livestock product, which they sell at Khaling and Womrong market. The highlander cattle from Merak and saktang also moves to FMU area during winter and returns back in April and May.

3.3 Traditional Use of the Forest

Ever since the settlement has been taken place in and around FMU area, people of Khaling & Lumang Gewogs has been using forest area within the FMU for the supply of timber, firewood, fodder, leaf litters, fencing materials, farm implements, bamboo and grazing land for cattle. Rural House Building timber is considered as the most important forest product by public next to firewood which used for cooking and heating. However, shingles are rarely collected since it is substituted with galvanized sheet. People also collect pole/post from the FMU area for fencing and for other purposes. The Non-Wood Forest Products such as fodder, leaf litters, mushrooms, cane, medicinal plants and bamboos are freely collected from the FMU area.

Persea spp, Mechelia spp, Magnolia spp, Alnus spp and castonopsis spp tree species are mostly preferred for construction. while *Qurcus spp* are mostly preferred tree species for firewood. Bamboo is considered as important Non-wood species since it can be used for various purpose in their daily needs.

3.4. Grazing

Grazing is seen as a major threat for sustainable management of Forest within the FMU area, since grazing is evident in almost throughout the FMU. The migratory cattle from Merak and Sakten are brought down within FMU area during winter and grazed within FMU area. All fodder trees within FMU are looped for fodder purposes. Besides, it has also affected the establishment of plantation/seedlings due to heavy grazing. It was observed that grazing within FMU at current rate will significantly impact on the soil and water quality besides sustainability of FMU as a whole.

People of Khaling & lumang also raise cattle. However, no horses are reared with the road facilities within the gewog. They are being grazed within FMU area. According to data collected from RNR center of Lumang and Khaling, there are approximatly 2146 number of cattle within two gewogs.

3.5. Forest fires hazards

Forest fire is one of the major cause of forest depletion and degradation in the country. Forest fire has both positive and negative effect on the ecology of forest. However, in Bhutan negative effect of forest fire would be more common. The causes of forest fire in Bhutan are both natural and anthropogenic.

Forest fire in the eastern region is an annual phenomenon, especially in the Chir pine forest. However, forest fire is not so prevalent in the FMU area. Majority of FMU forest area consist of broadleaf forest in which forest fire is not a severe issue. However, regular vigilance and alertness is required to prevent forest fire besides educating the people on effect of forest fire on the forest ecology and ecosystem.

3.6 Forest pest and diseases

Forest pest and diseases are always present and it's a part of ecosystem in any type of forest. But its presence has not significant due to its level of injury to the forest. Forest pest and diseases are most rampant in the mixed conifer forest in the west and central region. Although, there is patch of mixed conifer forest within Khaling block, pest and diseases are not very common within the area. However, strict and regular monitoring needs to be carried out to prevent outbreak of pest and diseases within the area as well as other broadleaf forest area.

The guidelines developed by the DoFPS for forest protection and management of pest and diseases in the forest must be followed and strictly implemented.

3.7 Non-wood Forest Products

Non-wood Forest products(NWFPs) play importance role in the daily lives and overall wellbeing of the Bhutanese people especially among the rural farming community; for instance they are major source of off-farm income, food, medicinal and aromatic products, fodder, fiber, dye, incense, spices plants and local construction materials. Khaling Kharungla FMU too has wide array of NWFPs that is used by the community of Khaling and Lumang Gewog. Among many NWFPs, bamboo is widely used NWFP since it can be used for numerous purposes required in their daily life.

Some of the NWFPs found within FMU areas are grouped as per their usage and are listed accordingly in the following tables.

3.7.1 Medicinal plants

Bhutan is rich in biodiversity including medicinal plant. Use of wild medicinal plants has been an age old practices in Bhutan and is recognized by the Royal Government of Bhutan (RGOB). The medicinal plants are used by traditional medical practitioner to prepare drugs.

Similarly, Khaling-Kharungla FMU too has number of medicinal and other economical plant that is used by the people of Khaling and Lumang. The list of medicinal plants were collected during interview with local public.

Botanical Name	Local Name	Habit	Part used	Treatment
Artimisa spp	Meringma	Shrub	Leaf	Antiseptic
Balamcanda	Gemtsesha-shaba-meto	Herb	Root	-do-
Gourd species	Khogtsaam shabha	Runner	Leaf	-do-
Cyclamen spp	Dug-man (Brokpa)	Herbs	Tuber	-do-
Astibe rivularis	Tongsa-ja-shabha	Herb	Rhizome	Body pain &
Ex-bucklandia spp	Ja-shing(lem-shing)	Tree	Leaf	Syphilis
Viscum album	Nga-shing jurma	Miseletoe	Whole plant	Bone fracture &
Cyclamen spp	Pat-pa-man	Herb	Succulent	Leech cuts
Cannabis sativa	Phag-pa-nam	Shurb	leaf	Bloat/gastric
Pseudoginseng	Dingi- raza (ginshing)	Shrib	Tuber/root	Traditional

3.7.2 Economic plant

There may be thousands of economical plants that human have found economically useful. The lists of plants below are those that are identified through interview with local public.

Table 8: List of economic plants

Botanical Name	Local Name	Habit	Parts eaten
Auricular auricula	Na-gor-bamung	Wood saprophyte	Whole tissue
Plerotus	Yu-la-bamung(yellow)	-do-	-do-
Plerotus oestreatus	Yu-la-bamung (white)	-do-	-do-
Plerotus salmoneo	Yu-la-bamung (red)	-do-	-do-
Ramaris spp	Ba-sha-bamung	-do-	-do-
Tremela fuciformis	Na-gor-bamung	-do-	-do-
Lichen spp	Bai-nang-punpa	-do-	-do-

3.7.3 Edible fruits and nuts

Wild edible fruits and nuts are nutritionally very rich and of great medicinal value. Collection of edible fruits and nuts are age old practices in Bhutan. The people of Khaling and Lumang also collect wild fruits and nuts from FMU area for home consumption. Following are some of the wild edible fruits and nuts that are basically collected by the public of Khaling and Lumang.

Table 9: List of edible fruits and nuts

Botanical name	Local name	Habit	Part used
Castanopsis spp	Tshoi-shing	Tree	Fruits
Juglans regia	Khe-se	Tree	Fruits
Persia fructifera	Goli	Tree	Fruits
Pyrus spp	Li-tong	Medium tree	Medium tree
Pyrus	Thu-kag-pa	Tree	Tree
Rubus ellipticus	Ser-gong	Shrub	shrub
Urtica diocia	Ju-zu-ngom	Shrub	shrub

3.7.4 Fibre

Plants provides fibre for vide verities of humans daily need including clothing. Followings are some of the fibres that is basically collected from FMU and used by the people of Khaling and Lumang.

Table 10: List of fibre

Botanical name	Local Name	Habit	Part used	Remarks
Daphne spp	Sho-gu-shing	shrub	Bark	
Borindagrossa	Shi	Bamboo	Culm	
Cannabis sativa	Phag-pa-nam	Shrub	bark	
Rubiacordifolia	La-ni-ngong	Shrub	Stem	
Girardinia spp	Zang-ru	Shrub	Bark	

3.7.5 Natural dye

There are numbers of dye yielding plants within KKFMU area. Local people obtain the dye from the plants by simple traditional method. The following are some the natural dyes from the people from FMU area.

Table 11: List of natural dye

Botanical Name	Local Name	Habit	Part used
Berberis spp	Kerpa -zoo	Shrub	Root
Elsholtzia fruticosa	Lhas– khangshing	Shurb	Leaf and bark
Quercusgriffithi	Bai-nang- shing	Tree	Leaves
Juglansregia	Khe-shing	Tree	Sheel
Rhuswallichi	Roptang-shing	Tree	Fruits
Symplocus spp	Zim-shing	Tree	Leaves
Lycopodium spp	Za-la-gadang	Moss	Whole plant
Rubiacordifolia	La-ni-ru	Vine	Stem

3.7.6 Incense materials

Incense stick is manufactured from the plants that yield sweet scents. The following are some of the incense plant readily available within KKFMU area.

Table 12: List of incense materials

Botanical Name	Local Name	Habit	Part used
Daphne spp	Sho-gu-shing	Shrub	Wood-chips
Rododendronspp	Zhu-dang-meto	Tree	Leaf and bark
Gautheriaspp	Shak-shing-ma	Shrub	Leaf
Berbirisspp	Kerpa-zoo	Shrub	Whole plant
Elsholtziaspp	Lhas-khang-shing	Shrub	Leaf
Artemesiaspp	Me-ring-ma -shing	Shrub	Whole plant

3.7.7 Spice plants

Generally spices plants are used as food flavouring agent. Many of spices plants also has medicinal value. Following are some of spices plants available within KKFMU.

Table 13: List of spice plant

Botanical Name	Local Name	Habit	Part used
Linderaneesiana	Neng-se	Tree	Fruits
Zanthoxylemspp	Ghi	Shrub	Fruits
Rhuswallichi	Robtang-shing	Medium tree	Seed

3.7.8 Plants materials used for roofing

In the past, people in Bhutan including has been using the following materials for roofing. However, with development of country, these materials are now hardly used for house roofing. It is now used only for other purposes like cowshed roofing, fencing etc.

Table 14: List of plant materials used for roofing

Botanical Name	Local Name	Habit	Parts used
Borindagrossa	Shi	Bamboo	Culm
Castonopsisspp	Tshai-shing	Tree	Wood
Pinusroxburghii	Roinang-shing	Tree	Wood
Yushiniaspp	Shi-za	Bamboo	culm

4. ECOLOGY AND WILD LIFE

4.1 Ecology

Bhutan has great diversity of ecosystem partly because of its location at the juncture of Palearctic realm of the temperate Eurasia and the Indo-Malayan realm of Indian sub-continent, and partly due to the country's great geological relief and climatic heterogeneity (RGOB, 2002). Through this natural endowment, Bhutan has acquired special significant so-called East Himalayan biodiversity "hot spot" (salter,1995). The Royal Government of Bhutan's policy to maintain at least 60 percent of the total land area under Forest cover with conservation given priority over extraction and utilization of natural resources for economic gains. Therefore, this has to be

considered in the forest management and underpin all forest activities within the FMU should compromise biodiversity or Ecological functionality.

4.2 Floral Association

Bhutan has a very diverse flora with affinities to southeast Asia (mainly tropical *taxa*), China/Japan(temperate *taxa*), Tibet, the Euro-siberian region, and the arctic/alpine areas of Europe and Asia and to a very limit extent, to the floras of India and Sri lanka (BAP,2003). However, detail classification of the vegetation in Bhutan has not been taken in Bhutan and work of Champion and seth (1968) on classification of the classification of forest in India which includes Himalayas could be applied to many of forest types in Bhutan.

On basis of forest zonation, KKFMU occupies the central and southern belt and exhibits a distinctive vegetation zonal distribution pattern ranging from low to high altitude terrains.

4.3 Flora of KhalingKharungla

Following are the list of floral association found within KKFMU.

Table 15: List of flora found in KKFMU

Common Name	Scientific Name
Chestnut	*Castonopsisindicanopsis*
Maple	*Acer spp*
Birch	*Betilaspp*
Pipli	*Exbucklandiaspp*
Lindera	*Lindraneesiana*
Gumilo	*Symplocospaniculata*
Chir pine	*Pinusroxburghii*
Bhutan pine	*Pinusbotanica*
Lemon grass	*Cymbopogonflexuosus*
Yew	*Taxusbaccata*
Champ	*Micheliachampaca*
Kutmeri	*Litseanmonopetala*
Kawla	*Perseafrutifera*
Oak	*Quercusgrifithii*

Rhododendron	*Rhododendron spp*
Utis	*Alnusnepalensis*
Tarshing	*Beilschmiediaroxburghiana*
Malagiri	*Cinnamomumspp*
Setochulatro	*Brassaiopsishainla*
Ficus	*Ficusspp*
Arkaula	*Lithocarpusspp*
Red sandalwood	*Daphniphyllumhimalense*
Walnut	*Jugalansreg*
Bhalayo	*Rhuswallichi*
GashaThung say	*Elaeocarpuslanceifolius*
Zala-shing	*Schimawallichii*

4.4 Fauna of KhalingKharungla

Khaling-kharungla is home to various species of birds and animal. The wildlife listed here are those which have been observed and spotted during the field inventory. Wild animal like barking deer, wild pig, jungle fowl, and monkey have been sighted on many occasions while indirect evidence verifying the existence of some of the animal such as bear has been observed as well. Additional information was collected during the socia-economic survey in the area. During the PRA exercise, it was found out that Wild boar followed by Barking Deer, Sambar Deer are some most nuisance to the people. They not only destroyed their main source of cash crop but also expended farmer time in having to guard the crops against these nuisance wild animals.

Table 16: List of fauna in KKFMU

Common name	Scientific name	Comment
Barking Deer	*Muntiacusmuntjak*	
Samkhar Deer	*Cervus unicolor*	
Monkey	*Rhesus sp.*	
Porcupine	*Erethizondorsaum*	
Jungle Fowl	*Gallus gallus*	
Fyling squirrel	*Petaurista sp.*	

Grey Langur	*Presbytis entellus*	
Rufouse-necked hornbill	*Acerrosnipalensis*	
Goral	*Nemorhaedus goral*	
Bear	*Ursus sp*	
Wild dog	*Cuon sp*	
Common leopard	*Panthera sp*	
Wild boar	*Sus scrofa*	

4.5 Avifauna

Khaling-Kharungla Forest Management Unit has rich diversity of bird species. The different categories of forest ecosystem in the KKFMU are best suited for the avifaunal wealth present there. Bird survey and identification was conducted along with inventory during resources assessment. Following are some of the bird recorded during the resources assessment.

Table 17: List of common avifauna in KKFMU

Common Name	Scientific name	Comment
Rufous Breasted Accentor	*Prunella strophiata*	
Russet Sparrow	*Passer rutilans*	
Yellow Bellied Fantail	*Rhipidura hypoxantha*	
Rufous Sibia	*Heterophasia capistrata*	
Common Kestrel	*Falco tinnunculus*	
Grey Treepie	*Dendrocitta formosae*	
Long-tailed Shrike	*Lanius schach*	
Wedge tailed green Pigeon	*Treron sphenurus*	
Plumbeous Water Redstart	*Rhyacornis fulignosus*	
Whiskered Yuhina	*Yuhina flavicollis*	
Hill Partridge	*Arborophila torqueola*	
Blue Whistling Thrush	*Myophonus caeruleus*	
Oriental Turtle Dove	*Streptopelia orientalis*	

Large- billed Crow	*Corvus macrorhynchos*	
Oriental White-eye	*Zosterops palpebrosus*	
White Throated Laughingthrush	*Pterorhinus albogularis*	
Blue Fronted redstart	*Phoenicurus frontalis*	
Kalij Pheasant	*Lophura Leucomelanos*	
Black Bulbul	*Hypsipetes leucocephalus*	
Great Barbet	*Megalaima Virens*	
Green backed Tit	*Parus monticolus*	
Bhutan Laughingthrust	*Trochalopteron imbricatum)*	
Grey Bushchat	*Saxicola ferrea*	
Green- tailed Sunbird	*Aethopyga nipalensis*	
Rufous-necked Hornbill	*Aceros nipalensis*	
Great Hornbill	*Buceros bicornis*	
White Capped Redstart	*Phoenicurus leucocephalus*	
Striated Laughingthrush	*Garrulax striatus*	
Yellow Bellied Blue Magpie	*Urocissa flavirostris*	
Grey Wagtail	*Motacilla cinerea*	
Greater Yellownape	*Picus flavinucha*	

Soucre: Prem Nanda, KKFMU, Womrong

5. SILVICULTURE ASSESSMENT

5.1 Present Forest Types

According to Champion and Seth, the country is divided into three physiographic zones, each with one or more distinct vegetation zone(s).

Northern belt	Altitude above 4000masl, with no forest cover; the alpine areas
Central belt	Altitude between 2000masl and 4000 masl containing the major temperature conifer and broad-leaved forest
Sothern belt	Between 200masl and 2000 masl altitude containing tropical and subtropical vegetation.

On this basis, KKFMU falls within the central and southern belt. Thus the forest within FMU constitute of temperate, tropical and sub-tropical forest. The forest land within the FMU is classified in the following types.

1. Warm broadleaf forest – the forest type found occurring at altitudes between 1000-2000m with lower rainfall and contain mixture of evergreen and deciduous broad leaved tree species. Many of the tropical species are not represented but temperate genera are well represented. The predominant species are *Schima wallichi, Castanopsis indica, persea species etc*.
2. Cool broadleaved forest – above the warm broad leaved forest are found cool broad leaved forest. The drier art contains the evergreen oak forest and the wetter part contains mostly mixed forest, which oaks are less common. The species mostly found in this forest type are *Quercus species* and *Castanopsis* in the drier part and *Acer species, Betula alnoides, Symplocus species, Lindera neesiania etc.*
3. Chir Pine Forest – this is a low altitude (900-1800m) xerophytic forest ecotype occurring in the deeper rain show valley with low rainfall between 100 and 130cm. These valleys have a very long dry season during which forest fires are common and heavy rain occurs only in the monsoon season when abundant herbs, especially lemon grass and other under growth appears. Almost on other trees species occur. Typically, the soils are shallow, skeletal in path, light reddish brown with a lack of humus content. The characteristic species in this forest types area: *Pinus roxburghii, Cymbopogon flexuosus, Cymbopogon martini, Rhus paniculata, Zizyphus species.*

Warm broad leaf or hardwood forest is found in all the six blocks. The stand in general is mature but pockets of immature stand also exist. Khaling block has good stock of timber however, trees within block III 2 of Khaling (above and beyond forest road) are heavily lopped by the High Lander cattle herders. In general, regeneration in KKFMU is good however, due to grazing pressure from highlander cattle, regeneration in some of the areas in KKFMU is poor and need strict management interventions.

Table 18: Area covered by different Forest types and percentage of FMU area.

Forest Types	Area (ha)	%
Broadleaf	5522.55	77.67
Chirpine	6.06	0.09
Mixed conifer	25.07	0.35
Grand Total	5553.69	78.11

5.2 Past Silviculture Treatment

Khaling-Kharungla Forest Management Unit is under third phase of Management Plan. During the first and second management plan, KKFMU was grouped into following working circles.

Table 19: Past working circles

First Management Plan		Second Management Plan	
Working Circle	***Area***	***Working Circle***	***Area***
Protection	2210.76	Soil Protection	3903.72
Community Forestry	1261.39	Soil Conservation	565.37
Broadleaf (Hardwood)	3804.39	Local Use Only	296.61
		Religious Site Protection	114.22
		Riparian Reserve Protection	598.86
		Local Water Supply Protection	290.68
		Road buffer	583.89
Bamboo over-lapping			
Total area	**7276.54**		**6353.35**

Since the area under harvesting operation was mostly hardwood, only one silviculture system that was small patch clear feeling system was prescribed. The annual coupe size was fixed at 22 hectare in the first phase of management. With regeneration problem encountered in the broad leaved forest, the mode of regeneration was artificial. The working circle was with special objective management which was unattained.

5.3. Plantation

With regeneration issue in broad leaved forest, artificial regeneration is only mode of regeneration. The area operated are artificially planted by NRDCL. The species planted are mixture of *Persia, Acer, Michelia, Juglan and Nyssia* at the spacing of 2.5m x 2.5m. However,

there are severe problem with regeneration in the FMU. Grazing is the main problem in FMU. Besides, grazing pressure from local cattle, the highlanders too bring their cattle within the FMU for grazing. Therefore, high numbers of cattle grazing within FMU area is serious threat to the regeneration in the area. The whole of the production block especially Khaling and Sherubtse block is grazed all year round. Better accessibility due to FMU road and profuse growth of grasses along the open corridor has encouraged cattle grazing in the operated area. Local people intentionally open up or destroy the fence and let the cattle inside the plantation areas. Deliberate opening of fence are common sight observed in the plantation area.

There is a long gestation period between post-harvest operations and planting. The long gap between clearing of residues of forest and regenerating the area is one of the serious problem that lead to failure. Following are some plantation and operation details carried out over the last 10 years i.e during the 2nd phase of Management Plan.

Table 20: Plantation detail

Sl. No	Plan period	No. of cable lines	Total area felled (Ha)	Area planted (Ha)	No of seedling	Species
1.	2009	0	0	0	0	Acer, Juglance, Mechalia, Exbucklendia, Persia, Nyssia
2.	2010	0	0	0	0	
3.	2011	0	0	0	0	
4.	2012	6	9.8	0	0	
5.	2013	4	4.22	8.06	12896	
6.	2014	2	1.89	6.79	10864	
7.	2015	2	1.96	9.93	15888	
8.	2016	1	2.22	2.04	3264	
9.	2017	1	2.15	4.04	6464	
10.	2018	0	0	3.03	4848	
	Total	16	22.24	33.89	54224	

Note : The plantation survival percentage of above plantations is less than 49% on an average. Thus there is a need for replantation of seedlings in above plantation during this plan period.

6. Socio-economic

6.1 Common source of income

Mixed farming is been practice by the people residing within KKFMU. Therefore, products from the field and livestock are the major source of income of farmer living in the KKFMU. However, agriculture is restricted because of rugged terrain and fragmented and holding. Potato and maize are main crops grown within two Gewog. Varieties of vegetables like cabbage, cauliflower, broccoli, onion, pumpkin, cucumber, beans, reddish and carrot are grown within two Gewogs. People usually rear cattle, horse, pig and poultry. They earn some income through agriculture and livestock products which they sell at Womrong and Khaling market.

7. Current timber supply and demand.

Khaling-Kharungla Forest Management unit not only supplied commercial timber but it also supplies timber and fuels wood for rural use. Since local communities have been using the FMU area for collection of firewood, timber and other NTFPs even before the establishment of the FMU, communities have traditional right over such use within the FMU area. Accordingly, Unit Office, Womrong has catered following quantity of forest produce from the area until 2019.

Table 21: Commercial and Rural Timber supply

- **Rural Timber Supply**

Plan period	Year	Timber (M^3)	Poles (M^3)	Firewood (M^3)	Total standing volume
2nd plan period	2009	0	0	0	
	2010	316.38	0	0	460.38
	2011	702.49	188.25	105.55	996.29
	2012	666.76	19.07	124	809.83
	2013	49.27	9.23	152.73	211.23
	2014	37.38	7.93	239.42	284.73
	2015	169.92	121.01	955.25	1246.18
	2016	195.7	81.03	196	472.73
	2017	41.6	60.23	234	335.83
	2018	580.22	19.18	376.77	976.17
	2019	-	-	-	544.81

	Total	**2759.72**	**505.93**	**2383.72**	**6338.18**

Source: Unit Office, KhalingKharungla, Trashigang

The rural AAC allotted for KKFMU in the second Forest Management Plan is 1009.01M^3, which would accumulate to 10090.1M^3in 10 years. However, within 10 years of management plan, total quantity of timber supplied from KKFMU for rural use is only 6338.18 M^3.

	AAC as per the management plan (m^3)	**AAC for 10 years (2009-2018)**	**Actual timber volume allocated (m^3)**	**Undercut Volume**	**%**
Rural	1009	10090	6338.18	3751.92	37

Therefore, the Rural AAC of the FMU has been undercut by 37% during the last plan period (2009-2019).

- **Commercial Timber Supply**

Sl. No	**Year**	**AAC as per Mgt Plan**	**Standing Volume allotted (m^3) as per the OP**	**Volume extracted (m^3)**
1	2010-2011	1697	848.5	0
2	2011-2012	1697	848.5	328
3	2012-2013	1697	3209	4196.58
4	2013-2014	1697	1352.17	3723.4
5	2014-2015	1697	1462.417	4461.43
6	2015-2016	1697	1697.13	1639.53
7	2016-2017	1697	1697.13	850.2
8	2017-2018	1697	1697.13	822.43
9	2018-2019	1697	1697.13	286
10	2019-2020	1697	295	0
		16970	14804.107	16576.24

	AAC as per the management plan (m^3)	**AAC for 10 years (2009-2018)**	**Actual timber volume allocated (m^3)**	**Undercut Volume**	**%**
Commercial	1697	16970	16576.24	393.76	2

Therefore, the Commercial AAC of the FMU has been undercut by 2% during the last plan period (2009-2019).

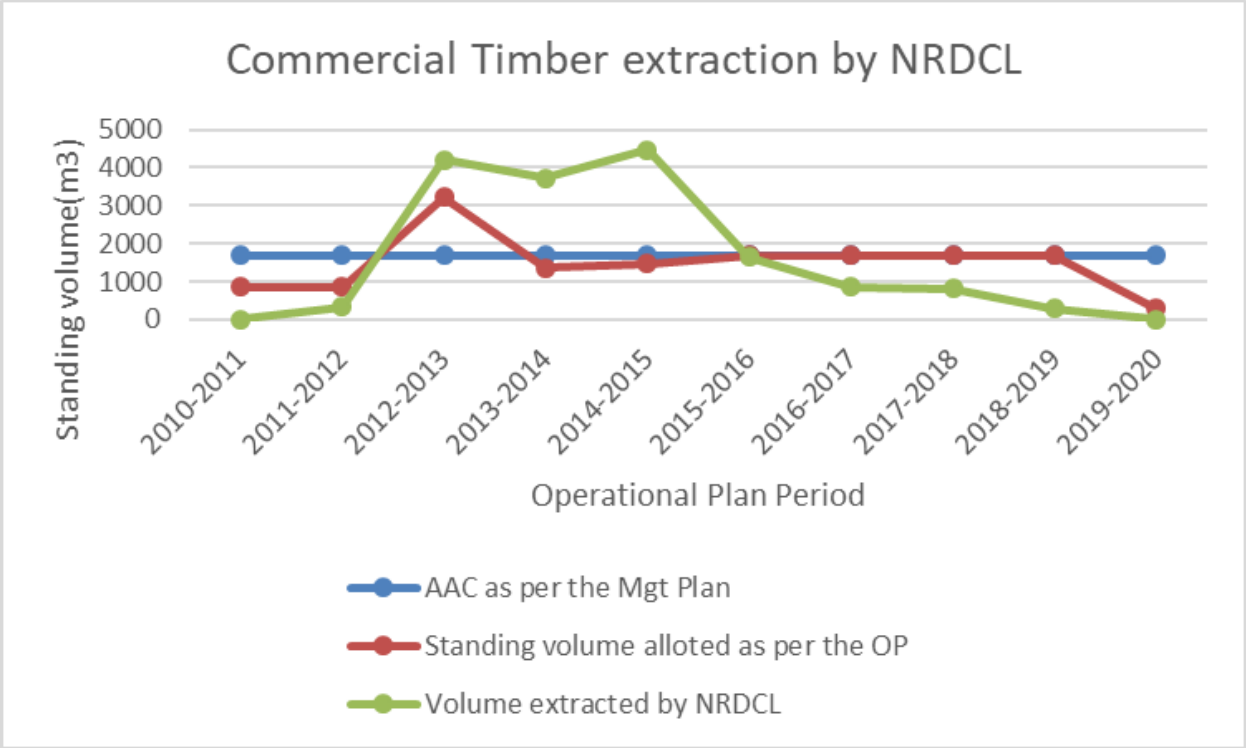


Figure 6: Commercial Timber Extraction from Khaling Kharungla FMU

8. ORGANIZATION AND ADMINISTRATION

8.1 Organization

Khaling-Kharungla FMU is under the jurisdiction of the Trashigang Forest Division and is directly administered by the Chief Forestry Officer. The Chief Forestry Officer is supported by the Unit In-charge, who supervises the FMU. Operational plans will be developed and written by FMU management, with assistance and input of the Chief Forestry Officer, Trashigang. The unit office is located in Womrong.

8.2 Health and safety

Forestry operation involves major health risk especially during the operation and transportation of timber. Health and safety has been featured within the environmental statement of the national environmental commission. As stated in the environment statement and the consultation report, harvesting and extraction method have identified as the areas of most concern and need to be addressed.

NRDCL taking up the implementation part of the management, the issues need to be addressed by the implementers. At present health and safety measures are poor and sometimes absent. Site specific risk assessment seems necessary if not generic risk assessment.

Action can be initiated with little or no expenditure to ensure health to ensure health and safety of the field staff. Following are some of the recommendation to minimize the health hazards in the field.

1. Ensure all the workers are equipped with safety gears and proper safety equipment.
2. Conduct health risk assessment for all activities
3. Ensure chain saws equipped with full functioning chain breaks
4. Always ensure feller to keep two tree length apart while felling.
5. Explain the danger of falling timber and overhead cables lines.
6. Stack timbers in the same direction and stack not too high.
7. Never approach or climb log piles from the bottom of slope.
8. Always dismantle a stack from the top rather than from bottom.

8.3 Record keeping

The Forest Management Code of Bhutan (2004) has identified record keeping as a critical and concern. Vital information that would be very helpful in planning were either not properly maintained or lost. Forest Resources Management Division (FRMD) under Department of Forest and Park Services (DoFPS) developed comprehensive format for record keeping.

Keeping above few points in mind, FMU office shall maintain all information at different record entry point as per the record keeping format available within Forest Management Code of Bhutan (2004).

9. INFRASTRUCTURE, TRASNPORT AND EQUIPMENT

9.1 Roads.

Khaling-Kharungla FMU has good network of road and no road construction is required within the period of this Plan. However, major road maintenance need to carried out within Khaling block for safety of transporters and to protect other proprieties.

The Trashigang –SamdrupJongkhar highway dissect the KKFMU. There are three byways off the highways leading inside the FMU. Ones goes through the Breakha block that leads till Kangpara. Another through Kurchilo block that leads to Lumang. These farm roads are constructed by Trashigang Dzongkhag Administration during the 10th five year plan. NRDCL also has constructed road length of 8.50Km through Kurchelo block to harvest timber from Kurchilo area during the first phase of management plan. Another road length of 6.25Km was constructed by NRDCL during the second phase of Management Plan to harvest timber from Khaling block.

