ROYAL GOVERNMENT OF BHUTAN
MINISTRY OF AGRICULTURE AND FORESTS
DEPARTMENT OF FORESTS AND PARK SERVICES
DIVISIONAL FOREST OFFICE, MONGAR

FOREST MANAGEMENT PLAN FOR KORILLA FOREST MANAGEMENT UNIT, MONGAR DZONGKHAG

PLAN PERIOD: 1ST NOVEMBER 2016 TO 31ST OCTOBER 2026

Tashi Wangdi
Sr. Forest Ranger
Mongar Forest Divisional Office.

AUTHORITY FOR PREPARATION, REVISION AND APPROVAL

PERIOD OF THE PLAN

This Plan is valid for the period of 10 years from 1st November, 2016 to 31st October, 2026.

AUTHORITY FOR PREPARATION, REVIEW AND APPROVAL

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

PROVISION FOR REVISIONS AND CHANGES

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

APPROVAL

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

Submitted for approval:

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

Recommended for approval:

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

Recommended for approval:

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

APPROVED/NOT APPROVED

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

ACKNOWLEDGEMENTS

The authors would like to acknowledge the constant support and assistance received from all during the planning process of this Management Plan. This document is the product of many people who assisted in bringing the Plan in its final form.

In this regard, the authors would like to particularly extend gratitude to Mrs. Dimpal Thapa, Deputy Chief, FRMD and Mr. Phuntsho, FO, FRMD for their support, encouragement and technical assistance provided in the planning process and forest function map preparation.

The authors would also like to thank the CFO and all the supporting staffs of Korilla Forest Management Unit (KFMU) from both Territorial Division (TD) and Natural Resources Development Corporation Limited (NRDCL), Regional Manager (RM), Zhonggar Division, NRDCL and people from Ngatshang Geog for rendering assistance during the field visit and field work.

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དཔལ་ལྡན་འབྲུག་གཞུང་།
National Environment Commission
Royal Government of Bhutan

NECS/ESD/Dzo-Mongar/3449/2017/ **June 20, 2017**

Environmental Clearance

In accordance with Section 34.1 of the Environmental Assessment Act 2000 and Section 34 of the Water Act 2011, this Environmental Clearance (EC) is hereby issued to Director, Department of Forests and Park Services, Thimphu for operation of Third Forest Management Unit (FMU) Plan (2016-2026) of Korilla FMU under Mongar Dzongkhag with the following terms and conditions:

I. General

The holder shall:

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

II. Environmental standards

The holder shall comply with the existing Environmental Standards.

III. Import and use of secondhand equipment

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

IV. Water use and management

The holder shall:

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

NATIONAL ENVIRONMENT COMMISSION

V. Waste prevention and management

The holder shall:

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

VI. Management of excavated materials and run-off

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

VII. Implementation plan

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

VIII. Monitoring and reporting

The holder shall:

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

IX. Renewal and modification

The holder shall:

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

Reservation

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

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

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

Validity:
This EC is issued with valid from **June 21, 2017** until **June 20, 2022** for the operation of Third FMU plan (2016-2026) of Korilla FMU only.

(Sign & Seal)
Secretary

NATIONAL ENVIRONMENT COMMISSION
THIMPHU: BHUTAN

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

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

LIST OF ABBREVIATIONS

%	Percent
AAC	Annual Allowable Cut
CFO	Chief Forest Officer
cm	Centimeter
DBH	Diameter at Breast Height
DFO	Divisional Forest Office
DoFPS	Department of Forests and Park Services
DzFO	Dzongkhag Forest Officer
EIA	Environmental Impact Assessment
FMP	Forest Management Plan
FMU	Forest Management Unit
FMCB	Forest Management Code of Bhutan
FRMD	Forest Resources Management Division
GIS	Geographic Information System
Ha	Hectare
km	Kilometer
m	Meter
m^3	Cubic Meter
masl	Meter Above Sea Level
MC	Mixed Conifer
mm	Millimeter
MoAF	Ministry of Agriculture and Forests
NRDCL	Natural Resources Development Corporation Limited
NTFP	Non-Timber Forest Products
Nu	Ngultrum
NWFP	Non-Wood Forest Products
PFM	Participatory Forest Management
PRA	Participatory Rural Appraisal
RGoB	Royal Government of Bhutan
RM	Regional Manager
RNR	Renewable Natural Resources
RRA	Rapid Rural Appraisal
sp(p)	Species (plural)
UIC	Unit-In-Charge
UM	Unit Manager
WC	Working Circle
WWMP	Wang Watershed Management Project

EXECUTIVE SUMMARY

This is the third Plan for Korila FMU. The Plan structure is as per the guidelines reflected in the Forest Management Code of Bhutan. It comprises of three parts:

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

PART 1 GENERAL DESCRIPTION AND THE CURRENT SITUATION

- Korila Forest Management Unit (KFMU) is located in Mongar Dzongkhag. It is situated within $91^{O}14'$ North to $91^{O}25'$ North longitude and $27^{O}13'$ East to $27^{O}25'$ East latitude. The altitude ranges from 600 m to 3240 masl. The FMU became operational in 1995. The total Area of KFMU is 13,137 ha.
- Warm broadleaved forest comprises mixture of evergreen and deciduous broad leaved tree species. The predominant species are *Castanopsis indica, Macaranga pustulata, Schima wallichii, etc.*
- Cool broadleaved forest comprises the evergreen oak forests and the wetter part contains mixed forests. The species found in this forest type are Castanopsis or oak in the drier part and *Acer cambelli, Betula alnoides, Symplocos, dryophila, Exbucklandia populalnea, Lindera neesiania*, etc.
- Chir pine forest occurs in the deeper valleys of low altitude. These valleys receive heavy shower during the monsoon season and go through very long dry season. The long dry season exposes the area for fire hazards.
- The AAC of the last Management Plan have been set at 4000 m^3, including the AAC for local use. As per the data collected from Korila Forest Unit Office at Ngatshang, the average commercial volume harvested for the last nine years is **19123.44 m^3** and rural volume is **28692.51 m^3** in Standing Volume. This shows that commercial extraction is undercut by **4726.56 m^3** of total AAC of nine years and rural extraction exceeded by **16542.51 m^3**.
- A total of 15.11 km of forest road have been constructed in FMU during the last two Plans' period. During the first and second plan period 9.71 km and 5.40 km respectively. The road network has benefited the local people of Korilla, Pangtog, Ngatshang, Yadi and Chaskar.

PART 2 FUTURE MANAGEMENT

- The overall Goal of the Management Plan is to:

  Manage the forest on the multiple use sustainable yield basis for the production of timber, firewood and other forest products; and for watershed and environment protection.

- The Korila FMU has been organized into four Working Circles viz. **Protection, Production and Non-production** for the smooth implementation of the Plan.

  Production Working Circle have been divided into three Management Working Circles; Production areas for commercial timber harvesting, Limited production areas for mass timber harvesting mainly for local use and Gangola Watershed for very limited harvesting for rural needs from Gangola Watershed Area. This allows different areas to be managed and evaluated separately.

- **Management based on Forest Functions**

  Management based on different forest functions will also be adopted as per the prescriptions in the Plan. Following forest functions and the management options with restrictions have been described in detail.

Code	Function Group (Bold) and Functions
S	**Soil Protection and Conservation**
SC	Soil Conservation
SP	Soil Protection
W	**Water and Watershed Conservation**
WRR	Riparian Reserve Protection
WSh	Watershed Conservation
WLS	Local Water Supply Protection
Soc	**Social Function**
SocL	Social (Local Use Only)
SocRS	Religious Site Protection
RB	**Road Buffer**

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.

- **AAC for Management Working Circles in Standing Volume**

Stratum (Working Areas)	Net operable area (ha)	Rotation (years)	RME standing volume (m^3/ha)	AAC (m^3/yr)	Actual AAC (m^3/yr)	Clear cut Equivalent (Ha)
Commercial Production area (broadleaf forest)	1999.06	110	53.34	1114.38	1100	20.62
Local Use only						
Broadleaf & Conifer Forest	4974.09	110	53.34	2772.95	2700	46.86
TOTAL	**6973.15**				**3800**	**67.48**

Based on the inventory data and net operable forest area available, the AAC has been fixed at 3,800 m^3 in Standing Volume per year.

- **Allocation of AAC**

Standing Volume (m^3)	Allotment
2700	Local users (Local villagers and the general public).
1100	NRDCL for commercial use

- **Silvicultural Systems**

The prescribed Silvicultural System for the commercial harvesting is the Group Selection System with artificial regeneration. Group openings will be created in the stand allowing optimum quantity of light to reach the forest floor and creating conductive micro climatic conditions for seed germination and establishment of seedlings. Criteria for opening the groups and laying out annual coupes are given in detail in the Plan.

For Local Use Only for rural marking Single Tree Selection System will be applied.

- **Environmental Assessment**

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

taken into consideration in this Management Plan.

- FMU Planning & Zoning
- Road Construction and maintenance
- Harvesting and Extraction
- Regeneration and Post-harvesting treatment
- Riparian Zone protection
- Biodiversity Conservation within the FMU
- Local use forest area

PART 3 IMPLEMENTATION OF THE PLAN

- The CFO, Mongar assisted by UIC and other support staff will be the implementing agency. Determination 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 format. FRMD will evaluate at an interval of 5 years.
- FMU Level Management Committee chaired by the CFO, Mongar 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 the recommendation for management and implementation of the FMU. Planned activities to achieve the FMU objectives will be discussed in the FMU Level Management committees.
- Unforeseen circumstances may warrant deviations from Plan prescriptions and in such an event the CFO Mongar must obtain prior written approval from the Head of the Department. The reasons for the deviations must be fully justified by the CFO in this respect and such approved deviations entered into the Management Plan during the next scheduled revision.

Actions required by the FMU Plan	Responsibility
Implementation and Review	
The CFO Mongar, as the senior territorial officer will be responsible for the implementation of this Management Plan, assisted by the Unit-In-charge and staff.	CFO
A FMU sub-committee of the Divisional Management Committee, chaired by the CFO, will be established to ensure the smooth implementation of the Management Plan.	CFO

Actions required by the FMU Plan	Responsibility
The CFO and UIC will ensure that only the silvicultural systems described for each working circle are used for that working circle, and they are implemented thoroughly and correctly.	CFO & FMU UIC
The Head, FRMD, will ensure that the Plan is reviewed five years after implementation (mid-term review), and at the end of the plan period (end-of-term review)	Head, FRMD
Monitoring and Evaluation	
The CFO will ensure that monitoring is carried out on an annual basis according to the guidelines issued by FRMD	CFO
The Head FRMD will ensure that evaluation is carried out at five year intervals, based on the information collected by annual monitoring and other necessary information.	Head, FRMD
Operational Planning	
A bi-annual Operational Plan will be prepared by the CFO to facilitate the timely implementation of this Management Plan, and completed and submitted to FRMD by 2nd October 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.	FMU UIC
The CFO and the RM, NRDCL will cooperate and coordinate to ensure that the logging operation and log out turn are conducted smoothly and in accordance with local and other demands.	CFO RM, NRDCL
The FMU UIC will ensure that stocking regeneration surveys are conducted as and when required.	FMU UIC
Enrichment planting, if necessary, will be carried out by NRDCL.	NRDCL RM
Fencing or other action to protect regeneration will be carried out by NRDCL, in consultation with the FMU UIC.	NRDCL RM

Actions required by the FMU Plan	Responsibility
The FMU UIC will inspect the coupes when harvesting is completed and will issue a Coupe Clearance Certificate only if all aspects of the operation are satisfactory.	FMU UIC
Road survey, design and construction will be carried out by NRDCL.	NRDCL
NRDCL road engineers must follow acceptable standards, designs, estimates and provide supervision during construction to ensure that the standards are met.	NRDCL staff
Regular inspection will be conducted by the FMU staff to detect and report any pest and disease outbreaks to enable earliest possible remedial or preventive measures to be initiated.	FMU staff
Participatory Forest Management	
Records of all trees marked and issued for local use or for conversion within the forest, by Blocks and Compartments will be maintained by the Unit staff and furnished monthly to the CFO Mongar.	FMU UIC
Timber and non-wood products, including fuelwood, Daphne bark, and bamboo, can be allotted to bonafide local villagers.	FMU UIC, via Operational Plan
The views of stakeholder groups will be incorporated into the operational plans through the inclusion of stakeholder representatives on the FMU sub-committee of the Divisional Management Committee.	CFO

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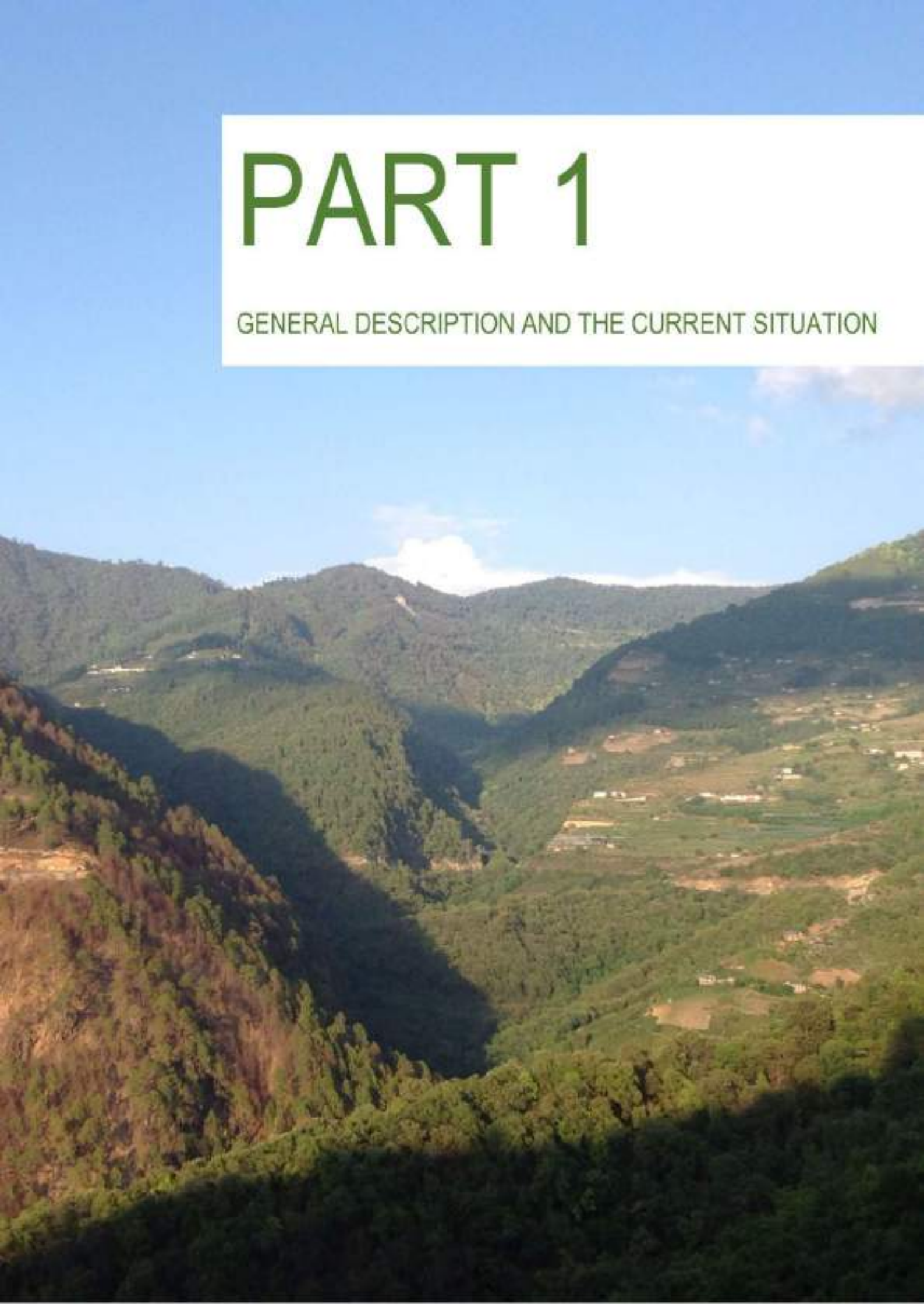
GENERAL DESCRIPTION AND THE CURRENT SITUATION



1. LOCATION, BACKGROUND, AREA AND STATUS

1.1 Location of Korila FMU

The Korilla FMU is about 13,137 ha in total area It is located in the Mongar Dzongkhag within 91°14' North to 91° 25' North Longitude and 27° 13' East to 27° 25' East Latitude. The altitude ranges from 600-3240 m above mean sea level. Korilla FMU does not lie in any of the Protected Area Systems. The FMU comprises mainly State Reserved Forests.

The historical background was mostly obtained through semi-structured interviews and informal talks with the elderly and key residents of the FMU and examining previous records.

Prior to creation of the Forestry Department and even after its inception in the mid-1950s, people within the unit had unlimited access to the forest and there was uncontrolled harvesting of timber and fuel wood. However, this did not affect much on the growing stock or forest cover since the demand was too low and the removal was insignificant. Management plan was written for the unit and has been worked for last twenty years. Intensive logging has taken place in the east of Korilla pass on either side of the highway and also in Chompa and Gongla block. The Silvicultural system adopted was selective felling and most of the valuable species were creamed out during these operation.

It was found that in the 1980s, the recorded annual removal of fuel wood and timber was about 25,000 m^3 and 2000 m^3 respectively.

1.2 Area statement

The following table and figure gives the detail land use types of the FMU. These figures are obtained from the LUPP land use map after ground truthing.

Table 1: Area Statement by Land use

Land use*	Area (ha)
Religious Sites	32.83
Road buffers	1184.39
Soil protection	2414.78
Riparian Reserve	556
Private/Cultivated Land	1482.08
Broadleaf Forests	5515.92
Conifer Forests	1407
Others	544
Total	**13137**

1.3 Forest Condition

The Korilla FMU is mostly cool Broadleaved Temperate Forests. The small patches of Chir Pine forests are scattered throughout the FMU. Though the FMU was not under pressure from timber production, the cattle pressure was very high that refrained the area from restocking to its natural form. It was basically hard in getting the valuable species in place for the future sustainability.

Since regeneration is a major problem in the broadleaved forests, intensive artificial regeneration will be adopted with frequent monitoring and better financial supports from the NRDCL. These areas will be regenerated with local viable species from the nursery maintained by the NRDCL. Any possible ways to bring back the forests into greenery is of utmost importance for the implementing agencies and DoFPS at large.

1.4 Legal Status

1.4.1 Ownership

The Forest and Nature Conservation Act 1995, defines forests as " any land and water body, whether or not under vegetative cover, in which no person has acquired a permanent and transferable rights of uses and occupancy, whether such land is located inside or outside the forest boundary pillars, and includes land registered in a person's name as tsamdo (grazing land) or sokshing (wood lot for collection of leaf litter)". All such areas are considered as Government Reserved Forest and entire Korilla FMU falls within this category of reserved forest, except for the cultivation land, which is private.

1.4.2 Rights and Privileges

The Rights and Privileges of the local communities, with regard to the use of forest are as per the Forest and Nature Conservation Act of 1995 and National Forest Policy of 1994. The Forest Act permits grazing and collection of firewood, fodder and leaf mould for domestic use, either free or on payment of royalty. Fire wood collection is permitted only from dead and fallen trees. Timber trees are issued for bonafide domestic use, after the recommendation from the Dzongkhag concern and royalty has been paid. Hunting is totally prohibited within the Forest.

1.4.3 Grazing Rights

The entire accessible forest land of Korilla FMU is grazed by cattle from the villages of Mongar, Chaskhar and Ngatsang Geogs. The Forest and Nature Conservation Act 1995 gives authority to the DoFPS to regulate and restrict grazing anywhere in the country to prevent environmental damage.

1.4.4 Water Rights

The local population has the traditional rights to use water from the streams and rivers for their domestic purposes, such as home consumption, watering livestock and irrigation of crops. The Kurichu and Sherichu are the main source of water, besides numerous small

streams and creeks within the Korilla FMU.

1.5.4 Historical Monuments and Monasteries

Within the Korilla FMU there are numerous gneys, goenpas and lhakhangs. All these monuments encountered during the visit are provided a buffer of 100 m around within the FMU. Recently, in 2006 Korilla Chorten was constructed along the national highway and consecrated by esteemed religious leaders. The Chorten is a popular site for visitors.

Figure 1: Korilla Chorten

2. PERMANENT SITE FACTORS

2.1 Topography and Slope

The Korilla FMU is in general moderate to steeply sloping and mountainous with deeply incised valleys running mainly north-south. Elevation ranges from 600 m close to Sherichu in the South- East to 3240 m in the North-West of the unit. The terrain is dissected by many small streams, which flow mainly from north- south. Most of these streams are seasonal, coming into life only in the rainy seasons. All the streams in the FMU drain into main rivers; Kurichu and Sherichu.

2.2 Aspect

The general terrain within the FMU is relatively gentle compared to other regions of Bhutan. The valleys are not very deep and are U-shaped with lower slopes and flatter areas under cultivation.

Approximately 70–80% of the area faces North–South direction and remaining 20–30% faces East–West direction. The unit is cool during winder and moist and warm during summer.

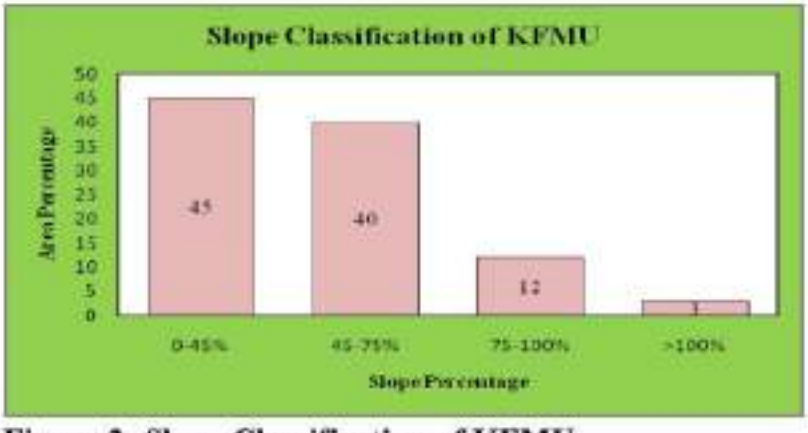


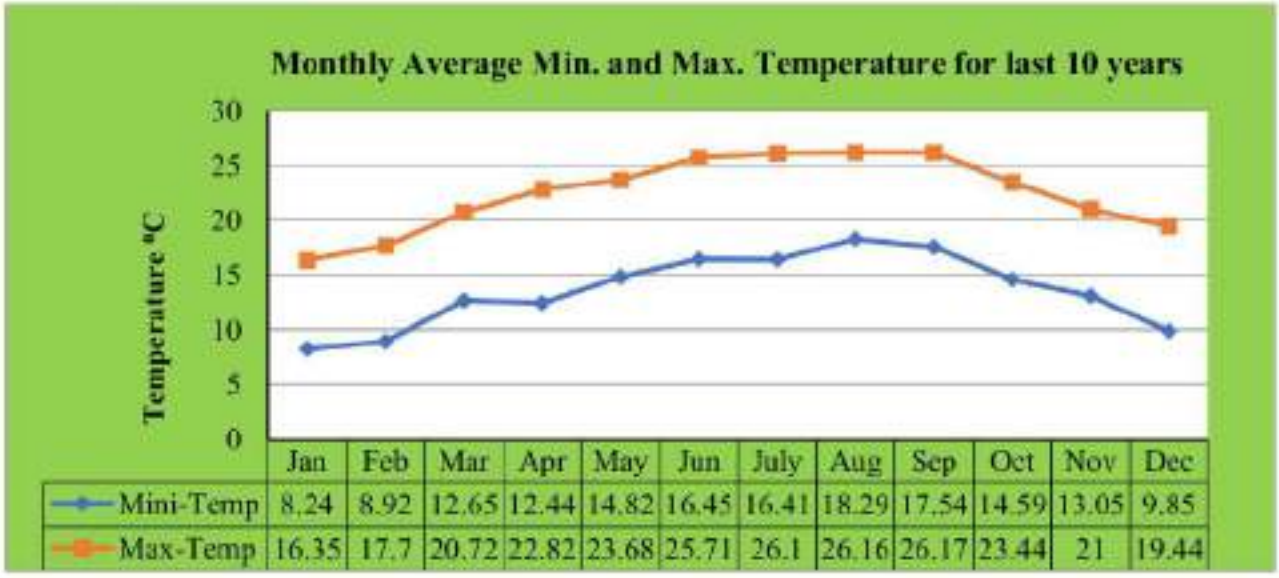
Figure 2: Slope Classification of KFMU

The slope classification was done using 30 m resolution ASTER DEM of Bhutan. Surface analysis was carried out and slopes were reclassified as per Forest Management Code of Bhutan (FMCB, 2004).

2.2 Climate

There is a meteorological station within the Korilla FMU. The weather station is at Yadhi, which is right inside the Korilla FMU, but the data on climatic condition for last nine was not available. The following climatic conditions data on temperature and rainfall are from Department of Hydro-Met Services, Ministry of Economic Affairs.

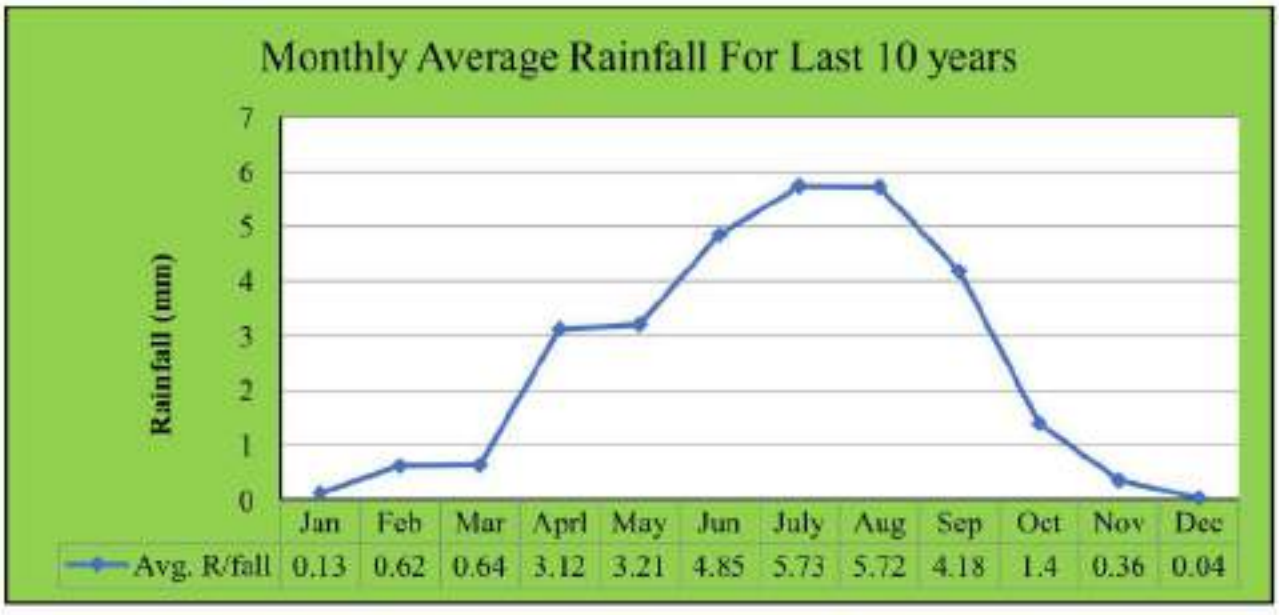
2.2.1 Temperature



	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Mini-Temp	8.24	8.92	12.65	12.44	14.82	16.45	16.41	18.29	17.54	14.59	13.05	9.85
Max-Temp	16.35	17.7	20.72	22.82	23.68	25.71	26.1	26.16	26.17	23.44	21	19.44

Figure 3: Average Annual Temperature for 10 Years

2.2.2 Precipitation:



	Jan	Feb	Mar	Aprl	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Avg. R/fall	0.13	0.62	0.64	3.12	3.21	4.85	5.73	5.72	4.18	1.4	0.36	0.04

Figure 4: Average Annual Rainfall for 10 Years

2.3 Geology and Soil

The Daling Formation (Samchi/Shumar) of Pre-Cambrian age cover the rock types found in the KFMU. The rock unit consists of:

- Quartzite Unit: Massive Quartzites, interbedded minor phyllites, basic silts.
- Phyllitic Unit: Sericite-chlorite phyllitic with copper mineralization, grey phylliutes, calcite quartzites and basic silts.

The indication of the parent materials are that the soils are of reasonable quality and will not be a hindrance to sustainable harvest of wood and reforestation.

2.4 Hydrology

The Korilla FMU is the watershed for Kurichu and Sherichu, which lies within the sub- catchment, of the main Kurichu and Drangme catchment respectively. There are several sub watershed; the most important ones are those of the Guda stream, Yakpugang stream and many numerous streams, which serve as the source of water for the livestock and the settlements. All the waters from the Korilla FMU finally drain into Manas in the south.

3. VARIABLE SITE FACTORS

3.1 Population and Demography

Mongar Dzongkhag consists of seventeen Geogs of which three Geogs namely Mongar, Chaskar and Ngatshang fall within Korilla FMU with a total population of about 9,339. The livestock and their products are one of the main sources of income for the inhabitants of these Geogs. There are about 1486 households inside the Korilla FMU and the average number of person per household is about 8.3. However, increased urbanisation and developmental activities is taking place in Mongar town, resulting in unprecedented population growth including business immigrants. The Geog wise distribution of households and their population are as follows:

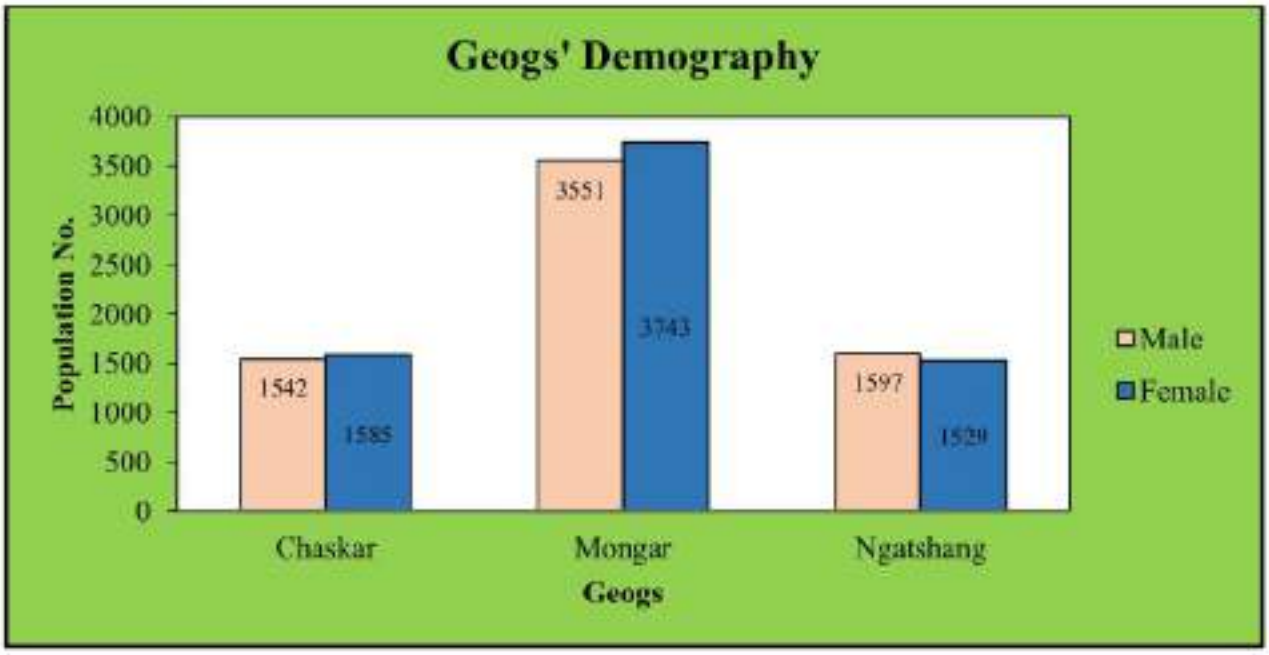


Figure 5: Geog's Demography

3.2 Farming and Agriculture

Summer crops are maize, paddy and vegetables. Potato, wheat and some vegetables are grown during the winter.

Few fruit trees are grown for their consumption, but one would find orange plantation for commercial purposes.

The people living in the valley are subsistence farmers. Their main source of income is from agriculture and livestock and their products. However, cash is becoming more important for the villagers for paying school fees, farm implements, and to buy food items from the local markets. People earn their cash income by selling livestock products, vegetables and few horticultural items.

3.3 Traditional Use of Forests

All the timber requirements for the communities in an around the Korilla FMU meet their requirements from the FMU. Since, the FMU is operating in the area harvesting at larger quantity has taken place.

There are many *tsamdos* within the Korilla FMU. Grazing is going to be one of the main pressures in the KFMU. Local cattle graze during the summer months and added upon it from the migratory herds during the winter months. It is estimated that population of cattle equal to 6880 are there within the FMU, besides sheep, goats, horses, etc.

3.4 Grazing

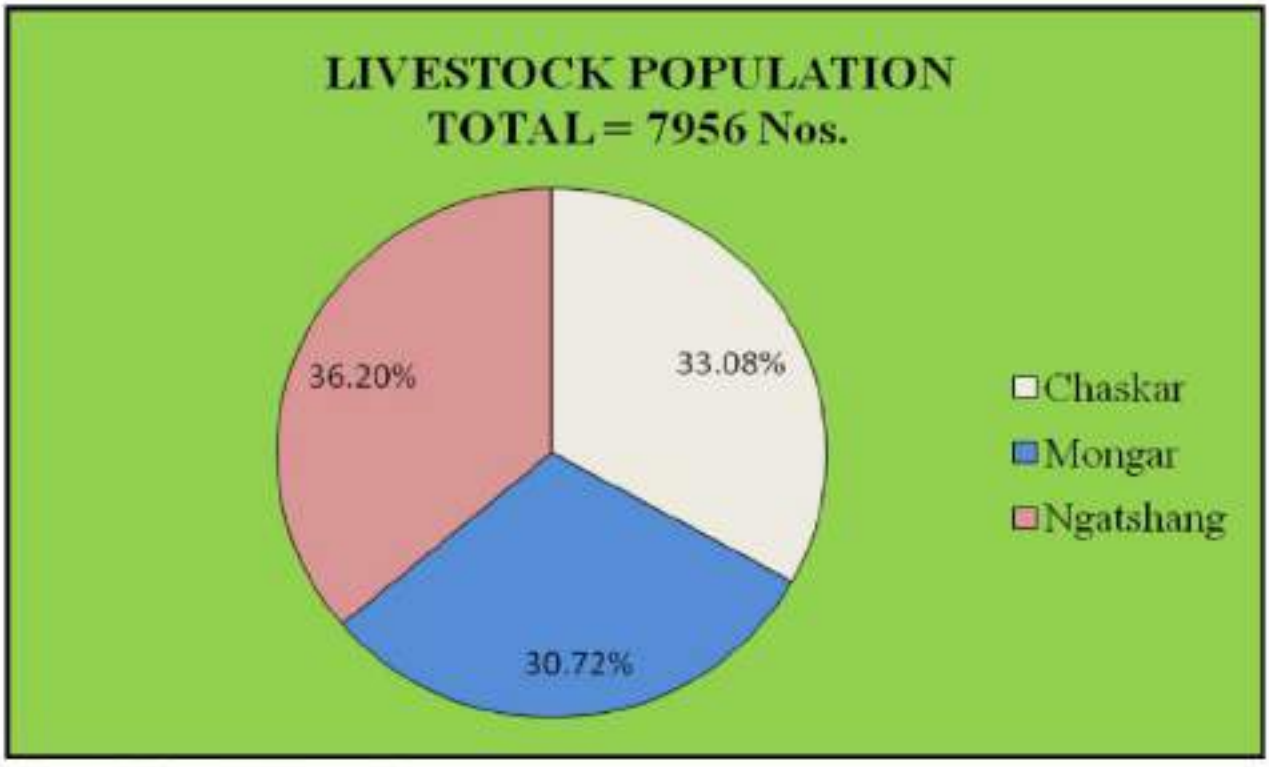


Figure 6: Livestock Population

There are many *tsamdos* within the Korilla FMU. Grazing is going to be one the main pressures in the Korilla FMU. Local cattle graze during the summer months and added upon it from the migratory herds during the winter months. It is estimated that around 6880 cattle within the FMU, besides sheep, goats, horses, etc. Uncontrolled

grazing has led to poor regeneration in the operated areas.