The Dzongkhag Administration Trashigang has also constructed road length of 15km towards Thrimshing Drungkhag that runs through Bephu block.

9.2 Building

Trashigang Forest Division is well equipped with well-constructed office building. The Chief Forestry Officer and other officers are stationed in Trashigang. KKFMU too is equipped with two storied building typically build in Bhutanese style. This building is used as KKFMU office cum residence for In-charge. Beside, KKFMU has one storied building that can accommodate two staff with family.

9.3 Transportation

Due to lack of budget, Division has not provided any kind of locomotives for the Unit staff. Unit In-charge owned his personal two-wheeler by which he makes his journey for FMU activity monitoring. Availability of vehicle has remained static, probably due to lack of fund from government. The lack of mobility facility is major factor that hindered effective implementation of activities prescribed in the management Plan.

9.4 Equipment

The unit office is ill equipped with an old computer, fax machine and telephone. The facilities are very basic. The Unit office is provided with a very little forestry equipment, few fire fighting equipment, some equipment for forest mensuration and inventory purposes.

10. REVIEW OF PREVIOUS PLAN (2009-2019)

The past harvesting activities and other associated activities in Khaling Kharungla 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 overall goal set for the last two plan was basically set to manage forest on a multiple use, sustained yield basis for the production of timber, fuel wood and other forest products and for watershed and environment protection".

The objective in the last plan was set purely based on the Management circles and working circles to ease the implementation. The brief review of activities in the last management plan with set objectives are as below:

10.1.1 Protection Management Circle:

To conserve the water catchment:- KKFMU is water catchment areas for *Khaling* and *Lumang* public including womrong town. All water source and catchment areas were identified and protected. A buffer of 30meter along the water source are maintained within operated area. Therefore, the particular objective is found achieved.

To protect the forest from fire and illegal activities:-KKFMU mostly comprises of broadleaved forest and has never recorded any fire within KKFMU. Minor illegal activities like extraction of stone and other NWFPs product were recorded in FMU office. The objective is considered as achieved.

To allow low-impact collection of Non-Wood Forest Products:-KKFMU has issued permit for collection minor forest products like firewood, bamboo, stone, etc. However, no major environmental impact was observed due to collection of NTFPs. Therefore, the objective is been achieved.

To conserve and enhance wildlife habitats and biodiversity:- In fact, the management intervention dedicated to conserve and enhance wildlife habitat and biodiversity was not initiated, however the management plan has prescribed to maintain interline of not less than 75meters between two cable lines. This prescription has basically helped to achieve the objective. Human wildlife conflict is still prevalent and major issue with the public residing within FMU. Therefore it indicates that objective is full filled.

To raise awareness of biodiversity and natural forest:- Concept of sustainable management of Forest resources based on scientific principal have not reached deep inside the mind of general public. However, local people are well aware that conservation of environment is one the four pillar of GNH. Local people are actively involved through the FMU level management committee. Therefore, the objective is fulfilled to certain extent.

10.1.2 Non-production Management Circle:

To management grazing for livestock: During winter, migratory cattle of Highlanders are brought down to KKFMU for grazing. The cattle are freely grazed within FMU about four to five months. Some of the Highlanders have also resides within FMU for whole years. Besides, the local cattle were also grazed within FMU area. Therefore, particular objective was found not fulfilled even in the second Management Plan.

To conserve the water catchment function:-All water catchment areas within FMU are identified and protected. Buffers of 30meters are maintained along the stream and rivers. Therefore, objective is full filled.

*To maintain and improve the forest condition:-*There is less indication of forest degradation within FMU. Much of the vegetation cover in FMU are maintained as harvesting was carried out using sky line. The operated areas reforested by NRDCL in the coming season. A total of 31.94 hectare is reforested during the period of second management. The objective is fulfilled.

10.1.3 Production of Management Circle:

*To meet local demand as a priority, for timber, fuel wood and other forest products on sustainable basis:-*The AAC set for rural timber in the last management plan is *1009.01m^3*. As per the data compiled from operational plans, the timber volume including pole harvested over last 10 years is 6338.18M^3 for rural use. Besides, the KKFMU unit Office has also supplied 760030 number of bamboo, Daphne bark 500Kgs, Rubia spp 7359Kg, 128 T/L of stone boulders and 2946.39M^3 of firewood for rural. Therefore, FMU has met the local demand as priority for timber, fuel-wood and other forest products on sustainable basis.

To manage the commercial timber production on sustainable basis:-

The AAC set for commercial timber in the second phase management plan is 1697m^3 deviation +_10%. As per the data compiled from operational plan, total volume of 16576.24m^3 has been harvested and disposed by NRDCL. The volume harvested is low, however it is within the excepted deviation of +or- 10%. Therefore the commercial timber production on sustainable basis was achieved.

*To create local employment opportunities:-*Local people were engaged in activities like extraction of firewood, creation of plantation, plantation maintenance work and in other maintenance activities. However, extraction of timber has been carried out by NRDCL on departmental basis. Therefore, certain part of the objective is been fulfilled.

*To continually improved health and safety standards of the labourers:-*The cable line operators including helper were provided with all necessary safety equipment like helmet, hand glove, gumboot, and hand set for operators. However, their lack proper latrine within the camp area. Therefore, the objective has been fulfilled partly.

*To maintain biodiversity within the production area:-*To achieve this objective, the plan has prescribed to operate only one third of the selected area. The patches were to be opened up along the cable lines at distance of 50 meters. The patch was to be opened in alternative order. Interline of not less than 75 meters was supposed to be maintained with production. However, in reality these prescriptions were not properly taken up in some of the operated area. It is therefore, found that objective is not fully achieved in the actual ground.

10.2 Road construction

Constructions of road for extraction of timber are very important but at the same time it equally important to minimize the damages to the environment. During the two phase of Management Plan, KKFMU has constructed a total road length of 14.75Km. A road length 8.5Km road was constructed through Kurchelo block during the 1st phase of management Plan. And road length

of 6.25Km was constructed through Khaling block during the 2nd phase of management Plan. The road constructed were well built but lack proper drainage, culverts etc. The road soiling within Khaling block is in dilapidated condition and need immediate maintenance. In general, major maintenance is required within Khaling block where operation will be carried out during this plan period.

10.3 Harvesting

Timber harvesting is carried out with a sky line fixed cable system which has reduced the extensive construction of road, thus reducing environmental damages and the expenditure on the road. Besides, felling technique, proper utilization of timber, protection and the hauling system, the present system of harvesting was encouraging with far less damages to the environment.

However, on reviewing the some of the harvesting activities carried out in the last plan period (2009-2019), following are some of finding.

10.3.1 Felling

On visit to the operated area, it is felt that proper felling direction was not maintained to yield maximum yield besides avoiding damage to the surrounding environment. This has also affected interlines maintained between two cable lines. Therefore, maintaining proper felling direction, stump height, selecting sink and felling cut etc. are some of main measures that need attention in the future.

10.3.2 Utilization

All timber that has been harvested are transported to KKFMU timber depot located within Kurchelo block. On visit to depot, the timber were found all disposed. All lops and tops from operated areas were extracted by the skyline till road head and it's disposed by the firewood contractor. However, on visiting the operated areas, it was observed that lops and tops are not properly extracted. Therefore, proper monitoring was felt neglected or over looked which need to pay attention in future.

10.4 Reforestation

Khaling-Kharungla Forest Management unit predominantly falls under broadleaf forest where natural regeneration is very minimal or no natural regeneration in the harvested area. Artificial regeneration is only means of regeneration in the operated area. During the second phase of management plan, NRDCL has planted an area 31.94 hectare with native tree species like Persia, walnut, Morus etc. The plantations were fenced with barbed wire fencing. However, during the field visits, it was observed that plantation survival percentage is low in the both the operated areas in 1st & IInd phase management Plan(Less than 70%). The low survival rate of seedlings planted are mainly due to heavy grazing and browsing by Cattle. The harvested area has profuse growth of grass due to canopy opening thus are most sought after by cattles as grazing ground. Cattles from local area freely graze throughout the year within the area. Besides, highlanders of

Merak & Sakteng bring their cattle within KK-FMU for grazing during winter. Few highlander have even resided permanently within the FMU area. Though the plantations are fenced, the barbed wires are destroyed by the cattle herders to let their cattle inside the plantations. Bamboo invasion was found another issue in some of the patches operated during Ist phase Management Plan (Kurchelo block) and survival rate of plantations carried out during the 1st Phase of Management plan is less than 12%.

Above issues were also observed by the final evaluation team from Department. The team practically verified the plantations carried out in 2012 and 2015. The average survival percentages of these plantation is around 49%.The team recommended for immediate refilling of the plantations especially those with very low survival percentage. It is also recommended that issue of low survival of seedlings leading to failure of plantations needs to be adequately addressed and prescribed through this management plan of the FMU. Further, it is also recommended to maintain species diversity (at least five native species) of seedlings planted in the plantations to avoid mono specific stands in the FMU. The team also observed heavy loping of trees by Highlander.

Table 22: Reforestation carried out within operated area

Corridor No.	Length of cable line (m)	Width of corridor (m)	Nos. of patches	Clear cut area (Ha)	Area planted (Ha)	Year of plantation
2012/1	534	4	5	1.26	2.33	2013
2012/2	446	4	4	1.1	1.95	2013
2012/3	998	4	8	2.29	3.78	2013
2012/4	1026	4	7	2.02	1.95	2014
2012/5	797	4m	6	1.7	2.17	2014
2012/6	698	4m*	5	1.43	1.57	2014
2013/1	436	4m*	3	0.85	1.39	2014
2013/2	511	4m*	5	1.13	2.17	2015
2013/3	622	4m*	4	1.15	2.06	2015
2013/4	455	4m*	4	1.09	2.04	2015
2014/1	254	4m*	2	0.77	0.97	2015
2014/2	274	4m*	3	1.12	1.54	2015

2015/1	358	4m	3	1.15	1.23	2016
2015/2	333	4m	2	0.81	0.81	2016
2016/1	880	4m	8	2.22	2.95	2017
2017/1	969	4m	8	2.15	3.03	2018
Total	**9591**		**77**	**22.24**	**31.94**	

Note:*** this corridor width are beyond the prescribed width in MP.

10.5 Review of Annual Allowable Cut (AAC)

	AAC as per the management plan (m^3)	**AAC for 10 years (2009-2018)**	**Actual timber volume allocated (m^3)**	**Undercut Volume**	**%**
Commercial	1697	16970	16576.24	393.76	2
Rural	1009	10090	6338.18	3751.92	37
Total	2706	27060	22914.42	4145.68	39

Table 23: Commercial and Rural Timber extracted

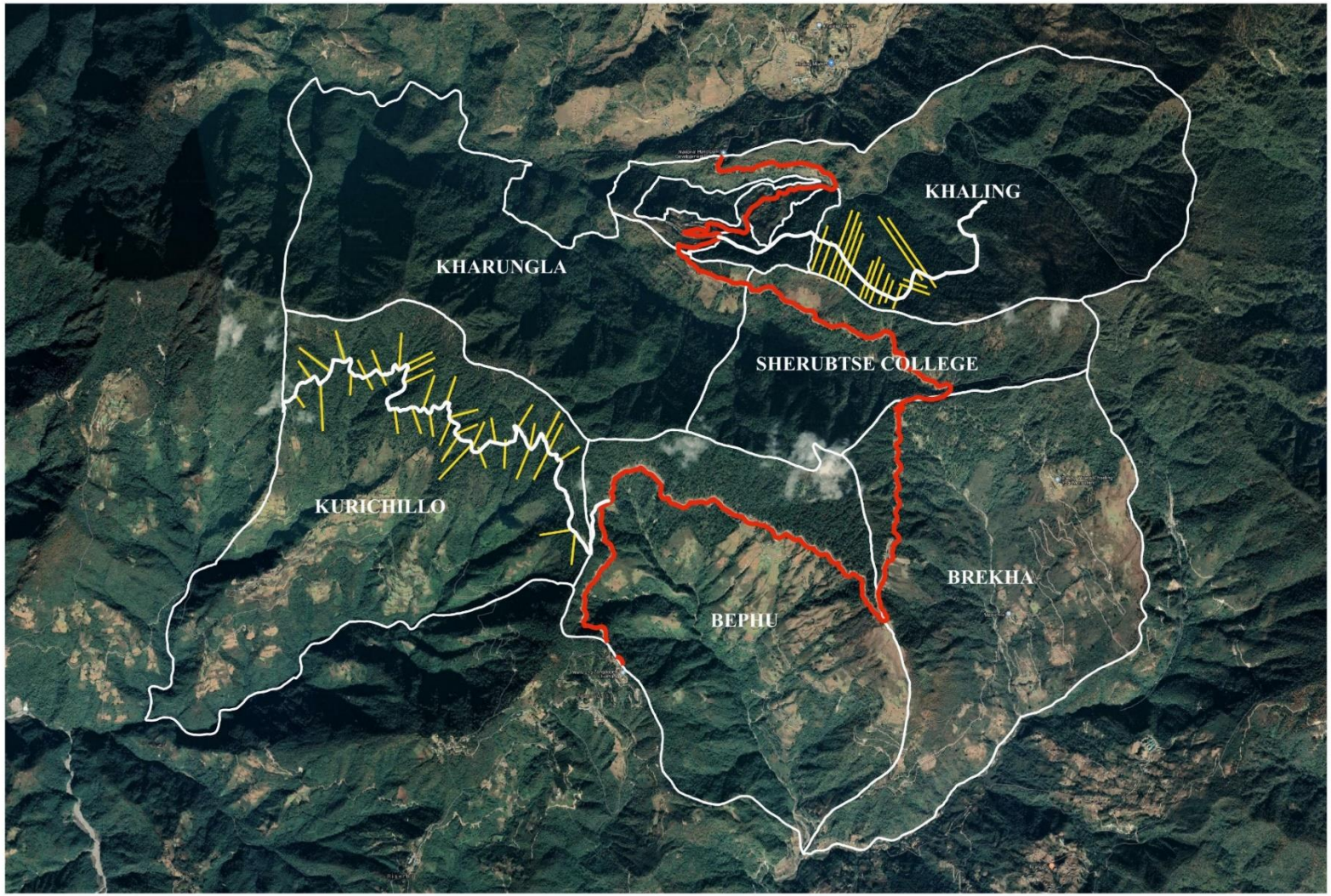
	Clear cut equivalent area as per the management plan (ha)	**Total clear cut equivalent area for 10 years (2009-2018)**	**Actual clearcut area (ha)**	**Excess clear cut area (ha)**	**%**
Commercial	4.5	45	47	2	104

Table 24: : Clear cut area for commercial timber extraction

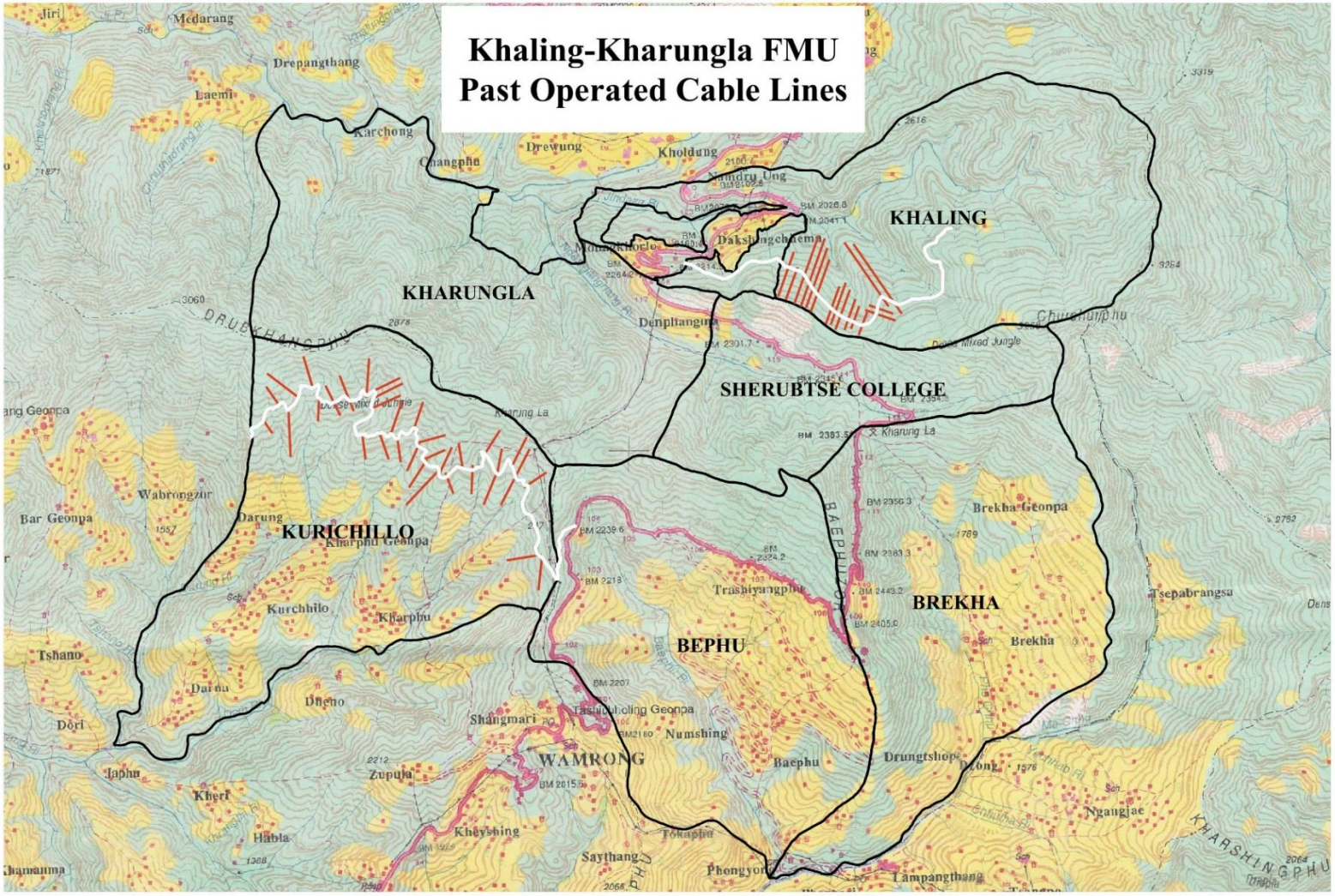
As per the Management Plan of Khaling Kharungla FMU (2009 to 2019), the total volume of timbers that could be harvested in ten years is 27060 m^3 (10 x 2706) in standing form. Against this, 22914.42 m^3 (commercial and rural) of timber in standing form has been extracted from the FMU over the last ten years (2009- 2019)- Table 23. The team observed that the timber harvested from Khaling Kharungla FMU did not met the target set in the management plan and is less by 4145 m^3 or 39% of the total AAC of the FMU.

However regarding clear cut area the total clear cut equivalent area for commercial timber extraction for ten years is 45 ha (4.5 x10) as per the Management Plan. Against this the actual clear cut area in FMU for this plan period is approximately 47 ha (Table 2). Therefore the clear cut area has exceeded by 2ha in the FMU. The increase in clear cut area is mainly attributed to Trashigang-Samdrup Jongkhar highway widening carried out by Dantak and also farm road

construction in the FMU area. Around 13.3 km of farm road and forest road and 22 km of Highway widening was carried out during this plan period. Therefore, though the total volume of timbers extracted has not exceeded the total AAC allocated the clear cut area has exceeded by about 2 ha against the prescribed limit.

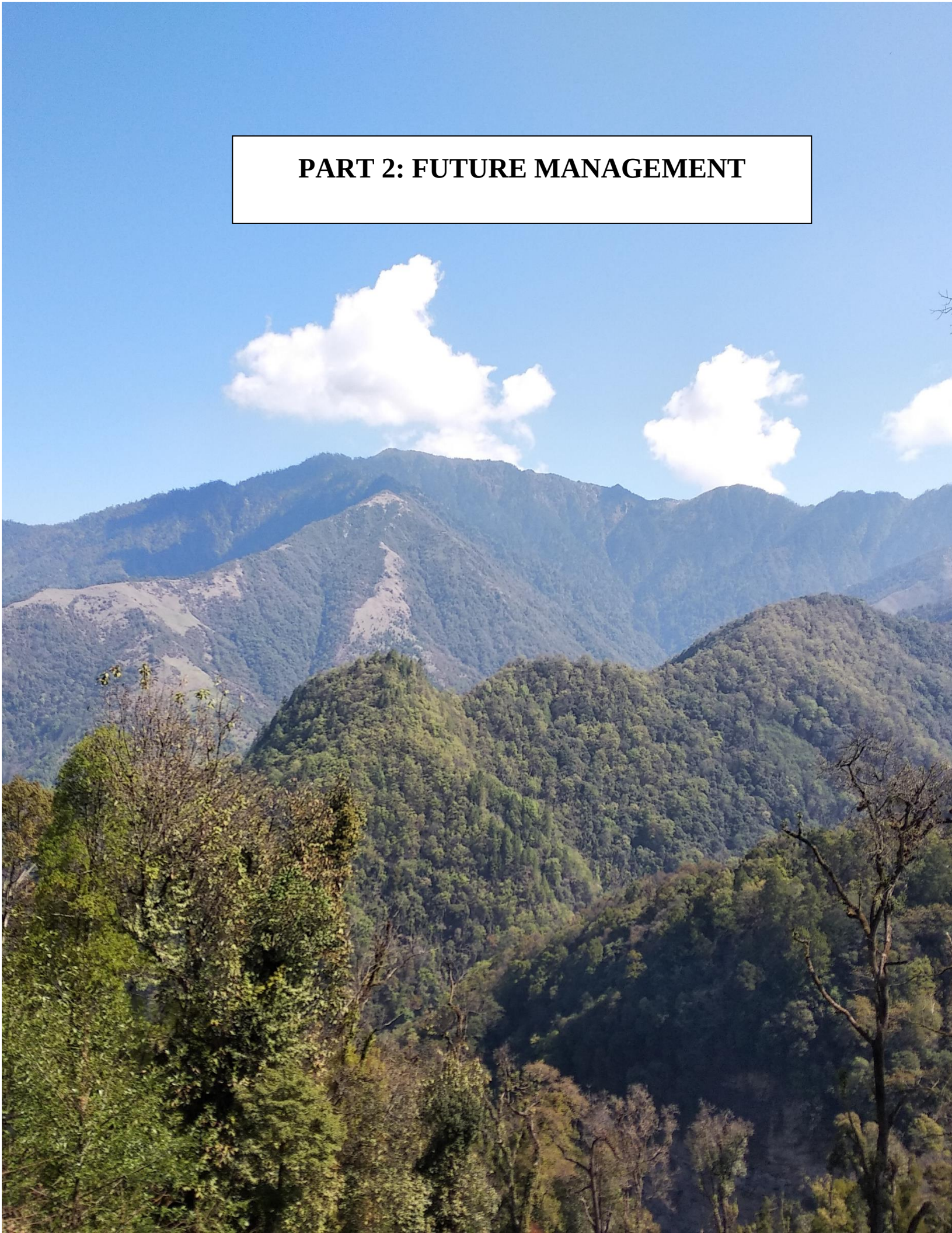


Map 3: Map showing Past Operated Cable lines in Khaling Kharungla FMU



Map 4: Toposheet showing Past Operated Cable Lines

PART 2: FUTURE MANAGEMENT



PART 2: FUTURE MANAGEMENT

11. INTRODUCTION

The Royal Government of Bhutan's has committed to maintain at least 60% of its total land under forest cover for perpetuity an enshrined in the constitution. All productive forest are to be managed under a system of sustained yield using scientific management.

11.1 Forest Policy

- ✓ Forest, being important natural resources since immemorial necessitated a management plan for generation of sustained timber yield. Thus according to the National Forest policy of 2011, Management plan need to be prepared for all GRF land focusing on sustainable supply of forest products or ecosystem. Several principal have been considers while framing the National Forest Policy of 2011and worth mentioning are: Equity and justice in term of access, optimal utilization, conservation of resources and its ecosystem services. The RGoB has adopted a conservation-oriented policy that focus on biodiversity conservation and meeting local demand through sustainable forest management.

- ✓ The Forest and Nature Conservation Act enacted in 1995 requires that management plans to be approved and implemented for all protected and for all forest where commercial logging is to be undertaken. The Act provides the legislative framework to streamline community participation in forest management and the preparation of supporting forest rules and regulation.

- ✓ KKFMU plan is prepared in line with the National Forest Policy of 2011, Forest and Nature Conservation Act of 1995 and Forest and Nature Conservation Rule of Bhutan, 2017. The plan reflects the government's commitment to the sustainable management of it natural resources.

11.2 Overall Goal

The over Goal of the management plan is to:

Manage the Khaling-Kharungla FMU on a multiple use, sustained yield basis yield basis for the production of timber, fuel wood and other forest products and for watershed and environmental production.

11.3 Objective

The objective of the KKFMU have been divided under the different Management Circle and Working Circle set up for the ease of implementation. The Management Circle identified are: ***Protection Management Circle, Non-Production Management Circle*** including ***Non-wood Forest produce*** (overlapping) and ***Production Management Circle.*** The specific objective for

each Management Circle are as listed below. This allows different areas to be managed and evaluated separately. Some of the same objective may occur under different Management circles.

However, these objectives can be achieved only through proper record keeping, vigilant monitoring and evaluation and appropriate budget consideration by NRDCL.

Protection Management Circle

- Check soil erosion and denudation in the catchment areas of river lakes and reservoirs in the interest of soil and water conservation.
- Protect the forest from fire, grazing and illegal activities
- Conserve and enhance wildlife habitats and biodiversity.
- Allow low impact collection of Non-timber Forest Products.
- Raise awareness on biodiversity and the natural forest.
- Respect the sanctity of religious places and to protect the historical sites.

Non-Production Management Circle

- Maintain and improve the forest condition
- Manage and regulate grazing for livestock
- Meet the local demand for NWFP
- Conserve water catchment functions
- Conserve and enhance biodiversity

Production Management Circle

- Meet the local requirement, as priority, for timber, fuel wood and other NWFPs forest products on a sustainable basis.
- Manage the FMU for commercial timber production and other NWFPs on sustainable basis.
- Protect the forest from fire and illegal activities and over grazing in plantation/regenerating areas.
- Create employment opportunities for local people
- Improve health and safety standards of labourers continually
- Enhance and improve forest condition and productivity to meet national needs
- Conserve water catchment functions
- Maintain biodiversity within the production.

11.4 Management Based on Forest Function

11.4.1 Introduction

The grouping of different potentials uses of forest is termed as forest function. The different forest potentials includes soil conservation, water and watershed conservation, nature conservation in relation to flora and fauna habitats and resource based for many kinds of human

needs. The value and ranking of such function may differ for different FMUs depending on different factors like location, site, forest type, accessibility, landscape and a host of many other factors.

Some functions can only be fulfilled from large connected forest areas (e.g..., watershed conservation and wildlife protection), while some others may be satisfied by quite small forest patches (e.g.., habitat for rare plant or insect). Some forest function can be easily demarcated and mapped (e.g., soil conservation) and some cannot be done so easily (e.g…, wild life conservation). Some of the forest function depends on time constant factors (e.g .., topographic feature and therefore soil conservation), while others depend in time variable factors (e.g., social function). Function may overlap (e.g .., environment conservation and wild life protection) or can be mutually exclusive (e.g.., wildlife protection and intensive agriculture)

Forest Management Code of Bhutan (2004) describes forest function as forest area within the FMU and can be categorized as ecological, environmental and social function. The most important result of forest function planning is the Forest Function Map. It is prepared on the basis of existing information such as LUP, 2016, topographic map, QGIS coverage etc. and must be prepared for the entire permanent forest areas including bare land or rangeland where reforestation is to be carried out.

The function maps forms the bridge between planning and implementation. Forest function map provides the information on the area that can be brought under commercial production; the areas that have to be reserved for local use and area reserve for nature conservation. The forest function map, combined with the description of working circle and their management prescription are basic tools of the FMU In-charge for field implementation of this management plan.

The legal backing for forest function planning is provided by section 5; Management Plans and section 21; Establishment of Protected Areas of the Forest and nature Conservation Act of Bhutan 1995. The objective of forest function planning are:

- Define particular area of FMU with different environmental and social functions of forest and depict them on maps
- Identify production forest, protection forest with limited production and completely protected areas
- Provide a tool for the management planner for balancing the different requirement of nature conservation, environment protection, society forestry and commercial timber production, among others; and also to provide the spatial information required to compute the sustainable AAC while, at the same time, satisfying the management prescription and restriction for the different forest function and
- Provide the FMU In-charge with information on the location of different forest function in order to enable him/her to specify the required management prescriptions on the ground and to control their implementation.

11.4.2 Objectives of Forest Function Mapping

The main objectives of forest function mapping in this plan are:

1. To define different environmental and social functions of the forest and depict them on the maps;
2. To identify production, non-production and protection area within the FMU;
3. To provide a tool for the management planner for balancing the nature conservation, environment protection, social forestry and commercial timber production and also to provide the spatial information required to compute the sustainable AAC;
4. To provide the FMU In-charge with information on the location of different forest functions in order to enable him/her to specify the required management prescriptions on the ground and to control their implementation.

11.4.3 Function groups

The function used in this management plan are listed in the table below. Some of these function groups include functions that differ only in the degree of intensity of their management prescription.

Table 25:List of Different Forest Function Groups and Functions

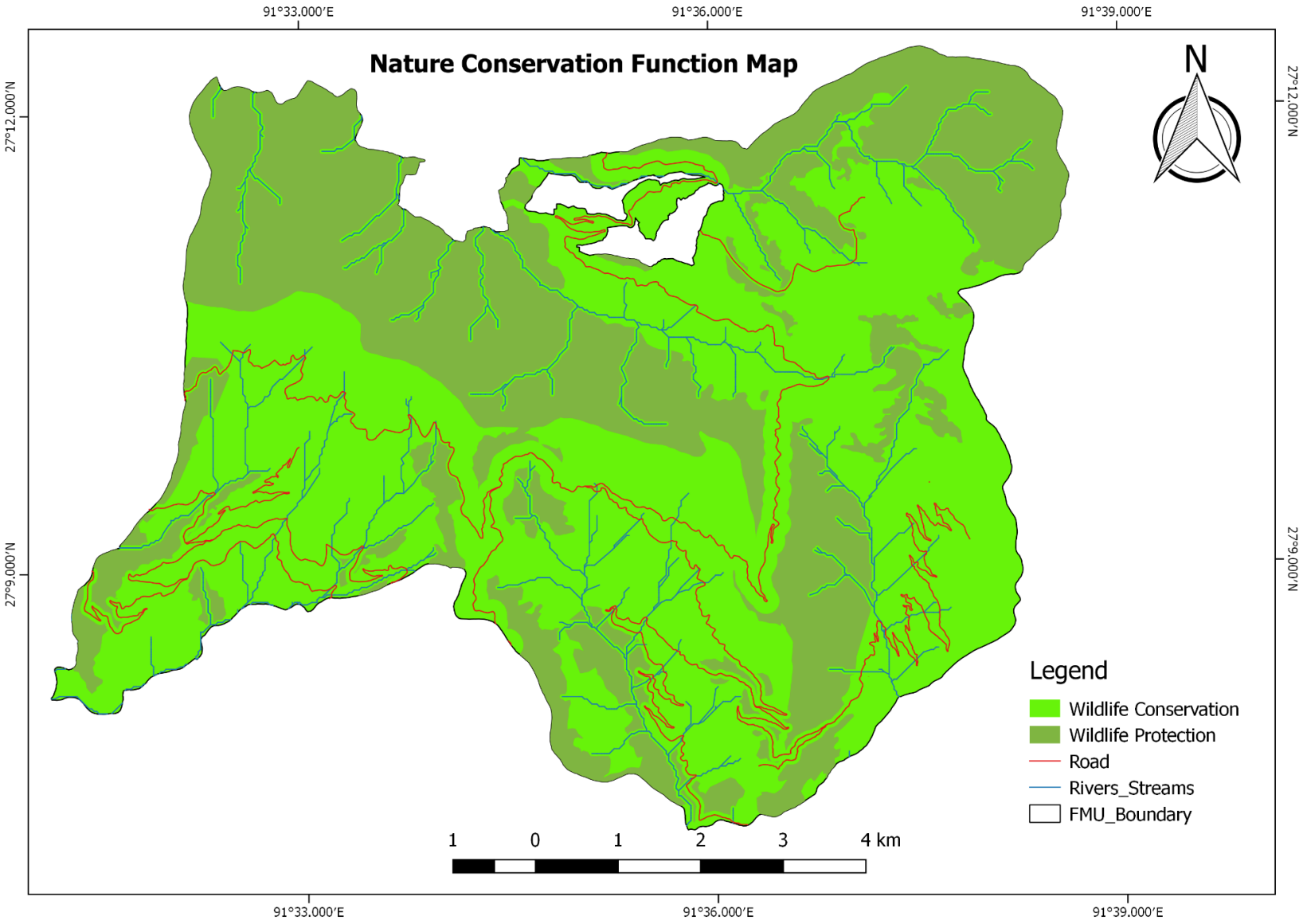
Code	Function Group	Code	Function Group
S	**Soil Protection and Conservation**	**N**	**Nature Conservation**
SC	*Soil Conservation*	***NWP***	*Wildlife Protection*
SP	*Soil Protection*	***NWC***	*Wildlife Conservation*
W	**Water and Watershed Conservation**	**SoC**	**Social Function**
WRR	*Riparian Reserve Protection*	***SocL***	*Social (Local use only)*
WSH	*Watershed Conservation*	***SocRs***	*Social (Religious Site Protection)*
WLS	*Local Water Supply Protection*		

11.4.4 Mapping forest functions

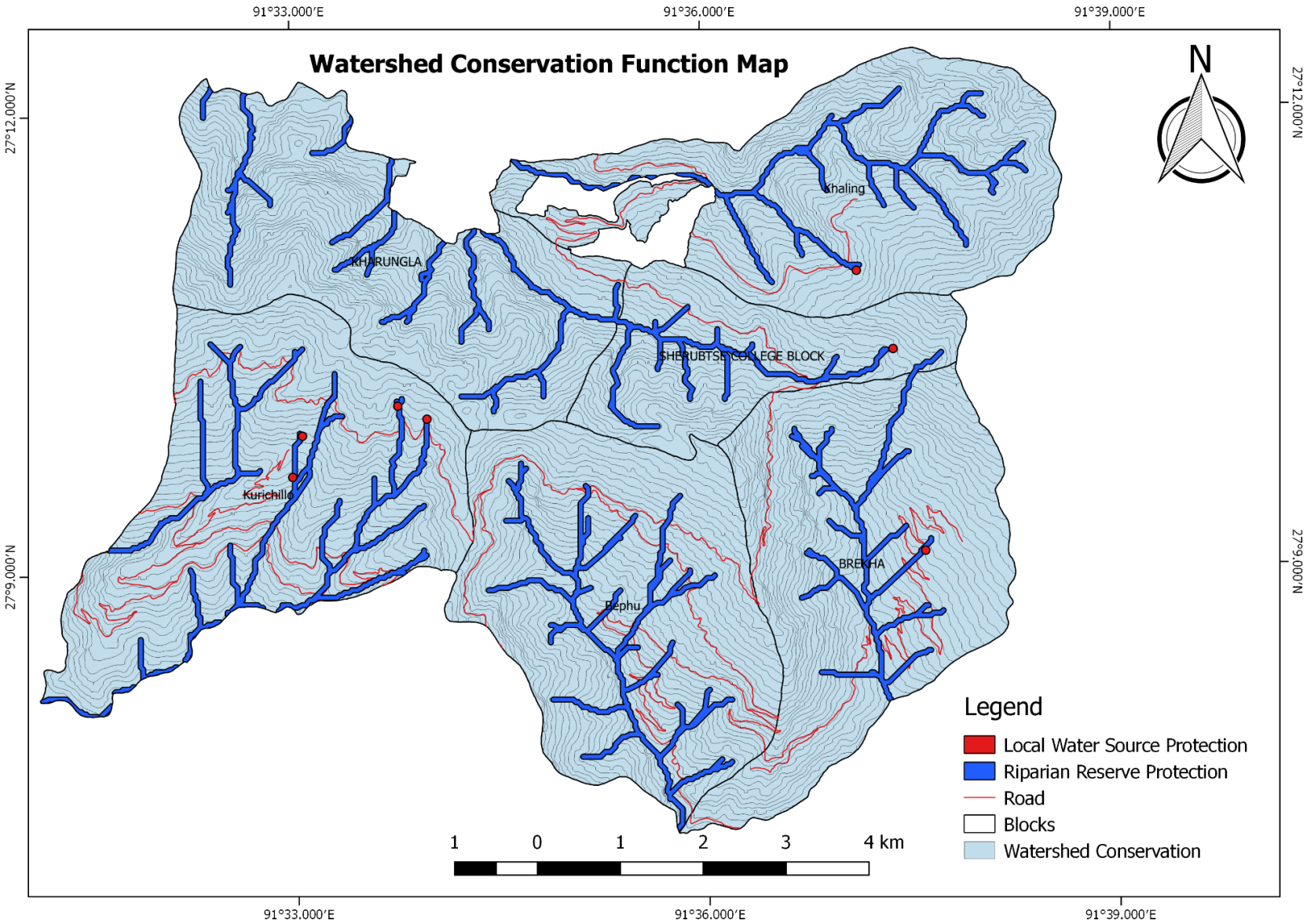
The criteria to prepare forest function maps for the FMU are given in the table below. All the information available in the table are not mapped to scale used for planning purpose. When operation plan are prepared new details are to be collected and these criteria should be implemented.

Table 26: Criteria for Mapping Forest Functions.

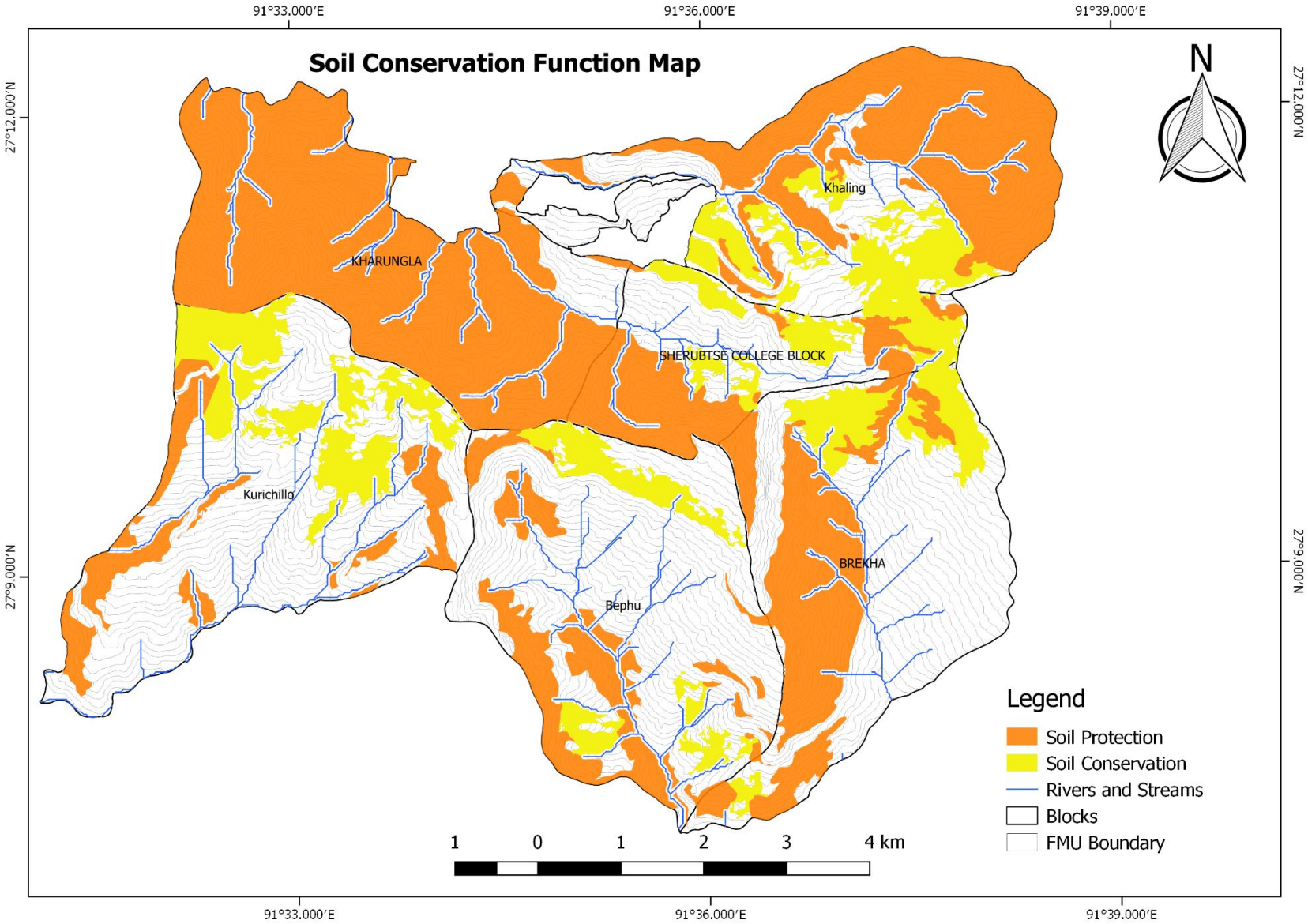
Function group and codes	Criteria for mapping
Soil Protection and Conservation	**SP:** Very steep areas (slopes of greater than 100%), *areas with indication of slight to moderate erosion,* **SC:** steep or sensitive areas (slopes of 76-100%).
Water and Watershed Conservation	**WSh:** catchment areas of watercourses on steep slopes and on poorly drained areas; other sites serving water retention areas or water sources(for this FMU, all the catchment) **WRR:** areas within thirty meter along all perennial streams, shongari Chu and Yunarichu, poorly drained or waterlogged sites, most areas and swamps.
Nature Conservation	**NWP:** Endangered species territory, alpine areas, *ecosystem of high conservation value (e.g.., swamp forest)*
Social Function	**Socl:** area close to or accessible to settlement or village, the areas traditionally used already, with definable boundaries; **SoCRS:**Lhakhang/goembas and gneys and other places with high religious value.



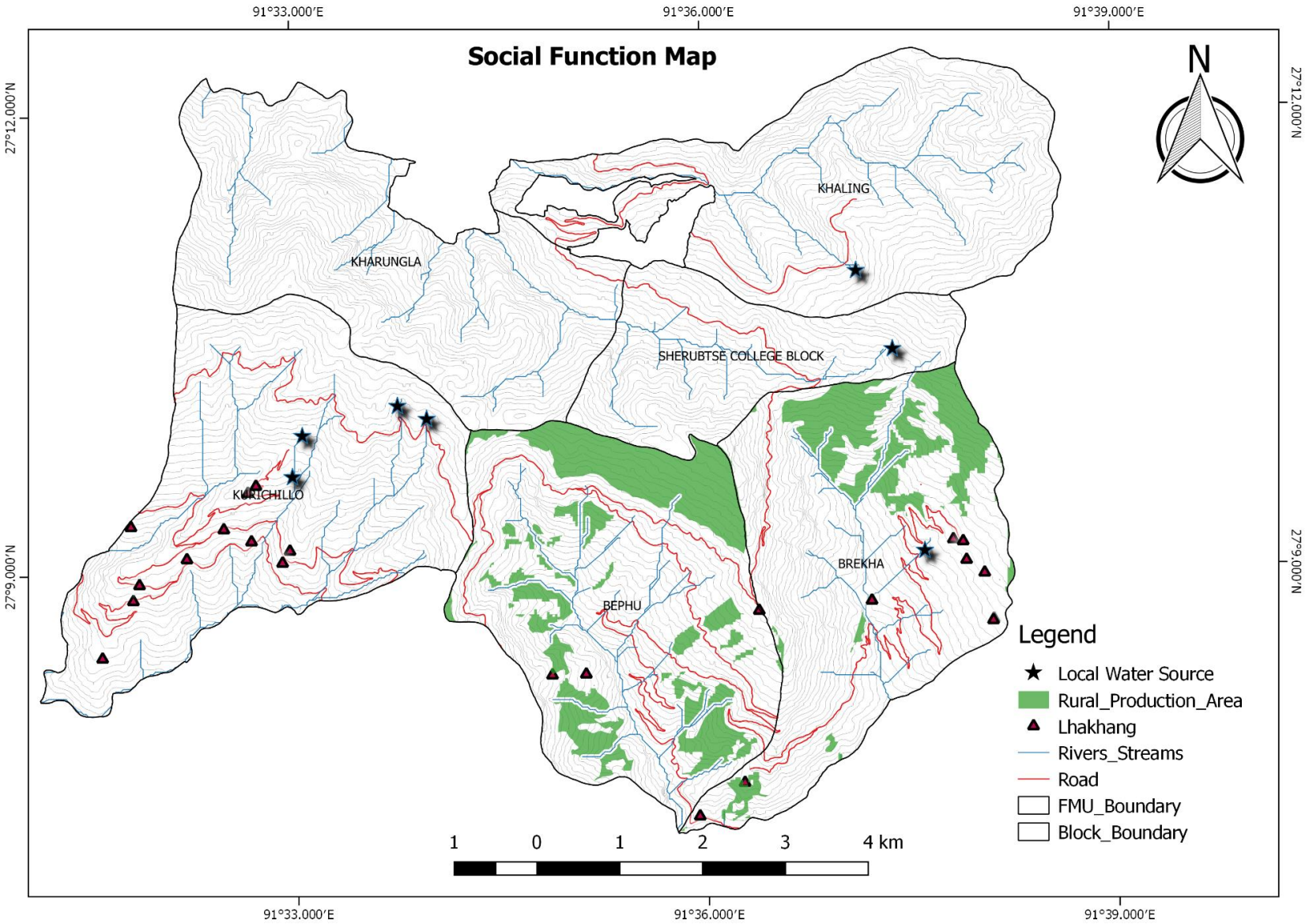
Map 5: Nature Conservation Function Map



Map 6: Water and Watershed Conservation Function Map



Map 7: Soil Conservation Function Map



Map 8:Social Function Map

11.4.5 Restrictions of Forest Functions

The forest function identified in KKFMU sets restrictions for commercial and local activities as required by each function for management. The specific restriction to be applied to forest in the various function categories are summarized as below.

Table 27: Forest function restrictions.

Code	Function	Restriction on Commercial Use	Restriction on Local Use
SP	Soil Protection	No commercial use	No tree felling, minimize human interference
SC	Soil Conservation	No commercial use	Low impact local use
WLS	Local Water Supply Protection	No commercial use	No tree felling, minimize human interference
WSh	Watershed Conservation	No commercial use	Low impact local use, single tree selection
WRR	Riparian Reserve Protection	No commercial use	Only collection of NTFP
NWP	Wildlife Protection	No commercial use	Restriction to activities that do not change habit quality and disturb wildlife.
SocRS	Religious Site Protection	No commercial use	Use only which do not disturb sanctity
SocLC	Local cum Commercial Use	Low impact commercial use	No restriction
SocL	Social (Local use only)	No commercial use	No restriction for local use only
RB	Road Buffer	No commercial use	No felling

Source: Forest Management Code of Bhutan, 2004

11.5 Identification and description of functions

11.5.1 Soil Protection and Conservation

11.5.1.1 Soil Protection (SP)

Soil protection includes very steep slopes, rocky and stony areas which are extremely sensitive to landslides and soil erosion. These areas include in particular unstable slopes above or near important objects such as villages, settlements, individuals houses, roads, agriculture land, etc are defined for protection reason as soil protection.

The objective are to prevent damages caused to the environment, infrastructure, to protect soil from erosion and to sustain soil fertility. As per function mapping an area of 5320.23 hectare is identified under soil protection and conservation. Kharungla and sherubtse block fall under total protection under this function.

11.5.1.2 Soil Conservation (SC)

This function includes all areas, which are very steep, water logged area which are sensitive to soil erosion and landslide. The objective is to minimize or prevent negative impacts to soil, soil fertility and other degradation processes due extraction of forest resources.

An area of 591.86 hectare has been classified under Soil Conservation wherein harvesting operations is permissible under strict management prescription. There should be minimum disturbance and damages to the under storey vegetation and/ or residual trees. Indiscriminate grazing should be strictly prohibited in regeneration areas.

11.5.2 Water and Watershed Conservation

11.5.2.1 Riparian Reserve Protection

Riparian areas occur along the banks of rivers and streams. They include the water body itself, areas subject to periodic inundation and flooding, areas with high water tables and immediate adjacent uplands. Riparian areas often contain the highest plant and animal diversity, and some of the highest valued non timber forest resources in the forest landscape. They provide critical habitat, home ranges, travel corridors for many mammals and birds species, and maintain ecologically important vertical and horizontal linkage throughout the forest landscape. The objective are to prevent negative impact due to forest resources use on stream channels stability, water quality and aquatic ecosystem productivity and diversity and to protect and sustain plant diversity associated with riparian areas.

Generally, the streams are not entrenched and do have high risk of soil erosion. Moreover, it has been observed that soil is not exceptionally prone to frequent or extensive surface erosion or landslide in the presence of vegetation. However, there is a possibility of surface erosion and gulling if vegetation is removed. So intercept the problem of soil erosion a buffer of 30m (FNCA, 1995) has been maintained along the streams and rivers. Riparian Reserve are put under strict protection. No forestry activities are allowed to operate within the buffer zones except for those required to improve the forest condition and to restore the original natural condition. The total area of Riparian Reserve is 603.67 hectare. Road constructions have to be undertaken after considering all the measures to prevent soil erosion and allow continuous flow of water.

11.5.2.2 Local water supply (WLS)

Clean water supply is basic requirement for flourishing human civilization. It is therefore of utmost important that buffer have to be defined for all areas, including the water-body itself and swampy or water logged catchment areas. Although, there are numerous drinking water sources within FMU, the main important catchment areas located within Sherubtse and Kurchelo block are identified and map. These areas supplies drinking water for Womrong ,Thrimshing and Lumang village areas.

The objective are to prevent negative impact due to forest resources use on water quality and stream channel stability, prevent damages to water and irrigation channels stability and to prevent damages to water and irrigation channels.

All the water sources that are located in the forest areas used by the villagers have been identified area. The total area of Local Water Supply is 603.67 hectare. In addition to maintaining 30 m buffer, some of drinking water sources are totally protected from tree felling, intensive cattle grazing, chemical application and disposal of garbage, oil and establishment of infrastructure.

11.5.3 Watershed Conservation (WSh)

Upper catchment areas of watercourse on steep slopes and poorly drained or permanently waterlogged areas and all other sites serving as water retention or water feeding bodies are classified as Water Conservation areas. The objective is to maintain both ground and surface water cleanliness, to prevent surface run-off of precipitation and sustain continues water supply. To sustain and maintain continuous water supply the water infiltration rate should be kept as high as possible. Therefore, forest harvesting operation should minimize disturbance to under-storey vegetation. Clear felling and conversion of natural forest into plantation is prohibited. Efforts should be made to developed multi-storied structure of forest to increase infiltration rate of water into the soil. Indiscriminate grazing should not be allowed in the area. The use of heavy machine, application of fertilizers and changing of oil is strictly prohibited.

11.5.4. Social Function

The social function and local uses of the forest were identified and described during the course of Socio-Economic Study.

11.5.4.1 Local Use Only (SocL)

The forest which are and have been intensively used the local people from tradition and which are an integrated and indispensable component of their subsistence are classified as Local Use (SocL). The area have been excluded from commercial logging in order to ensure the provision of all forest products required for the people subsistence needs in a sustainable way. This also includes areas where the objective of local use and commercial timber production are in conflict.

For this purpose all areas in the immediate vicinity of settlement were classified as Local Use only. The size and boundary was determined based on present forest use, ability of resources and site condition, vicinity to the settlement and on demand/supply considerations.

Most of the areas identified for local use are intensively used by the local people for firewood, fencing post, timber and cattle grazing. The standing forest in the settlement vicinity does not qualify for commercial harvesting. It is just enough to meet the rural demand. The forest area delineated for Local Use Only accounts to 566.7 hectare.

11.5.4.2 Local cum Commercial Use (SocLC)

Forest areas which are used by the local population for the collection of construction timber, shinglaps, non- timber forest products, especially bamboo, brooms, fencing post, medicinal plants and mushrooms were classified as Local cum Commercial Use Forest.

Commercial forest management in this zone must be carried out in such a way that continuous and sufficient supply with the above mentioned products is ensured. This requires that management activities implemented by NRDCL in these area need to be done in consensus with the local population. It has to be mentioned at this places, that there will be not much conflict when it comes to the use of trees for construction timber. During commercial harvesting, joint marking of trees should be done, NRDCL and local people.

11.5.4.3 Religious Site Protection

Many religious sites such as monasteries, meditation houses and other religious objects plays an important role in disseminating religion. In order to respect the sanctity of these holy places and not to disturb people in their religious practices, any kind of forestry operations should not be permitted within a distance of 50 meter around the site.

Silvicultural improvement measures such as planting, weeding, tending and thinning should be planned and implemented if the religious site is located on a Soil Protection area. Local use shall be restricted to those activities, which do not disturb the sanctity of the religious sites. Three religious site have been identified, namely *Kharphu Gongpa, Bephuthang Gongpa and Brekha Gongpa.* The total area under Religious Site Protection account to 31 hectares.

11.5.5 Nature Conservation

It is the objective of the nature conservation function to balance the diverging interest of commercial logging with that of nature conservation and environment protection.

11.5.5.1 Wildlife Protection (NWP)

In order to protect and rare animal from human disturbance, their habitat and corridors used for their movement are excluded from commercial use. All the habitat and other relevant areas that have the occurrence of rare or endangered mammals and birds are included under wildlife protection function. Such areas are under complete protection and have to be totally excluded from commercial use. To avoid the transformation of vulnerable wildlife to endangered ones over the time, their protection must be given the foremost priority.

In order to create a balance between wildlife and nature, firstly the conservation of habitat of protected wild animals along with the wildlife corridor for their movement must be taken care of. Secondly, protected animals have to be prevented from human disturbance. Commercial logging has to be strictly prohibited in wildlife habitat and corridor. Only local forest use is permitted on the basis that habitat quality must not show any significant degradation (i.e single tree felling for shinglep production) and the disturbance to protect animal is as minimum as possible. Road construction in vulnerable areas should be avoided as much as possible.

11.5.5.2 Wildlife Conservation (NWC)

Wildlife conservation function includes all the forest area that thrives quite a number of wildlife in terms of variety and number, particularly of mammals and birds. Its aim is to minimize or prevent negative impact on wildlife habitat as result of forest resources use and to minimize disturbance due to human impacts. Wildlife Conservation areas are not under strict protection and some degree of forestry operation are permitted with minimum disturbance to under storey vegetation, particularly bamboo and to residual trees. There should not be any kind of exploitation of fruit and fodders trees, fed on by wildlife. Small pasture areas and gaps have to be left open. Snag trees shall be left to provide arborous living with tree cavities.

11.5.5.3 Biodiversity Protection (NB)

Biodiversity protection deals with the preservation of rare and extraordinarily rich ecosystem (i.e swamp forest, gallery forest, alpine shrubs) and ecological niches. Such areas are generally smaller than Wildlife Conservation areas and may range between 1 and 100(or more) hectares. Forest management activities shall not be permitted within these areas including the collection of NWFP and other forest products. These areas shall also be exempted from cattle grazing. No road construction within the Biodiversity Protection areas is permitted.

So far, no information was available on rare or extra ordinary rich ecosystems. In case, during operational planning one comes across areas which qualifies for Biodiversity Protection then those areas shall be delineated on the Forest Function Map manually.

11.5.5.4 Road Buffer

A road buffer is the zone along a road to protect the road from rock fall, land and snow slide, surface run-off of precipitation and erosion and to safeguard traffic. According to section No. 14.a (i) of Forest and Nature Conservation Act (1995)" no permit to fell or to take any timber within 200m uphill and 100m downhill along motor able roads". In line with the Act, total of

300m has been maintained as road buffer for National Highway, 100m for farm road and 30m for forest rod. Commercial harvesting has to be prohibited particularly within this zone. However, collection of deadwood, fallen branches for firewood and collection of NWFP such as fruits, medicinal herbs, etc for the local use will be permitted.

The areas protected as road buffer adds up to 1005.81 hectare for KKFMU.

12. FOREST ZONING

The degree of impact on forest management/restrictions varies with different forest functions. Some functions exclude the applicant of all forest management activities, some exclude only commercial logging and road construction and some impose only minor management restrictions.

Table 28: Impact of forest function management and local use

Rank	Code	Function	Restriction on commercial Use	Restriction on Local Use
1.	NB	Biodiversity Protection	No commercial use, no roads, no chemicals	No local use
2.	WLS	Local Water Supply Protection	No commercial use, no roads, no chemicals	Low impact use only; no cattle grazing
3	SocRS	Religious site Protection	No commercial use, no roads	Only use which do not disturb sanctity of place.
4	SP	Soil protection	No commercial use, restricted road construction	No tree felling, no tsamdo; no soking
5	WRR	Riparian Reserve Protection	No commercial use, restricted road construction, no chemical	Only collection of NTFP; no tsamdo; shoking
6	NWP	Wildlife protection	No commercial; no road construction unless not otherwise possible.	Restriction to activities that not change habitat quality and disturb wildlife
7	RB	Road Buffer	No commercial use	No tree felling
8	Socl	Social (Local use only)	No commercial	No restriction
9	SC	Soil Conservation	No clear cutting; no	Low impact local use;

			conversion into plantation; extension of rejuvenation periods; no ground based skidding with heavy machinery	no intensive cattle grazing
10	WSMA	Special Management Area around Water Courses	No clear cutting; no conversion into plantation; minimize disturbance to understory vegetation.	Low impact local use; no intensive cattle grazing
11	WSh	Watershed conservation	No clear cutting; no conversion to plantation site; minimize disturbance to understory vegetation.	No intensive cattle grazing
12	NWC	Wildlife conservation	No clear cutting; no conversion to plantation site; leave some undisturbed patches; minimize disturbance to under-storey vegetation (bamboo)	Local use should minimize disturbance to wildlife
13	SocLC	Social (Local cum Commercial Use)	Depends on type of local use; has to be individually determined from case to case.	No restriction
14.		Production	No restriction	No restriction

Source: Forest Management Code of Bhutan, 2004

In many cases forest function overlap. In such cases, all prescribed management restrictions have to be observed. Based on their impact on commercial forest management, the forest the forest function are classified into following zones:

Table 29: Forest Zonation

Protection Zone	Production Zone		
	Local Use	**Commercial Production**	
		Non- Production Zone	**Production Zone**

Biodiversity protection **Soil Protection** **Riparian Reserve Protection** **Wildlife protection** **Local Water Supply Protection** **Religious Site Protection**	Local use only	Soil conservation Wildlife conservation Watershed Conservation Local cum Commercial Use	Includes all remaining areas having no defined function.

On the basis of identified forest functions, the entire area of Khaling Kharungla FMU has been classified into four categories of forest, namely

I. Areas where commercial production is feasible under defined sets of management prescription are considered as production Forest, without any particular management restriction except those imposed by the Forest and Nature conservation rules and regulation of Bhutan (2017) and other relevant rules issued by Department of Forest and Park Services from time to time.

II. Areas where no commercial production is permitted and exclusively set aside for local population are considered as Local Use Only.

III. Aras where no forest management activities are allowed are considered Protection Forest

Table 30: Distribution of forest zone according to type of management.