Livestock is one of the main sources of income for the Geogs in the Korilla FMU. Although grazing has been continuing for generations and is considered as traditional rights, it would be difficult if little restriction is not imposed, at least within the FMU in order to bring back the vegetation after the NRDCL's harvesting. Of course, all these livestock do not graze throughout the year in the unit. Some are migratory between the neighbouring Geogs. The cattle population in the three Geogs are as follows:

3.5 Forest Fires

Fire is not a regular phenomenon within the Management Unit. However, the upper portion of the FMU does attract extra vigilance due to occurrence of conifer species. Fire has been observed as one of the main problem in other areas especially during the dry months in conifer regions.

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Chaskar	600	250	0	200	200	550	200	0	212	150
Ngatshang	30	0	55	0	0	25	0	30	0	150

Figure 7: Forest fire outbreak in Chaskar and Ngatshang Geog

3.6 Pest and Diseases

Pest and Diseases in reality are always present in any type of forests. But its presence has not become significant due to its level of injury to the forest. The Korilla FMU being mixed broad leaf is present with numerous insects and fungus, which are the main sources of injury to the forest health. As such there is no record of pests and diseases affecting the health of the forest above the economic injury level. Mistletoe in Chirpine is very common along the Chaskar road.

3.7 Non-Wood Forest Products (NWFPs)

NWFP is assumed as one of the main resources for the rural communities. KFMU, is richly stocked with numerous forest products. The most important ones are canes, bamboo, mushrooms and wild vegetables.

The use of medicinal plants in Bhutan has been an age old practice and is recognised by the

RGoB. Water from the catchment is used by the local population, cow herders and their cattle.

NWFPs in the Korilla FMU, (Mongar).

Table 2: Wild Vegetables

Sl. No.	Scientific Name	Vernacular Name	Part(s) Used	Remark
01	*Cantharellus*	Sisi shamu	Entire	Mushroom
02	*Diplazium*	Nakey	Tender parts	Fern
03	*Elatostema lineolatum*	Damroo	Entire	
04	*Girardinia diversifolia*	Zocha	Flower, bud and young leaves. [Bark used to make fine rope]	Rope
05	*Laportea terminalis*	Zocha	Flower, bud and young leaves. [Bark used to make fine rope, leaves are used as fodder]	Rope, fodder
06	*Musa sp.*	Re-ngala	Flower buds [Fruit edible]	Vegetable
07	*Plectocomia himalayana*	Pa-tsha	Young shoot	Cane, craft weaving material
08	?	Kachu shamu	Entire	Mushroom

Table 3: Wild Potatoes

Sl. No.	Scientific Name	Vernacular Name	Part(s) Used	Remark
01	*Dioscorea belophylla*	Rekay / ban-tarul	Tuber edible [Leaves are used to make tea leaf]	Tealeaf
02	*Dioscorea bulbifera*	Maka / geetha	Tuber edible boiling with ash	
03	*Dioscorea pentaphylla*	Chakay / bhaegur	Tuber edible	

Table 4: Wild Fruits

Sl. No.	Scientific Name	Vernacular Name	Part(s) Used	Remark
01	*Castanopsis tribuloides*	Sokey, musuray katus	Nut edible, leaves are used as fodder, buds & young leaves are	Fodder, tealeaf
02	*Elaeagnus*	Bji	Fruit edible	
03	*Ficus sp.*	Kushing, kutse	Fruit edible, leaves use as fodder	Fodder
04	*Ficus prostata*	Omtse	Fruit edible	
05	*Juglans regia*	Ta-shing	Nut edible, bark yields black dye also has some medicinal value	Medicinal value, dye
06	*Morus alba*	Kimbu (sanu)	Fruit edible. Juice extract from root is best medicine to cure jaundice and for deworming. Leaves used as fodder.	Medicinal value & fodder
07	*Rhus chinensis*	Bhakimlo	Fruit edible sour in taste.[Fruit used in treatment of dysentery… Flora of Bhutan Vol. 2 Part 1by A. J. C. Grierson & D. G. Long 1991]	Medicinal value
08	*Rubus ellipticus*	Tshema-tshelu	Fruit edible, root has medicinal value to prevent diarrhoea	Medicinal value

Table 5: Medicinal Plants

Sl. No.	Scientific Name	Vernacular Name	Part(s) Used	Remark
02	*Artemisia sp.*	Khempa	The dried immature leaves, flowers' heads are used for expulsion of worms from the stomach. Also useful in fevers & dropsy and also as a stimulant.	Found as weed
04	*Cassia tora*	Tapre	Leaves paste is an effective remedy for ringworm (A.J.C. Grierson & D.G.Long, 1987)	Found as weed
05	*Centella asiatica*	Tapre jhar	Entire part is said to have medicinal value	

Sl. No.	Scientific Name	Vernacular Name	Part(s) Used	Remark
06	*Ficus semicordata*	Khanew	Figs used in treatment of leprosy…(Flora of Bhutan Vol.1 Part 1 by A.J.C. Grierson & D.G. Long 1983)	Fig edible
07	*Juglans regia*	Ta-shing	Bark has some medicinal value	
08	*Morus alba*	Kimbu (sanu)	Juice extract from root is best medicine to cure jaundice and for deworming.	Found rare
09	*Rhus chinensis*	Bhakimlo	Fruit used in treatment of dysentery… Flora of Bhutan Vol. 2 Part 1by A. J. C. Grierson & D. G. Long 1991	
10	*Rubia cordifolia*	Majito, tshoe	Entire	Has medi-cinal value to relief body-pain
11	*Rubus ellipticus*	Tshema-tshelu	Root has medicinal value to prevent diarrhoea	
12	*Thysanolaena latifolia / maxima ./ agrostis* *	Tshakusha, amleso	Root paste applied to mature and cure boils; juice extract from root is for deworming purposes.	Matured infloresc-ence used as soft broom and leaves as fodder
13	*Viscum nepalensis*	Ngensithup	Paste of entire parts can be used for treating fracture, its decoction can relief body-pain.	
14	*Viscum sp.*	Ripha slima,	Paste of entire parts can be used for treating fracture, its decoction can relief body-pain	

Table 6: Cane and Bamboo

Sl. No.	Scientific Name	Vernacular Name	Part(s) Used	Remark
01	*Calamus acanthospath*	Tshim-tsha	Young shoots are used as vegetable. Small and fine split of mature canes are use as raw material to weave handicraft items	Cane
02	*Calamus*	Ao, mau bet		
03	*Plectocomia himalayana*	Pa-tsha		
04	*Bambusa*	Shizhing	Young shoot can be used as vegetable. Bamboo stem itself used for various purposes such as making small house, erecting fence and small fine split can be used as raw material to weave handicraft items.	Bamboo
05	*Bambusa sp.*	Pakshing		
06	*Cephalostachyum sp.*	Jhi		

Table 7: Fodder Species

Sl. No.	Scientific Name	Vernacular Name	Part(s) Used	Remark
01	*Acer*	Putli	Leaves	
02	*Amoora*	Lali (thulo ruk)	Foliage	
03	*Brassaiopsi*	Tompam	Leaves	
04	*Castanopsis*	Sokey, musuray katus	Leaves	
05	*Eurya*	Jhigani, sanu	Leaves	
06	*Ficus*	Dabgo,	Leaves	Figs edible
07	*Ficus*	Khanew	Leaves	Figs edible
08	*Ficus sp.*	Kushing, kutse	Leaves	
09	*Morus alba*	Kimbu (sanu)	Foliage	
10	*Morus*	Kimbu (thulo	Foliage.	Bark gives
11	*Prunus*	Arupatey	Leaves	
12	*Thysanolaena latifolia*	Tshakusha, amleso	Leaves	Matured inflorescenc
Leaves of all bamboo species are used as good fodder				

Table 8: Other Uses

Sl. No.	Scientific Name	Vernacular Name	Part(s) Used	Remark
01	*Artemisia sp.*	Khempa	Entire used as incense	Found as weed
02	*Bidens pilosa*	Jachigzu, kataray kuro	Entire	Actually it is unwanted weed but sometimes people used this to make tealeaf
03	*Cinnamomum zeylanicum*	Shingtsim, dalchinee	Leaves	Used as tealeaf
04	*Cupressus sp.*	Tshenden, dhupi	Leaves & twigs used as incense	Planted
05	*Daphne sureil*	Dhey nap	Bark	Raw material for making traditional paper. Also used to make rope
06	*Edgeworthia gardneri*	Dhey kap	Bark	Raw material for making traditional paper. Also used to make rope
07	*Piper hamiltonii*	Jungali pan	Leaves	Collect and sell to the market
08	*Piper*	Ruk peepla	Fruit	Can be sold to market.
09	*Rubia cordifolia*	Majito, tshoe	Entire	Gives red dye. Also has medicinal value to relief body-pain
10	*Thysanolaena latifolia*	Tshakusha, amleso	Matured inflorescence	Used as soft broom.

4. ECOLOGY

Bhutan comprises an important part of the so-called East Himalayan biodiversity "hot spot" (Salter 1995). Globally, it is one of the few places with such a high concentration of species and endemism. This rich biodiversity is due to the wide variation in altitude, slope and aspect within a short latitudinal range, a varied climate, and Bhutan's location at the interface of the Indo- Malayan and Paleartic Realms, where essentially different groups of species have evolved (Salter 1995). Preserving biodiversity is a high priority for RGoB. Therefore this has to be considered in forest management, and underpin all forestry activities. No forestry activities within the FMU should compromise biodiversity or ecological functionality.

4.1 Floral Association

There is no detailed classification of the vegetation in Bhutan. However, with minor variations, the works of Champion and Seth, 1968 on the classification of forests in India, which include Himalayas, could be applied to many of the forest types in Bhutan.

On the basis of forest zonation, as stated above, Korilla FMU occupies the Central and the higher portion of Southern belts.

Table 9: The plant species recorded during the inventory

SL. NO	LOCAL NAME	SCIENTIFIC NAME
01		*Acer cambelli*
02	Chiluane	*Schima wallichii*
03		*Pentapanax racemosa*
04	Betula	*Betula utilis*
05		*Alnus nepalenses*
06	Sinkawla	*Cinnamom faxicenofolius*
07	Malata	*Macaranga denticulate*
08		*Amoora wallichii*
09	Champ	*Michelia champaca*
10	Gooli	*Persea frutifera*
11	Toon	*Toona ciliate*
12	Bajratha	*Quercus lamelosa*
13		*Quercus glauca*
14		*Quercus semicarpifolia*
15	Okhar	*Juglan regia*
16	Kalo seris	*Albizia labbeck*
17	Angare	*Phoebe spp.*
18	Pasia	*Sorbus griffithii*
19	Phutla	*Brassaiopsis mitis*
20	Kharane	*Symplocus spp.*
21	Chinde	*Macropanax spp.*
22	Jhingni	*Eurya cavinervis*
24	Musse katus	*Castanopsis tabuloides*
26	Bhadrase	*Elaeocarpus spp.*

SL. NO	LOCAL NAME	SCIENTIFIC NAME
27	Bohari	*Cordia oblique*
28	Ghoge champ	*Magnolia campbellii*
29	Bepari	*Ostodes paniculata*
30	Kawla	*Persea spp.*
31	Rani champ	*Michelia doltsopa*
32	Dudhila	*Ficus neriifolia*
33	Tarsing	*Beilschmiedia spp.*
34	Kimbu	*Morus serrata*
35	Guay champ	*Michelia velutina*

4.2 Fauna

Following the inventory of 2002, the area showed the presence of wildlife in most of the FMU. The following species are recorded during the inventory;

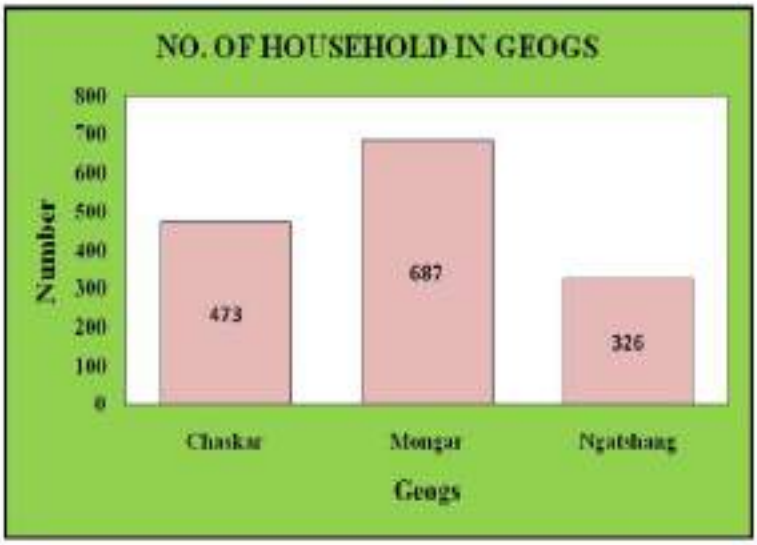
Table 10: Fauna

SL.NO	LOCAL NAME	SCIENTIFIC NAME
01	Sambar	*Cervus unicolor*
02	Barking Deer	*Muntiacua muntjak*
03	Wild Boar	*Sus scrofa*
04	Common Langur	*Presbytis entellus*
05	Musk Deer	*Moschus chrysogaster*
06	Goral	*Nemorhaedus goral*

4.3 Avifauna

There are quite a number of birds in the FMU. No documentation of the birds in this FMU is recorded. The nature of forest types in the FMU is best suited for the avifaunal wealth present there.5. SOCIO-ECONOMICS

5.1 Sources of Income and Expenditure



There are 17 Geogs within Mongar Dzongkha of which three Geogs namely Mongar, Ngatshang and Chaskhar Geog fall within the Korilla FMU with a total population of 13,547. The number of households in each geog is shown in the Figure 8 and the number of recorded household increased from the second plan to the third plan is shown in the Figure 9 below.

Figure 8: Households in three Geogs in KFMU

There are 9339 households within the unit, with an average of 8.3 persons per household. The female population is little more than the male population. The average number of domestic animals per household, within the FMU is about 4.2. The average size of land holding is about 1.3 Ha, including tsamdo and soksing. Most of the dwellers practice substance farming, depending mainly on crops like rice, maize, buckwheat and cattle raising. The inhabitant's priorities are focused on meeting basic needs for food, fuel wood, and income. They have no interest in participating in the activities which are not likely to yield immediate benefits. They have no difficulty in obtaining their fuel wood and timber.

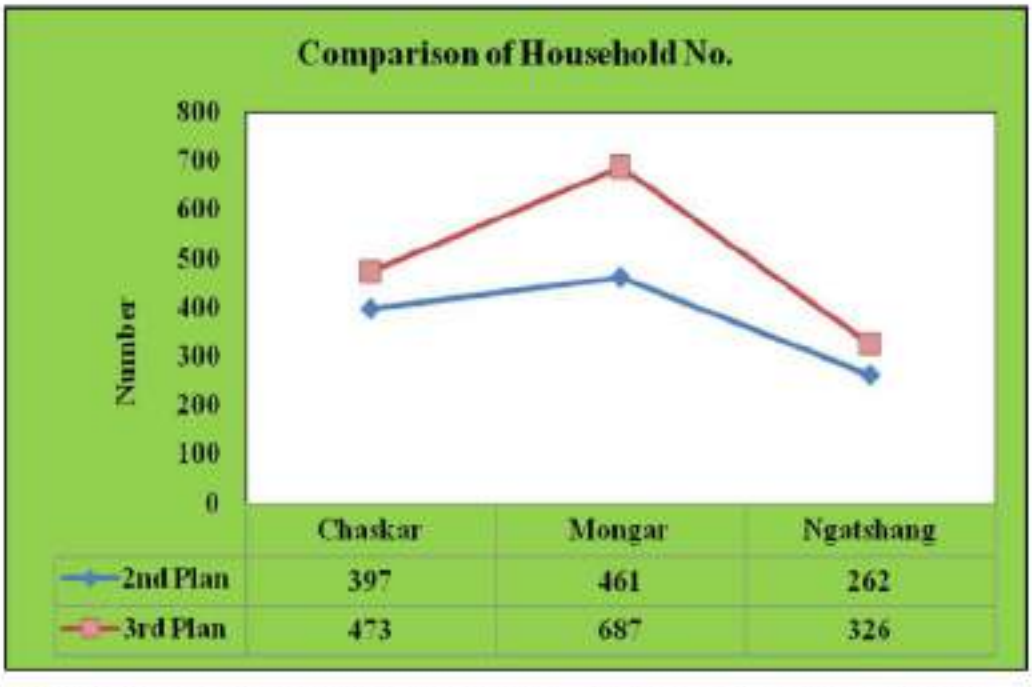


Figure 9: No. of household increased in third plan from second plan

The Korilla FMU provides forage for grazing animals, both domestic and wild. Inventory records and field observations show that most part of the Korilla FMU is grazed by local cattle. The total numbers of domestic animals mainly in the three Geogs are around 6208. They are distributed as shown in the figure below:

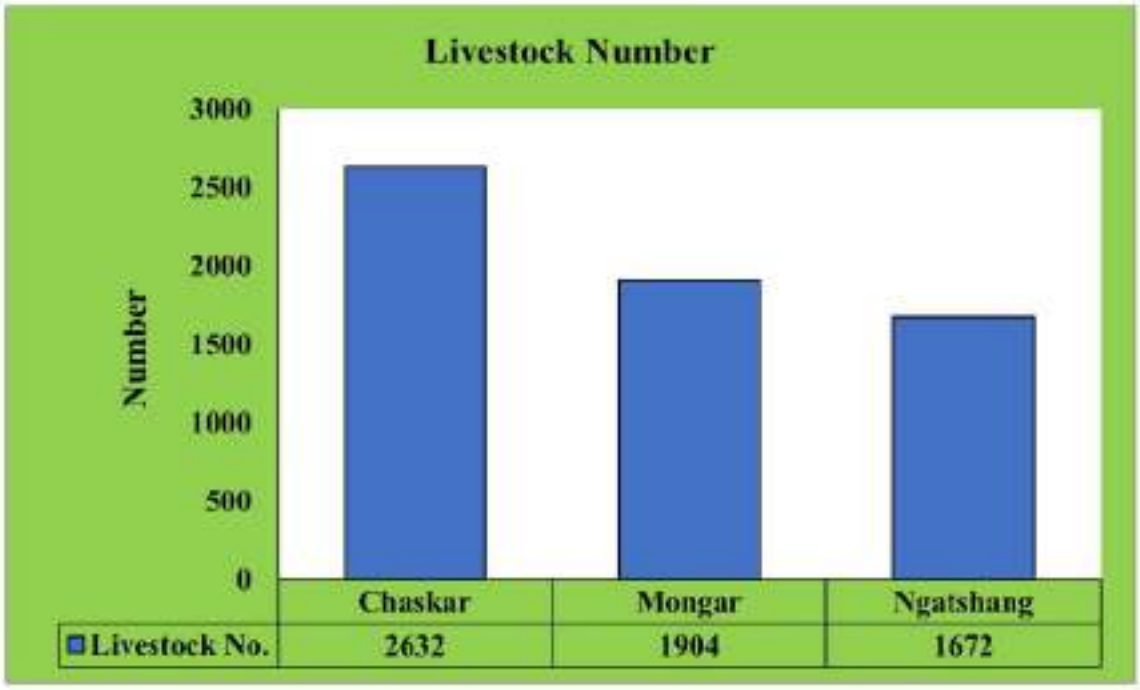


Figure 10: No. of livestock in each Geog

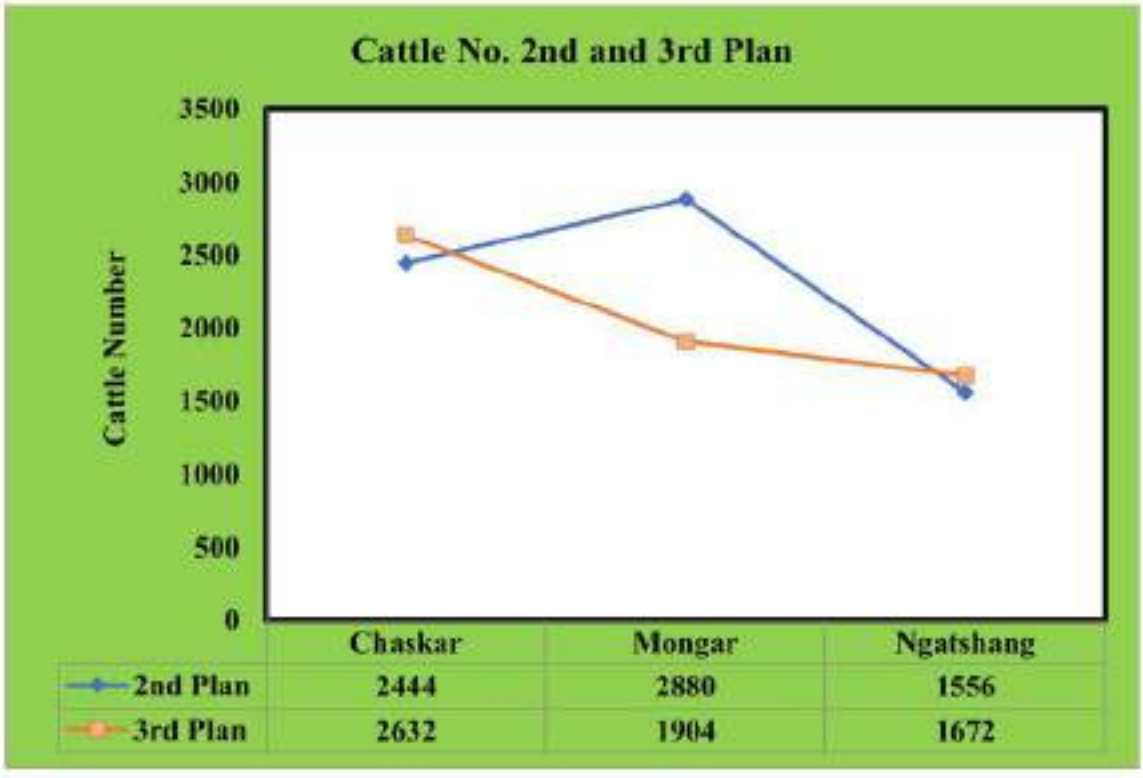


Figure 11: Comparison of livestock population in the second and the third plan

6. CURRENT TIMBER DEMAND AND SUPPLY

Timber and fuel wood demand for the period of 2006-2015 for Mongar Dzongkhag has been projected in the first plan. With very little information available at that time, the data could be used as reference and not as true picture at present. Now with the development of record keeping in the fields we would be better in projecting the demands and information generating for future plans.

With few information obtained from the Forest Offices, the following table shows the trend of timber allotments not accounting of the AAC, prescribed for the FMU.

6.1 Supply of commercial timber, firewood and wood chips from FMU.

The supply of commercial timber, firewood and wood chips from Korilla FMU from 2006 to 2015 (as of October 2015) is given in the Table below.

Table 11: Supply of Commercial Timber, Firewood and Wood chips

Year	Timber-Logs (m^3)	Firewood (m^3)	Wood chips (m^3)	Total (m^3)
2007	2205.28	859.39	815.65	3880.32
2008	1690.22	612.00	_	2302.22
2009	3483.57	115.00	2,105.56	5704.13
2010	2228.94	755.59	758.89	3743.42
2011	3695.79	1503.77	975.15	6174.71
2012	4119.05	2731.28	_	6850.33
2013	666.98	332.00	_	998.98
2014	645.51	1137.15	_	1782.66
2015	1040.66	1680.46	_	2721.12
Total	**20442.98**	**10058.64**	**4655.25**	**34157.89**

6.2 Supply of Rural Timber and Firewood from FMU.

All the people living within the FMU collect timber and firewood from nearby forests. It is utilized for construction of new houses, repair, renovation and extension of rural houses, shed for livestock, farm guard shed/watch tower, toilet and machinery sheds. Besides, it is also used for agricultural implements including, domestic furniture, flag poles and fencing posts. The supply of rural timber and firewood from Korilla FMU during the period from 2007 to 2015 has been given in the table below and the figure 10 shows comparison of the rural allotment made during 2007 to 2015 against it AAC.

Table 12: Supply of Rural Timber and Firewood

Year	Timber (m^3)	Firewood (m^3)	Total (m^3)
2007	242.65	1168.00	1410.65
2008	828.49	2092.00	2920.50
2009	972.79	1142.00	2114.80
2010	4366.49	1511.00	5877.49
2011	2375.96	3117.90	5493.86
2012	1263.16	2731.28	3994.45
2013	1710.00	802.94	2512.94
2014	1234.11	246.66	1480.77
2015	1808.00	1080.73	2888.73
Total	**14801.65**	**13892.51**	**28692.51**

Besides the sale of timber by NRDCL through open auction, timber and firewood are also directly supplied by the DFO within the Dzongkhag. The rural subsidized timber for house

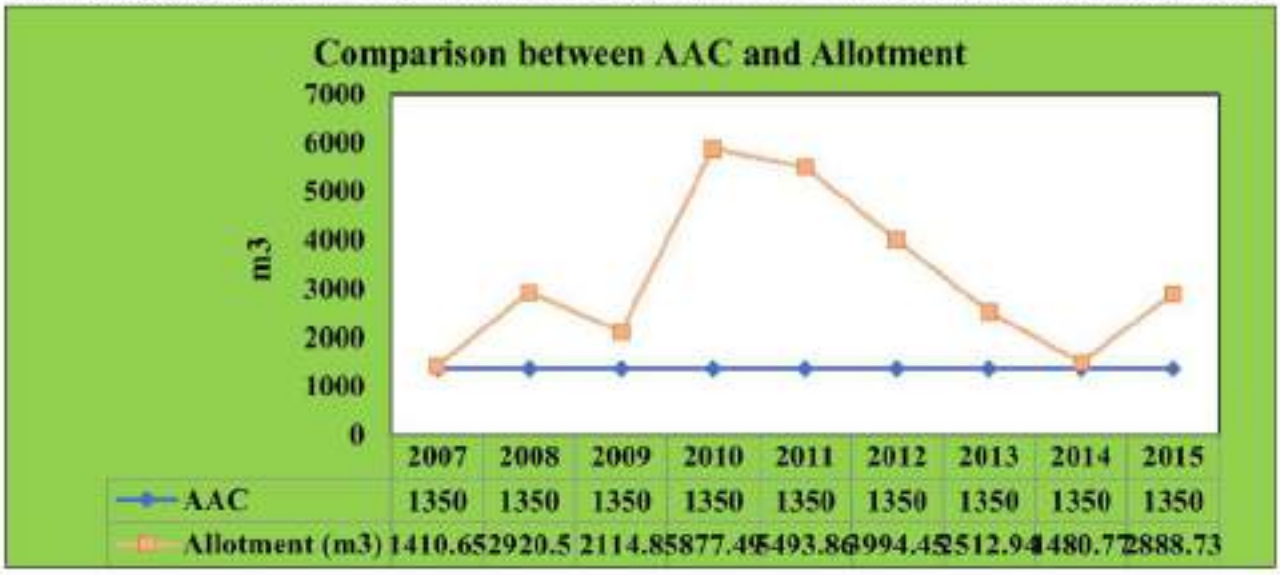


Figure 12: Comparison of Rural Allotment and its AAC in the plan

construction, repair/renovation/extension and other purposes form a major portion of the timber supplied through DFO. Supply from 2007 to 2015 fluctuated between 49,801.20 cft and 102,004.16 cft, attributable to the periodicity of entitlement of subsidized timber every 25 years for new construction and once in a block period of 12 years for repair, extension and renovation.

7. SILVICULTURAL ASSESSMENT

7.1 Past Silvicultural Treatment

The KFMU was grouped into four Working Circles in the previous plan.

1. Protection Working Circke
2. Watershed Working Circle
3. Broadleave Working Circle
4. Chir Pine Working Circle.

Since the area under harvesting operation was mostly Hardwood, only one Silvicultural System that was ***Clear Felling*** System was prescribed. The annual coupe size was fixed at 0.25 ha. With the regeneration problem encountered in the broadleaved forests, the mode of regeneration was artificial. The Working Circle was also prescribed with the special object of management which was unattained.

As per the records available from the Unit office (2006-2015), during the last plan period, 23.44 hectares have been harvested, within a 21 cable line and timber measuring standing volume equivalent to 47815.95 m3 were allotted for commercial and rural use.

7.2 Forest Types

The country is divided into three physiogeography zones each with one or more distinct vegetation zones.

Northern Belt: altitude above 4000 masl, with no forest cover (alpine areas).

Central Belt: altitude between 2000 – 4000 masl, containing major temperate conifer and broad-leaved forests.

Southern Belt: altitude between 200 –2000 masl, mostly tropical and sub-tropical vegetation.

Korilla FMU as such falls in the Central and the Higher part of Southern belts as classified by the Champion and Seth in 1968. Thus the forests within the FMU constitute of temperate, tropical and sub-tropical forests. The forested land within the FMU is classified in the following types:

1. **Warm broadleaf forest** – this forest type found occurring at altitudes between 1000-2000 m with lower rainfall and contains 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 *Castanopsis indica, Macaranga pustulata, Schima wallichii, etc.*
2. **Cool broadleaved forest** – above the Warm broad leaved forest are found cool broad leave forests. The drier part contains the evergreen oak forests and the wetter part contains mostly mixed forests, in which oaks are less common. The species

mostly found in this forest type are Castanopsis or Oaks in the drier part and *Acer cambellii, Betula alnoides, Symplocos dryophila, Exbucklandia populalnea, Lindera neesiania* etc.

3. **Chir pine forest**: this is low altitude xerophytic forests occurring in the deeper valleys. These valleys receive very less but heavy shower during the monsoon season and go through very long dry season. The short heavy shower brings greenery with shrubs and herbs especially lemon grass and other under growth. The long dry season exposes the area for fire hazards and the Chir pine needle adds fuel on to it.

For management purposes the FMU is divided into two working Circles, ie. Broadleaf WC and Conifer WC. The gross and net operable areas are shown in Table 31, in the main part of the management plan.

Table 13: Ares covered by different land use and percentage of FMU area

Land use	Area (ha)	Percentage (%)
Religious Sites	32.83	0.30
Road buffers	1184.39	9.01
Soil protection	2414.78	18.38
Riparian Reserve	556	4.23
Private/Cultivated Land	1482.08	11.28
Broadleaf Forests	5515.92	41.99
Conifer Forests	1407	10.71
Others	544	4.10
Total	**13137**	**100.00**

8. ORGANIZATION AND ARMINISTRATION

8.1 Organization

The FMU is under the jurisdiction of Mongar TD, and is directly administered by the CFO. The CFO will be supported by the Unit In-Charge (UIC), who will supervise the FMU operations. Operational Plans (OPs) will be prepared by the UIC for FMU management, with assistance and input from the CFO, Mongar. All activities within the FMU will be administered by the CFO, Mongar.

8.2 Health and Safety

The forestry operation involves major risk during harvesting and transportation of timber. Site specific risk assessment is required for the FMU to ensure health and safety of the field staffs. First aid box and necessary field gears needs to be provided to the workers during the operation.

The following are recommended to minimize hazards in the field:

- Ensure chain saws equipped with full functioning chain breaks
- Always ensure feller to keep two tree length apart while felling
- Explain the dangers of falling timbers and overhead cable lines
- Stack timbers in the same direction and stack not too high
- Never approach or climb the log pile from the bottom of the slope
- Always dismantle a stack from the top rather than from the bottom
- Keep two products length while stacking mechanically.

8.3 Record Keeping

The FMU Unit office shall maintain the records of all the activities within the FMU as per the record-keeping format of the FMCB 2004. The activities may include area or number of cable lines harvested annually to achieve Annual Allowable Cut (AAC), timber volume accrued from operated cable lines, forest road construction and sanitation or epidemic felling, among others. The records have to be maintained both in standing and log volume.

9. INFRASTRUCTURE, TRANSPORT AND EQUIPMENTS

9.1 Roads

The Trashigang - Thimphu highway runs through the FMU. There are several byways off the high way leading inside the FMU. These roads are constructed either by the NRDCL or the DOR. See the forest management map for the road network within the FMU.

Road construction is probably the most significant financial investment in the FMU as well as having one of the greatest environmental impacts. Well-constructed roads require less maintenance and have lesser environmental impact.

Road survey, design and construction will be carried out by NRDCL. NRDCL will mark the design centreline in the field, so that the contractor's compliance to it can be monitored effectively. The road design should be part of the contract document.

10. EVALUATION OF SECOND PLAN (1st November 2006 - 31st October 2016)

Forest Engineers of TFDP developed a set of road standards. These road standards, although developed in the east, address policies that require throughout Bhutan. These standards will be adopted for the Korilla FMU and NRDCL engineers must follow the standards, given in the Annexure 4.

A cambered profile and good roadside drainage with frequent culverts are therefore very important.

The recommended road design for the Korilla FMU is in annexure 4. The design would

keep away road from water pooling and rutting road surfaces. It also reduces from road slips and keeps the maintenance cost minimal.

10.1 Review of Goals and Objectives

The overall goal of the first Management Plan was to manage the FMU on a sustained yield basis for the production of timber, firewood and other forest products and for watershed and environmental protection. However the last Plan has focused more on timber production as the key objectives. The present Plan tries to incorporate all the aspect of sustainable utilization of forests resources, involving stakeholders and the local people in the FMU.

The broad goal to manage on a multiple use and sustained yield basis is usually considered as the long-term objective of management and should be met in the long run. It was observed that forest cover around the water sources have been protected well and no felling/harvesting have been allowed in the second plan period. Much of the vegetation cover in the FMU is largely intact due to improved harvesting technology. As per the record maintained by the FMU office, a total area of 23.44 ha was cut in the FMU over the last nine years (Table 14).

Table 14: Details of Area Harvested and Annual Timber Harvested

Year	Area Cut	Timber Harvested in Standing Volume (m^3)
2007	1.57	1098.84
2008	1.95	1312.94
2009	2.45	1174.32
2010	4.17	3286.86
2011	3.09	2243.34
2012	4.57	4279.26
2013	2.97	2790.65
2014	2.67	1895.24
2015		1050.99
Total	**23.44**	**19123.44**

The figure below shows the comparison of AAC and Annual Timber harvested from 2007-2015. The commercial timber harvesting has been below AAC in the last plan.

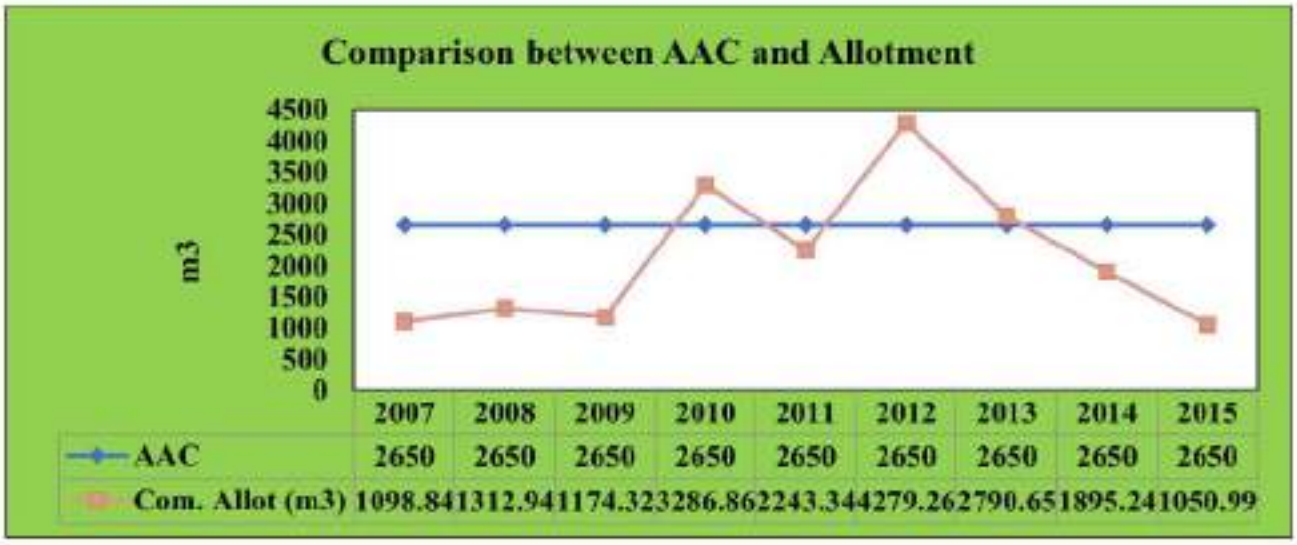


Figure 13: AAC and Allotment comparison in the second plan

The mid-term evaluation team from DoFPS have observed survival of plantation creation in the harvested area less than 60%. In some plantation areas they have observed 3-4 stands of barbed wire used to fence which was not adequate to keep away wild animals from entering the plantation. The seedling inside fenced plantation were browsed. Therefore, NRDCL was recommended to keep adequate budget for plantation creation and its maintenance till it gets established. For successfully regenerating the harvested areas, strong monitoring, good fencing, timely weeding and maintenance and controlling grazing required. In order to minimize grazing pressure people should be educated with the knowledge of improving the pasturelands, rearing more productive and improved breeds to reduce grazing pressure in the future.