Function	Area (Ha)	Remarks
Non- Production area	998.94	
Local use only area	570.80	
Protection area	4299.09	
Production area	1812.58	

13. Quantitative resource assessment.

13.1 Forest inventory

Inventory of Khaling-Kharungla Forest Management Unit was carried out from February till March 2018. The FMU Inventory was led by Trashigang Forest Division in collaboration with inventory team from Forest Resources Management Division (FRMD). The standard FMU inventory technique was used, with data being collected from trees >10 cm DBH(OB). A total of 457 plots were laid throughout the FMU area at the spacing 400m x 400m, thus each plot representing an area of 16 hectare. The inventory was designed with target sampling error of +- 11.59% at confidence level of 90 percent.

The field data was collected using COLLECT and data were analyzed in Calc. The general object of the inventory was to provide essential background information for drawing up a management plan. More specifically the objective of the inventory were:

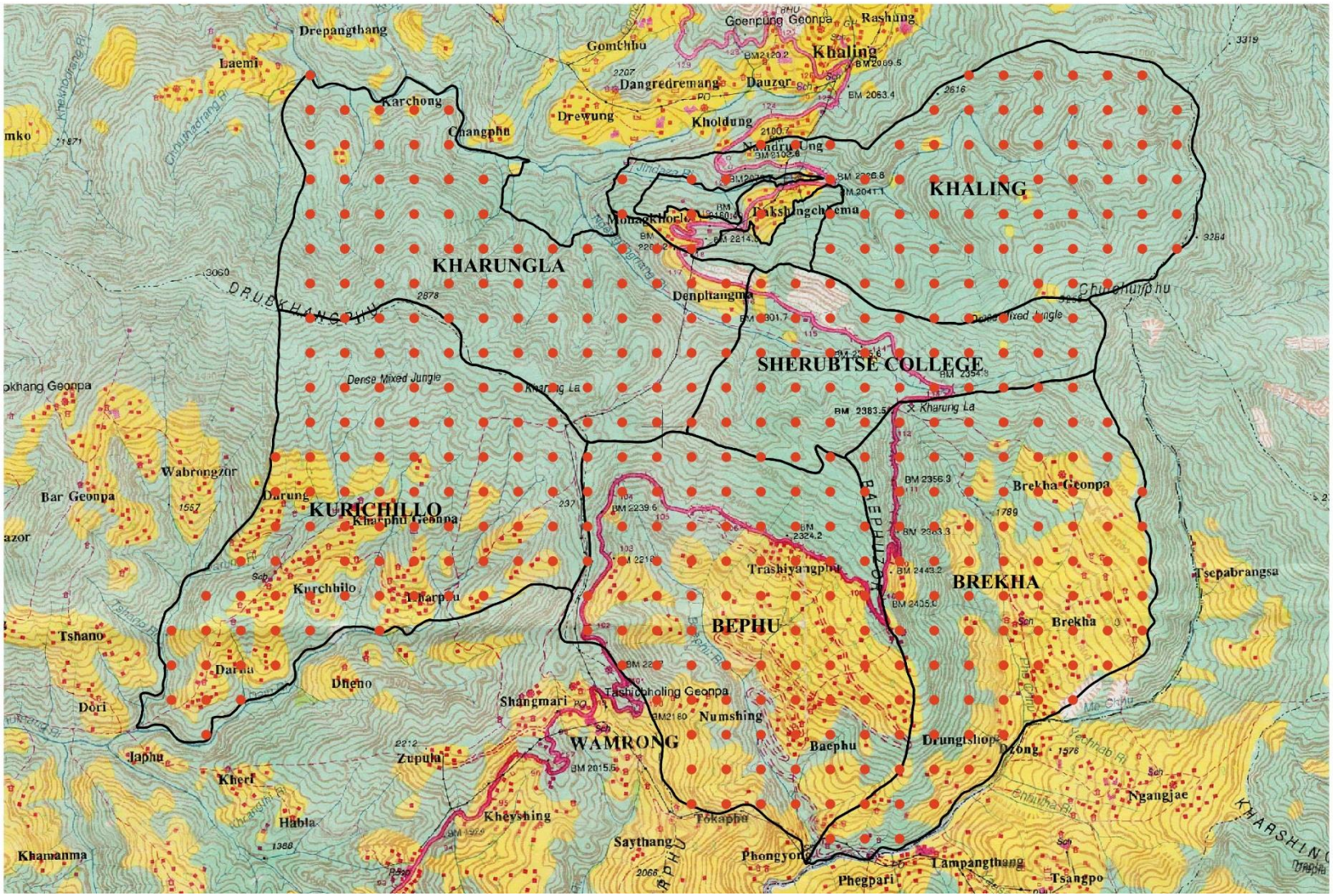
- To provide relatively accurate overview of the growing stock and regeneration potential of natural forest in the area, according to major forest types.
- To give overview of the general site characteristic of the natural forest, in terms of soil, non-green vegetation and the use by the local population.
- To provide an indication of timber quality in different forest types.
- To facilitate the supply of timber demand for the local population and to the development activities.
- To enable an evaluation of the effects of the management practices on the FMU area, during the previous plan period.
- To furnish essential data on tree to enable the construction of local volume table for main species.
- Find out major changes in the growing stock.

13.2 Inventory Result

The summery of inventory result for the FMU.

Table 31: Inventory Result

Forest Type	Gross area (Ha)	Nos. of plots	Ave. no of trees/ha	SE%	Ave. basal area/ha	SE%	Ave. vol/ha	SE%
Hardwood	7110.60	457	113.28	8.95	12.55	10.05	87.14	11.59



Map 9: Forest Inventory Map

14. AREA ORGANISATION

14.1 Spatial Organization

The strategy for forest management begins with the formation of working circle. Therefore, the formation of working circle is an important step in the planning process. Working circles are further divided into blocks, compartment and sub-compartment. The block have been demarcated according to natural features like ridges and natural drainages as far as possible.

Block

The blocks are the basic orientation and administrative units within the FMU. They are essentially major water-catchment separating easily recognizable major parts of the FMU. Therefore, the block boundaries in most cases followed ridges separating individuals water-catchments. Other prominent topographical features such as large streams or rivers were also used to identify blocks boundaries. The whole FMU area is divided into six major Blocks: Khaling, Kharungla, Kurchelo, Bephu, Brekah and Sherabtse College blocks.

Compartment:

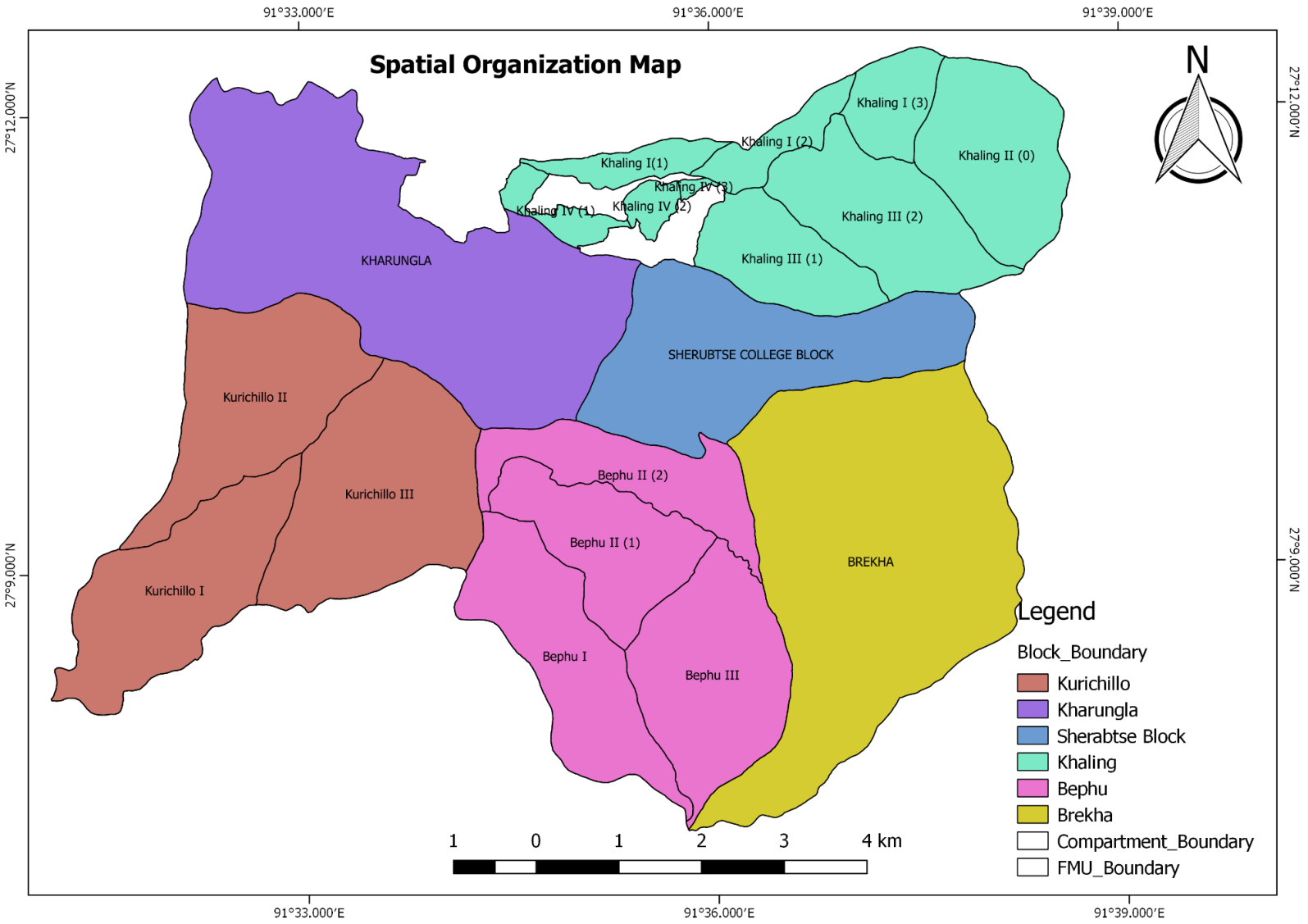
The compartment are basically orientation units created to facilitate easy orientation within each unit and to provide for easy administration, recording and monitoring of operations within the FMU. The boundaries of the compartment followed easily identifiable topography or planning features such as roads, streams, rivers, main ridges etc.

Blocks are further sub-divided to compartment and sub-compartments as shown in Table below.

Table 32: Areas by Blocks and compartments in the FMU.

Block	Compartment	Sub-compartment	Area (Ha)
	I	1	75.23
		2	86.69
		03	115.03
	II	0	334.98
	III	1	211.86
		2	327.02

Khaling	**IV**	1 2 3	54.19 33.41 6.61
	Sub Total		**1245.86**
Kharungla			1206.61
Kurchilo	**I** **II** **III**		429.58 443.75 545.45
	Sub Total		**1418.78**
Bephu	**I**		387.68
	II	**1** **2**	290.34 254.37
	II		417.06
	Sub Total		**1352.31**
Brekha			1276.64
Sherabtse College			610.17
	Total		**7110.37**



Map 10: Spatial Organization Map

14.2 Determining Operable Area

Forest are managed for multiple purposes. The multiple uses of forest are generally protective, climatic, productive, scientific recreational etc. But while managing a unit area of forest, all such purposes cannot be equally synchronized. One purpose has to take precedence over other. The area for commercial and rural forestry activities are those area that are left after areas for other critical functions were identified and mapped out, using QGIS and inventory information. The function that take precedence over commercial and rural forestry activities are:

- ✓ Soil protection areas (slope greater than 100%)
- ✓ Soil conservation
- ✓ Agriculture uses
- ✓ Riparian buffer and zones
- ✓ Local water supply protection
- ✓ Biodiversity areas (wildlife protection and conservation)
- ✓ Religious site protection
- ✓ Road buffer

Table 33: Function Areas in Working Circle

Function/Zones	Code	Area covered (Ha)
Soil Protection	SP	2728.41
Soil Conservation	SC	881.19
Local use Only	SoCL	566.7
Religious Site Protection	SocRS	31
Riparian Reserve Protection	WRR	608.05
Local Water supply Protection	WLS	216*
Road Buffer	RB	1007.80
Production		1812.58

* An area identified during public consultation over the Google earth and rectified.

14.3 Organization into Working Circle

Function mapping was used to delineate broad management circle of Khaling-Kharungla FMU. The three broad management circle for Khaling-Kharungla Forest Management Unit are Protection, Production and Non-production Management Circles. The specific prescriptions are as below:

14.3.1. Protection Management Circle

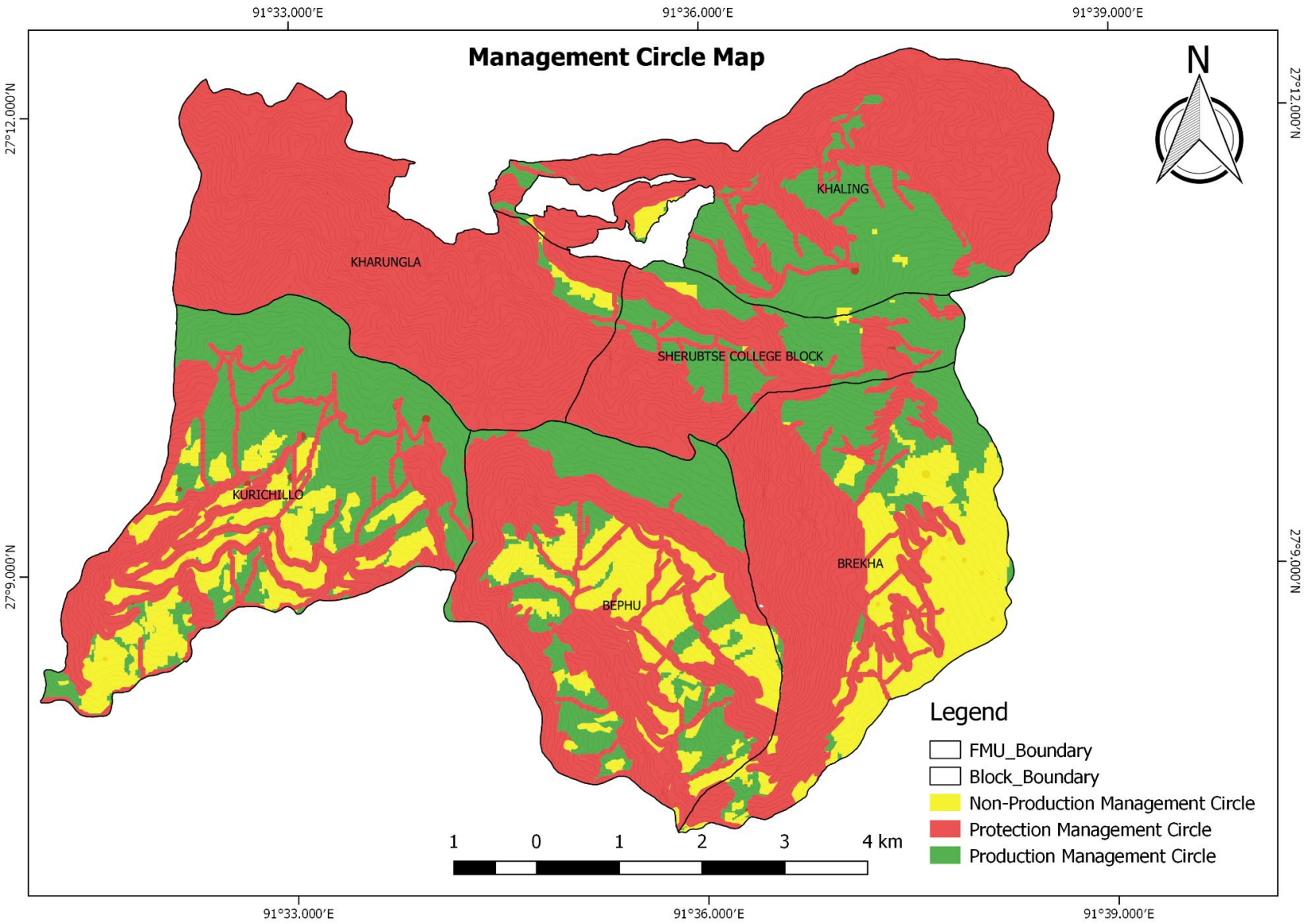
The protection Management circle is area under protection where no commercial activates can take place. The protection Working Circle is the sum of all protection function; wildlife protection, soils protection, riparian reserve protection, religious site protection and local water supply protection and covers a total area of **4299.09 ha.** The management objective and option are briefly outlined below, but management of individuals protection function will comply with prescriptions as detailed under table

Table 34: Protection Management Circle

Management Objectives	Management Options	Responsibility
• **To conserve and enhance wildlife habitats and biodiversity**	• Avoid disturbance • Promote research	• All parties • Territorial
• **To conserve the water resources**	• Minimal interference	• Territorial • All parties
• **Low impact NWFPs collection**	• Defer from intervention encase reduces water quality	• Territorial
• **To protect the forest from grazing, fire and illegal activities**	• Involve local people in mitigating impacts	• Territorial
• **To raise awareness of the important biodiversity areas.**	• Public meeting/field visits • Literature • Research	• Territorial • Territorial • Territorial
• **To respect the sanctity of religious places.**	• Non-intervention	• All parties

14.3.2 Non-Production Working Circle

The Non-production Management circle includes areas where production is not economical or feasible. It generally comprise of Non-forest areas, settlements and agricultural use areas. The total Non-Production Working Circle area adds up to **998.94 Ha**. The management objectives and options are described below, but the most important objectives is to regenerate the poorly regenerated or blank areas and improve the existing forest condition.



Map 11: Management Circle Map

Table 35: Non-Production Management Circle

Management Objectives	Management Options	Responsibility
• **To improve grazing for livestock**	• Rotational grazing • Local involvement	• Territorial/Dzongkhag/Gewog Administration.
• **To conserve and enhance biodiversity**	• Promote research	• Territorial
• **To conserve water catchment functions**	• Replant deforested area • Maintain vegetation cover • Introduce Soil & Water Conservation Activities	• Territorial / NRDCL • All parties • Territorial /NRDCL

14.3.3. Production Management Circle

The Production Management Circle is the area derived from the remaining area after critical function were identified and mapped out and consequently grouped into protection and non-production management circles. The Management Circle is divided into two working circles and management options and objectives are described fro each in subsequent sections section. To ease the management the whole production area has been divided into blocks and compartments. The total area under Production Management circle inclusive of commercial and rural is **1812.58 hectare.**

14.3.4 Non-Wood Forest Products (Overlapping) Management Circle

Non-Wood Forest Products (NWFPs) are important part of the economy, and also an effective incentive to conserve forest, woodland and other ecosystems. The use of NWFPs by the rural people in making a living has developed to involve assets, income generating activities and entitlement, contributing to their livelihood. To sustainably manage the ecosystem that supported these NWFPs and reduce the vulnerability of those people entirely dependent on these, there is need to evaluate losses in harvesting these resources against the potential benefits accruing from them. This management plan is not meant to provide an in-depth analysis of various inventory techniques but to re-visit some of them, which are inevitable. Hence the need to meaningfully and genuinely integrate NWFP working Circle in this Forest Management Plan appears to be necessary.

Management Circle shall overlap with all other management Circle including Protection and Non-Management circles, which constitutes the entire FMU area. The overall objective of this Working Circle is to manage the NWFPs in Khaling-Kharungla on sustainable basis, and monitor low impact collection. Among many other NWFPs, bamboo is most abundant and

widely used NWFP *spp* within Khaling-Kharungla FMU. The notes and management guidelines for NWFPs (bamboo) in Khaling-Kharungla FMU is discussed below:

i) **Bamboo**

Khaling-Kharungla FMU is stock with bamboo, cane and other minor forest products like mushroom, Ferns, leaf mould, top soil ..etc. The unit has three species of bamboo viz. *Borinda, Yushania and Chimonobambusa* species. Though bamboo is a minor forest produce, it plays a very important role in our national economy as it is poor man's timber. Silvicultural management of commercial bamboo has never been practiced in eastern Bhutan, in spite of its growing importance as an important forest product for roofing, flooring, wall partitioning and as source of raw material for cottage industries. The villager depends on the bamboo resources for their local need and small quantity is commercially traded. In spite of its great importance, there is no record of species and areas covered by bamboo.

Silviculture of bamboo

The bamboo belongs to family of *Poacea* and its monocarpic plants. Thee seedling of bamboo resembles a blade of grass. Underground stem or rhizome is produced from the base of seedling. Rhizome grows outwards from the center. Since the rhizome develops outward new clump are produced on the periphery every year and reach full size during the growing season.

The rotation of bamboo varies from 4-25 (Tshering Dendup & Dimple Thapa, 2009). It is also said that bamboo keeps on growing and expending out word till flowering. But usually they are restricted by the biotic interferences thus creating congestion and making cutting and extraction very difficult. It is very important to leave some mature clumps in a slump to support young culms. Felling of mature culms is usually done based on their morphological characteristics. Some of these characteristics are culms sheath, culms coloring, branching etc.

Bamboo flowering are usually are of type: Sporadic flowering in which one or few culms in a clumps in a locality may flower. Gregarious flowering is often followed by death of the clumps.

Silvicultural system

Bamboo working has being going on since long time, but there has not being one system named for the management purposes. The most appropriate system adopted in few countries is the *culm selection system*. This system will be followed under definite rural to ensure harvesting and regeneration.

Harvesting of Bamboo

People harvest bamboo as and when the particular bamboos are needed. The harvesting techniques applied vary for different bamboo species according to use. As per the case study by Renewable Natural Resources Research Center (RNRRC) Bajo, the selective harvesting was

practiced by the harvester where only matured, straight, longest and largest culms were chosen and harvested. This ensures the continuity of the resources as the younger culms (less than two years) are left behind as future crop. However, with the rapid increase in demand for bamboo products, even young shoots are harvested. Therefore, to avoid further degradation of resources, it is important to understand the silvicultural requirement of the bamboo.

Harvesting guidelines:

Harvesting guidelines will differ with species. Following general guidelines may be applied.

- Culms should be harvested from the base or at the first long internodes.
- Bamboo shoots or culms of less than one year old should be left intact.
- All culms older than 4 years should be removed
- Maximum 33% of 1+years and 2+year old culms per clump should be harvested each year and 67% should be kept for regeneration. 70% of the 3+years old culms be harvested. It is important to leave some old culms to provide physical support to 1+ year and 2+year old clums ((Tshering Dendup & Dimple Thapa, 2009).
- Culms should not be harvested when new shoots are sprouting as this practice will harm the new developing shoots. The preferred timing for harvesting bamboo culms is one two months before the bamboo-shooting season(this season differs according to location and altitude)
- Respect the traditional belief *(ladam/ridam)* realated to the allowed timing for entering the forest which overlaps with the bamboo shooting season.

Others

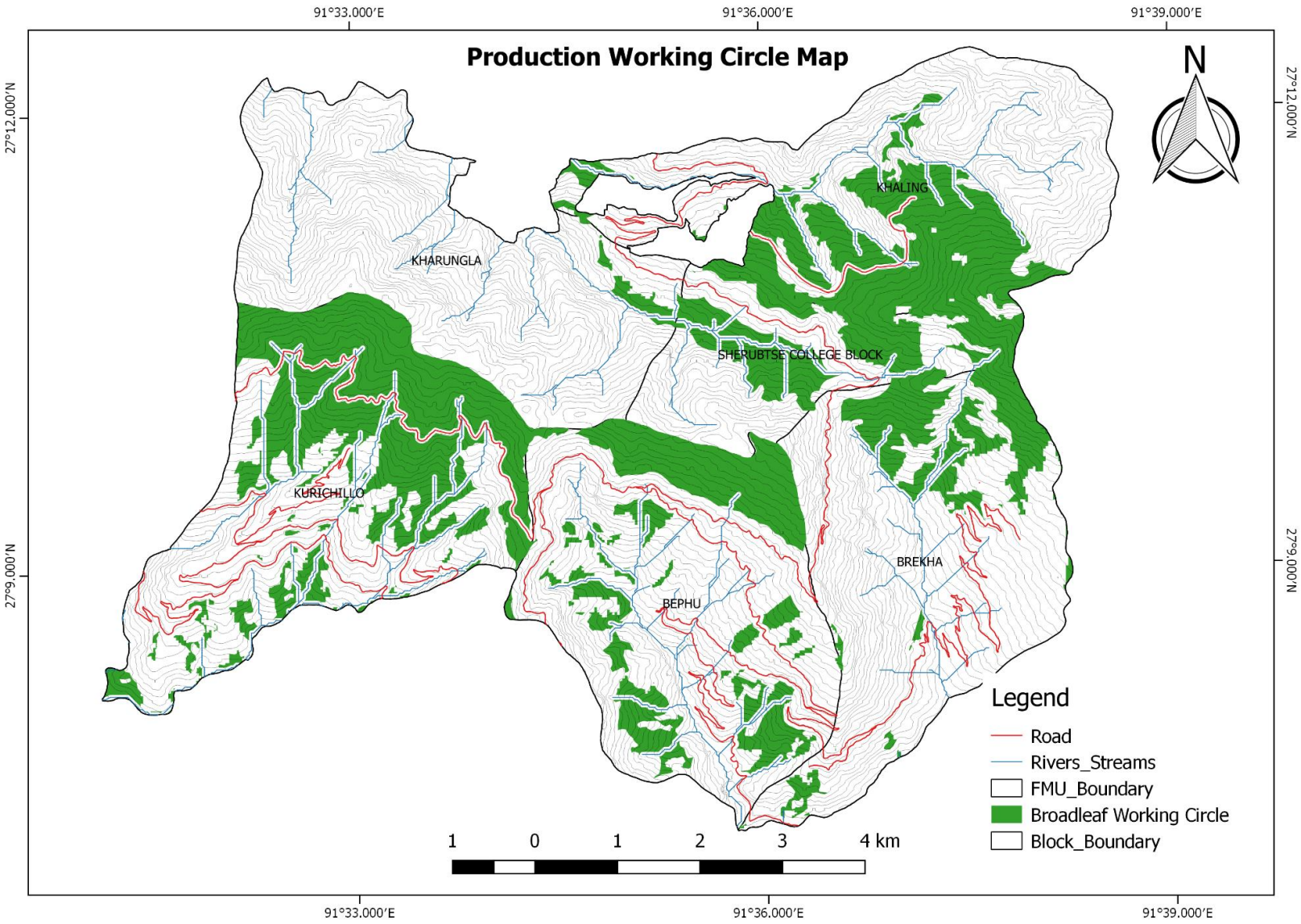
The other important NWFPs found and collected in the FMU are enlisted and discussed in the previous chapters.

Management prescription

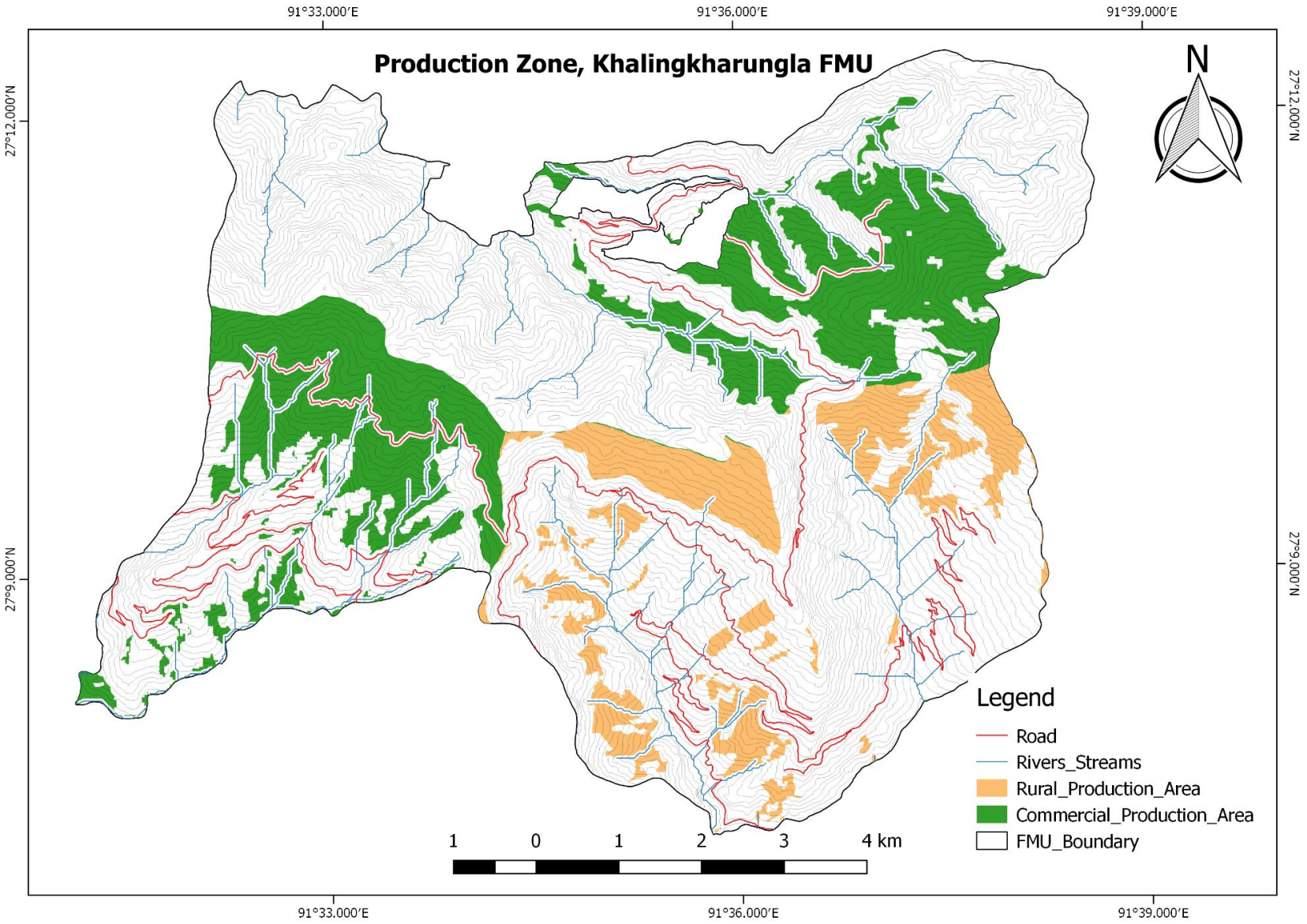
Low impact collection of NWFP should be done and wherever possible a check on sustainability should be made. Trashigang Forest Division shall identify threats to sustainability of NWFPs and prescribed management prescriptions in consultation with Social Forestry and Extension Division of DoFPS. Trashigang Forest Division should also consult with the public of Khaling and Lumang and accordingly form NWFP group for bamboo.