The seedling raised in the nursery were browsed, therefore NRDCL should emphasise improving and intensifying nursery. So that good quality seedlings produced in the nursery contribute towards successful plantation in the logged areas.

The AAC of the last Management Plan have been set at 4000 m^3, including the AAC for local use. As per the data collected from Korilla Unit office at Ngatshang, the total commercial volume harvested for the last nine years is **19123.44m^3** (Table 14) and rural volume is **28692.51m^3** (Table 12) in Standing Volume. The commercial harvesting in the FMU is undercut by **4726.56 m^3** of the total AAC, but the rural allotment exceeded by **16542.51 m^3** from its total AAC for nine **12150 m^3**. In total the FMU has allotted **28692.51 m^3** for rural construction, firewood, poles, etc. The main cause of excessive rural supply was owing to the mishap of earthquake in 2009.

Wildlife habitat management was not carried out since the habitats are not disturbed to a large extent. Human wildlife conflict is still prevalent in the FMU. The forest harbors a number of wildlife population as seen from indirect evidences like pug marks, droppings, pellets and unstructured interviews with the local people. Therefore, the faunal diversity is still very good.

The network of forest road within the FMU has been constructed as per the Plan with necessary mitigation measures. However, some sections of the forest road were in need of immediate maintenance and side drains were blocked in some areas. The width of the cable lines corridors were wider than the prescribed maximum limit of 4 m. Trees were marked and allotted from interlines for rural purpose which widened the cable corridors and reduced the distance between interlines (75 m). In some cable lines 30 m river buffer was not maintained and rural marking was given from interlines. Owing to excessive harvesting from the production area of the FMU the commercial extraction were carried out only from National High Way road widening and power transmission lines. Annual monitoring forms of the FMU for first five year and tree marking register was not properly maintained in the FMU office.

10.2 Review of Harvesting Activities

The harvesting is done with a fixed skyline and gravity cable system till date. It is believed to considerably reduce construction of forest road and disturbance on soil and natural regeneration. But, heavily disturbed soils were observed in operated areas. However, some of the issues that have also been observed while evaluating the previous Plan are as follows;

- The FMU office has no transportation facilities to monitor effective implementation of the prescriptions of the Management Plan.
- Since the FMU Unit is located at Ngatshang and working site far away from the office regular monitoring is difficult for staff in the absence of transportation.

10.3 Review of Road Building Activities

In total 18.14 km of forest road have been constructed in FMU during the first and the second Plan period. The road network was mostly concentrated in Korilla block, as extraction operations were carried out in this block. The forest road in Korilla block has benefited the local people of Pangtey and Ketongri, the road in Kharnang block benefited people of Karmabrangsa and Shajula village and whole Chaskar Geog and the road in Ngatshang block benefited people of Ngathsang village. The forest road has been maintained well throughout the FMU but some sections of the forest road required immediate maintenance.

Table 15: Details of Road Construction

Block/Compartment	Year	Road Constructed (km)
Ngatshang	1995	2.88
-do-	1996	0.16
Korilla I	1998	3.65
Kharnang III	2001	2.86
Korilla I	2008	3.00
Korilla II(a)	2009	1.70
Korilla II(a)	2014	0.70
Korilla II(a)	2015	3.30
Total		**18.41**

10.4 Review of Reforestation

It has been observed that natural regeneration in the FMU in general is poor by the evaluation team. Some of the factors that contributed to poor regeneration are:

- Grazing Pressure
- Regeneration itself is altogether a problem in the Mixed Broad leaved Forest.
- No timely maintenance of plantation by the NRDCL.
- Reforestation is lacking in some areas that need attention.
- Large openings facilitated profuse weed growth.
- No good fencing to protect plantation in harvested areas.
- Cable lines 7, 8 and 9 are kept as research plots and reforestation work is not carried till date. In the cable lines no natural regeneration was observed and the evaluation team recommended to carry out artificial regeneration after talking with Research Division.

The Korilla FMU broadly fall under warm and cool temperate Forest has difficulty in restocking naturally. This was proposed to Research Division for advice, and the Research Division Yusipang has suggested Patch Cut Silvicultural System to be adopted followed by artificial regeneration immediately.

The plan recommends to take up plantation in the barren areas that are fallow within the Forest Management Unit.

Since the commencement of first management plan of the FMU a total of about 136.72 hectares have been planted with over 218816 seedlings, as depicted in the Table 16.

Table 16: Plantation creation in harvested area

Year of creation	Block/ Compt.	Area (ha)	Nos of seedlings	Species
1996	Ngatsang 1	4.98	7968	Nyssia Exbucklandia Michelia sp. Juglans regia Acer sp.
1996	Ngatsang 1	7.28	11648	
1997	Ngatsang 1	3.15	5040	
1197	Ngatsang 1	4.95	7920	
1998	Ngatsang 1	3.41	5456	
1998	Ngatsang 1	4.97	7952	
2000	Ngatsang 1	5.57	8912	
2000	Ngatsang 1	4.41	7056	
2000	Ngatsang 1	4.93	7888	
2000	Ngatsang 1	1.78	2848	
2000	Ngatsang 1	3.99	6384	
2000	Korilla 1	5.14	8224	
2000	Korilla 1	4.08	6528	

Year of creation	Block/ Compt.	Area (ha)	Nos of seedlings	Species
2000	Korilla 1	1.48	2368	
2001	Korilla 1	5.36	8576	
2001	Korilla 1	5.02	8032	
2001	Korilla 1	1.17	1872	
2001	Korilla 1	6.17	9872	
2001	Korilla 1	5.72	9152	
2002	Korilla 1	3.64	5824	
2002	Korilla 1	3.35	5360	
2002	Korilla 1	1.86	2976	
2002	Korilla 1	1.86	2976	
2012	Korilla 2(a)	1.34	2144	
2010	Korilla 2(a)	0.76	1216	
2010	Korilla 2(a)	1.73	2768	
2011	Korilla 2(a)	1.52	2432	
2011	Korilla 2(a)	1.3	2080	
2012	Korilla 2(a)	2.62	4192	
2012	Korilla 2(a)	1.11	1776	
2012	Korilla 2(a)	0.8	1280	
2013	Korilla 2(a)	1.78	2848	
2013	Korilla 2(a)	2.08	3328	
2013	Korilla 2(a)	1.64	2624	
2014	Korilla 2(a)	2.58	4,192	
2014	Korilla 2(a)	1.79	2,864	
2014	Korilla 2(a)	2.02	3,232	
2015	Korilla 2(a)	1.19	1,904	
2015	Korilla 2(a)	1.21	1,936	
2015	Korilla 2(a)	3.70	5,920	
2004		5.4	8640	
2005		0.81	1296	
2005		1.29	2064	
2003		3	4800	
2009	Kharnang 4	1.23	1968	
2009	Kharnang 4	0.91	1456	
2009	Kharnang 4	0.64	1024	
TOTAL		**136.72**	**218816**	

10.5 Review of AAC

The AAC for the Korilla FMU, was fixed on the area basis. The excessive cutting for rural supply is deviations from the prescribed AAC for the FMU.

The 2016-2026 Management Plan has to accommodate adjustment of the excessive harvesting equivalent to **7825.95 m^3** done in the second management plan 2006-2016.

PART 2

FUTURE MANAGEMENT

11. INTRODUCTION

The article 5(3) of The Constitution of the Kingdom of Bhutan, which states that the Government shall ensure to conserve the country's natural resources and prevent degradation of the ecosystem by maintaining a minimum of 60% of Bhutan's total land under forest cover for all time (RGoB, 2008). Productive forests are to be managed under a system of sustained yield using scientific management. Consequently the RGoB has adopted a firm national policy requiring the preparation and implementation of scientific management plans for all areas where forests are harvested for commercial purposes.

11.1 Forest Policy

The Forest and Nature Conservation Act of Bhutan 1995 requires management plans to be approved and implemented for all protected areas and for all forests where commercial logging is to be undertaken. This plan has been prepared in line with the Act and the New Forest Policy that came into operation from 1st January 1999. The Plan reflects the government's commitment to the sustainable management of its natural resources.

The RGoB has adopted a conservation-oriented policy that focuses on biodiversity conservation and meeting local demand through sustainable forest management. The Kingdom's forest policy sets out four forestry goals:

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

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

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

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

The Forest and Nature Conservation Act of Bhutan was enacted in 1995. This Act provides the legislative framework to streamline community participation in forest management, and the preparation of supporting forest rules and regulations. The regulations lay out the best practices that apply nation-wide.

11.2 FMU Goal and Objectives

The goal of the management of Korilla FMU is to:

'Manage the forest on a multiple-use sustainable yield basis for the production of timber,

fuel wood and other forest products and for watershed and environmental protection'.

The specific objectives of the management are:

i. To protect the watershed values of the FMU.

ii. To improve the forest and other vegetative cover of the area.

iii. To provide the local population, on a priority basis, with a perpetual supply of timber and fuel wood to satisfy their needs.

iv. To increase the productivity and stocking of the forest through appropriate logging and silvicultural methods.

v. To supply timber and fuel wood to the locally based wood-using industries and to various Government organisations, as required within the AAC stated within this plan.

vi. To regenerate, either, through natural regeneration or artificially through planting those forest areas currently not satisfactorily regenerated.

vii. To improve the condition of young stands through thinning.

viii. To ensure the improvement of the presently degraded forest areas.

ix. To protect and conserve the environment and ensure the preservation of genetic diversity, wildlife habitat and the aesthetic value of the area.

x. To satisfy the needs of the local population for other forest products and grazing through their involvement in all phases of the implementation of this plan.

The emphasis of the objectives is on providing a sustainable supply of wood to the local population and industries, and at the same time conserving and improving the environment of the area.

The priorities of the management are to:

- Ensure prompt regeneration of harvested areas.
- Enforce sound harvesting practices.
- Make use of the over mature and decaying stands and ensure regeneration.
- Protect against pests, fire and erosion.
- Improve degraded forests.

11.3 Management Based on Forest Function

11.3.1 Introduction

Different potential uses of forest are grouped accordingly under the term, **"Forest Function".** The values and ranking of such functions are different for each FMU and

depend on location, site, forest type, accessibility, landscape and many other factors. Schindele and Dhital (1997) described the concept of forest function planning as applied in Bhutan. This reference provides background and detail concept for the planners while writing up management plan. The end result of the forest function planning is the **Forest Function Maps.** The forest function map forms the bridge between planning and implementation. Forest function map combined with management prescriptions are the basic tools of the FMU In-charge for field implementation of this management plan.

The Forest and Nature Conservation Act of Bhutan, 1995, provides legal backing for forest function planning under Section 5 Management Plans and Section 21 Establishment of Protected Areas.

The objectives of forest function planning for this management plan are:

i. To identify production forest, non-production forest and protection forest.

ii. To define a particular area for different functions and depict them on maps.

iii. To use as a tool for management planner for balancing the different requirements of the nature conservation, environment protection, social forestry and commercial timber production, among others, also to provide the spatial information required to compute the sustainable AAC while at the same time, satisfying the management prescriptions and restrictions for different forest functions, and

iv. 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 prescription on the ground and to control their implementation.

11.3.2 Function Groups

Schindele and Dhital (1997) list the full range of functions available. The functions used in this management plan are listed in the Table No. 19

Table 17: Different Forest Functions used in the Plan

Code	Function Groups(Bold) and Functions
S	**Soil Conservation SC**
Soil Conservation SP	Soil Protection
W	**Water and Watershed Conservation**
WRR	Riparian Reserve Protection
WSh	Watershed Conservation
Soc	**Social Function**
SocL	Social (Local Use Only)
SocRS	Religious Site Protection
RB	**Road Buffer**

11.3.3 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 the scale used for the planning purposes. When the Operational Plans are prepared new details are to be collected and these criteria should be implemented.

Table 18: Mapping Forest Function

Function group and	Criteria for Mapping
Soil Conservation	**SP:** very steep areas (slopes greater than 100%), areas with indication of slight to moderate erosion.
Water and Watershed Conservation	**WSh:** catchment areas of water courses, water retention areas, **WRR:** areas within 30m along all the perennial streams, water logged areas, swamps etc. **WLS:** upper catchment areas of streams serving as
Social Function	**SocL:** the areas traditionally used already (settlements/villages) with definite boundaries. **SocRS:** lhakhangs/goempas, gneys and other religious sites.

11.3.4 Restriction of Forest Functions

The forest functions identified in the Korilla FMU sets restriction for commercial and local activities as required by each function for management. The following table defines specific restriction against each function.

Table 19: Forest Function Restrictions

Code	Function	Commercial Use	Local Use
SP	Soil Protection	No Commercial use	Reduce human interference
WRR	Riparian Reserve Protection	No Commercial use	NTFP collection only
RB	Road Buffers	No Commercial use	No felling
SocRS	Religious Site Protection	No Commercial use	Allotment only if do not disturb sanctity of the place
WSH	Watershed Conservation	No Commercial use	Low impact local use
WLS	Local water supply	No commercial use	No tree felling
SocL	Social/Local use only	No Commercial use	Local use
SC	Soil Conservation	No Commercial use	Low impact local use

12. QUANTITATIVE RESOURCE ASSESSMENT

12.1 Forest Inventory Management

Inventory Design of Korilla Forest Management Unit

The general inventory of Korilla FMU was conducted during 2012-2013 for the preparation of the third Management Plan. The standard FMU inventory technique was used, with data being collected for trees >10 cm DBH (OB). A total of 223 plots were laid in the operable areas of the FMU at a more practical spacing of 550m x 450m, thus a plot representing an area of 23.45ha. The inventory was designed with target sampling error of +/- 10% at 95% confidence level using the coefficient variation of 70% calculated from earlier inventories. About 25% of the sample plots were measured as special plots.

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

12.2 Forest Management Inventory Result

The summary of the inventory results is shown in the table below:

Table 20: Summary of Inventory Results for overall FMU area

Result type	Results	Margin of Error percent	Confidence Interval low at 90 percent	Confidence Interval high at 90percent
Total Area of FMU(ha)	13137	NA	NA	NA
Number of plots	223	NA	NA	NA
Total number of trees	1810903	6	1698035.95	1923770.14
Total basal area(m2)	211237.9	9	192047.51	230428.3
Total growing stock of Korilla FMU(m3)	805570.5	32	548402.43	1062738.52
Number of trees per hectare	138	6	129.26	146.44
Basal area per hectare(m2)	16.08	9	14.62	17.54
Volume per hectare(m3)	61.32	32	41.74	80.9

Table 21: Summary of Inventory Results for commercial harvesting area for the FMU

Result type	Results	Margin of Error percent	Confidence Interval low at 90percent	Confidence Interval high at 90 percent
Total Area of Production area(ha)	1999.06	NA	NA	NA
Number of plots	42	NA	NA	NA
Total number of trees	339352.6	12	298968.89	379736.36
Total basal area(m2)	51257.9	19	41481.88	61033.91
Total growing stock of Production area(m3)	165920.6	66	56007.39	275833.73
Number of trees per hectare	170	12	149.55	189.96
Basal area per hectare(m2)	25.64	19	20.75	30.53
Volume per hectare(m3)	83	66	28.02	137.98

Table 22: Summary of Inventory Results for commercial harvesting area for the FMU

Result type	Results	Margin of Error percent	Confidence Interval low at 90 percent	Confidence Interval high at 90 percent
Total Rural Area of FMU(ha)	4974.09	NA	NA	NA
Number of plots	92	NA	NA	NA
Total number of trees	682315.4	9	617978.57	746652.21
Total basal area(m2)	69118.1	13	60009.64	78226.61
Total growing stock of Rural(m3)	369094.8	31	253066.02	485123.61
Number of trees per hectare	137	9	124.24	150.11
Basal area per hectare(m2)	13.9	13	12.06	15.73
Volume per hectare(m3)	74.2	31	50.88	97.53

13. AREA ORGANIZATION

13.1 Spatial Organization

The main management tools used for implementing silvicultural and management regimes are the use of working circles. Scientific management of the FMU is achieved through organisation of the working circles into blocks, compartments, and where applicable, sub-compartments. These blocks will be managed according to the forest type and functions designated to the compartment and sub-compartment (through function mapping), and applying the appropriate silvicultural regime for the forest type and function. Strict controls on the amount of harvested wood and the ways harvesting is conducted are specified. Blocks have been demarcated according to natural drainage and terrain features wherever possible. The composition of Blocks and Compartments is given in the table below:

Table 23: Management Blocks in the Korilla FMU

BLOCK	Compartment	Sub Compt.	Area in Ha
Korilla	1		352
Korilla	2	a	1254
Korilla	2	b	743
Gangola			3693
Ngatshang	1		738
Ngatshang	2		852
Ngatshang	3		320
Ngatshang	4		622
Sheri chu	1		1000

BLOCK	Compartment	Sub Compt.	Area in Ha
Sheri chu	2		869
Sheri chu	3		836
Kharnang	1		402
Kharnang	2		575
Kharnang	3		433
Kharnang	4		243
Kharnang	5		205
Total			**13137**

Cable lines are usually aligned along stable, well-stocked ridges and slopes and away from environmentally-sensitive gullies and valley bottoms. Since the felling of trees along river banks, streams and in steep gullies is not permitted under the Forest Act, Compartment boundaries have been drawn to, as far as possible, follow natural waterways to a point where a spur easily recognisable on the ground leads to a ridge top. This facilitates the recording of removals by cable lines and compartments.

During the Forest Function Mapping, the Production areas have been separated for Local Use and Commercial Use. During the FMU Level Committee Meeting and during the course of the Plan endorsement, it has been agreed that demarcation of separate areas will be done, and production forests will be shared. However, preference will always be given to native inhabitants for rural timber and NWFPs.

It was felt necessary that the management plan should create a buffer around local communities to restrict NRDCL interventions and avoid conflicts. However, this was not possible by a mere map work and without a thorough field visit and consultation with local people. Compartment reviews and prescriptions have been done in consultation with field people where it has been mentioned that certain area should be kept for local use only. In this plan period, the production areas have been divided into production areas for commercial and local use area for local use. This is done to avoid conflicts.

During the implementation of this plan, it is important as per the discussions in the FMU-Level committee meeting that their demand for timber would be met from production area in the event of inadequacy from areas allotted to them. This consensus should be discussed during Operational Planning and Operational Inventory. Therefore, Operational Planning for Korilla FMU should take care of all these to avoid conflicts.

IMPORTANT NOTE: ***Rural markings from interlines (between the harvested cable lines) is not permissible under any circumstances.***

13.2 Organization into Working Circles

Using the above functions the Korilla FMU has been delineated into 3 (Three) broad Working Circles as enlisted below:

i. Protection Working Circle
ii. Production Working Circle

iii. Non-production Working Circle

Table 24: Working Circle with Area Statement (ha)

Protection Working Circle	**4188.00**
Religious Sites	32.83
Road buffers	1184.39
Riparian Reserve	556.00
Soil Protection	2414.78
Production Working Circle	**6973.15**
Broadleaf Forests (Commercial)	1999.06
Conifer Forests (Rural)	1457.23
Broadleaf Forests (Rural)	3516.86
Non-production Working Circle	**2026.08**
Others	544.00
Private/Cultivated Land	1482.08
Total	**13,137**

13.3 Working Circles

13.3.1 Protection Working Circle

The Protection Working Circle is an area under protection where no commercial activities can take place. It is the sum of all protection functions; wildlife protection, soil protection, riparian reserve protection, religious site protection and local water supply protection and inaccessible areas. The total area under Protection Working Circle is 4188 ha. The management objectives and options of Protection Working Circle are given below in the Table 25:

Table 25: Protection Working Circle

Management Objectives	Management Options	Responsibilities
• To conserve water resources.	• Minimal disturbances, • Minimal interferences	Territorial
• Low impact NWFPs collection	• Defer from intervention encase reduces water quality	Territorial
• To protect and conserve biodiversity	• Involve people in protecting and conserving the areas	Territorial
• To create awareness and educational purposes	• Public meetings and field visits, research, etc.	Territorial
• Environmental conservation	• Refrain from any environmental threat activities	NRDCL/Territorial

13.3.2 Production Working Circle

The Production Working Circle is the area from where harvesting will take place and it consists of 6973.15 ha. For better and easier management and to avoid conflicts inside the FMU, this Working Circle has been divided into two working areas:

i. Production Commercial:– areas delineated mainly for commercial timber harvesting by NRDCL

ii. Production Rural:– areas delineated mainly for local use to meet the rural timber demand of people residing within the FMU.

In the previous plan the whole Gangola Block was retained as Watershed Working Circle but the area has been used for and utilization of forest resources only to meet the needs of the local population. The local use is primarily associated with single tree selection system and does not impact the health of forest. Therefore, in this plan period the area has been designated for local use only.

Marking trees in this block by the territorial staff should be done professionally to prevent adverse impact on soil, water and landscape. This block is the watershed for the main river Gangola which flows into Kurichu. The forest areas will be preserved and protected with regulated grazing. The management of this block is of considerable importance because of drinking water supply to Mongar town.

Table 26: Production working Circle

Management Objectives	Management Options	Responsibilities
To meet local needs for timber and other forest produce on sustainable basis.	Priority must be given to local people	Territorial Division
Manage commercial timber production on sustainable basis.	Scientific and systematic harvesting	NRDCL/ Territorial Division
Enhance and improve forest condition and productivity	Suitable silvicultural operation	NRDCL/ Territorial Division
	Plant degraded area	
Create employment	Involve local people	NRDCL/ Territorial Division
Maintain Biodiversity within production area by habit management	Field visit and research	Territorial Division

13.3.3 Non -production working Circle.

The Non-production Working Circle comprises of area which are not economical or feasible, rocky outcrops, agriculture lands, meadows, shrubs and NWFPs. The overall objective of this Working Circle is to manage the NWFPs in Korilla on sustainable basis, and monitor low impact collection.

Korilla FMU is stocked with bamboos, canes and other minor forest products. Since one of the goals of the management is to protect environment and to supply other forest products through the involvement of people seems left out for the time being. With the opening of areas for management gives easy accessibility for any item easily traded off. In addition, these leads to rampant harvest of forest products besides timber.

This section now gives full implementation courage to the NRDCL, to manage any commercially important products within the FMU. The rural demands will be met as before. NRDCL will pay royalty to RGoB as per the existing rule. Since, bamboo is harvested quite intensively in the FMU, henceforth; management will be as per the Annexure 4. The bamboo management will be employed as and when the bamboo stock is encountered. This should be taken care while writing operational plan. This closure for the harvest is in accordance with the local population's view in the GYT.

Table 27: Non-Production working Circle

Management Objectives	Management Options	Responsibilities
To meet local needs for collection of NWFPs.	Promote community Monitoring	Territorial Division
To maintain and improve the forest condition	Regeneration	NRDCL/ Territorial Division
	Silviculture operation	
To regulate grazing by livestock	Fodder tree plantation and people's participation	Gup/ Territorial Division
Environmental conservation	Environmental concerns are to be taken into consideration while activities are implemented	NRDCL/ Territorial Division

The notes and management guidelines for the NWFPs in Korilla FMU are discussed below:

A. Bamboos

Introduction

Though bamboo is a minor forest produce, it plays a very important role in our national economy as it is a common man's timber. It is presumed to be over 20 species of bamboo

that occur in our forest. In spite of its great importance, there is no record of the species and areas covered by bamboo.

Silviculture of Bamboo

Silviculture of bamboo is different from that of trees. It affects the working of forest considerably. Therefore, a brief description is necessary to understand it proper working. The bamboo belongs to family ***Gramineae.*** The seedling of bamboo resembles a blade of grass. Underground stem or rhizome is produced from the base of the seedling. These rhizomes grow outwards from the centre. Since the rhizome develops outwards new clump are produced on the periphery every year and reach full size during the growing season.

The rotation of bamboo varies from 4-12 years. The bamboo keeps on growing and expending outwards till flowering. But usually they are restricted by biotic interferences thus creating congestion and making cutting and extracting very difficult. It is very important to leave some mature clump in a slump to support to the young culms. Felling of mature culms is usually done based on their morphological characteristics. Some of these characteristics are Culm sheath, Culm colouring, branching etc.

One usually comes across two types of flowering in a bamboo. Sporadic flowering, which one or few culms in a clump or a few clumps in a locality may flower. Gregarious flowering is often followed by death of the clumps.

Silvicultural System

Bamboo working has been going on since long time, but there has not been one system named for the management purpose. The most appropriate system adopted in few countries is the ***Culm Selection System***. This system will be followed under definite felling rules to ensure harvesting and regeneration.

Harvesting of Bamboos

The harvesting techniques applied vary for different bamboo species according to uses. People harvest bamboo as and when the particular bamboos are needed. In such cases, the local management for bamboo is variable even in use of harvesting technique. Therefore, previewing to the context of sustainability and to keep flowing the bamboo production, it is necessary to observe certain norms during harvesting.

Therefore in general, culm selection system for harvesting should be adopted. The sustainable methods of harvesting require leaving at least 2 to 3 fully grown culms and that should be 1 to 2 years old for every developing young shoot. The felling cycle of 4 years is most suitable for bamboo (Palijon, and Luna, 2000).

As per the case study by Renewable Natural Resource Research Centre (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 resource as

the younger culms (less than 2 years) are left behind as future crop. However, with the rapid increase in demand for bamboo products, even young shoots are harvested. This affects resource adversely and is the major cause of degradation of the resource in many locations, for instance in Nobding (Tshering, August 2002) under Wangduephodrang Dzongkhag. Therefore, to avoid further degradation of the resource, 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:

i. Immature culms less than 1 year old should not be cut (should be applicable to bamboos which young shoot not used as vegetable).

ii. Immature culms of 1 to 2 years have very high water content and shrivel up when cut, this makes them useless for construction. Speed of development depends on the condition of the clump and the position of the culm: if the clump is vigorous and the culm is in an exposed position it matures much sooner; culms at the centre of a poor clump mature more slowly (Haun et al.-1961 & Storey-1988a written in Bradshaw paper 2001).

iii. In a clump containing 12 culms or more, at least 6 mature culms over 1 year old should be retained, and in a clump containing less than 4 mature culms over 1 year old, all should be retained during felling. Mature culms should be left evenly distributed throughout the clump to provide mechanical support as well as nourishment (Gautam-1988, Bahadur et al.-1980 written in Bradshaw paper 2001 and Luna, I.F.S. India).

iv. All culms older than 4 years should be removed.

v. Culms should never become so overcrowded that they touch one another at the base. There must be sufficient space between them to allow movement of the cutting instrument (Sharma-1988 written in Bradshaw paper 2001).

vi. The culms should not be cut lower than the first node above ground level, to ensure that the rhizome is not damaged and not higher than 30 cm. Thinning the clumps reduces rhizome overcrowding and encourages the production of new culms in the centre of the clump (Gautam-1988 and Sharma-1988 written in Bradshaw paper 2001).

vii. Large bamboos should (ideally) be thinned annually during winter, as this is the time when the plants growth is slowest. However, it is possible to harvest at any time except when new shoots are developing (Storey-1988a written in Bradshaw paper 2001).

viii. Damaged culms, debris and cut branches which may have become infested with shoot- boring moths (family: Pareuplexia), should be removed and burnt as well as

all dead and dry culms (Bahadur et al.-1980, Stapleton-1985a, Storey-1988a & Gautam-1988 written in Bradshaw paper 2001).

ix. The smaller Arundinaria and Drepanostachyum species [nigalo] are (according to local practice) harvested by removing the shoots of a lighter green colour, which are readily distinguishable in March. Harvesting age should be 16-20 months. This leaves the clump uncongested and produces culms of consistent size and quality (Thompson-1986, Stapleton- 1987 & Lamichhaney-1988 written in Bradshaw paper 2001).

Harvesting Technique

The mature culms are selected and harvested. Fully mature culms are stronger, denser, more durable and less prone to insect attacks. Mature culms should be cut during the dry season (especially in winter) when starch content is low and no young shoot is sprouting. At this stage, the culms are not susceptible to attack of powder post beetle. Culms should be cut close to the ground to maximise utilization of quality portions of the culm (Palijon, 2000).

The culms should be cut off by cutting round once with the sharp tools (any sharp pruning tools like hand-saw, axe, sickle, khukuri and patang) angled at 45 degrees to the stem, then again with it angled the opposite way to produce a wedge-shaped notch. This avoids splitting the culm.

B. Daphne

Introduction

Daphne plants are used mainly for making simple ropes and paper. The barks are being peeled off and used as ropes to tie the butter/cheese packs. The collection of Daphne especially in Korilla region needs to be monitored. It is therefore recommended that sustainable use of the plant be in place.

Management prescriptions

The harvesting guidelines and an equation to estimate yield from stem diameter has been developed by the RNR-RC Yusipang. Communities and Daphne entrepreneurs can use the recommendations. Also, as per the findings it is feasible to plant Daphne, as it gives good profit after 7-15 years.

Harvest at the right age (not too young). The correct age is 7-15 years depending on species. The plant should be first cut above the ground and not uprooted.

To calculate the bark biomass, use the volume equation developed. The equation is: $\text{Log}10(W_d) = -1.5918 + 2.2722 * \text{log}10(D10)$, where W_d = weight of dry bark, D10 =diameter of stem at 10 cm above ground. This equation can be applied for *Daphne bholua, D.suriel, Edgeworthia gardneri* for the whole area of Bhutan.

C. Others

Introduction

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

Management prescriptions

Low impact collection of NWFPs should be done and wherever possible a check on sustainability should be made. The UIC shall identify threats to sustainability of NWFPs and prescribe management prescriptions accordingly.

13.3.5 Community Forestry Working Circle

Yakpugang Community forestry exists within the FMU. The Community forest falls under Mongar geog, and is located at about 7 km from Mongar town. A written management plan for this community forestry is available, approved by the Department. This working circle will therefore be independently managed under the community forestry management plan approved by the Ministry of Agriculture and Forests.

13.4 Management of the Production Working Circles

As mentioned, the Production Working circle has been divided into Three Working Areas. All working areas address the goal and objectives stated before. However, the priority and focus on separate objectives differs for each working circle. The objectives are overarching and apply equally to all working circles, and are general principles of management. Table 27. Table 28 and Table 29 describe the objectives, options, management responsibilities, monitoring, evaluation and silvicultural systems specific to each working circle.

The following general silvicultural prescriptions should be adhered to in all working circles where appropriate:

i. Site preparation and clearance will involve the removal of small, unwanted debris, cutting of shrubs, bushes and weeds, burning of debris and the collection and disposal of debris and other material. This should be conducted as part of the harvesting operation to minimise costs.

ii. Artificial regeneration is the main, and desired, method of restocking in the broad leaved areas.

iii. Planting will be carried out as soon as the felling and extraction is over inside the production areas.

iv. Enrichment planting should be used where appropriate.

v. Remove the dense brush and other vegetative cover that could hinder the seedling establishment and seedling growth, weeding will be carried out as required, during the first three years after the planting. To provide some protection

against frost and excessive heat only a small area around the seedlings should be cleared.

13.5 Implementation o f activities in the Working Circle

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

Table 28: Broadleaf Working Circle

Sub-Working Circle: Mixed Broadleaf				
Management objectives	*Management Options*	*Responsibility*	*Monitoring*	*Silvicultural systems*
To meet commercial timber requirement on a sustainable basis	• Operate entire cable length • Ensure cable-line layout allows interline logging • Use prescribed silviculture method and appropriate logging method • Encourage cleaning of entire cable lines	• Territorial/NRDCL • Territorial/NRDCL • Territorial/NRDCL • Territorial/NRDCL	• Territorial	The FMU is mainly stocked with the hardwood resource. The research finding is out and has suggested ***Patch Cut System. The patch will not exceed more than 0.2ha and will be spaced in the interval of 50m. 4m cable corridor will BE maintained.*** Artificial regeneration will be taken up immediately after coupe clearance is issued. NRDCL to maintain nursery at the site for artificial regeneration. Nursery to stock with local and commercial species.
To improve the forest and other vegetative cover of the area.	• Minimum intervention forestry should be practiced, to improve the resource	• Territorial/NRDCL	• Regeneration Survey/Terriotorial	
To meet local requirements, as priority, for timber, fuelwood and other forest products on a sustainable basis.	• Dialogue with local community to ensure their needs for hardwood products (including lopping etc.) are being met and resource is not diminishing.	• Territorial	• Territorial	
To protect the forest from grazing, fire and illegal activities.	• Control grazing, fire, illegal felling through participation & dialogue, & acceptable fencing	• Territorial	• Territorial	
To create local employment opportunities.	• Encourage contractors to hire locally.	• NRDCL	• NRDCL	
To conserve the water catchment functions	• Minimal interventions • Abide by the buffers prescribed.	• Territorial/NRDCL • FDL/Territorial	• Territorial	
To maintain biodiversity within the production area.	• Low impact silviculture systems	• Territorial/NRDCL	• Territorial	

Table 29: Chir Pine Working Circle

Sub-Working Circle: Chir Pine Working Circle				
Management objectives	*Management Options*	*Responsibility*	*Monitoring*	*Silvicultural systems*
To meet local demands on priority bases for timber, fuel wood and other forest products on a sustainable basis.	• Operate entire cable length • Ensure cable-line layout allows interline logging • Use prescribed silviculture method and appropriate logging method • Encourage cleaning of entire cable lines	• Territorial/NRDCL • Territorial/NRDCL • Territorial/NRDCL • Territorial/NRDCL	• Territorial	The FMU is partly stocked with the Conifer resource. The silviculture system that will be adopted in the Conifer forests is ***Group Selection System***. The Group sizes will not exceed more than 0.15ha and the spacing between the groups will be 50m minimum. The cable corridor will be restricted to 4m. Natural regeneration will be given priority after coupe clearance is issued. If regeneration status is poor after the regeneration survey, artificial regeneration will be taken up immediately. NRDCL to maintain nursery at the site for artificial regeneration. Nursery to stock with local and commercial species.
To improve the forest and other	• Minimum intervention forestry should be practised, to improve the resource	• Territorial/NRDCL	• Regeneration • Survey/Terriotorial	
To protect the forest from grazing, fire and illegal activities.	• Control grazing, fire, illegal felling through participation & dialogue, & acceptable fencing	• Territorial	• Territorial	
To create local employment opportunities.	• Encourage contractors to hire locally.	• NRDCL	• NRDCL	
To conserve the water catchment functions	• Minimal interventions • Abide by the buffers prescribed.	• Territorial/NRDCL • FDL/Territorial	• Territorial	
To maintain biodiversity within the production area.	• Low impact silviculture systems	• Territorial/NRDCL	• Territorial	

Table 30: Objectives and Management Prescriptions common for the Working Areas

Management objective	*Management Options*	*Responsibility*	*Monitoring & Evaluation*
To protect the watershed values of the FMU.	• Ensure prompt regeneration of harvested areas • Protect against pests, fire and erosion • No logging on steep sites (+ 100%), erodable sites, riparian zones	• NRDCL/Territorial • Territorial • NRDCL/Territorial	• Regeneration survey • M & E Environmental Form • Site inspection at Mid-term review
To protect and conserve the environment and ensure the preservation of genetic diversity, wildlife habitat and the aesthetic value of the area.	• Ensure prompt regeneration of harvested areas • Enforce sound harvesting practices • Protect against pests, fire and erosion • Improve degraded forests • Manage all areas considering wildlife and biodiversity impacts • Have a working circle specifically addressing this objective	• NRDCL • Territorial/NRDCL • Territorial • Territorial/NRDCL • Territorial/NRDCL • Territorial	• Regeneration survey • NRDCL to monitor contractors: Site inspection at mid-term review • M & E Environmental form • Record & Site inspection at Mid-term review • Mid-term review of implementation of management plan • Mid-term review of implementation of management plan
To satisfy the needs of the local population for other forest products and grazing through their involvement in all phases of the implementation of this plan.	• Involve local stakeholders in management planning and implementation • Allow objectives to be set by Divisional Forest Management FMU committee • Consult annually with Divisional Forest Management FMU committee to determine if this objective is being met • Implement appropriate silviculture to address this objective	• Territorial • Territorial/management committee • Territorial/management committee • Territorial/NRDCL	• Minutes of meetings – mid-term review • Minutes of meetings – mid-term review • Minutes of meetings – mid-term review • M & E Environmental form: Site inspection at mid-term review

14. YIELD REGULATION AND HARVESTING

14.1 Determining operable areas

14.1.1 Introduction

Principle of sustainability is the backbone of forest management which focuses on sustainable utilization of forest resources by present generation and preservation for future generation as well. The concept of Sustained Yield allows harvesting of forest resources by which annual cut and other losses of timber do not exceed the average annual growth. It also assures continuity of harvest without compromising the productivity of the soil. Calculation of Sustained Yield is expressed as AAC.

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

- Road buffers
- Riparian buffers and zones
- Soil protection areas (slopes greater than 100%)
- Biodiversity areas (wildlife conservation and protection)
- Religious site protection
- Agricultural uses
- Meadows for grazing
- Soil Conservation areas
- Local Water Supply Protection

The above areas do not come under timber production.