14.4 Organization into Working Circles

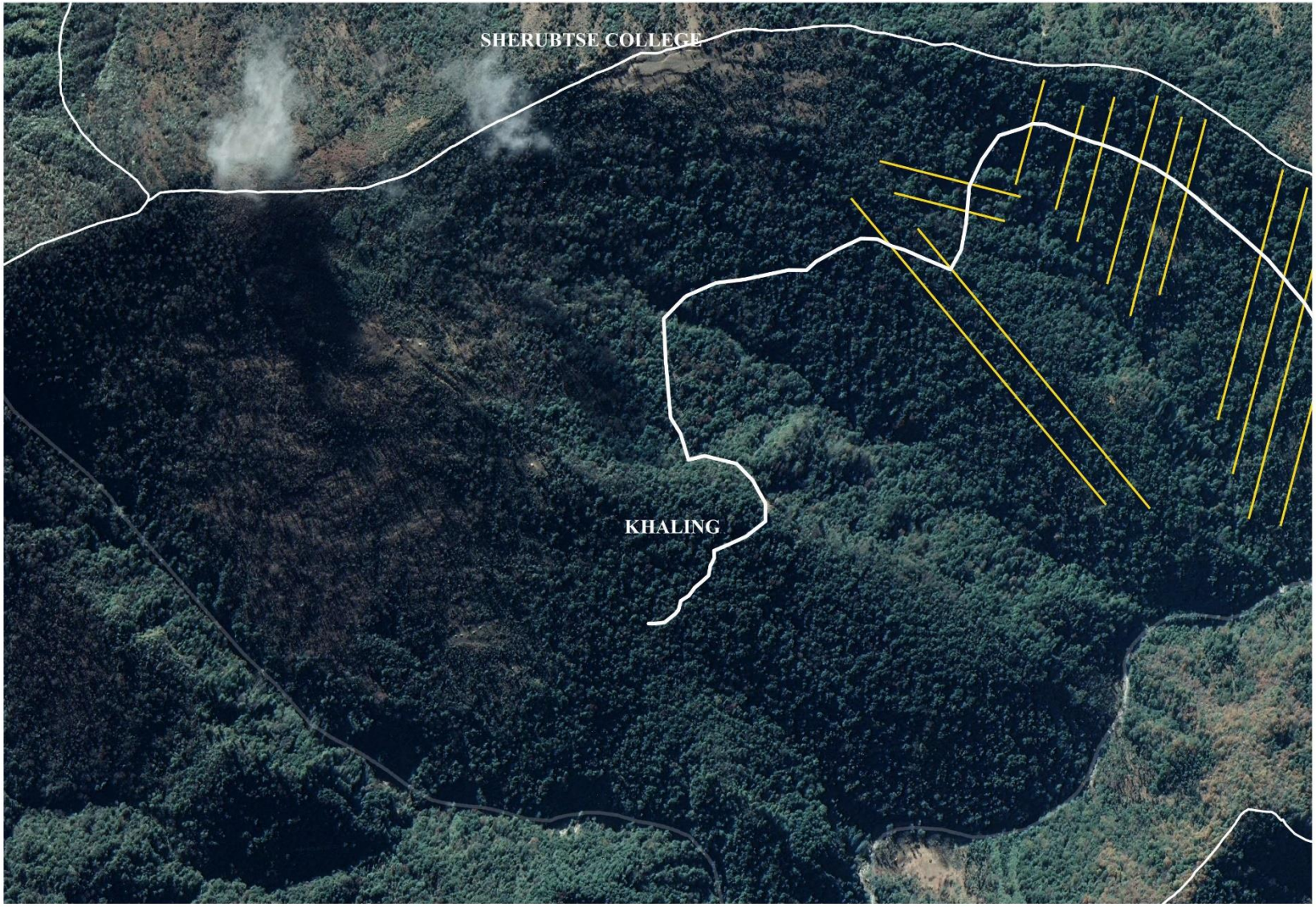
The Production Management Circle has been classified into only one working circles.i,e Broadleaf Working Circle for easy management of the forest. The Production Working Circle includes all areas where harvesting can occur, both commercial as well as local. To further ease the implementation, the working circles has been managed through the formation blocks, compartment and sub-compartments. The working circle has been created on the consideration of stands requiring similar silvicultural treatment and rotation age.



Map 12: Production Working Circle Map



Map 13: Map showing Production Zones



Map 14: Google Image of commercial production areas

14.5 Management of Working Circle

Table below describe the objective, management options, responsibilities, monitoring and evaluation and silvicultural system specific to Broadleaf working circle.

Table 36: Broadleaf Working Circle

WORKING CIRCLE: BROAD LEAF				
Management objective	***Management Option***	****Responsibility***	*****Monitoring***	***Silvicultural System***
• **To meet the commercial timber production on a sustainable basis**	• Operate entire length of cable line • Ensure cable line layout allows interlines logging • Encourage cleaning of ENTIRE lines by firewood contractor • Use appropriate logging and silvicultural methods • Harvest all areas regardless of financial returns	• Territorial/NRDCL • Territorial/NRDCL • NRDCL • NRDCL/Territorial • NRDCL	• Territorial • Territorial • Territorial • Territorial • Territorial	Silvicultural system applied will be patch clear-cut system with artificial regeneration. NRDCL will provide fencing for proper establishment of seedling for a period of 7-8 years.
• **To create local employment**	• Provide proper training • Encourage contractor to hire locally	• NRDCL/Territorial • NRDCL	• Territorial • Territorial	Commercial harvesting in this working circle is dependent on the construction of proposed
• **To protect the forest from fire and illegal**	• Control grazing, forest fire, poaching and illegal felling with local community	• Territorial	• Territorial	

activities and from grazing in the regenerating areas.	participation.			forest read. Nursery to stock with local and commercial species.
• **To enhance and improve forest condition and productivity.**	• Ensure that all bare and past harvested areas are restock sufficiently with desired species composition • Use stand tending techniques • Work with local communities for planting/restocking activities • Create favorable condition for regeneration and growth	• NRDCL/Territorial • NRDCL/Territorial • NRDCL/Territorial • NRDCL	• Territorial (Regeneration survey) • Territorial • Territorial • Territorial	
• **To continually improve health and safety standards.**	• Provide training to contractor • Promote awareness in the locality	• NRDCL • Territorial	• Territorial • Territorial	
• **To conserve the water catchment function**	• Minimal intervention • Abide by stream buffer prescribed	• Territorial /NRDCL • NRDCL/Territorial		
• **To maintain**	• Low impact silviculture systems	• Territorial/ NRDCL	• Territorial	

biodiversity within the production area				

Note: All objective will be evaluated annually by the FMU Level management Committee

* Lead agency for responsibility is the agency listed first

** Al objectives and activities will be evaluated during the Mid-term Review

14.6 Implementing Working Circle Management

The Forest Function planning concept has been used in this plan to allocate land use among the forest in the FMU, so that strategic planning for sustainable yield can be carried out. Forest Function mapping for Khaling Kharungla FMU was carried out using QGIS software. However, problem still remains to implement these prescriptions on the ground. Later sections indicate that this will be done through an operational planning process whereby information that is more detailed is collected through inventory and discussion with stakeholders, local communities and NRDCL.

Therefore, the Unit In-charge will have to use the provided maps to the best of his/her ability. Areas should be observed on the forest function maps prior to going into 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 on all streams and steep slopes should be measured and observed for soil protection or conservation. The forest function map will be updated accordingly as per the field observation.

15. YIELD REGULATION AND HARVESTING

15.1 Yield Regulation

15.1.1 Determination of the AAC

Principle of sustainability, the backbone of Forest Management is accepted norms in the Forest Management and forms the core principle of organized forestry. The concept has been evolved from the basic consideration that the later generation may derive from the forest at least as much of the benefits as the present generations. The principle of sustained yield ensures the stability and continuous supply of raw material to the industries and meets the social and domestic needs of the people. Sustained productivity, the basic aim of forest management may be visualized in two respect:- continuity of growth and continuity of yield or harvest.

Sustained Yield management allows harvesting of forest resources in a way by which annual cut and other losses of timber do not exceed the average annual growth and assures continuity of harvest, expressed as *Annual Allowable Cut (AAC)*

15.1.2 The Most Appropriate AAC Method

A wide range of formula and calculation approaches are available and advantages and disadvantages can be argued for each.

Whilst it is difficult to define a clear best method for the country, there is a strong believe for standardization around a fairly simple and robust single methodology. The method which is used for the calculation of AAC in Khaling Kharungla Forest Management is based on combination of area, volume and rotational age of species.

The method used for calculating the AAC for KKFMU:

$$\boldsymbol{AAC\ per\ Working\ Circle} = \frac{\boldsymbol{Net\ operable\ area}}{\boldsymbol{Rotation}}\ \boldsymbol{X}\ \boldsymbol{Average\ standing\ volume\ per\ Ha}$$

15.1.3 Calculation of AAC for Khaling-Kharungla 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 preventharvesting operations. This occurs mainly when the cable lines are being laid out. Beside this, Patch cut 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, the past management plans practiced the method whereby around 20% of area from the gross operable area has been reduced to calculate the net operable area in commercial Working Circles. However, this practice has led to inefficient use of production areas and has affected the sustainability of FMUs in the country. Therefore, this management plan does not prescribe the reduction in areas to calculate net production area as all areas which are inaccessible and inoperable are already mapped out as designated under protection working circle (Table 34). This prescription mandates the Unit In-charge and NRDCL to properly utilize the available production areas so that the area can be sustained for future harvesting operations. Any deviations from the prescribed cable line layout should be approved by the Department prior to implementation.

Table 37: Net Operable Area.

Sub Working Circle	Gross Operable Area (Ha)	Net Operable area (Ha)
Broadleaf Working Circle (Commercial)	1241.78	1241.78
Broadleaf Working Circle (Rural)	570.80	570.80
Total	**1812.58**	**1812.58**

Rotation

Since reliable increment data is still very limited for Bhutan, assumed rotation length need to be cautious. For Patch Cut System, the objective is to have more or less even aged regeneration in the operated areas. For Broadleaf forest, the regeneration period is rather very long and particularly in Khaling Kharungla, problem of natural regeneration have been serious issues due gazing and invasion from bamboo within operated areas. The assumed rotation length for broadleaf regeneration period is rather long. The assumed rotation period for Broadleaf forest within KKFMU is 100 years. Therefore, while calculating AAC for Khaling Kharungla FMU, 20 years has been added to the rotation of broadleaf forest which is 120 years.

Average Standing Volume

The matured Standing Volume is taken from the inventory data. The calculation was carried out at Forest Resources Management Division (FRMD). The average standing volume for the stratum is individual volume of each specific stratum. For AAC calculation, Reliable Minimum Estimates of the Average Standing Volume has been taken.

Table 38: Average Standing Volume

Strata	Average Standing Volume (M^3/Ha)	Sampling error % (at P= 90)	Reliable Minimum Estimate (M^3/Ha)

Hardwood	110.00	11.59	87.14

AAC for Broadleaf working circle

The AAC for broadleaf working circle, based on the above table is given in the table 36.

Table 39: AAC for Broadleaf working Circle in standing volume

Strata	Net operable area (Ha)	Rotation	RME of Average standing Volume (M^3/Ha)	AAC (M^3/Year)	Clear cut Equivalent (Ha)
Broadleaf (commercial)	1241.78	120	87.14	901.73	10.34
Broadleaf (Rural)	570.80	120	87.14	414.49	4.75
Total	1812.58			1316.22	15.09

Therefore, the total workable AAC for Khaling Kharungla FMU is fixed at **1300 m^3** in standing volume out of which **900m^3** has been allotted as Commercial AAC for commercial use and **400m^3** has been allotted as Rural AAC for rural use. 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.

There is a substantial decrease in the AAC allocation compared to last plan period. The last plan had allocated AAC of **2706 m^3** of which 1697 m^3 is allocated to commercial use and the remaining 1009 m^3 is allocated to rural use. The decrease in the AAC for this plan period to **1300 m^3** is mainly attributed to following reasons:

There was a change in the inventory methods and subsequently the inventory results in the two plan periods. In the last plan the inventory was conducted only in the natural forested area covering an area of only 4645.42ha. Of the total 131 plots planned only 66 plots were enumerated at a spacing of 700 meters. The subsequent volume per hectare (RME) calculated and used for the purpose of AAC calculation was **520.42 m^3/ha** with an Standard error of 34.85%. However, for the current plan the inventory was carried out throughout the FMU area irrespective of forested areas laying 457 plots at a spacing of 400m x 400m. The inventory was designed with target sampling error of +-11.59% at confidence level of 90 percent. The

subsequent volume per hectares (RME) calculated and used for the purpose of AAC calculation is **87.14 m^3/ha.** Therefore though the production areas of the FMU has increased from **624ha** in the first plan period to **1812.58 ha** in the current plan period the AAC of the FMU has been reduced from **2706m^3** in the last plan to **1300m^3** in the current plan mainly due to reduced volume per hectares as mentioned above.

Infact the total production areas of the FMU has increased from 624ha in the last plan to 1812.58ha in the current plan. The increase in the production areas is mainly due to the change in the forest function mapping methodology using high resolution Digital Elevation Models adopted in the current planning purpose unlike in the past.

15.2 Recording and Accounting for AAC

AAC will be monitored through the records of the trees 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. All trees marked within KKFMU either along the surveyed cable line or marked for any development activities shall recorded and accounted in the AAC.

15.3 Allocation of AAC

The concept of FMU encompasses the right of the people within the FMU. Therefore, allocation of AAC has taken into account the needs of the local people living within FMU, besides providing NRDCL with timber and accounting for the needs of other organizations. The allocation of AAC for rural and commercial use is as follows.

Table 40: Allocation of AAC

Standing Volume	Allotted to
900 m^3	Commercial harvesting by NRDCL to meet the timber demand in the market.
400 m^3	Local public for house construction and other purposes in the rural area.

15.4 Distribution of the cut

Although the AAC is volume based, it is essential to monitor the amount of area that is being harvested. Assuming the reliability of inventory (average standing volume) is reasonably high, the volume per hectare should be calculated to represent the number of lines that can be feasibly

operated and mentioned in Operational Plan. Therefore, if the UIC notices that more cable lines or less are being harvested annually then the AAC must be adjusted.

16. SILVICULTURE SYSTEMS

16.1 Patch clear cut System

For the Broadleaf Working Circle in the FMU, Patch Cut is the prescribed Silvicultural System. The particular Silvicultural System has been selected based on the ecosystem and natural regeneration system. Under the Patch Cut 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 patch will be opened along cable lines. The distance between cable lines will be not less than 75 m, and between patch along cable line not less than 50 m. The corridors should not exceed 4 m width. The length of the cable lines and number of openings along a cable lines must be determined by the availability of the stocks in a cable line. In the event of good stocks, the AAC or patch cut area equivalent of the FMU (whichever is achieved earlier) could be met even from a single cable line. In such instances, laying of subsequent cable lines must be restricted to next harvesting period only (Next OP).

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 patches will be almost impossible. Aspect, slope and silvicultural requirement would influence the actual size of the patch. An average maximum of 0.25 ha opening is recommended.

The signs of existing windfall, stands which are matured or diseased, and stands infested with mistletoes should be chosen 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 SouthWest 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 Patch Cut 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 Patch Cut System.

The Patch Cut System has the following advantages:

1. Regeneration in the patch under even-aged condition gives better stem form.

2. Creates less of a visual and environmental impact in forested areas.
3. Larger openings in comparison to that under single tree selection system permit the establishment of intolerant species.
4. Harvesting is more concentrated, so the logging cost is lower.
5. Harvesting in patch lower damages to residual stands.
6. Intermediate cuts may be made less frequently.
7. Aesthetically and environmentally more acceptable than clear cutting system.

General guidelines for Patch Cutting System in broadleaf forest. (Vide Forest research finding and Recommendation during the 8th FYP, RNR-RC Yusipang, 2003).

- Patches of matured and over-matured trees under which there is existing regeneration or which are most likely to regenerate successfully should be given preference. This would include large trees with spreading crowns, which absorb sunlight if permitted to reach the forest floor would enhance seedling development.
- In selecting patches, ridges too are preferred over the depression, uphill slop position over downhill slop in order to minimize damage to the regeneration in subsequent felling operation.
- The size of opening should depend on stand composition and condition. In general, the size of opening should vary from 0.15 to 0.25 ha. It should not be too large, as it will favour the growth of other species which have less timber value.
- Distance between the patches retained should be such the patches of tree retained will form a wind firm group of trees and appear as a uniform patch.
- In mature broadleaved forest with many matured and over matured trees it is expected that 75% of standing volume would be harvested by felling 40 to 60% of area.
- The direction of the tree lean and the topography should be taken into account to prevent large trees being felled on nearby advanced growth.
- Dead or dying trees or those showing symptoms of dead or damage (snags, scars, conk, mistletoe, etc.) should be retained to safeguard flora and fauna niches or habitats.
- Sufficient seed tree in the interlines spaces adjacent to the cable lines opened up should be retained as potential seed sources for seedling regenerations in patch-cut.

16.1.1 Working pattern

Only one third of the selected area will be subjected to harvesting between intervals of fourty one years for mixed broadleaf forest. Patch will be opened along the cable line. The distance between the cable lines will not be less than 75 meters and not less than 50 meter between the patches along the cable lines. The width of corridor should not exceed 4 meters. The effective area within the limit of standard cable length is 7.5 hectare (1000 m x 75 m), less the area of the corridor of 0.40 hectares (1000 m x 4 m), thus the one third removal would be equivalent to 2.4 ha((7.5-0.4)

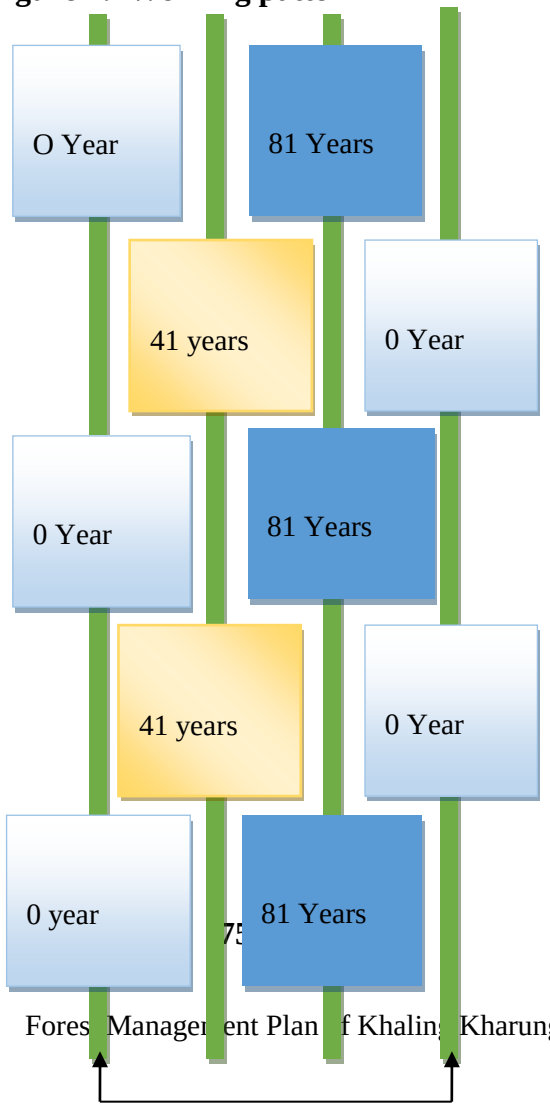
/3), which is the area available for ***patch opening***. Thus it would be possible to open up around 9 to 10 patches along the standard cable lines. The total removal of crops within the standard cable line area of 7.5 hectare will be 2.7 ha for 9 patches and 2.9 hectare for 10 patches laid out along the standard cable lines (i.e. 9 or 10 patches x 0.25 Patch area +0.4 corridor area).

The individual opening need to be uniform in shape and size or systematically located along cable lines. In most cases the opening will be irregular in shape and systematic location of patches will be almost impossible. Aspect, slop and Silvicultural requirement will influence the actual size and shape of the patches. On average, patch opening of 0.25 ha is recommended along the cable.

In order not to lose the site protection effect of the surrounding trees, it is necessary that specific size for opening should be strictly adhered. Trees should be felled towards the center of the patch opening whenever possible to avoid damages to the unmarked trees.

The figure in the following pages gives the schematic diagram for laying out the patches along the cable lines. This figure is to be used as a guide and reference only and is not to scale with actual dimension in the field.

Figure 7: Working pattern



Distance between two cables lines = 75 m

Area of group opening = 0.25 ha

Distance between two group opening along the cable lines = 50 m

Cable corridors = 4 m

Table 41: Workout for cable lines

Strata	Volume (m^3/ha)	AAC ((m^3/ha)	Clear cut Equivalent	Clear cut area of one cable line of 1000m length with 10 openings	Nos. of cable/Year
Broadleaf (commercial)	87.14	900	10.33	2.9	4

Based on the above calculation, four cable lines of 1000m length and 4 m width with 10 openings of 0.25 ha will be sufficient to harvest the commercial AAC, but in reality the length of the cable line varies between 600m to 1100m. Therefore, the numbers of cable lines may also vary as per the length of cable line. This adjustment can be made in subsequent year through FMU level committee meeting. However, since the volume per hectare from operational inventory may vary with the volume per hectares of the FMU inventory the UIC will accordingly calculate the number of cable line feasible and mention in the Annual Operational Plan based on the operational inventory result.

16.2 Single Tree Selection System

This system will be practical in Local Use Only forest areas for rural marking. 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 the forest area. This system helps to maintain uneven-aged character of the crop in the forest as in nature.

It is observed that in most cases, the trees of best economic interest are selected and felled. Instead of following this, the UIC should judge and familiarize with the forest condition and silviculture of the species and do the selection with the interest of meeting the objective of the system. As far as possible, selection of trees to be felled should be done for the following categories first especially in young and immature stands.

- Dead, dying, diseased, mis-shapen or otherwise defective trees interfering the growth of neighboring vegetation.
- Trees of undesirable species.
- Immature trees which can be removed by judicious thinning

- Matured trees above the exploitable diameter which will leave gaps for regeneration to come up.

17. FOREST PROTECTION

17.1 Fire

There is no incidence of forest fire within KKFMU during the 1st and 2nd phase of management plan period. However, the UIC should place strict vigilance to prevent forest fire. In view of a shortage of access road and firefighting equipment, fire protection should primarily address preventive measures. These are awareness education for the local population and contractors, especially during the dry season. These awareness can also be initiated through FMU level meeting and informing the gewogs reprehensive to pass on the information to the people under their jurisdiction. The UIC and Range manager should review forest fire protection programs at regular intervals in close consultation with local people.

17.2 Pest and Diseases Management

The Forestry staff will be periodically monitored to detect any outbreak of pest or diseases. Regular inspection will be conducted by FMU staff to detect and report any incidence of pest and diseases outbreak to enable possible remedial or preventive measures to be initiated.

Detailed description on symptoms and damages, preventative and control measure has been reflected in the Forest Management Code of Bhutan under Chapter No 5. Implementation - Sub-section No. 5.04 Forest Protection (*Pest and Diseases).* Report on the pest & diseases must be made to the CFO and relevant research specialist (s) contacted.

The control may include the following:

- Forest sanitation, hygiene measures
- Regular survey of regenerated areas and removal of infested plants and their slash and detached barks.
- Use of insecticide or fungicide in close consultation with forestry research section.

17.3 Grazing

In line with the multiple use objective of forest and a provided in the Forest Policy of Bhutan, grazing will be allowed to continue in the FMU. More importantly, a participatory approach to secure the corporation of local villagers in keeping their cattle out of environmentally sensitive areas and away from the regenerating coupes will be adopted with high priority. These strategies will be implemented through the combined effort of Dzongkahg and CFO, and should be a core part of PFM approaches.

Fencing, which is expensive, will be adopted as last resort to protect regenerating seedlings and sapling in the harvested coupes. Barbed wire fencing will be employed to close such areas to grazing for at least 10 years, or sufficient stems are above grazing height, whichever occurs sooner.

18. ENVIROMENMTAL STATEMENT FOR ENVIRNMENTAL IMPACT ASSESSMENT

18.1 Introduction

The Environment Assessment Act (2000) requires all developmental proposal in Bhutan to meet a series of environmental criteria. Chapter III (s/c 18) list five general requirements that must be fulfilled by any applicant requesting for the environmental clearance. The National Environmental Commission has developed various Sectoral Environmental guidelines to be adopted by the applicant. The environmental clearance Guidelines for Forestry Activities specifies the details criteria to be met by an applicant to carry out the forestry activities. It is assumed in this chapter that if the sectoral guidelines are met, the requirement of the Act will be met.

This section therefore, plan to provide information on how the forestry activities will be carried out and controlled so that the proposed activity meets the requirement of the Act

18.2 Project Description

18.2.1 Introduction

The timber demand is continuously increasing in the market. Therefore, the key principle of Department of Forest and Park Services under Ministry of Agriculture and Forest is to encompass one Forest Management Unit (FMU) in each Dzongkhag to supply timber raw materials to the people of Bhutan on sustainable basis. Khaling Kharungla has been chosen as one of the potential forest management unit that could cater the needs of the forest to the people on a sustainable basis and had proved to be so during its implementation in the first and second plan period.

Khaling-Kharungla forest management unit will work on the principal of sustainability thereby making the timber available in the market as well as meeting the *bona fide* requirement of the local people. Forest Management based on the principal of sustainability will considerably improve the forest stand. The whole of Khaling-kharungla area measuring approximately 7110.30 hectares has been taken for the project, with the net operable area of 1812.58 hectare. The project will be harvesting Vis-a-Vis reforesting thearea. On one hand, matured and over matured trees will be felled to improve the stand condition and on the other hand, timber will be available in the market to meet the timber needs.

18.2.2 Objective:

The main objective of creating forest management Unit is:

- To improve the forest stand of Khaling-Kharungla
- To ensure supply of timber, fuel wood and non-wood forest produces on a sustainable basis.
- To regulate grazing in an organized manner so as to curtail its adverse effects;
- To help local people through generation of employment.

18.2.3 Project Location and Area

Khaling-Kharungla Forest Management Unit is situated within Khaling and Lumang geog under Trashigang Dzongkhag. It is located between 27°20'04" North latitudes and 91°64'7" East longitudes under Trashigang Dzongkhag. The Highway between Sumdrupjongkhar and Trashigang traverse the FMU. The total area of the FMU 7110.30 hectare. The total production area of the FMU is 1812.58 ha which will be subjected to timber harvesting in scientific and sustained manner. Rest of the FMU area is categorized under various protective and local use functions as per the Forest Function Mapping.

18.2.4 Benefits

The production areas of Khaling Kharungla FMU which are covered under this plan was not subjected to commercial operations in the past and thus it has lots of matured stands. These over matured stands can be harvested so that it creates space for regeneration to establish. This would not only benefit in terms of generating revenues but also help improve the forest conditions. The FMU activities can also contribute towards providing employment opportunities to the local communities. Local people can be involved as unskilled labour during maintenance of road, construction of forest road, extraction of timber and transportation. This will help uplift the livelihood of the people residing near by the Forest Management Unit. The forest roads constructed for the purpose of extracting timbers from these un-operated forest areas will benefit the settlements near the FMU in extracting rural timber from the local use area. The FMU road will also help people extract rural timber for their house construction and renovation purposes.

The harvesting of matured trees as per the prescription of the plan will allow the extraction on sustainable basis and also contribute towards government revenues. Managed forest will definitely ensure future sustainability of the resources.

18.3. Method

18.3.1 Forest Management Unit: Planning and zoning

Khaling-Kharungla FMU is under commercial operation for last twenty years. The forest was brought under scientific management in 1995. All the Management Plans will have to be written based on the Forest Management Code of Bhutan (2004). Very comprehensive and

consultative land use planning was also carried out while preparing the third forest management plan. The process is briefly outlined below:

All potential area with well stocked forest was identified close to the roads using GIS technique, followed by the reconnaissance survey in the field. Consultation with the community of Khaling and Lumang gewog was carried out to ascertain potential conflict between forestry use and existing local use. A forestry resources inventory was carried out to provide the information about tree stocking, regeneration, timber volume, site characteristics, wildlife presence and under storey species.

Forest zoning is based on above data, using the forest mapping prescribed in the Forest Management Code of Bhutan. The area is divided into different forest types called working circles and they are further divided into blocks, compartments and sub-compartments. The protection areas such as soil protection, wildlife protection, river and streams buffer protection, etc are excluded from the net operable area. The silvicultural system to be implemented is Patch Clear Cut System for broadleaved forests. No clear cutting will be allowed and all the trees will be harvested using the skyline cable crane. The size of patch clear-cut should be 0.25 hectare. The distance between the cable lines will be not less than 75 meters and distance between the groups will be not less than 50 meters.

18.3.2 Harvesting and Extraction

Fixed volume of timber expressed as Annual Allowable Cut (AAC) is prescribed in this management plan. The AAC prescribed in this management plan is 1300m^3 per year. This means that the maximum volume that can be extracted from the KKFMU will not exceed 1300m^3 per year. The timber will be extracted using the skyline cable crane, manual dragging and rolling is strictly prohibited.