14.1.2 Determination of AAC

Principle of Sustainability, the backbone of Forest Management is an accepted norm in Forest Management and forms the core principle of organized forestry. The concept has been evolved from the basic consideration that the future generations may derive from the forests 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 is the basic aim of forest management visualized in two respects: - continuity of growth and continuity of yield and 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, indefinitely, without impairment of the productivity of the soil. Calculation of Sustained yield is expressed as *Annual Allowable Cut (AAC)*.

A wide range of formulae 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 standardisation around a fairly simple and robust single methodology.

14.2.3 Increment based AAC

In many of the FMUs, increment based method could be used for sustainable cut based on the yearly increment. Unfortunately, this method relies heavily on the growth data for which in Bhutan we do not have permanent sample plots to ascertain the data. At present, the increment data available has, therefore, not been used in determining the AAC.

14.1.4 Area based AAC

Area based AAC requires less inventory data and works well with an even distribution of volume over the forest, which is not the case in the natural forests of Bhutan. An area based AAC would indicate difficulties for NRDCL in practical planning and operational viability as actual volume brought to market would vary dramatically year to year.

14.1.5 The Most Appropriate AAC Method

Given the options of many formulae with their own advantages and disadvantages, many studies were done and it was found that a fairly simple and robust methodology could be used and accordingly the following calculation is used for calculating the AAC in standing volume equivalent. The formula is based on a combination of area, volume and rotation.

$$\text{AAC per Working area} = \frac{\text{Net operable area}}{\text{Rotation}} \times \text{Average standing volume per ha.}$$

14.1.6 AAC calculation for Korilla FMU

Net operable area

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

above inevitable fact around 20% of area from the gross operable area has been reduced to calculate the net operable area in commercial Working Circles. In case of local use, the gross operable area has not been reduced because of the fact that Single Tree Selection System will be applied.

Table 31: Net operable Areas

Forest Type	Gross operable area (ha)	Calculation	Net operable area (ha)
Broadleaf Forest (commercial)	2398.87	Gross operable area (ha) – 20%	1999.06
Broadleaf Forest (Rural)	3516.86	Gross operable area (ha)	3516.86
Conifer (Rural)	1457.23		1457.23
TOTAL			**6973.15**

Rotation

For Broadleaf forests, the regeneration period is rather very long, and particularly in Korilla, problems of regeneration have been a serious issue. Therefore a 10 year has been added to the rotation of broadleaf forests (100+10).

Average Standing Volume

The mature average standing volume is derived from management forest inventory data statistically analysed using "R". Owing to the high sampling error, the range of possible standing volume at 95% probability level is large and with high level of uncertainty. The sampling error and RME for each stratum is given below;

Table 32: AAC for the Working Areas (Standing volume)

Stratum (Working Areas)	Net operable area (ha)	Rotation (years)	RME standing volume (m^3/ha)	AAC (m^3/yr)	Actual AAC (m^3/yr)
Commercial Production area (broadleaf forest)	1999.06	110	53.34	1114.38	1100
Broadleaf & Conifer Forest	4974.09	110	53.34	2772.95	2700
TOTAL	**6973.15**			**3887.33**	**3800**

Looking at the past experience of the FMU having marked trees in interlines for rural allotment owing to not having identified local use area in the 2nd Forest Management Plan for rural allotment. In this plan separate area for local use area is identified for meeting rural timber demand for the people residing within the FMU. For commercial production of timber

by NRDCL only five compartments are kept namely Korilla 1 and 2a, Ngatshang 1 and Kharnang 3 and 4. Complying with the resolution of the public consultation meeting and rural use area identification other blocks and compartments are kept for rural people. It is also due to the fact that the areas are covered with settlements and the timber production in these areas are commercially not viable.

The inclusion of unproductive forests in production area also exaggerate Annual Allowable Cut (AAC) leading to deterioration of forest health.

Therefore the total AAC for Korilla is fixed at **3800 m^3 standing volume.** The proposed figure will be supplemented with the AAC calculation with an area method. The AAC will be reviewed during the mid-term review.

For commercial AAC, an area of 20.62 ha will be clear cut equivalent area to be harvested per year. The area should be used as control for the AAC. Under no circumstances, the total clear cut equivalent area should not be exceeded even if the volume indicated above is not achieved.

The AAC for each stratum must be strictly adhered to. It will not be permitted to transfer AAC allocation from one stratum to another. The AAC may be varied by +/-10% in individual year but the volume cut in each five-year period must not be more than five times the AAC.

The over harvested volume of timber in the 2nd plan equivalent to 7825.95 m^3 will be adjusted in this plan. If required, commercial harvesting may be halted to adjust the excess volume removed or the adjustment can be shared throughout the plan period to keep the FMU functional.

14.2 Recording and accounting for AAC

AAC will be monitored through trees marked and recorded in the Tree Marking Book (TMB) and Tree Marking Register (TMR) separately for both **commercial and local use** in all Working Circles. AAC has been calculated as gross bole volume and this is the measure that should be totaled on an annual basis from the TMB and TMR.

The records of the logs, firewood, woodchips, poles, etc. extracted from the FMU should also be recorded. The supplied volumes of the same should be totaled annually to monitor AAC.

14.3 Allocation of the AAC

The allocation of the AAC has to take into account: the local village rights and needs for timber, fuelwood, poles; the needs of the general public for Shinglep, firewood; local *ad hoc* needs; and other demands from outside the Dzongkhag.

Owing to insufficient participatory work to determine if needs have changed the allocation of timber for local and rural needs are as follows:

2700 m^3 gross - allocated to local users (local villages, general public, urban population and *ad hoc)*. The volume of posts, poles etc. from operations in the immature stands will be included in this allocation. (the allocation will be done from limited production areas and local use area as delineated on the maps)

1100 m^3 gross - allocated to NRDCL for commercial purposes.(from production areas only, as delineated on the maps)

Ad hoc demands, especially if the demand is for Government uses, shall be met by NRDCL. The CFO can make adjustments with the AAC allocation as per the actual demand but the fact should be borne in mind that AAC is calculated by working area and is not transferable between working area.

Korilla FMU is under tremendous pressure meeting demands more from outside the FMU and Dzongkhag. The concept of FMU encompasses the rights of people within the FMU. While, if the system of supplying timber on standing forms to communities outside the FMU and Dzongkhag is continued, it shall be very difficult to sustain the FMU.

The AAC workout and the demand assessment has been done based on the existing demand trend and the other factors involved in the standard formula determining the AAC. **Therefore, during this plan period the AAC allocation is strictly for the local communities and NRDCL. Demands from people outside FMU and other Dzongkhags should be encouraged to be met from the NRDCL depots at subsidized rates wherever applicable.**

Note: the allocation can be altered after documented dialogue with stakeholder groups.

The calculation of AAC in log volume is difficult since there is no reliable data regarding the conversion. FRMD recommends 40% recovery log volume for broadleaf and 60% for conifers. But this is subject to change in field conditions, and the figure can be used as a base only.

Table 33: Log Recovery volume

Stratum	AAC (m3)	AAC (cft)	Recovery Log volume (m3)	Recovery Log volume (cft)
Production Commercial NRDCL)	1100	38841	440	15536.4
Production Rural (Local use only)	2700	95337	1080	38134.8
Total	**3800**	**134178**	**1520**	**53671.2**

NOTE: The AAC and sustainability of the FMU are based on the above considerations. The forest is highly variable, and the above are ***guidelines***, not prescriptions. Cycles for specific sites can be lengthened or shortened, depending on restocking and growth rates.

14.4 Distribution of the cut

The AAC has been calculated by using the most simple and relevant method. However, to provide properly organized and regulated management, economical harvesting and regeneration an orderly and sequential system of harvesting has to be adhered to. This did not happen in many of the FMUs, with an emphasis being given to easily accessible, high yielding stands.

The mixed broad leaf resource covers the largest area of any resource within the FMU. The broadleaf forest MUST be managed more intensively and with a view to increasing the potential for commercial harvesting.

The Korilla FMU after been under management for last 20 years has encountered with difficulty in timber disposal and regeneration problem, especially with the commercial species. Keeping this view in mind the AAC thus less would not create timber shortage especially for the broadleaved species. This twenty years management plan involves a lot of re-structuring: moving away from a logging-centered approach, exploiting the existing old-growth forests; towards a forest development approach, involving thinning, silvicultural development and the involvement of stakeholders to allow for zoning.

To allow harvesting to operate in an orderly fashion for this plan period, blocks, compartments and sub-compartments where kept as such in the first and second plan and further harvesting operations will occur in this plan period in the Korilla and Kharnang Block. The blocks identified have been operated in the last plan period but provides further extension to access deeper forests.

Table 34: Brief description of the Blocks

Block	Description
Ngatshang	Settlement areas and mostly operated in the previous plan period. The compartment was falling within the production Circle before and even now it can be further extended for production.
Gangola	Mostly settlements and acts as reserves for drinking water supply for the Mongar town and the other governmental institutions. The areas to the south were once the supplier of ***Borinda grossa***, now shows its disappearances which needs a stop for the harvest.
Korilla	The compartment is very sparsely populated the area is operated in the last plan period. This compartment can further be operated in the revised plan also. It houses very good stock of ***Borinda grossa*** north-west part of the compartment.
Kharnang	To the east of the compartment the area is thickly populated. There is a room for timber extraction towards the western part of the compartment.
Sherichhu	Settlement areas in the south and south – west part. inaccessible towards the east and south east part of the compartment.

Once the harvesting in each individual coupe is completed according to the work detailed in the Operational Plan no other cut will be permitted in the area without an agreement and approval of the Director General of Forests. This is important to maintain the integrity of the spatial and sequential progression of the chosen silvicultural system.

It is, however, important to ensure that harvesting is not concentrated in one isolated area but distributed throughout the FMU in each year of the plan duration.

15 SILVICULTURAL SYSTEMS

15.1 Prescribed Silvicultural System in Broadleaf Forests - Group Selection System with Artificial Regeneration

On 17th of January 2005, Silvicultural Systems Consultative Workshop was held at the Department's Conference Hall. During the workshop, the participants agreed to prescribe Group Selection System with artificial regeneration as the silvicultural system in broadleaf forests in Bhutan.

The following considerations should be made before the application of the silvicultural system.

1. ***Factors of Locality***

   Factors of locality include micro-climate, slope aspects, soil, humidity, rainfall, and geology of the locality which affect the growth of the plant. The nutrient of the soil is also very important for regeneration of the area. Biotic factors like grazing should be considered before clear felling.

2. ***Potential Productivity of the Site***

   Potential Productivity of the site should be assessed and the silvicultural technique suitably modified to ensure rapid growth of new plants in the clear felled areas. In Bhutan there is a lack of information on potential productivity of sites. It is also imperative that inputs are applied judiciously. In other countries, people have even irrigated as well as applied fertilizers to the site.

3. ***Species and composition***

   Clear felling system is suited to light demanding species. The composition of the species can be changed to ensure the best financial results. But there are trees that can't withstand wind throws. So, clear cutting is going to expose them, causing uprooting and other damages. Some species can't stand the frosts during winter. Clear cutting expose them to such adverse condition. Choice for species and composition should be made taking into consideration these characteristics of different species.

4. ***Regeneration***

   The success of any system depends entirely on the success of the regeneration of the logged areas. Artificial regeneration is the only option if there is no natural

regeneration.

The practice of keeping the area barren for a year allowing firewood contractors to collect lop and tops from the cable line could mean extended exposure of the area to soil erosion. But in sub-tropical conditions of Bhutan, grasses and shrubs cover the soil soon after the clear cutting. Thus, even with the canopy gone, the cover provided by grasses and shrubs are enough safeguards against soil erosion or soil deterioration.

However, the invasion by grasses and shrubs can mean danger of fire for other inter-cable line stands. Once the area is about to be planted, the weeds and shrubs should be weeded out. Weeding should take place thrice a year as per the Norms and Standard of Plantation 2016 issued by SFED.

To ensure the survival of artificial regeneration created by the NRDCL the UIC should carry out plantation survival survey by doing total count in the planted areas annually. If the survival percentage is less than 70% the NRDCL should be apprised to carry out beating up and other necessary maintenance work to improve the status of survival.

Group Selection System has been prescribed in the broadleaf forests. The group selection system has been prescribed in preference to Strip Clear Cutting system that was in operation in previous plan basically because the latter is seen as environmentally riskier. The large tracts of land being clear felled would open the area to hazards of monsoonal rain and soil erosions. Even aesthetically, the large openings would be an eye sore. In group selection system, trees develop in clearly defined even-aged aggregations; this is of substantial advantage in developing good form especially in hardwoods.

Under the group selection system, small openings will be created in the stand allowing light to reach the forest floor and creating microclimatic conditions conducive for seed germination and establishment of seedlings.

There are important unresolved problems with sub-tropical and warm broadleaved silviculture in Bhutan; particularly the poorly understood regeneration dynamics of commercial species. Good regeneration has proved extremely difficult. There are also still considerable doubts regarding the best silvicultural systems for managing broadleaved forest. It is likely to be some time before research results are available and it is quite possible that stand succession towards commercially useful species is naturally a very long process (Whitfield, 2001).

Since one of the main reasons for failing of silvicultural systems is the lack of regeneration, it has been proposed during the Consultative Workshop that the group selection system should be combined with artificial regeneration.

The Group Selection System with artificial regeneration is synonymous to the Patch Cutting System as recommended by the RNR-RC Yuispang as per the *Forest Research Findings and Recommendations during the 8th FYP, RNR RC Yusipang (2003).* The "patch" in patch

cutting system would mean smaller groups (as compared to groups Group Selection System in Conifers) in Group Selection System. As per their research findings, the patch cutting system with fencing is proven to be the best option in terms of fostering biodiversity, mitigating grazing impact and safeguarding financial viability for sustainable management of mixed broadleaf forests in Eastern Bhutan.

General guidelines for Patch-cutting system (group selection system) in broadleaf forest. (vide the *Forest Research Findings and Recommendations during the 8th FYP, RNR RC Yusipang, 2003)*

- Patches of mature and over-mature trees 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 crowns, which absorb sunlight if permitted to reach the forest floor would enhance seedling development.
- In selecting patches, ridge tops are preferred over depressions, up slope positions over down slope in order to minimize damage to regeneration in subsequent felling operations.
- The size of openings should depend on stand composition and condition. In general, the size of opening should vary from 0.15 to 0.5 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 that patches of trees retained will form a wind firm group of trees and appear as a uniform patch.
- In mature broad-leaved forests with many mature and over-mature trees it is expected that 75% of the standing volume would be harvested by felling 40 to 60 % of the 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 decay or damage (snags, scars conk, mistletoe, etc.) should be retained to safeguard flora and fauna niches or habitats.
- Sufficient seed trees in the interline spaces adjacent to the cable lines opened up should be retained as potential seed sources for seedling regeneration in patch-cuts.

The Group Selection System has following advantages:

- Regeneration in the small groups under even aged conditions, which gives better stem form
- Larger openings in comparison to single tree selection system permit the establishment of intolerant species
- Harvesting is more concentrated, so logging cost is lower
- Harvesting in groups lower damages to residual stands

- Immediate cuts may be made less frequently
- Aesthetically and environmentally more acceptable: than clear cutting

In areas where openings cannot be created under group selection system (in between two cable lines) such areas should be operated under single tree selection system. However, care should be taken that spatial distributions of the trees are strictly followed and should match with the openings created under group selection system. Care should also be taken to avoid felling trees on environmentally sensitive areas, buffer areas and corridor protection areas.

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

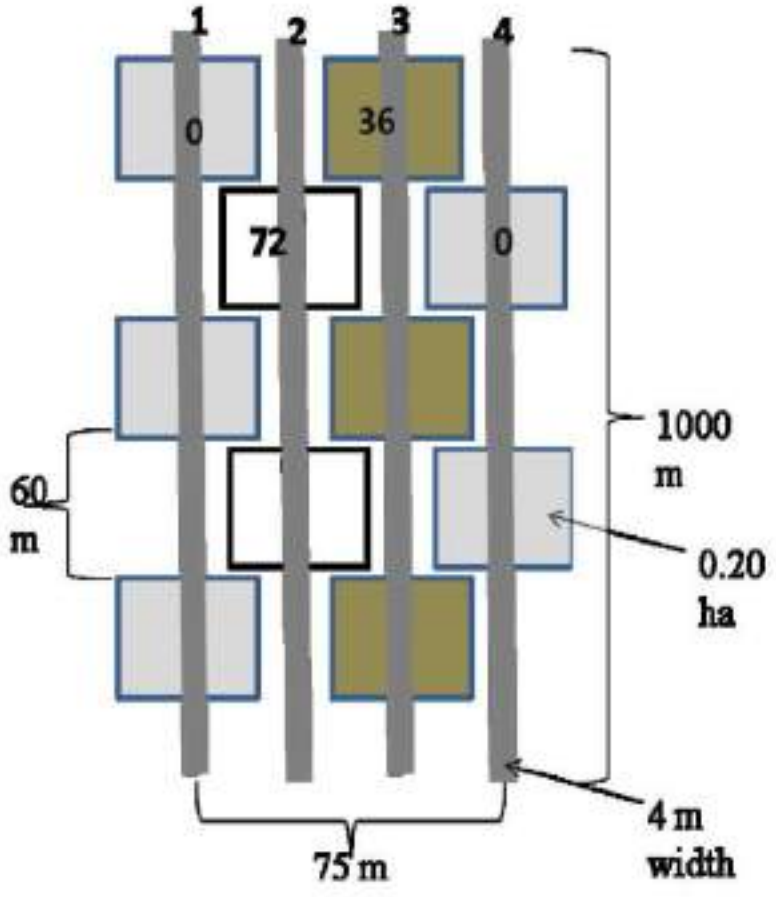


Figure 14: Cable Line Layout in Broadleaved forests.

Cable length = 1000 m
Distance between two cable lines = 75 m
Area of the group openings = 0.2 hectares
Distance between two group openings along the cable line = 60 meters
Cable corridor = 4 m

Only one third of the area of the stand will be subjected to harvesting between intervals of thirty three years for mixed broadleaf forests. The groups will be opened up along cable lines. The distance between two cable lines would be 75 meters, and between groups would be 60 meters.