18.3.3 Road Construction and Maintenance

There will be no new road construction during implementation of this plan since the FMU is covered by the road network. The road was constructed during the second phase of management plan. However, minor maintenance need to be carried since roads were affected during the summer season in some location.

For stream crossing, culvert, hum-pipes and bridges are necessary to minimize the negative impacts on streams. For road maintenance, excavator will be deployed instead of bull dozer. Road Standards recommended by FRMD and the general principles and practices of the forest road construction as identified by NEC Forestry Sectoral Guidelines will be followed. These will ensure that the road construction in KKFMU will meet the recommendations and also ensure that any erosion or other negative impacts will be minimized or eliminated.

18.3.4 Regeneration and Post Harvest Treatment

It is prescribed in the management plan that timber harvesting will be followed by the artificial regeneration, since natural regeneration is usually a failure in the broadleaf forest . The series of operation after harvesting is prescribed in the management plan in details. Regular maintenance

of the plantation will be done by NRDCL and CFO shall evaluate the regeneration or plantation at the end of three years. If the survival percentage is lower than 70-80%, immediate beating up will be carried out with the same local species.

18.4 Existing Environment

18.4.1 Topography and Geology

The general terrain of Khaling-Kharungla Forest Management Unit ranges from very steep to moderate. The slopes are basically steep towards higher elevation with highest proportion of steep area within Kharungla block. Altitude of KKFMU ranges from 1120m towards extreme end of Kurchilo block below Darna village to 3880m in Kharungla block at the highest point.

The general terrain of KKFMU ranges from moderate to very steep in most part of the compartment. However, most of the area either falls within the steep area or settlement there by reducing actual operation area. Slope classification was done using 30 m resolution ASTER DEM of Bhutan. Surface analysis was carried out and slopes were reclassified as required in the FMCB, 2004. 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.

18.4.2 Hydrology

The entire KKFMU is the watershed for Jiridazza Ri, NgesigangnangRi, Pho Chhu, Mo Chhu, BephuRi, Dem Ri and DarungRi. There are several perennial and seasonal streams in the FMU that flows into the rivers. Kharungla entire area particularly is an important area as it designated as main drinking water source for Womrong town area. KKFMU is also water source for all residents residing within the FMU area as well people residing outside the FMU.

Appropriate silvicultural system and harvesting methods along with a stream buffer of 30m must be maintained mandatorily to ensure the quality and quantity of water is not affected due to forest operation.

18.5 The Future Management

18.5.1 Plant, Animal Species and Habitat

Multi-resource inventory was carried out by team from Trashigang Forestry staff in collaboration with team from FRMD inventory crew between January and March, 2017. During the inventory, the crew recorded various signs and sighting of wild animals over the entire period and corresponding data were collected based on indirect/direct evidences (footprints, scats, droppings, pellets etc.). Wild animals like barking deer, sambar deer, wild boar and Himalayan black beer were recorded. Since the data did not indicate the number of different species in a particular area, the measure of density of the population of different species at this planning stage may not be possible.

Khaling-Kahrungla Forest Management Unit has good floral diversity, due to its altitudinal variation and aspects. No threatened/endangered plant species has been recorded within the production area of the FMU.

18.5.2 Scenic Qualities

The entire FMU can be viewed as one travels from Trashigang and Samdrupjongkhar. Therefore

special care has been taken to maintain the scenic beauty of the area by maintaining the road buffers both above and below the road. Moreover care has been taken to manage the FMU based on the scientific principles of sustainability.

18.5.3 Cultural Significant Sites

There are many important religious sites within KKFMU of which three important religious sites namely Kharphu Gongpa, Bephuthang Gongpa and Brekha Gongpa has been identified as most important religious sites within KKFMU. The total area under Religious site Protection accounts to 31 hectare.

18.6 Assessment of Impacts and mitigation measures

18.6.1 Impact on water

Water pollution:

Workers engaged for road maintenance and harvesting operations might pollute the rivers and streams through garbage disposal and other human waste. Other pollutants might come from the oil spills from machineries and vehicles.

The FMU has been already covered by the road network. Therefore no new road construction will take place during the period. Harvesting operations and opening of forests might result in decrease in the volume of water and water quality.

Mitigations:

A buffer of 30 meters in the main river, drinking water source and other perennial streams has been 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 will be in place and the camp site will be at least 100m away from the main streams. Forest road passes through streams and rivers sources but to mitigate the impacts, 100 meters buffer have been allotted to prevent damage to the water source.

18.6.2 Impact on Forest Resources

The silvicultural system prescribed in this management plan is the Patch Clear-cut system for broadleaf forest. The opening of corridors and patch during the harvesting operation might open the area for grazing with less regeneration of principle timber species. This could result in reducing the total forest cover within the Forest Management Unit. More opening would provide more area for under growth, which in turn might results into more grazing ground for the cattle. Implementer might go in the easily accessible areas only and start logging only in areas while the whole idea of opening the forest management unit is to manage the forest on sustainable basis. It is likely that operation would occur along the rivers and streams buffer whereby polluting the water sources. Many of the streams and river sources originate from the forest area and if the buffers are not respected there could be conflict between the implementers and the local communities. Improper harvesting techniques by untrained personnel would result into damaging the surrounding trees that may not require felling. It would also result in waste of timber resources.

Mitigations:

The management plan for the whole area for a period of ten years is prepared before the harvesting operations. Harvesting will not exceed the prescribed allowable annual cut (AAC) in the management plan. The size of the opening will not be in any cases larger than that prescribed in the management plan. Artificial regeneration will be initiated from the succeeding year of operation since natural regeneration are not very successful in the broadleaf forest. The introduction of exotic species will not be allowed.

For proper planning, implementation and monitoring of activities in the Forest Management Unit, a full set of staff for the FMU will be required from both DoFPS and NRDCL. The wetlands and marshy areas have been avoided during the road alignment to minimize the impacts on the ecology.

18.6.3 Impact Faunal Diversity

Wildlife is very important component in the forest ecosystem. Due to the harvesting operation and other forestry operations, there might be degradation/loss of wildlife habitat and thereby reducing wildlife population in the area.

Mitigations:

The species composition and forest type is similar throughout the Forest Management Unit. The protected and non harvested area will provide sufficient space, food and cover for movement of the wild animals. Hollow and fruiting trees will be retained. The area opened for extraction of timber will be fenced to protect the regeneration from cattle and wild animals. The area will be supplemented with artificial regeneration with local species from the succeeding year of operation. The animals require good forest for foraging, shelter and cover. Therefore, clear felling of large stretch of forest will be avoided and the harvested forest areas will be brought under forest cover within short span of time either by natural regeneration or by reforestation.

18.6.4 Impacts on Ecology (Flora)

The most anticipated impact on ecology is the change of present forest composition from over matured stand to normal stand especially within the operated areas in the long run.

Mitigations

While harvesting timbers from the demarcated cable lines, enough interlines will be maintained. The trees from the interlines will act as mother trees. Artificial plantation with native tree species will be carried out within operated area.

The entire FMU is already covered by the road network, therefore no new construction is proposed in this plan. However, minor road maintenance with minimal impact on the environment need to be carried out during the plan period. In many of the critical areas that might damage the surrounding environment, hume pipes, culverts and bridges will be designed and installed.

18. 7 Monitoring and Evaluation

The Management plan, which is for the period of ten years, will be prepared by Trashigang Territorial Division, DoFPS. It will be reviewed by FRMD and will be approved by the Minister, Ministry of Agriculture and Forests. The plan will be implemented by NRDCL under the supervision of Chief Forestry Officer, Trashigang Territorial Division. Annual Operational Plans will be prepared by Trashigang Territorial Division in consultation with the stakeholders, based on the management plan. The OP will be approved by the Head of the Department. Annual

monitoring will be carried out by Trashigang Territorial Division (CFO and Unit In-charge). A report will be submitted to FRMD, Department of Forest and Park Services, based on the annual monitoring forms. FRMD will also monitor the implementation of the activities. The plan will be reviewed after five years and at the end of plan period, evaluation will be done prior to

Table 2. 15 Checklist of Environmental parameters for forestry projects

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

	Adverse Environmental Impacts	Preliminary Evaluation			
		No Significant Effect	Small Effect	Moderate Effect	Major Effect
3. Data base 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	NA			
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) soil compaction	*b) increased runoff*	✓			
c) log floatation	*c) impede navigation*	N.A.			
d) allocation	*d) less than optimum economic benefits*	N.A.			
4. Logging in riparian	4. Degradation of waterways/fisheries	N.A.			

	Adverse Environmental Impacts	Preliminary Evaluation			
		No Significant Effect	Small Effect	Moderate Effect	Major Effect
zones					
5. Socio-economics					
a) employment opportunities		✓			
b) loss of traditional forest use	*b) economic and cultural losses*	✓			
D. Considerations Regarding Post-Project Activities					
1. Rehabilitation and conservation		NA			
2. Road shutdown		NA			
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. Rehabitation	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	*a) social conflict if local people not significantly*	✓			

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

	Adverse Environmental Impacts	Preliminary Evaluation			
		No Significant Effect	Small Effect	Moderate Effect	Major Effect
c) enhanced fisheries		✓			
d) enhanced recreation/ tourism		✓			
7. Water resources benefits					
a) minimized overland flows		✓			
b) reduced flood peaks		✓			
c) water quality			✓		

Source: Forestry Sectoral Guidelines, NEC (1999

19. FINAMCIAL AND ECONOMIC APPRAISAL

Ten years financial forecast and economic appraisal has been drawn for Khaling-Kharungla FMU. This is intended to identify the revenue to NRDCL, treasure (via royalty), the cost and royalty paid by NRDCL. Overhead cost to NRDCL are not included. Some of the figures are based on the assumption listed and the information made available to the planner, The assumption for the forecast are listed in table 40. A summary of the forecast is presented in table 41.

Table 42: Financial forecast -assumption

M^3 to cft	35.31
Recover Volume NRDCL (%AAC)	40%
Length of existing road (Km)	6.25
New road construction (km/yr)	Nil
Road maintenance per annum per Km	14000
Distance to depot (Km)	18
Rural allotment (area in ha)	
Regeneration maintenance per cable line(Nu/ha)	3000
Existing plantation (ha)	
Plantation cost (as per plantation norms and standard, SFD for 5 ha model plantation)	

Table 43: Financial forecast summery

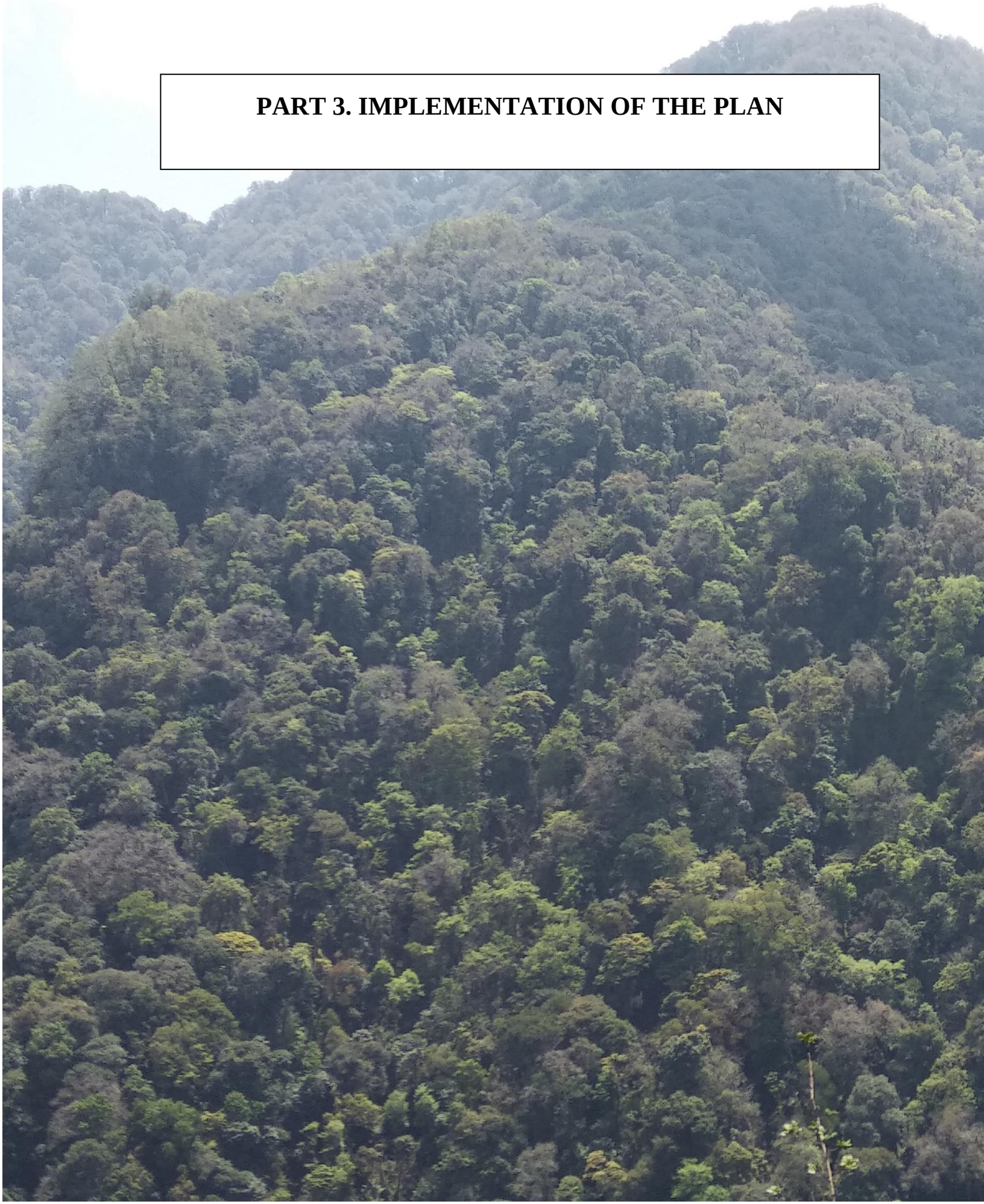
Financial Summary for Plan Period	
Total Revenue NRDCL	Nu.18.18 million
Total Cost NRDCL	Nu. 12.01 million
Total Royalty NRDCL	Nu.1.09 million
Total Revenue less Royalty less Cost	Nu. 5.07 million

Note: The above calculation is inclusive of cost that will be incurred for creation and maintenance of plantations.

#NAME?					2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	10 years total
	AAC(M³)	Rec.vol m3	Nu/cft	Nu/m3											
Revenue :NRDCL															
Timber- commercial	900	360	143	5050.76	1818273.6	1818273.6	1818273.6	1818273.6	1818273.6	1818273.6	1818273.6	1818273.6	1818273.6	1818273.6	18182736
Timber - rural															
Total Revenue NRDCL					1818273.6	1818273.6	1818273.6	1818273.6	1818273.6	1818273.6	1818273.6	1818273.6	1818273.6	1818273.6	18182736
Cost :NRDCL															
Road maintenance					14000	14000	14000	14000	14000	14000	14000	14000	14000	14000	140000
Marking cost			0.08	2.82	1015.2	1015.2	1015.2	1015.2	1015.2	1015.2	1015.2	1015.2	1015.2	1015.2	10152
Inventory cost															
Felling and cross cutting			3.5	124	44640	44640	44640	44640	44640	44640	44640	44640	44640	44640	446400
Debarking			3	106	38160	38160	38160	38160	38160	38160	38160	38160	38160	38160	381600
Transportation to depot			16	565	203400	203400	203400	203400	203400	203400	203400	203400	203400	203400	2034000
Plantation Maintainence			Nu.80000/ha	5ha/annually	400000	400000	400000	400000	400000	400000	400000	400000	400000	400000	4000000
Platation Creation			Nu.100000/ha	5ha/ annually	500000	500000	500000	500000	500000	500000	500000	500000	500000	500000	5000000
Maintenance of nursery			8/seedling												
Total cost NRDCL					1201215.2	1201215.2	1201215.2	1201215.2	1201215.2	1201215.2	1201215.2	1201215.2	1201215.2	1201215.2	12012152
Total Revenue less Cost					617058.4	617058.4	617058.4	617058.4	617058.4	617058.4	617058.4	617058.4	617058.4	617058.4	6170584
Royalty															
Royalty -Commercial			8.6	303.752	109350.72	109350.72	109350.72	109350.72	109350.72	109350.72	109350.72	109350.72	109350.72	109350.72	1093507.2
Royalty - Rural															
Total Royalty NRDCL					109350.72	109350.72	109350.72	109350.72	109350.72	109350.72	109350.72	109350.72	109350.72	109350.72	1093507.2
Revenue less Royalty NRDCL					507707.68	507707.68	507707.68	507707.68	507707.68	507707.68	507707.68	507707.68	507707.68	507707.68	5077076.8
Timber -commercial															
Timber -Rural															
Total Revenue less Royalty NRDCL					***1708922.88***	***1708922.88***	***1708922.88***	***1708922.88***	***1708922.88***	***1708922.88***	***1708922.88***	***1708922.88***	***1708922.88***	***1708922.88***	***17089228.8***
Total Revenue less Royalty less Cost NRDCL					***507707.68***	***507707.68***	***507707.68***	***507707.68***	***507707.68***	***507707.68***	***507707.68***	***507707.68***	***507707.68***	***507707.68***	***5077076.8***

A total Budget estimate of **Nu. 9 million @ Nu.0.9 million/year** has been proposed for **50 ha of Plantation creation and 50 ha of plantation maintenance** in KKFMU during this plan period which shall be funded by NRDCL. The cost has been included in the Financial forcast worked for this plan period. Annually NRDCL must create atleast 5 ha of new plantation and maintain atleast 5 ha of plantation at KKFMU during this plan period.

PART 3. IMPLEMENTATION OF THE PLAN



PART 3. IMPLEMENTATION OF THE PLAN

20. IMPLEMENTING AGENCY

The Department of Forest and Park Services is assigned with the responsibility of protection and management of the forest resources in Bhutan. The Department will discharge the responsibility through the Territorial Division. The CFO, Trashigang Territorial Division will be responsible for the implementation and monitoring of this Management Plan. The CFO, Trashigang Territorial Division will be assisted by the Unit In-charge and other support staff.

20.1 Cutting Cycle

For sustainable harvesting of the forest resources, the cable line spacing must be properly laid so as to enable the subsequent passes in the future. To enable two passes in the future, a minimum distance of 75m needs to be maintained in between the cables lines. The spacing should be roughly make an area of 0.25ha in circular patch for Broad Leaf Working Circle. The rotation period is 120 years, this means that the three cable lines that will be implemented are occurring ay Year 0, 42 and Year 81. See Fig 6 the original lines (Year 0) will be therefore harvested in Year 120. This gives adjacent areas time to regenerate so as not to cause large openings and blank areas within the forest.

Line spacing and patch clear cut size need to be carefully considered on a site -by- site basis and provide for specific number of subsequent passes. One prescription will not be appropriate charge, looking ahead and planning accordingly must therefore tailor the field to suit the terrain.

Less sensitive sites with degrading over mature stand may require a shorter conversion period resulting in close initial line spacing and higher removal per pass than more sensitive sites.

The Broadleaved working circle will be worked under Patch-cut System. The patch will not exceed more than 0.25 ha and will be spaced in the interval of minimum 50 m. 4 m cable corridor will be maintained. Artificial regeneration will be taken up immediately after coupe clearance is issued. NRDCL should maintain nursery at the site for artificial regeneration. Nursery should be well stocked with local and commercial species for replantation.

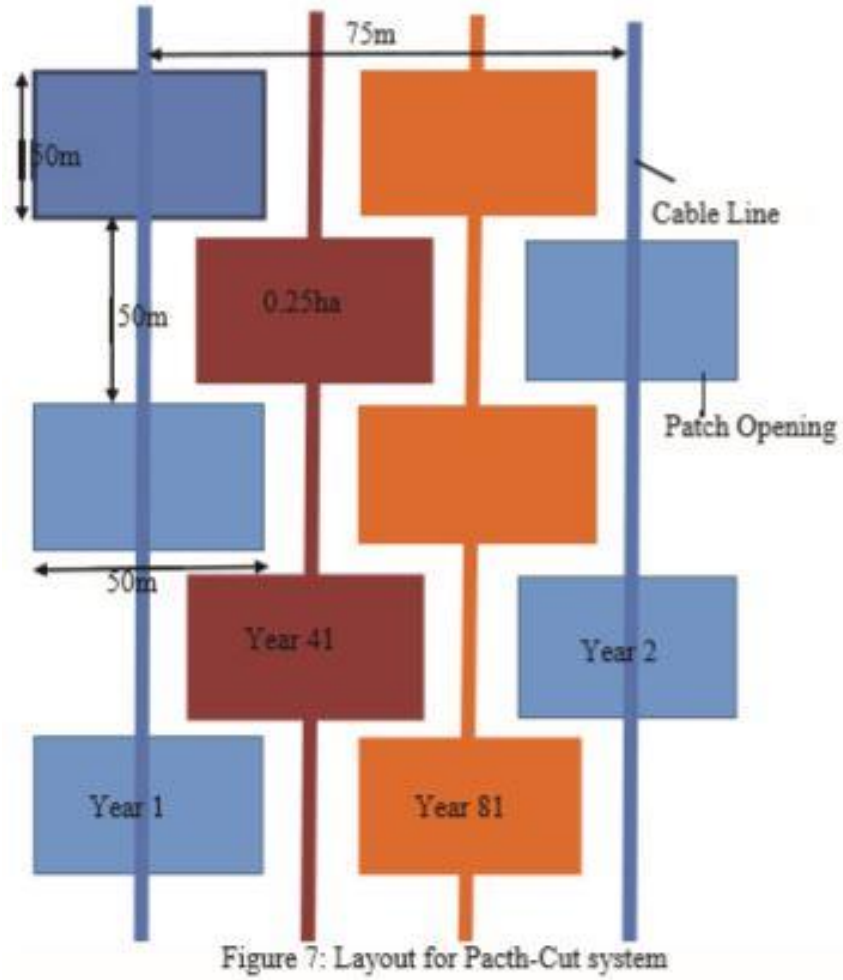


Figure 7: Layout for Pacth-Cut system

20.2 Annual Coupe

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

- ❖ Based on the Silvicultural System, the annual coupe will follow the required spacing designated above, within the limits of the AAC.
- ❖ The Unit In-charge will determine the location and extend of cable lines in the compartment to be harvested annually, in consultation with NRDCL staff. NRDCL will then plan for harvesting operation and the location of the cable crane, alignment of cable lines and designate log landing points. Environmentally sensitive areas designated in the forest function map will be identified, their position indicated and care taken to ensure the appropriate prescriptions/restriction are followed.
- ❖ The Unit In-charge will then mark threes in the sub-coupes as prescribed.
- ❖ Cable lines layout will be based on the safety stand composition, environment and cost consideration. NRDCL will be permitted, in consultation with the Unit In-charge, to align cable lines diagonally across contour lines in order to avoid environmentally sensitive sites, identify stable landing points or to secure a sufficient length of cable corridors in order to put the cutting system into effect in a cost efficient manner.
- ❖ Cable lines may traverse slope greater than 100% but forest on such slopes is not to be harvested.
- ❖ Because of constraints imposed by the terrain and other on site consideration, adjacent cable lines need not be necessary parallel to one another. The prescribed interval between the sub-coupe cable lines is considered a minimum value.

- ❖ All prescription and restriction and restriction laid down in the plan must be considered and followed strictly.

20.3 Tree Marking Rules:

Marking rules for works in the FMU to follow in general to all stands.

- ❖ Before starting the work the coupes designated for harvesting will be delineated on the maps and the year of operation indicated. The boundaries will be surveyed in the forest and demarcated.
- ❖ Patches of mature and over-matured trees showing profuse regeneration underneath should be selected.
- ❖ Generally, the size of patches clear-cut opening is 0.25ha: but the opening can vary from 0.15ha to 0.5ha depending on the stand composition and site condition. However, care should be taken not to make the opening too large as it will favour the growth of unwanted species.
- ❖ The direction of the tree lean and topography has to be taken into account to prevent large trees being felled on nearby advanced growth.
- ❖ Dead, dying, malformed or damaged (snags, scars, conks, etc.) trees will be retained in between patches and in interlines spaces, to safeguard flora and fauna niches or habitats, but not in the harvested patches themselves, where there is the risk of wind throw and danger to personnel working underneath. Diseased trees(bark bettle, 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 measurement along the estimate 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 also be recorded.
- ❖ No marking will be done 30 meter on each side of the perennial streams.

20.4 Harvesting

To reduce the negative impact to the forest and environment due to extraction, the hauling method for transporting log 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 zone. Cutting trees of 10cm above the ground level will be strictly followed to avoid the wastage. To maintain the sanitation and hygienic condition of the forest, the cutover debris must be disposed off and if possible burn in a proper place avoiding forest fire. The skyline cable system has the following advantages:

- ❖ Minimize soil disturbance and initiation of soil erosion
- ❖ Maximize work safety (if used correctly according to the manufacture' direction and according to the safety practices in the Code of logging Practice)
- ❖ Avoid damages to residual reserve stand.
- ❖ Minimize 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.

1. The layout of the cable lines should be planned and undertaken well in advance of the harvesting operation after the logging coupe has been demarcated. Suitable log landing should be identified along the road. Care should be taken to avoid locating lines in and along gullied and other protected areas, but lines may cross these at an angle. Trees to be felled will be enumerated and marked in time so as not to delay harvesting operations.
2. The cable corridors shall not exceed the prescribed width stated in the Silvicultural System for each Working Circle.
3. Trees will be felled, de-limed, crosscut, extracted on the cable, loaded and hauled to the log depot. Only chainsaws and handsaw will be permitted in felling operations. Trees will be felled, where possible, into natural opening, into harvested opening or in a direction that will not damage residual stands. Damage to soil should be minimized at all times.
4. The use of axes is discouraged except in fuel wood splitting.
5. All logs will be measured and recorded in the Log Yard Register. This should be up-to-date and made available to inspecting officer as required. A copy of the list of logs/timber entered in the Log Yard Register will be submitted to the CFO every month. This information will be used for royalty calculation and issuance of removal permits. Private haulage contractor will transport logs and all deliveries will be made to designated depot and/or sawmills.
6. Record of all trees marked and issued for conversion within the forest by blocks and compartments will be maintained by the Unit Staff and furnished monthly to the CFO, Trashigang.
7. The CFO and the Regional Manager (RM), NRDCL will co-operated and co-ordinate to ensure that the logging operation and log outturn are conducted smoothly and in accordance with local and other demands.
8. 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 tree to become fuel wood are extracted with the cable lines and fuel wood conversion occurs at the designated log landing areas.

Gravity cable system are the only from of cable harvesting system used in Bhutan. Although no other harvesting system is being introduced, it would be beneficial to investigate other

possibilities that would increase production. This would allow less desirable timber to make it to the landing, promoting utilization of poorer quality timber and fuel wood residues.

20.5 Reforestation of Harvested Sites

For sustainable development of the forest resources, it is crucial that harvested areas are restored immediately after the harvesting operation. Artificial regeneration is preferred in the broad leaved forest than natural regeneration. For artificial regeneration, prior to plantation, nursery shall be raised for local species. The area shall be planted with commercially viable local species with not more than 3 species on each site. Regular maintenance of plantation shall be done to ensure the survival percentage of the plants. The CFO shall evaluate the plantation at the end of three years and if the survival percentage is lower than 80%, immediate beating up should be carried out with the same species.

Although, a monitoring process has been adapted in FRMD, it is recommended that regeneration survey be conducted every three years, until the regeneration has reached a height that will ensure its survival. If the second survey indicates poor stocking, remedial action must be taken in the planting season following. The FMU In-charge will ensure that stocking of natural regeneration is first monitored within three years following completion of the harvesting operation.

The factors that limits the success of regeneration includes; grazing pressure, protected harvesting periods and weeds and brush growth. These problems must be addressed if regeneration is to have a fighting chance. It is recommended in this plan period to adopt more tending activities, such as weeding, brushing and fencing, so that regeneration has a chance to establish. This would also reduce the cost of regeneration as clearing and replanting a failed area would cost of reforestation as clearing and replanting a failed area would cost much more than the initial tending for natural regeneration.

Enriching planting, if necessary will be carried out by NRDCL. Depending upon the cattle population and site condition, barbed wire fencing shall be done in the plantation area. Fencing or other action to protect regeneration will be carried out by NRDCL, is consultation with the FMU In-charge and the FMU Level Management Committee. All regeneration survey and regeneration activities will be funded by the implementing agency - NRDCL. Budgetary requirement will be written in the Operational Plan in consultation with NRDCL. Some of the main recommendation for reforestation of the harvested besides above prescriptions are:

1. NRDCL must carry out replantation of all the failed plantations of last management plans (1st and 2nd) during this plan period.
2. NRDCL must ensure all of these plantations are well established at the end of this plan period through proper fencing. If need be NRDCL may explore recruiting care taker for plantation carried out in the Khaling Kharungla FMU. Possibility of

involving the local people and nomads living within KKFMU to be explored by NRDCL.

3. NRDCL must keep an annual budget as per the plantation norms and standard for creation of at least 5 ha of plantation in KKFMU annually during this plan period.
4. NRDCL must also keep an annual budget as per the plantation norms and standard for maintenance of plantations till establishment in KKFMU annually.
5. Plantation creation and maintenance within KKFMU will be an annual FMU activity of KKFMU which must be reflected clearly along with budget estimates in the annual Operational Plan of the FMU.
6. The plantation survival assessment for plantations carried out in KKFMU will be an annual FMU activity and the report must be submitted annually to FRMD along with the Operational Plan.
7. The grazing issues of Plantation by cattles/yaks owned by Nomads(Brokpas) needs to be officially raised and discussed with the Local Government and the Dzongkhag Administration. To this the Division must take a lead role in taking up the issue with the Gewog and Dzongkhag administration in order to come out with suitable strategies to address the grazing issues in the FMU.

A total Budget estimate of **Nu. 9 million @ Nu.0.9 million/year** has been proposed for **50 ha of Plantation creation and 50 ha of plantation maintenance** in KKFMU during this plan period which shall be funded by NRDCL. The cost has been included in the Financial forcast worked for this plan period under section 19.

20.6 Sequence of operation relating to the annual coupe

The operation relating to the annual coupe should follow the sequence given in Table 42.

Table 44: Sequence of operation

Operation Description	Timing (months)(- before felling: + after felling)
Unit In-charge decided on the location and size of annual coupe in accordance with the Annual Operational Plan	-12
NRDCL and FMU IC prepares an estimate of human, materials, equipment and financial resources required	-10
Unit In-charges finalize the annual coupe size,	- 6

demarcates the coupe and instructs NRDCL to carry out pre-logging planning	
NRDCL prepare cable line layout and alignment plan, as well as proposed log depot and log landing points and submits these to Unit In-charge for approval.	- 3
Unit In-charge marks the carriage corridor trees and the trees to be felled in the first sub-coupe	- 2
NRDCL manually fells trees that are in the way of the skyline installation and installs the Skyline and cable crane.	-1
NRDCL commences systematic harvesting and extraction operation according to the approved sequence in the Annual Operation Plan.	- 0
NRDCL/ Contractor complete harvesting and extraction	When completed
The FMU Unit In-charge will inspect the coupe when harvesting is completed and will issue a Coupe Clearance Certificate -only if all aspect of the operation are satisfactory and all timber is removed from the annual coupe.	
DoF asses success of natural regeneration	As per guidelines
NRDCL completes post harvesting operation	As per FMU IC instructions

20.7 Road Construction

Forest roads forms an essential part to managed forest estate, both for timber extraction and forest management as well as for monitoring. Road construction in FMU requires extra precautions. 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.

The entire KKFMU is covered by network and no new road construction is proposed during the plan period. During this ten years plan period NRDCL will carry out maintenance of the existing road length of 6.25km.

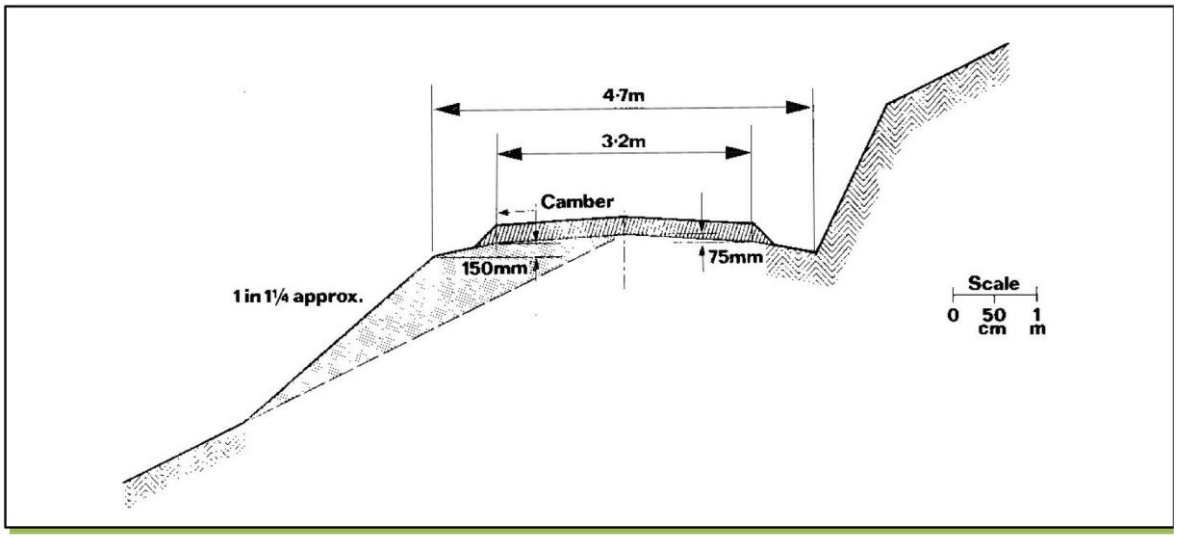
20.7.1 Road standards

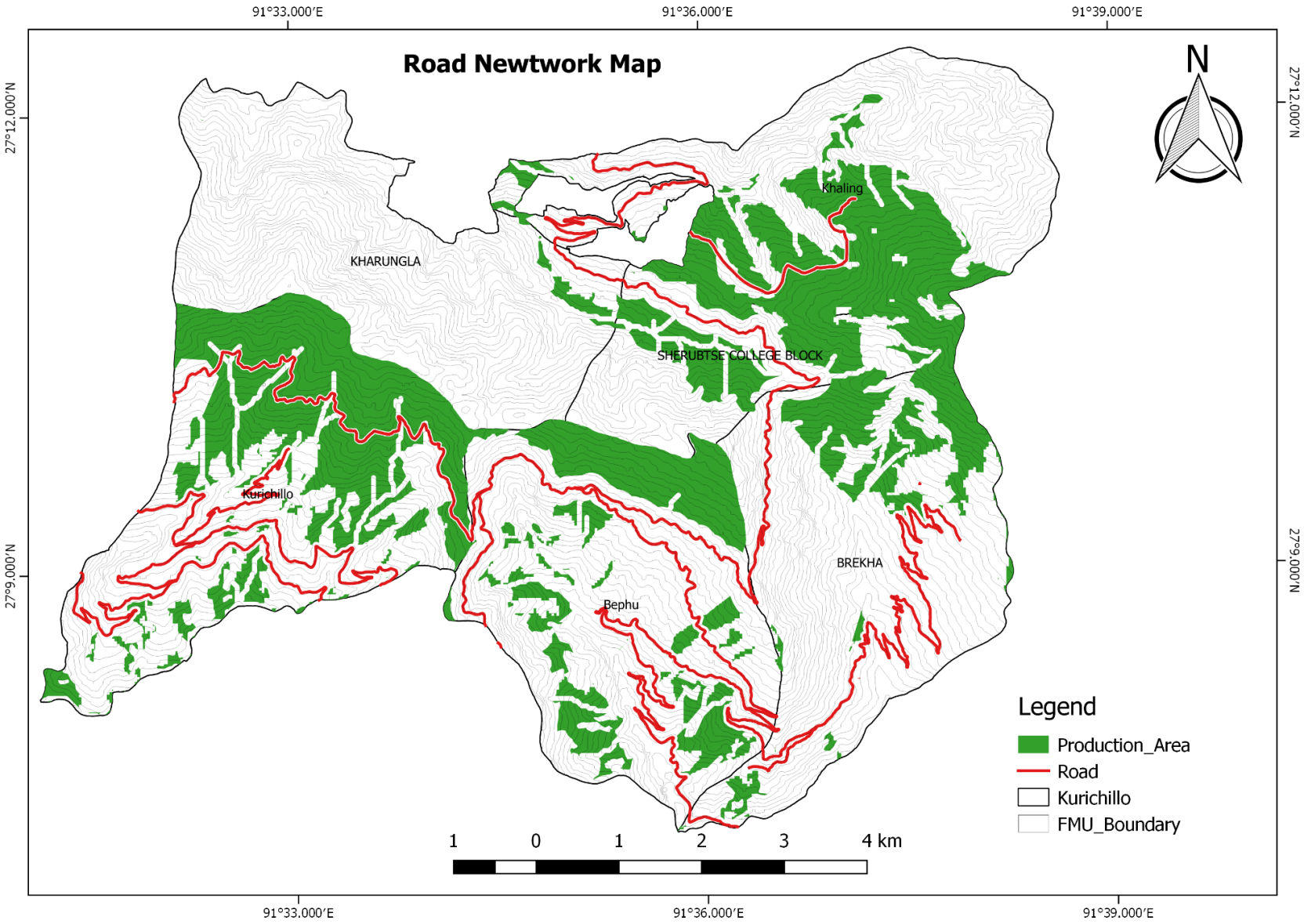
A set of road standards has been developed by Forest Engineers of TFDP. These road standards, developed in the east, however it address policies that are required throughout Bhutan. These

standards will be adopted for Khaling-Kharungla FMU and NRDCL road engineer must follow these standard, given in annexure II, during designing and estimating and provide supervision during construction to ensure that the standard are met.
Road design in Khaling-Kharungla FMU should follow the recommended road profile given in the figure 8 to avoid excessive water pooling leading to rutted road surface that inhibit access during monsoon season. Improper drainage may lead to landslide.

Besides, Bhutan environmental assessment sectoral guidelines issued from National Environmental Commission, 1999 must also be referred to, wherein general principal and practices to minimize negative economic and environmental impact of road access are cited.

Figure 8: Road profile





Map 15:Map showing Road Networks in the FMU

21. PLANNING

21.1 OPERATIONAL PLANNING

For facilitating the timely implementation of the Management Plan, Operational Plan will be prepared by the CFO, Trashigang Territorial Division and the Unit In-charge.

The primary aim in preparing Operational Plan is to determine and co-ordinate the timely input of resources to put the overall Plan into effect in a cost -effective manner and according to the objective. The Operational Plan is also the tool used to provide for change that cannot be foreseen or allowed for in the Management Plan, such as insect and disease outbreaks, severe forest fire, etc. If and when these occur, the current Operational Plans 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 is rolling plan, i.e Operational Plan are prepared annually but the plan period is for two years. It includes details of the activities for the coming year(year 1) and an outline of activities for the following year(year 2).

Guidelines for preparation of Operational plans are given in the Forest Management Code of Bhutan, (2004) and a copy of each is available to all territorial Division.

Figure 9: Concept of Rolling Plan.

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

The Operational Plan will be prepared in consultation with all of the agencies and parties whom will be using the forest, represented by the FMU Management Committee. Inclusion of consultation process with local communities in preparation is particularly important so the potential issues concerning communities in the forth coming operational areas are worked through before the plan is implemented.
The timing and schedule of steps for Management Planning and OP writing is given below:

Table 45: Preparation and Implementation of Operational Plans

Activity (Planning Step)	Objective	Out put	Responsibility	Comments
Approved: Forest Management Plan				
PRAs with local stakeholders	To prepare participatory plans for fire management; grazing control and rural timber	Participatory plan for grazing management; fire management or rural timber harvesting (to be incorporated within the OP)	DoF, FMU In-charge	First step is to entire into discussion with stakeholder and their representatives Use PRA techniques to prepare a plan Plan cost are included in the OP
Operational inventory	To assess the resources availability for the planned harvesting area. Calculation of the harvestable volume	Site level inventory data for operational area to be harvested Precise estimate of volume to be removed during the coming year	FMU In-charge NRDCL	For the area proposed for harvesting during the next year. May be combined with Harvesting plan and cable lines survey.
Harvesting plan and cable line survey	To plan for harvesting and extraction activities	Agreed extraction and roading plan	NRDCL	Within the selected identified harvestable area for the year May be combined

				with Operational inventory
Preparation of Operation Plan	To prepare cost a plan for implementation during the next 2 years (involving stakeholder participation for some activities) To formalize local institutional responsibility for planned activities (e.g grazing, fire management, rural timber distribution)	Approved Operational Plan with the budget Identified responsibilities for each planned activity Calculated cost for each planned activities	FMU In-charge with local stakeholders as required	Activities linked with objectives identified in the FMP and following options and guidelines in the FMP. Each activity with identified responsibility for implementation estimated cost, and site specific location.
FMU annual report presented to the FMU management committee	To review progress and identify and address any implementation problems To identify any future action necessary based on issues arising	FMU annual report endorsed by FMU management committee	FMU In-charge presents to the FMU management committee	During annual FMU management committee meeting Implementation problem need to be addressed before endorsing the new OP
OP reviewed by FMU committee and endorsed	For the FMU management committee to endorsed the OP (prior to approval by DoFPS) To endorse	OP endorsed by FMU management committee	FMU In-charge presents to the FMU management committee	During annual FMU committee meeting

	expenditure estimate for the coming financial years.			
NRDCL financial commitment within OP agreed	To ensure that NRDCL is committed to fund the agreed activities in the OP	Budget estimate for the OP endorsed by NRDCL and FMU management committee	FMU management committee	Meeting needs to take place by.....
OP approved by the Director	To approve the OP for implementation	Approved plan and budget	DoFPS and FRMD	Op approval linked with sanctioned budget for all planned activities.
OP implemented by NRDCL	To carry out planned activities	Timber/fuel wood extraction and other protection, constructions and maintenance activities conducted	NRDCL and FMU In-charge	Each activity with a specific responsibility and budget
Monitoring of activities	To assess the level of achievement of the planned activities	Information for FMU annual report	FMU In-charge	DoFPS responsibility is to monitor the implementation of activities carried out by NRDCL Monitoring also has a cost which needs to appear in the OP
Unit In-charge prepares FMU annual report	To report progress against planned activities	FMU annual report	FMU In-charge	Prepared annually Progress is reported against each FMP

	To highlight any problem being encountered in implementation			objective and the associated activities
Prepare the next year's operational plan (step 2-5)	To prepare the next operational plan taking into account progress over the past year.	Operational plan	FMU In-charge	Operational plans may alter in response to FMU Management Committee suggestion and recommendation.

21. 2 Mid-Term and Final Review

The Head FRMD will ensure that evaluation is carried out at five year interval, based on the information collected by annual monitoring and other necessary information. The evaluation should be based around a review of the objective and option, to see how well the management plan is being implemented. If the objective are not being achieved this should be examined, reason determined and activities redefined if appropriate.

Corrective action, if necessary, may required change to a range of inputs or to implementation methodology. The evaluation will be carried out will be carried out by the evaluation team constituted by the Director, DoFPS as per the Forest Management Code of Bhutan. The findings and recommendation of Mid-Term Review will be discussed with FMU Level management Committee.

The Mid-term Evluation of Khaling Kharungla FMU will be carried out within **October to December 2024** and the Final Evaluation of Khaling Kharungla FMU will be carried out within **October to December , 2028**

21.3 FMU Level Management Committee

For the smooth implementation of the plan, FMU -Level Management Committee has been established. The Committee consist of the following member:

1. Chief Forestry Officer, Trashigang, Chairman
2. FMU Unit In-charge, Khaling Kharungla FMU, Secretary
3. Regional Manager, Zhonggar Division, NRDCL, Zhonggar
4. Production In-charge, NRDCL, Khaling Kharungla FMU
5. Gup, Lumang Gewog, Trashigang
6. Tshogpa, Lumang Gewog, Trashigang
7. Gup, Khaling Gewog, Trashigang
8. Tshogpa, Khaling Gewog, Trashigang

FMU-Level management committee; terms of reference

A. During FMU Management Plan Preparation

- To represent the interests of identified stakeholder groups during the planning process for FMP preparation.

- To discuss and agree on FMU forest management objectives for different parts of the forest (zones and working circles), based on the national priorities and combined with specific local conditions and local needs.

- To consult (along with FRMD) with specific groups of stakeholder likely to be significantly affected by the proposed activities such as road construction and timber harvesting and ensure that their interests are effectively accommodated in the field version of the management plan.

- To review and endorse the draft forest management plan before it is presented to Director, DoFPS and Ministry of Agriculture and Forest for final approval.

B. During operational planning, implementation and monitoring

- To represent the interest of all identified stakeholder groups during annual planning and review of activities under OPs.

- To review achievement during of the preview years (based on FMU annual report submitted by the FMU In-charge) and advise and act on any issues identified in this report.

- To make recommendation for changes to the proposed OP for the coming year based on the previous year's experience and on the need to achieve the agreed objectives in the FMP.

- To endorse activities, priorities and funding arrangement within the draft OP before submission to the Director, DoFPS.

- To participate in the 5 years mid-term evaluation of the FMP.

- To hold any additional meeting as required in respond to specific issues arising from FMP and OP implementation.

- To participate in the final (10 years) evaluation of FMP.

This will require at least one annual meeting of the FMU -level management committee during each year of FMP implementation with the possibility of further meeting to address any urgent matters arising. Meeting need to be timed to ensure consistency with the annual planning cycle and financial year.

21.4 Staff

The Chief Forestry Officer, Trashigang Division is over all controlling Officer. The FMU Unit In-charge will have direct responsibility in control and management of the FMU. The UIC office will be under the administrative control of the Chief Forestry Officer, Trashigang Division. The CFO is the direct representative of the Department in the field and as such he is solely responsible for all forestry activities both technical and administrative in his jurisdiction.

21.4.1 Responsibility

For the smooth monitoring and implementation of the plan in the FMU, following number of staff will be required:

1.	Unit In-charge	1
2.	Assistant Unit In-charge	1
3.	Assistant Forester	3

The unit In-charge will be responsible for the 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.

Assistant Unit In-charge will be responsible for carrying out operational inventory, help to prepare the operational plan, supervise road construction and maintenance and keep tarck of regeneration of the harvested areas. Assistant unit In-charge will also be responsible for supervising tree marking and felling, timber extraction, transport of logs to depot and reporting the coupe clearance. He will also be responsible for marking the trees for thinning operations, sanitation felling in fire and pest and disease activities. The forester will be assigned to help the Assistant In-charge.

21.5 Buildings

KKFMU has a Unit Office for Unit In-charge along with two unit staff quarter. The Unit Office was constructed during the first phase of Management Plan. It needs proper fencing to safe guard the government property as well as building maintenance.

21.6 Vehicles and Equipment

For the smooth monitoring and implementation of the plan, following equipment have to be made available.

Table 46: Equipment required

Items	Quantity
Motor cycle	1
Suunto clinometer	1
Suunto Compass	1
Diameter tape	2
Measuring tape	2
Altimeter	1
Computer/laptop	2 sets
Walkie talkie	4
Camping tent	3
Binocular	1
GPS	1

22. MONITORING AND EVALUATION

The primary focus of the Royal Government of Bhutan's Forest policy is to conservation of the process in necessary 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 FMU, two stage of verification process is necessary. The first stage checks that on ground activities are being carried out as planned in the short term and the second stage checks that the objective of the plan are being achieved over the longer term. Monitoring (checking on inputs on a year basis) is the term used for the first stage and evaluation (checking achievement against objective over five pear periods) in the second stage.

Standard forms for monitoring and evaluation were prepared and are available in the FMCB (2004). Different forms were developed on different time scale; Monitoring Form A for the annual monitoring process, Evaluation Form A for the five years evaluation and Evaluation Form

B for the once only Evaluation. The field data collection forms used, consist of Physical, Financial forms 1-3, Environmental Forms 4-11 and Physical, Financial and Environmental Summery Form.

All necessary Monitoring and Evaluation Forms are available with CFO office, Trashigang.

22.1 Record Keeping

The record should be kept by blocks and compartment. This would ensure that each activity that occurs is recorded in an easy to find format. Total of the AAC allotment would then be submitted monthly to the CFO -as is already required.

It is essential that all records of activities and operations within the FMU be maintained so that analysis and investigation of past management can be carried out and AAC allotment can be followed. Although record keeping may not seem as important as some management activities, it is the backbone of future management decision and the importance must be stressed.

The guidelines to complete and fill the forms; one for Rural Allotment, one for Commercial Allotment and one for Stand Tending and Regeneration activities are available in all territorial Division and UIC offices.

It is also important to record all activities for future management and monitoring and evaluation.

22.2 Mid-term Review of the FMU plans

The Head, FRDD, will ensure that the plan is reviewed five years after implementation. The review should be preceded by an evaluation.

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

22.3 Monitoring

Monitoring is the continuous/ periodic review undertaken by the management at every level of implementation, of activity to ensure that input deliver, work schedules targeted out and other required actions are proceeding according to the plan.

The CFO, Trashigang Territorial Division will ensure that monitoring is carried out on an annual basis according to the guidelines issued by FRMD. It is important that monitoring forms are recorded regularly and handed over for review. The plan must be monitored to obtain the best production of forest produce.

22.4 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 action 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 Director, DoFPS, will appoint the Evaluation Team.

The Mid-term Evluation of Khaling Kharungla FMU will be carried out within **October to December 2024** and the Final Evaluation of Khaling Kharungla FMU will be carried out within **October to December , 2028**

23. CONSTRAINTS AND RISK

The possible risk and constraints in smooth implementation of the management plan are:

- Inadequate funds for forest management
- Uncertainty of natural regeneration, due to excessive grazing, and undergrowth competition
- Lack of research information
- Lack of skilled and trained forest workers
- Lack of sufficient support to UIC
- Poor communication between field and office staff and between involved parties.
- Forest Management Plan relates to multiple uses of forest resources. Increasing benefits of one type may impair or damage others. For, instance, timber management may lead to underproduction of non-wood forest products and degradation of bio-diversity. For effective assessment, not only the production function, demand and price structure of

each product need to be understood, but also the relationship and conflicts of resource use should be fully comprehended.

24. DEVIATIONA FROM PLAN PRESCRIPTION

The annual harvested AAC should be made to allow for unforeseen situations. For these and other bona fide reasons, the annual AAC 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 prescriptions. In such an event, the CFO, Trashigang Territorial Division must obtain prior written approval from the Head of the Department. Any such request for plan deviation(s) must 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 Department if any.

25. REFERENCES

- RGoB, MoAF, DoFPS, FRMD,(2004). Forest Management Code of Bhutan.
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ANEXURE - I

COMPARTMENT REVIEW AND PRESCTRIPTION

Compartment Review and Presentation

Block: Kharungla

Forest description: This block has been set for protection because of the fact that about 95% of the total area has slope greater than 100% wherein no harvesting is possible. The forest in general is mature with considerable occurrence of bamboo. However, it comprise of very good growth of broadleaf species including Persia, Castanopsis, Betula, Rhododendron, Qurcus, Acer and Cinnamomum.

Prescription: This block is excluded from harvesting being regarded as protection.

BLOCK : BEPHU COMPARMENT: I

Forest description: This compartment is various terrain from very steep to very steep with cultivation land within the area. Very small area is available for harvesting. The vegetation is almost scrub in the vicinity of the settlement with mixture of young and mature broadleaf above and along the streams. Bamboo is also found at the higher altitude or above Samdrupjongkhar - Trashigang Natioanl Highway.

Prescription: Since vegetation within the block is very sparse and area is very steep, commercial harvesting is not feasible within the area. However, area is delineated for Local Use Only on Single Tree Selection basis.

BLOCK: BEPHU COMPARTMENT: II SUB-COMPARTMENT: 1

Forest description: Major portion of this sub-compartment is occupied with cultivated area and Nublang Breeding Centre. The terrain is very unsuitable and prone to landslides. The vegetation in and around settlement is mainly scrub and young broadleaf, which cannot be harvested. The size of broadleaf forest in this sub-compartment is very insignificant with no assured harvested as of now.

Prescription: Because of the negligible occurrence of broadleaf forest in this sub-compartment, it is also delineated for local use only and the silviculture system prescribed is Single Tree Selection System.

BLOCK: BEPHU COMPARTMENT :II SUB-COMPARTMENT :2

Forest description: The vegetation in this sub-compartment is comprised of mature broadleaf forest with bamboo growth at higher altitude. Although this area is potential for commercial logging, however, it is only from where the people of entire Bephu block meet their requirement.

Prescription: Since this sub-compartment is only area where people of Bephu meet their requirement, the area is identified exclusively for Local Use Only. The allotment from this block will be made on Single Tree Selection System.

BLOCK: BEPHU COMPARTMENT: III

Forest description: This compartment basically fall within the settlements with poor vegetation cover. The vegetation within the area consist of shrub with sporadic young broadleaf (Alnus) along the streams. The soil within the area is also very unstable. Therefore, many landslide has been occurred within the area. On the whole, the vegetation in this compartment is shrubby and degraded. As such this compartment is inappropriate for harvesting.

Prescription: This compartment is not suitable area for logging harvesting. Therefore, no logging is prescribed in this compartment

BLOCK: BREKHA

Forest description: This block is comprised of mature broadleaf forest, but cannot be brought under harvesting on account of its steepness and unstable terrain. The area under broadleaf cover is exceedingly prone to landslide. The vegetation around settlement is largely scrub. However, a patch of young Chirpine forest occurs within the block, which could be over exploited only for poles.

Prescription: Although, Brekha block has some forest cover, commercial logging will not be feasible. Nonetheless, few trees could be harvested on Single Tree Selection basis for Local Use Only. Therefore, some part of forested area of this block is designated as Rural Block for Local Use Only.

BLOCK: KHALING COMPARTMENT: 1 SUB-COMPARTMENT: 1

Forest description: This sub-compartment basically fall within the community forest and consist of broadleaf species comprising primarily of Quercus griffthii. Thenstock is young at lower altitude and mature at higher altitude.

Prescription: Only the steep area remained after demarcation Community Forest within the block. Therefore, no commercial logging would be feasible within the area. However, Single Tree Selection would be feasible for Local Use Only.

BLOCK: KAHLING COMPARTMENT SUB-COMPARTMENT: 2

Forest description: This sub-compartment too comprise of broadleaf species mostly of *Quercus griffithii* mixed with *Lonia ovalifolia*. the vegetation is a mixture of both young and mature stands. Young Rhododendon occupies higher elevation up to the ridge top.

Prescription: The entire sub-compartment as terrain greater than 100% and therefore will not be brought under operation.

BLOCK: KAHLING COMPARTMENT SUB-COMPARTMENT: 3

Forest description: This sub-compartment has broadleaf species all over that is mostly mature tree mixed with bamboo at higher altitude. However, the entire sub-compartment is very steep with slop greater than 100%.

Prescription: Since this sub-compartment is very steep, the area is excluded from harvesting and is regarded as protection area.

BLOCK: KAHLING COMPARTMENT: II

Forest description: Major portion of this compartment has mature broadleaf species. Matured stands of Fir occur at higher altitude and along the ridge on the southern and southern-eastern part of the compartment. There are small patches of Hemlock mixed with bamboo. Namboo is available in abundance in this compartment.

Prescription: Despite having matured stands, this compartment will not be brought under harvesting on account of steep terrain and area being considered sacred by the villagers (Dangling Tsho).

BLOCK: KHALING COMPARTMENT: III SUB-COMPARTMENT: 1

Forest description: This sub-compartment consists of broadleaf forest with mostly Quercus species that are matured at higher altitude and young at lower altitude. A small patch of young walnut occurs just above the national highway. This sub-compartment was under operation during the second phase of Management Plan.

Prescription: Since this sub-compartment was under operation during the second phase of Management, so commercial operation will be carried out in this plan period.

BLOCK: KHALING COMPARTMENT: III SUB-COMPARTMENT:2

Forest description: This sub-compartment is purely broadleaf with young stands at lower altitude and matured stand at higher altitude. Bamboo mixed with hemlock is found at higher altitude along the ridge up to the ridge top.

Prescription: This sub-compartment is only area that will be brought under operation in this Plan. All areas are either operated or fall under other functions where no operation carried out.

This sub-compartment has good stock of timber with moderate terrain. Therefore, this sub-compartment will be brought under commercial harvesting in this Plan period on Patch clear-cut system.

BLOCK: KAHLING COMPARTMENT: IV SUB-COMPARTMENT:1

Forest description: This sub-compartment comprise of broadleaf species with *Quercus griffithii* and *Alnus nepalensis* as dominant tree species. Generally the forest is young with mature stand along the streams and on the ridges. There is a small stretched blank area on the ridge to and scrub below comprising mostly of *Lyonia ovalifilia* and *Pieris formosa*.

Prescription: The general terrain of the area is mostly steep. The area with gentle slope basically fall within community forest. Therefore, since area is mostly under Namseyling communtiy no commercial harvesting is prescribed.

BLOCK: KHALING COMPARTMENT:IV SUB-COMPARTMENT: 2

Forest description: This sub-compartment has been occupied by human settlement with scrub forest around the settlement. The vegetation is primarily broadleaf with young stand at lower level and mature stand at higher level.

Prescription: Since the area is prone to landslide and the stock being young, no harvesting is prescribed in this sub-compartment.

BLOCK: KURCHILO COMPARTMENT: I

Forest description: This compartment too fall within the settlement, however there is also patches of forest along the periphery of the settlement and along the streams. The vegetation within this block are mostly young and it falls in steep area, which cannot be harvested. The vegetation in the rest of the compartment including settlement is again scrub with small patches of young broadleaf along the streams. This compartment is basically is very steep and not viable for harvesting.

Prescription: No commercial operation is prescribed due to lack of potential are. However, Single Tree Selection can be carried out for Local Use Only.

BLOCK: KURHILO COMPARTMENT: II

Forest description: The northern half of this compartment comprise of mature broadleaf stands that is possible for logging. However, the topography. The southern is steep and unstable in general . The southern half of has settlement enclosed with scrub and young broadleaf.
Prescription: The compartment has been operated in first phase of management therefore, no commercial operation has been prescribed.

BLOCK: KURHILO COMPARTMENT: III
Forest description: The forest description in compartment III is very similar to that of compartment II with mature broadleaf in the north and settlement with scrub and young broadleaf in the south. The topography too is steep and unstable to that of compartment II.

Prescription: This compartment was under operation during the previous plan period, so no commercial operation will be carried out in this plan period.

BLOCK: SHERUBTSE COLLAGE
Forest description: This block mainly consist of matured broadleaf forest however, immature broadleaf are also seen within the vicinity of settlement. Trees within this block are heavily loped by the high lender cattle harder as fodder. Area of this block is very gentle and feasible for extraction of timber.
Prescription: Commercial production is possible in some of the areas within the blocks. However, the area is allotted to Sherubtse Collage for natural resources study and research purposes according to the previous. So no commercial production to take place.

ANNEXURE II : Road Standards

Road Standards

The road standards developed in the east by TFDP will be implemented for design, drainage and construction of all forest roads in Paro-Zonglela FMU. Following are the standards:

Road Design

- Road lengths and density should be minimized, consistent with access requirements to reduce environmental impacts and enhance access economics.
- Where possible locate roads in areas with low side slopes, the maximum side slopes allowed in all areas except rock is 100%.

- Roads must be constructed in such a way that no earth works or soil spill into water courses or watercourse buffer areas. Care should also be taken to ensure that no earth works or soil is allowed to spill onto agricultural land, near houses or main roads.
- Roads should be planned in such a way as to balance cut and fill to minimize transport of construction materials.
- Roads should not be constructed in steep and unstable areas where there is the possibility of landslide. A thorough survey of any area suspected of being unstable should be undertaken prior to work commencing.
- Roads should be kept as narrow as possible to reduce damage to the environment and to reduce costs.
- Where possible, box cuts should be avoided, however they are acceptable for short distances (up to 300 m), if they reduce the length of the road, reduce environmental damage and are properly drained.
- Minimum radius formed by curves or corners should be 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 revegetate cut and fill slopes with shrubs, grasses and legumes as soon as possible after construction.
- Ensure proper maintenance of roads and enforce road use restrictions during critical weather conditions such as monsoon seasons.

Drainage

- Road planning should ensure that roads are located in such a way as to minimize stream river crossings.
- Roads should not be constructed in areas, which are prone to flooding in the monsoon seasons.
- In areas where side slopes of 70% or greater extend for a distance of 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 erodible material then the distance between the culverts must by reduced by 50%.

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

- ❖ Culverts should be laid at 2 to 5 % gradient across the road to enable water to flow but should not exceed 6 % as damage from erosion will result. Culverts pipes (Hume pipe) should be buried a minimum of 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 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 erodible 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 favourable 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.

ANNXURE – III : TREE MARKIGNGUIDELINES

Marking guidelines for the Patch Clear-cut System

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

- Patches of matured and over matured tree under which there is existing regeneration or which are most likely to regenerate successfully should be given first preference. This would include large trees with spreading crown, which absorbs sunlight if permitted to reach forest floor would enhance seeding development. The group will be located along extraction lines.
- In selecting patches, ridge top should be preferred over depression.

- In general, the size of opening of 0.25ha need to be strictly maintained and the size of the opening can vary from 0.15 to 0.5ha depending on the stand composition and condition. However, it should be remembered that the patch opening should be too large as it \will favour the growth of other unwanted species.
- The minimum distance between the extraction will be approximately 75metres.
- The distance between the patch clear-cut , along the extraction lines, will be less than 50metres.
- The extraction corridor must be as narrow as possible, however, no wider than 4 meters.
- The shape and size of the patch clear-cut can be adjusted according to the site and terrain condition and need be exactly circular.
- The direction of the tree lean and topography has to be taken into account to prevent large tree being felled on nearby advanced growth.
- Dead, dying, malformed or damaged (snags etc) tree will be retained in between patch clear-cut and in interlines spaces to safeguard flora and fauna niches or habitat but not in the harvested groups themselves, where there is risk of wind throw and danger to personnel working underneath. Diseased tree will be removed to protect the quality of the remaining stand.
- All species listed for protection under Forest & Nature Conservation Act,(1995) must be protected if encountered.
- Sufficient seed trees in the interlined space adjacent to the cable lines opened up should be retained as potential seed source for seeding regeneration in the patch cuts.
- The tree selected will be marked with authorized marking hammer close to the ground level by Unit staff and diameter measurement, 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 also be recorded.

Marking guidelines for seed Tree System

- Seed Tree System will be used only in chir pine stand.
- Seed Tree System will be used in the above stands only on suitable sites.
- The system will not be used on the steep and exposed, south or west sites.
- Slope characteristic, wind firmness and aesthetic value will be considered while utilizing this system.
- About 15-20 trees per hectare will be left standing.
- Diseased, malformed and dying tree will be felled on priority basis.
- Trees left standing will be of good health and forms to ascertain good seed source.
- Tree left standing will not be of the older or tallest in the stand. Overt matured trees will be cut on priority basis.

- The shape of an area chosen for the Seed Tree System can be irregular.
- Maximum size of a contiguous are harvested using this system will not exceed one hectare.

Marking for Rural Uses

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

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

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

ANNXURE - IV :CONTROL FORM

CONTROL FORM

MARKING CONTROL FOR FIREWOOD SUPPLIED BY CONTRACTOR

MANAGEMENT UNIT: BLOCK:

COUPE: COMPARTMENT

YEAR:

Species	No.of stem marked	Volume (m^3)	Remarks

CONTROL FORM

ANNUAL ALLOWABLE CUT CONTROL
MANAGEMENT UNIT:.....WORKING GROUP:.....
BLOCK:..... COMPARTMENT .....
YEAR..... COUPE .....

Area	Estimated	Volume marked	Remarks

CONTROL FORM

POST HARVETS OPERATION

MANAGEMENT UNIT:.....BLOCK.....
YEAR.....COMPARTMENT
COUPE .....

1. Type of operation prescribed

i) .....

ii) .....

2. Operation executed

1).....

ii).....

iii).....

CONTROL FORM

POST HARVEST OPERATION

MANAGEMENT UNIT .....BLOCK.....
YEAR:.....COMPARTMENT .....
COUPE.....

Particular	**Measurement**	**Species**	**No.**	**Volume**	**Remarks**
Marked not felled					
Felled trees/log not extracted					
Lops & tops not extracted					

High stump					
Felling outside coupe					
Avoidable damages					
Width of the corridors					
Any other deviations' of the plan					

ANNXURE – V : PUBLIC CONSULTATION

PUBLIC CONSULTATION MEETING FOR KKFMU THIRD PHASE PLAN REVISION

Venue: **Lumang Gewog Office**

Date: **8/9/2017**

Time: 10.25 am

Agenda for the mmeting.

1. Khaling Kharungla FMU plan revision.

The meeting was chaired by Chief Forestry Officer, Trashigang. Prior to the opening speech by Chief Forestry Officer, the DYT chairman welcome CFO and the team from Trashigang Divisional Office to Lumang Gewog. He expressed his gratitude on consultation conducted with his gewog public prior to implementation of KKFMU plan revision. He said it of great opportunity for his general public to express issues in front of chair person. He expressed that there are many pros and cons that need to be solved on rural timber allotment in his gewog. He said that these issues need to solved urgently and expressed issues will be solved during the meeting. He once thanked the chaired for conducting consultation meeting with Lumang public.

In the opening remarks by chair person, the chaired welcomed all the participants for the meeting. He informed the participants that particular meeting was planned in the August, 2017, however, due to monsoon season, meeting had to postponed since all roads between Womrong & lumang was blocked with heavy landslide. He apologized participant for not being able to make up as informed & planned.

The chairman highlighted on the main objective of the meeting and urged participants to actively participate in the meeting. He informed the floor that once minutes of meeting done and resolution is passed, the particular resolution will be implemented till plan period. He once more urged the participants come up issues related to KKFMU and get their issues cleared or resolved. The chairman thanked Gewog chairman for being able to make in the meeting besides his busy scheduled works.

After opening remarks by the Chief Forestry Officer, Trashigang, the following agendas were discussed:

1. Program for the day
2. Highlight on past KKFMU management and its achievement.
3. KKFMU plan revision and plan writing.
4. Discussion

1. Mr. Keazang Penjor, Unit Incharge, KKFMU briefly presented the program for the day. He also presented management of Khaling Kharungla FMU over the past 10 years, including achievements and result of the past management plan. He informed the floor that application for rural house constructions were mostly received from Lumang gewogs until establishment of CF. All this allotment were made from the indentified rural block at Brekha and Bayphu. He also said that AAC for rural allotment always remained under cut, since the species desired by the public are not readily and other inferior species were less preferred by the general public.

He informed that until 2017, 895 Nos of drashing, 286 Nos. of chams, 215 Nos. of Tsim and 7831 Nos. of dangchung and 388 Nos. of firewood with total cft of 1,51,490.13 in standing form allotted for rural public. The quantity of NWFP issued from FMU for rural use was also presented to the floor.

2. Mr. Tenzin Wangdi, FO presented on the revision of Management plan for another 10 years. He informed the floor every Forest Management Plan is aimed at sustainable management of State Reserve Forest for our future younger generation. He informed the floor that plan is prepared for the period of 10 years and second phase management plan for KKFMU will be expired by October,2019. Trashigang Forest Division has to therefore, come up with third phase management plan by end of 2019. The floor was informed that prior to coming with third phase plan, public consultation is very necessary, especially on identification of rural used area besides resolving other issues. The presenter has informed the floor that Bayphu & Brekha with total area of 291.62 hectors as identified in the 1st & 2nd phase will be identified even in the 3rd phase management plan. It was said that other than above two areas, identification of rural block from other areas are not feasible. Other areas either fall within production or protection area which restricted for rural allotment. Floor was informed that allotment of rural allotment from commercial production area would against the sustainable management of Forest.

Discussion:

1. Public of Lumang Gewog thanked the Trashigang Forest Division for identifying rural block at Brekah & Bayphu for the welfare of general public. But they informed the chaired that rural block identified at Breakha and Bayphu area is very far from their gewog. They have requested the chairperson to kindly consider marking from Kurchelu area (Kurchelu block) for welfare of Lumang public.

To this Chief Forestry Officer informed that floor that Kurchelu block was operated in the fast phase of management plan. The area now remains under improvement stand

(Plantation area). Allotment of rural timber or any other marking from the interlines would affect the working circle of the FMU, therefore allotment of rural timber or any other from interlines will not be feasible based on principle of sustainable management of forest for at all time to come.

The chairperson informed the floor since tree marking within interlines would affect sustainable management of FMU, other possible area may be explore from other area.

1. Mr. Samdrup from Wamrong has thanked KKFMU for providing access road to some villages. He has informed the floor that with establishment of FMU and they benefited especially for collection of NWFP during emergency.

2. CFO instructed planner to look into exclusion of settlements from FMU area. He informed the planner that inclusion of settlement has simply escalated the FMU area.

3. The chairman informed the floor that people can also avail rural timber from NRDCL depot at concessional rate. They were informed that cost of extraction by individuals would be similar to that of timber procured from the NRDCL depot.

Resolution:

1. No marking will be carried out from the interlines based on the principle of sustainable management of KKFMU. Marking area for Lumang Gewog public will be explored during the inventory in the field. Allotment will not be made from interlines for sustainable management of KKFMU.

2. Exclusion of settlements from FMU area will be discussed with DoFPS/FRMD.

3. If people choose rural allotment from the depot, NRDCL should allot the rural timber at existing rural rate. However, choice to species will governed by the NRDCL existing rule.

Khaling Khaarungla FMU

FMU committee level meeting

Venue: Range office, Wamrong

Date: 09/09/2017

Sl.No	Name	Designation& Adress	DSA	Initial
1	Gyop Wangdi	Gup, Chumang		
2	Ngawang Sandrup	Attendant, Riserbo	210	
3	Jamphel Gyeltshen	CF Chairman, Namdrup	210	
4	Nidup Gyeltshen	Attendant, Riserbo	210	
5	Tshering	CF Chairman, Shershai	210	
6	Chuki Dorji	Attendant, Deri	210	
7	Chendup	CF Chairman, Dorpthang	210	
8	Samten Wangmo	CC	210	
9	Tshewang Dema	Tshogpa Chumang	210	
10	Cheki Dorji	" Dungmanna	210	
11	Namgay Wangchuk	Attendant	210	
12	Wangchuk	"	210	
13	Sanjay Wangmo	Chipen, Khaspla	210	
14	Kunzang Chophel	Attendant	210	
15	Tashi Dorji	Tshogpa, Khaysching	210	
16	Chali maya Ghalley	ECCD	210	
17	Sanga Dorji	Resoap	210	
18	Shenub Gyeltshen	Caretaker	210	
19	Tashi Namgay	Tshogpa, Khaling	210	
20	Kinley Gyeltshen	Tshogpa	210	

21	Kata	Attendant	210	
22	Yangchen Choma	Gyedsung	210	
23	Kezang Dema	Farmers	210	
24	Tshering Yangchen	-11-	210	
25	Sonam Jamtsho	-11-	210	
26	Jigme	-11-	210	
27	Pema Thinley	-11-	210	
28	Chetem Zangmo	-11-	210	
29	Nima Wangchuk	-11-	210	
30	Yeshi Zangmo	-11-	210	

list of participants for consultation meeting

Date: 08/09/2017

Venue: Geog Hall, Lumang

Sl.No	Name	Designation& Adress	Initial
1	Dendup Tshering	CFO	
2	Tenzin Wangdi	FO	
3.	Wangdi	Gup, Lumang	
4.	Ngawang Sandup	Risesbo	
5.	Jamphel Gyeltshen	Namgeling CF Chairman	
6.	Nidup Gyeltshen	Attendant, Risesbo	
7.	Tshering	Shachab Chairman	
8.	Choki Dorji	Driver, Dorji	
9.	Chewdup	Dorpkhang CF Chairman	
10.	Sonten Wangmo	CC, Lumang	
11.	Tshewang Dema	Tshogpa Lumang	
12.	Kunchen Chamo	Gexbang Lumang Geog	
13.	Choki Dorji	Tshogpa, Dungmatsma	
14.	Ngawang Wangchuk	Attendant	
15.	Wangchuk	"	
16.	Sangay Wangmo	Chipas, Khaptha	
17.	Kunzang Chophel	Driver Lumang Geog	
18.	Tashi Dorji	Tshogpa, Khamdang	
19	Chali maya Ghalley	ECCD	
20	Sangay Phuntsho	Livestock	
21	Senga Dorji	Resoop	
22	Sonam Tobgay	Division Dzi	
23	Tshering Dorji	Warmzing RO	
24	Pema Wangdi	Lumang BO	
25	Kheshap Khandal	NRDC incharge	
26	Prem Kumar Nanda	KKMU	
27	Kezang penjor	"	
28	Dawa Tshering	Lumang BO	
29	Sherub Gyeltshen	Caretaker	
30.	Tshi Namgay.	Tshogpa (Keling Geog)	
31	Tinley Gyeltshen	Tshogpa	
32	kota	Attendant	
33	RB. Subba	KKMU.	
34	DB R~	Ro Warmzing	
35	Tenzin Nayyyal	" "	
36	Kezang Dems	Khaptha / Farmers	
37	Tshering Yangchen	-"-	
38	Sonam Jamtsho	-"-	
39	Jigme	-"-	

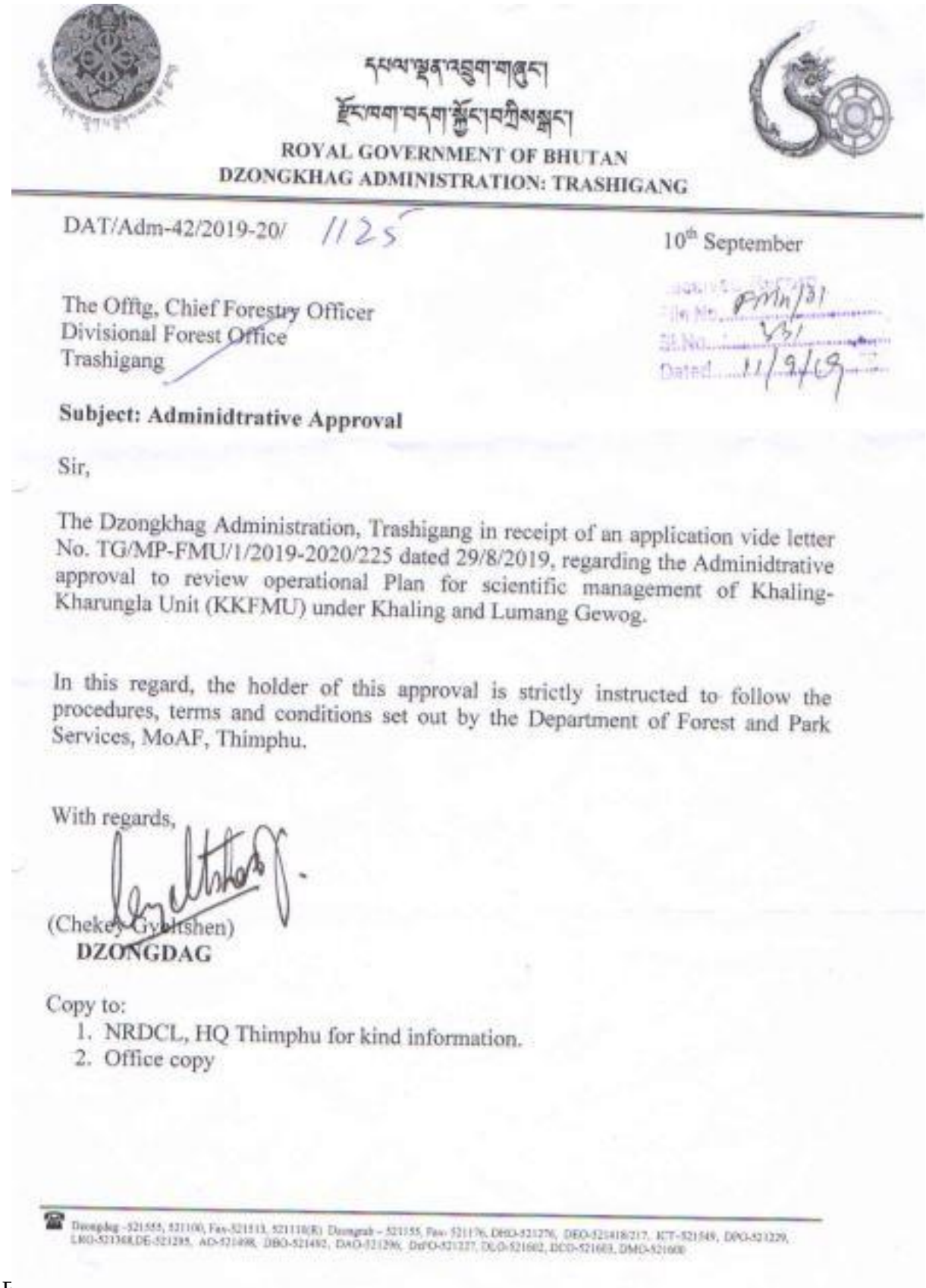
list of participants for consultation meeting

Date: 08/09/2017

Venue: Geog Hall, Lumang

Sl.No	Name	Designation& Adress	Initial
40.	Pema Thinley	Farmer	
41.	Chetsu Zangmo	-11- Khaphay	
42.	Nima Wangchuk	-11-	
43.	Yeshi Zangmo	-11- Khaphay	
44.	Beli		

ANNEXURE VI: DZONGKHAG ADMINISTRATIVE APPROVAL



ROYAL GOVERNMENT OF BHUTAN
DZONGKHAG ADMINISTRATION: TRASHIGANG

DAT/Adm-42/2019-20/ 1125

10th September

The Offtg, Chief Forestry Officer
Divisional Forest Office
Trashigang

File No. pmn/31
Sl No. 431
Dated 11/9/19

Subject: Adminidtrative Approval

Sir,

The Dzongkhag Administration, Trashigang in receipt of an application vide letter No. TG/MP-FMU/1/2019-2020/225 dated 29/8/2019, regarding the Adminidtrative approval to review operational Plan for scientific management of Khaling-Kharungla Unit (KKFMU) under Khaling and Lumang Gewog.

In this regard, the holder of this approval is strictly instructed to follow the procedures, terms and conditions set out by the Department of Forest and Park Services, MoAF, Thimphu.

With regards,

(Chekey Gyeltshen)
DZONGDAG

Copy to:
1. NRDCL, HQ Thimphu for kind information.
2. Office copy

Dzongdag -521555, 521100, Fax-521513, 521110(R) Dzongrab – 521155, Fax- 521176, DHO-521276, DEO-521418/217, ICT-521549, DPO-521229, LHO-521368,DE-521295, AO-521498, DBO-521492, DAO-521296, DoFO-521227, DLO-521602, DCO-521603, DMO-521600

F

ANNEXURE VII: DATA RECORDING FORMS

1. Timber Extraction Records for Cable lines and Adhoc areas

FORM 1.1 :Timber Extraction Records from Cable Line

Form 1.1: Timber Extraction Records from Cable Line					
Name of the FMU:					
Block:		Compartment:			
Cable Line No.:		Year of Operation (M/Y):			
Cable Line Length (m):		No. of Group(s):			
Azimuth (degree):		Clear-felled Area (ha):			
GPS Coordinate	Top Endmass (dd/mm/ss):				
	Bottom Endmass (dd/mm/ss):				
Start Date:		End Date:			
Details of Standing and Log Volume Marked from Cable Line (m3)					
Species	**Standing Volume Marked (m3)**	**Log Volume (m3)**	**Poles(m3)**	**Firewood (m3)**	**Woodchips (m3)**
Blue Pine					
Hemlock					
Spruce					
Fir					
Chir Pine					
Broadleaf					
Total					
	Details of Royalty Realized				
	On logs (Nu.):				
	On firewood/Lops & Tops (Nu.):				
	Total Royalty (Nu.):				

Description

FORM 1.1 is to be maintained one for every cable line operated in a year. The standing volume must be transfered from the Marking List maintained by the marking officer prior to operation of the cable line. The Log volume and the volume for Firewood/Woodchips must be entered post operation of Cable line. The data for Log volume, volume for Firewood and Woodchips can be transferred from **FORM 2.1**

FORM 1.2: Timber Allotment Records from Adhoc area

Form 1.2: Timber Extraction Records from Ad-hoc area					
Name of the FMU:					
Block:		Compartment:			
Purpose:					
Forestry Clearance No.:					
Length of Road/Transmission Line (m):					
Clear-felled Area (ha):		Area (substitute/land lease):			
Year of Operation (M/Y):					
Start Date:		End Date:			
Details of Standing Volume Marked from Ad-hoc Activities (m3)					
Species	**Standing Volume Marked (m3)**	**Log Volume (m3)**	**Poles(m3)**	**Firewood (m3)**	**Woodchips (m3)**
Blue Pine					
Hemlock					
Spruce					
Fir					
Chir Pine					
Broadleaf					
Total					

	Details of Royalty Realized (On Production Basis)	
	On sawn timber (Nu.)	
	On logs (Nu.):	
	On Poles (Nu.)	
	On firewood/Lops & Tops (Nu.):	
	Total Royalty (Nu.):	

Description

FORM 1.2 is to be maintained one for every adhoc activity in a year. The standing volume must be transferred from Marking List maintained by the Marking Officer prior to operation of the adhoc area. The Log volume and the volume for Firewood/Woodchips must be entered post operation of adhoc area. The data for Log volume, volume for Firewood and Woodchips can be transferred from **FORM 2.2**

2. Monthly Timber allotment records

FORM 2.1: Monthly Commercial Timber Production Details from Cable lines

Form 2.1 Monthly Commercial Timber Production Details from Cable Lines													
Name of the FMU:													
Month/Year:													
Date	COSDTMO No.	Cable lines no	Logs (A)			Poles (B)			Total volume (A+B)	Firewood		Woodchips	
			Volume (cft)	No. of Pieces	Species	Volume (cft)	No. of Pieces	Species		Species	Volume(cft)	Species	Volume (cft)

Description

FORM 2.1 is to be used for maintaining data of Commercial Timber Production from cable lines on actual production basis every month.

FORM 2.2: Monthly Commercial Timber Production Details from Adhoc areas

Form 2.2 Monthly Commercial Timber Production Details from Ad-hoc Areas													
Name of the FMU:													
Month/Year:													
Date	COSDTMO No.	Ad-hoc Area	Logs (A)			Poles (B)			Total volume (A+B)	Firewood		Woodchips	
			Volume (cft)	No. of Pieces	Species	Volume (cft)	No. of Pieces	Species		Species	Volume(cft)	Species	Volume (cft)

Description: FORM 2.2 is to be used for maintaining data of Commercial Timber Production from Adhoc areas on actual production basis every month.

FORM 2.3: Monthly Rural Timber Allotment (New Construction/ Renovation/ Extension)

Form 2.3 : Monthly Rural Timber Allotment Details (New Construction/ Renovation/ Extension)											
Name of the FMU:											
Month/Year:											
Sl. No.	Date of Issue	Name of the Applicant	CID No.	Address	Thram No.	House No.	Permit No.	Purpose (New Construction/ Renovation)	Sanction Letter No. and Date	Volume Marked	
										Standing Volume (m3)	Log Volume (cft)

Description

FORM 2.3 is to be used for maintaining data of Rural Timber allotments made for New Constructions, Renovation, Extension, Cow shed construction..etc from the FMU on monthly basis.

FORM 2.4: Monthly Rural Timber Allotment (Firewood, Flag Poles, Fencing Poles, Others)

Form 2.4: Monthly Rural Timber Allotment Details (Firewood, Flag Poles, Fencing Poles, Others)																			
Name of the FMU:																			
Month/Year:																			
Sl. No.	Name of the Applicant	CID No.	Address	Thram No.	House No.	Date of Issue	Permit No.	Purpose	Sanction No. and Date	Type and Quantity of Forest Produce Supplied								Total Qty (m3)
										Firewood (m3)		Fencing Post		Flag Poles		Others		
										Standing Vol. (m3)	Actual Prod.	Standing Vol. (m3)	Nos.	Standing Vol. (m3)	Nos	Standing Vol. (m3)	Nos	

Description

FORM 2.4 is to be used for maintaining data of Rural Timber Allotment made for Firewood, Flagpoles, Fencing Poles, Others..etc from the FMU on monthly basis.

FORM 2.5: Monthly NWFP Supply Record FORM

Form 2.5: Monthly NWFP Supply Record															
Name of the FMU:															
Month/Year:															
Sl. No.	Name of the Applicant	CID No.	Thram No.	House No.	Address	Permit No.	Date of Issue	Purpose	Sanction No. and Date	Description and Quantity of NWFP Supplied					
										Stone (m3)	Sand (m3)	Soil (m3)	Bamboo (nos.)	Gravel (m3)	Others

Description

FORM 2.5 is the cumulative data recording form for NWFP extracted from the FMU on a monthly basis.

3. Annual Timber Allotment Records

FORM 3.1: Annual Commercial Timber Extraction from Cable Lines FORM

Form 3.1 : Annual Cable Line Operation Data														
Name of the FMU:														
Reporting Year:														
Block/ Compartment No.	Cable Line					Total clear felled area (ha)	Standing volume for each species							Total standing volume (m3)
	No./ Year	Length (m)	GPS Coordinate (Top and Bottom Endmass)	No of Groups/ Area (ha)	Corridor Area (ha)		Blue pine (m^3)	Hemlock (m3)	Spruce (m3)	Fir (m3)	Mixed Conifer others (m^3)	Chirpine (m^3)	Broadleaf (m3)	

Description

FORM 3.1 is the cumulative data recording form for ***STANDING VOLUME*** extracted from all the cable lines operated in a year. The data can be transferred from **FORM 1.1**

FORM 3.2: Annual Commercial Timber Extraction from Ad-Hoc areas

Form 3.2: Annual Ad-hoc Timber Extraction Data										
Name of the FMU:										
Reporting Year:										
Block/ Compartment	Activities	Clear Felled Area (Ha)	Standing Volume for Each Species							Total Standing Volume (m^3)
			Blue Pine (m^3)	Hemlock (m3)	Spruce (m3)	Fir (m3)	Mixed Conifer (m3)	Chirpine (m^3)	Broadleaf (m3)	
	Road (FMU/ Forest Road)									
	Road (Others)									
	Transmission line									
	Sanitation									
	Others									

Description

FORM 3.2 is the cumulative data recording form for ***STANDING VOLUME*** extracted from all the Adhoc Working areas operated in a year. The data can be transferred from **FORM 1.2**

FORM 3.3: Annual Commercial Timber/Firewood supply from cablelines and adhoc areas

Form 3.3: Annual Commercial Timber/ Firewood Supply												
Name of the FMU:												
Reporting Year:												
Quantity Harvested from PLANNED OP Activities (m^3)						Quantity Supplied from UNPLANNED Activities (m^3)					Total Standing Vol. (m^3) (a)+(b)	Remarks
Standing Vol. (m3) (a)	*Log Vol.(m3)*	*Firewood (m3)*	*Woodchips (m^3)*	*Others (m^3)*		Standing Vol./m3 (b)	*Log Vol.(m3)*	*Firewood (m3)*	*Woodchips (m^3)*	*Others (m3)*		

Description

FORM 3.3 is the cumulative data recording form for Commercial Timber extracted from both cablelines and adhoc working areas in a year. The data for this form can be transferred from **FORM 1.1, 1.2, 3.1** and **3.2.**

FORM 3.4: Annual Rural Timber Supply

Form 3.4 : Annual Rural Timber Supply												
Name of the FMU:												
Reporting Year:												
Quantity Supplied in Standing Form											Total Standing Volume Supplied (m^3)	Remarks
Rural House Building Timber			Poles (m^3)		Fencing Post (m^3)		Firewood		Others			
No.	Standing Vol. (m3)	Log Vol. (m3)	No.	Standing Vol. (m3)	No.	Standing Vol. (m3)	No.	Standing Vol. (m3)	No.	Standing Vol. (m3)		

Description

FORM 3.4 is the cumulative data recording form for Rural Timber extracted from the FMU in a year. The data for this form can be transferred from **FORM 2.3** and **2.4.**

FORM 3.5: Annual NWFP supply

Form 3.5: Annual NWFP Supply								
Name of the FMU:								
Reporting Year:								
Year	Product Types							
	Bamboo (Nos.)	Sand (m3)	Top Soil (Tm3)	Stone/ Boulders (m3)	Gravel (m3)	Leaf Mould/ Litters (m3)	Mushroom (Kgs.)	Others (Unit)

Description

FORM 3.5 is the cumulative data recording form for NWFP extracted from the FMU in a year.

FORM 3.6: Royalty Statement

Form 3.6: Royalty Statement													
Name of the FMU:													
Year	Month	Cable Line No./ Name of Ad-hoc Area	Type of Forest Produce Extracted								Total Amount (Nu.)	Dispatch No. and Date	Remarks
			Logs		Firewood/ Lops & Tops		Poles		Sawn Timber				
			Volume (cft)	Amount (Nu.)	Volume (m3)	Amount (Nu.)	No./ Volume (cft)	Amount (Nu.)	Volume (cft)	Amount (Nu.)			

FORM 3.6 is the form for recording royalty details for timber marked and handed over to NRDCL from both cable lines and ad-hoc areas.