The approach of working to a minimum cable line spacing of 75 m for the group selection system will only work if matched with appropriate felling group sizes. Execution of this plan will keep a minimum of 75 m distance to prevent subsequent cable lines running through old previously cut groups and damaging regeneration. This is owing to the experiences gained from the implementation of the past two plans for 20 years. As have been planned in the paper it does not work in practical ground situation due to terrain, slope, direction of tree leaning, expertise of loggers, etc. Line spacing and group size then need to be carefully considered on a site-by-site basis and provide for a specific number of subsequent passes. One prescription will not be appropriate everywhere.

It is, therefore, very important for cable lines to be recorded properly. Once the cable lines are calibrated for the group openings, it would be important to have the same group opening spacing for the first phase of cable lines since the interlocking openings of second and third passes should not fall on the previously harvested areas. This requirement of the Square Interlocking groups' layout necessitates the excellent record keeping of the worked cable lines and their openings' locations.

15.2 Single Tree Selection System

This System will be practiced in Local Use forests areas for rural marking, particularly for firewood. 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. Felling should involve removing of trees or small groups of trees. 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 objectives of the system. As far as possible, selection of trees to be felled should be done for following categories first especially in young and immature stands.

- Dead, dying, diseased, 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
- Mature trees above the exploitable diameter, which will leave gaps for regeneration to come up.

Prescribed Silvicultural Systems for the FMU

- *For the production areas where commercial harvesting will take place, the prescribed Silvicultural system is the Group Selection system with artificial regeneration.*
- *For the local use limited production areas, local use areas and Gangola Watershed Working circle) the prescribed Silvicultural System is the Single Tree Selection system.*

16. FOREST PROTECTION

16.1 Fire

In view of a shortage of access roads and firefighting equipment, fire protection should primarily address preventative measures. These are awareness education for the local population and contractors, especially during the dry season. This awareness can be initiated through FMU level meetings and informing the Geogs representatives to pass on the information to the people under their jurisdiction. Any possible steps for preventing fire should be taken care by the NRDCL and the unit in-charge.

16.2 Pests and Diseases Management

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

Control may include the following:

- Forest sanitation, hygiene measures,
- regular survey of regenerated areas and removal and burning of infected plants and trees and their slash and detached bark,
- Use of insecticides or fungicides in close consultation with the forestry research section of RNRRC.

The planting stock at any nursery which will supply seedlings to the Unit also needs to be monitored for pests and diseases. Affected plants should not be brought into the Unit.

16.3 Grazing

In line with the multiple-use objectives of forest and as provided for in the Forest Policy of Bhutan, grazing will be allowed to continue in the FMU.

More importantly, a participatory approach to secure the cooperation of local villagers in keeping their cattle out of environmentally sensitive areas and away from regenerating coupes will be adopted with high priority. These strategies will be implemented through the

combined efforts of Dzongkhag and CFO, and should be a core part of the PFM approaches.

encing (barbed wire) will be adopted to protect regenerating seedlings and saplings in harvested coupes. Barbed wire will be employed to close such areas to grazing for at least 10 years, or sufficient stems are above grazing height, whichever occurs sooner.

It was discussed in the public consultation meeting that people in the Geogs with cattle would be supplied improved breeds of cattle by NRDCL, if they reduced number of unproductive ones.

As a remedy for plantation to thrive the following enforcements were discussed to be practised if the cattle were found grazing inside the plantation area:

i. The owner of the cattle would be liable for maintenance of fencing damaged
ii. The owner of the cattle would be liable for replanting equal number of seedlings damaged in addition to seedling cost for replanting
iii. The owner of the cattle would be imposed fine and penalty as per FNCR.

The Department in collaboration with Department of Livestock and Research Centres are in the process of conducting studies related to grazing and its impacts. The findings of these studies will be published and informed to the field level.

17. ENVIRONMENTAL STATEMENT FOR ENVIRONMENTAL IMPACT ASSESSMENT, 2002.

The Environmental Assessment Act, 2000 necessitates all developmental proposals in Bhutan to fulfill criteria as per Chapter III, Section 18 for obtaining environmental clearance. The National Environment Commission Secretariat has developed Regulation for the Environmental Clearance of Projects 2002 to be met by any applicant to carry out the forestry activities. This section of the Plan provides information on how the forestry activities will be carried out and controlled so that the proposed activity meets the requirements of the Act.

17.1 Introduction

The goal of the Korilla FMU is to manage the forests on a multiple use, sustained yield basis. This is basically to cater to the needs of the people in the Dzongkhag, support livestock, meet timber and fuelwood demand, watershed and wildlife purposes.

The Environmental Assessment Act 2000 requires environmental clearance for all the development proposals in Bhutan. The National Environment Commission has prepared Forestry Sectoral Guidelines that recommend more specific sets of criteria for the purpose of planning and implementation of forestry projects. These guidelines have been examined to ensure that the practices within Korilla FMU meet these requirements.

The Korilla FMU was brought under management as early as 1990. The FMU has high way from Trashigang to Thimphu running through it. Since the road length of almost 10 – 12 km is already constructed by the NRDCL, leading into the FMU. The roads constructed showed little impact on the environment and have been beneficial to the

remote villages so as to access necessary facilities.

The KFMU does not share a boundary with any park, wildlife sanctuary, or any of the buffer zones. The main environmental concerns are due to improper land use, heavy grazing pressure from the livestock within as well as from the neighbouring Geogs and Dzongkhags. Skidding or rolling of logs will not be allowed, instead cable crane shall be used and for road construction if possible an Eco-friendly excavator will be used. The cross drains and the side drains will be maintained throughout the season. In the unstable slopes, Bio – Engineering works needs to be carried out by planting faster and native species. The environmental statement also lists mitigating measures that will be undertaken to lessen any effects on the environment for the future. During planning environmental impacts were carefully taken into account and during the function mapping of the KFMU many areas were delineated for protection and conservation for wildlife, soil and water quality.

Monitoring and evaluation mechanisms are being designed to assist in the future care of the FMU and to aid in the identification of measures to disrupt the environment.

FMU acts as mitigating measures that will be put in place in the 2004 – 2014 management plan.

17.2 Method

This environmental statement is based on an EIA conducted between July 2003 and December 2003 as a part of ground truthing and information gathering for the plan. It is based on personal observation, views of the CFO, RRA with relevant people and engineering cell NRDCL. The forestry environmental parameter checklist developed by NEC was completed, identifying environmental effects and mitigating measures.

17.3 Environmental Performance of the FMU

The objectives of management are:

1. To improve the forest and other vegetative cover of the area.
2. To provide the local population, on a priority basis, with a perpetual supply of timber and fuel wood to satisfy their needs.
3. To supply timber and fuel wood to the locally based wood-using industries and to various Government organisations, as required.
4. To regenerate, either artificially through planting, or through natural regeneration those forest areas currently not satisfactorily regenerated.
5. To increase the productivity and stocking of the forest through appropriate logging and silvicultural methods.
6. To improve the condition of young stands through thinning.
7. To ensure the improvement of the presently degraded forest areas.
8. To protect the watershed values of the FMU
9. To protect and conserve the environment and ensure the preservation of genetic diversity, wildlife habitat and the aesthetic value of the area.

10. To satisfy the needs of the local population for other forest products and grazing through their involvement in all phases of the implementation of this plan.

It will be noted that many of these objectives relate directly to environmental performance of the FMU, and to satisfactorily meet these objectives mitigating measures have been stated. These are discussed below.

17.4 Checklist of Environmental Parameters for Forestry Projects

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

In general, the operation of Korilla FMU will have no significant adverse effect on the environment. The potentially critical areas of reduction in water quality and, closely linked, erosion control is being taken care. There is no observable evidence that significant erosion or reduction in water quality will occur. Even during the monsoon, the water leaving the catchment area has a low sediment loading. The environmental functions of the watershed and FMU will remain intact. The critical operations of harvesting/extraction and road construction have been sensitively addressed (see sections 17.5 below).

17.5 Environmental Statements for the Activities within the FMU.

17.5.1 Setting up of Management Unit.

Korilla FMU is being processed through all the necessary steps required for feasibility study. These steps take care of the Environmental, Social, Economical and Sustainable issues. The process involved the following key stages at its initial stage. The revision has fewer road construction and lesser disturbances to the environment.

1. An initial screening process using GIS techniques to locate areas of well stocked forest relatively close to road access. This was followed up by ground reconnaissance of FMU areas, in conjunction with community consultations to ascertain potential conflicts between forestry use and existing uses. These consultations included local communities and staff CFO and Dzongkhag.
2. A forest resource inventory was carried out to provide information about tree stocking, regeneration, timber volumes, site characteristics and understory species. Additionally, this inventory collected information about other flora and fauna (including species sightings, droppings, dung etc. as evidence).
3. Zoning within the FMU was then based on the above data, identifying forest types and appropriate management techniques. This management plan incorporates the Forest Function mapping technique prescribed by DoFPSPS (Schindele, W. and Dhital, D.B. (1997). It should be noted that this mapping directly addresses 8 function mapping requirements listed on p.2-10 of the forestry sector guidelines (NEC).
4. The silvicultural system to be implemented is the Group Selection System/Patch Cut System, in the Broadleaved Forests and Single Tree Selection System in the local use

areas. The trees will be harvested by cable craning methods. A buffer of un-harvested patch of at least 60 m will separate each Cable Line from other.

5. Best available system: the environmental impact is minimised.
6. The rotation age has been selected using age estimates from harvested trees, and ranges from 100–110 years. There will be significant areas of stands reserved from harvesting scattered throughout the FMU so that on a landscape basis, there will continue to be a range of tree ages up to the biological rotation. These stands include those reserved for stream protection (30 m buffers on all streams) and soil protection (all areas steeper than 45 degrees slope) and large areas of forest that because of terrain will not be accessible to cable cranes or suitable for road construction.

Annual Allowable Cut (AAC) calculation uses standard, internationally accepted, formula for calculating a sustainable yield of timber and are based on the growing stock in the operable area (determined from the inventory data), using a conservative rotation. The AAC calculated for the area will be economically sustainable level.

Operational schedules for harvesting are done on a year to year basis, so that current economic conditions are better known. The inventory data available from the FMU inventory is not sufficiently detailed for operational planning; more detailed inventory data for the potential operational area is collected every two years.

Potential Impacts on local communities will be monitored through on-going consultations carried out by Divisional staff as part of their day-to-day work in the FMU and as part of the Operational Planning process. The Ninth Five Year Plan will include provisions for the implementation of Participatory Forest Management, essentially inclusion of community for effective natural forest management.

17.5.2 Implementation of the Management Plan:

Baseline

The area has being under Management Plan so far. As such the area has the cattle population that affects the regeneration and added upon it the pressure from the migratory cattle from nearby areas.

Impact

If the Management Plan is not supported financially then it diminishes project efficiency due to lack of funds.

Mitigating Measures:

- Included detail resources required in the plan
- Raise awareness of the issue through workshops and dialogue.
- Responsible CFO and Unit Incharge

17.5.3 Felling:

Baseline

Felling for rural, as well as for commercial from the FMU has been carried out for last decade. Though the felling has been carried out at larger areas, not much of felling damage to the stands has being observed.

Impact

With the area opening up for revision, there might occur damages to residual stands.

Mitigating Measures

- Management Plan details requirement for addressing the problem.
- NRDCL and Contractors will be responsible for the details in the Plan to implement.

17.5.4 Uncontrolled allotment to rural use and grazing:

Baseline

Allotments for rural purposes are marked from the FMU, but there does not occur big open areas from such allotments. Grazing pressure is one of the highest in the country. Field visits certain us regeneration is a problem at present.

Impact

Lack of regeneration and abuse to forest stand.

Mitigating Measures

- Marking Rules laid tighter in the Plan.
- Dialogue with the local stack holders.
- CFO and unit-incharge will be responsible for crosschecking.

17.5.5 Road Construction and Maintenance:

Baseline

The Korilla FMU has good roads networks at present. The siltation is absent with minimum run of rate during rainy seasons. The pollution of waters down the stream is negligible. Of course, small land slips are common sights in the district, major slides are not common.

Impact

Road construction is the most significant environmental impact in the FMU. Major effects like erosions, compactions, siltation, water pollution, landslides, etc are associated with road construction.

Mitigating Measures

Forest roads are constructed to a good standard. This is demonstrated in the field as well as by the environmental assessment carried out in other FMUs in the country. There is no evidence of any major erosion having been caused by road expansion activities within the FMUs.

- The road network within the Korilla FMU will be kept to a minimum for both environmental and economic reasons.
- The road expansion activities will involve extending existing roads, and will involve about 10 kms of new road construction.
- The TFDP has prepared a set of Standards for Road Construction and Maintenance in close consultation with the NRDCL. These standards will be adopted in the 2016-2026, management plan. This will ensure that road construction within the FMU will meet the recommendations, and ensure that any erosion is minimised or eliminated.
- Roads are regularly maintained to ensure the function for their purpose and do not degrade, causing erosion potential.

17.5.6 Harvesting and Extraction

Baseline

Though harvesting and extraction are carried out on large scale in the FMU, these allotments are not significant in causing environmental concerns at present.

Impact

Harvesting and extraction comprise one of the important forest management activities, with a potential for negative environmental impacts. The harvesting exposes areas thus creating erosion potential and transporting timbers create ground disturbance which leads to soil compaction and damage to regeneration.

Mitigating Measures

Mitigating measures have been employed to minimize environmental impacts from these activities.

- Harvesting is prohibited on steep slopes to avoid creating erosion potential.
- Harvesting is carried out using Patch Cut System. This minimizes both the potential for negative environmental impact, and reduces the visual impact of harvesting activities with better regenerating method adopted i.e. Artificially regenerating the whole operated areas immediately after harvesting with fencing.
- Extraction is by skyline cable cranes. This avoids ground disturbance by physically carrying the logs, off the ground, to the nearest road. This greatly reduces the erosion

potential of harvesting activities on slopes.

- Sanitation felling is practiced to remove dead and diseased trees, to improve the environmental condition of the forest. Few deadwood both standing and fallen, is retained in the forest to provide habitat and nutrient recycling.
- Inspection of harvesting/extraction sites will be regularly monitored by the unit in-charge and will carry out as desired.
- The detailed description of harvesting and extraction activities are outlined in the operational plans that are duly approved by the competent authority within the DoFPS, MoAF.

17.5.7 Regeneration and Post Harvesting Treatments

Baseline

Regeneration problem is existed in the field at present. Post harvesting activities are carried out in the harvested areas.

Impact

With the revision of plan the FMU will be under operation and there might occur regeneration problem. If regeneration fails then the problem couples up with other environmental, social and economical bottlenecks later on.

Mitigating Measures

Series of operations prescribed for harvesting and Post-harvesting are detailed in the Plan.

- The sites are cleared off any residues left, and promote regeneration. A regeneration survey is conducted for both artificially and naturally regenerated areas. The stocking density of regeneration is compared to standards prepared by FRMD. If stocking of natural regeneration is inadequate, it is supplemented by enrichment planting of local species until the stocking standard is met. The plan provisions, in preferring artificial regeneration, in the broad leaved forests and natural regeneration in the conifer areas. Maximum intervention will be employed to ensure continued stocking with the tree species present on the site before harvesting. On sites that are failing to regenerate naturally, or where regeneration may be problematic (such as areas that have logged for sanitation purposes), plantations will be taken up. These are small-scale plantations of local species, and they are monitored for survival rates.
- Regeneration in the Korilla could be a problem with large number of cattle population in the area. For the reason the system adopted will give room to the implementers for safer artificial regeneration with fencing.
- It was discussed in the public consultation meeting that the following enforcement would be practiced if the cattle are found grazing inside the plantation area:

i. The owner of the cattle would be liable for maintenance of fencing damaged,

ii. The owner of the cattle would be liable for replanting equal number of seedlings damaged in addition to seedling cost and

iii. The owner of the cattle would be imposed fine and penalty as per FNCR.

17.5.8 Riparian Zone Protection

Baseline

The streams and rivers are naturally bedded with small bank erosions especially during monsoon seasons. Otherwise, the water quality, quantity, siltation erosion etc problems are negligible.

Impact

If the water bodies within the FMU are not given enough protection or devised proper mechanisms to keep intact the streams and the rivers, there will be problems like: drying up of water bodies, decrease in quantity, erosions, siltation, loses of aquatic life etc.

Mitigating Measures

Stream and river protection are provided in two stages:

- At the FMU planning level, i.e. in this plan, 30m buffers have been applied to all mapped streams. Further 15m buffer is provided for the drinking water source for the settlements and urban centres .The importance of buffer zone protection, for both erosion protection and biodiversity reasons, is fully appreciated by operational staff. The main purpose of mapping the buffer zones is to make the best possible estimate of the area reduction necessary for this purpose and thereby to make a conservative estimate of the net area available for harvesting and of AAC. In reality, during forest operations, many more small and perennial streams are identified. Thirty-m buffer zones are applied to these as well.
- During Operational Planning the provisions of the forthcoming Riparian Code of Practice will be applied so that stream protection will be applied on the basis of the stream classification system given in the Code during harvest. This Code will prescribe a range of stream buffer widths for different situations that can be delineated in the field.

  The important consideration is that a conservative area be estimated for the stream buffers that will finally be delineated in the field during operations – and this is done with the provisions in paragraph 1 above.

17.5.9 Biodiversity Conservation within the FMU

Baseline

Biodiversity is rich and intact now. The area is rich for both floral and faunal

diversity. The species are recorded in the Plan document.

Impact

Once the area is brought under management. The removal of forest produce in accordance to the Plan will take place. If the implementation is not according to the plan directives, we might lose species from the area.

Mitigating Measures

Objectives of the management plan directly address the conservation of biodiversity. It addresses two key areas of biodiversity:

- Conserving biodiversity; and actively promoting it. Biodiversity conservation is addressed by practicing low impact silvicultural systems. Most of the systems followed in FMUs create an uneven-aged forest with a high level of structural diversity. There is minimal disruption to the ground flora or soil structure.
- Deadwood is left to create diverse habitats. Natural regeneration, the preferred method of establishment, enhances the stability of the forest by ensuring that species suited to the site re- establish. The list of flora and fauna given in the Forest and Nature Conservation Act (1995) (Annex 6) are also to be totally protected during harvesting operations.
- In addition to practicing minimal impact silvicultural, there are large areas of the forest that are not commercially operated. These are buffer zones, inaccessible and non-operable areas.
- Areas may be non-operable for a number of reasons: they are too steep; they are of special cultural significance; or they are of particularly high biodiversity value.
- Biodiversity is actively promoted by increasing and diversifying the range of habitats that are available. Low impact silvicultural and harvesting creates a more diverse age structure and ensures that all stages of the stand-cycle are represented.
- Attempts have been made to protect areas from excessive grazing (the major factor affecting biodiversity). These have been successful in some areas, but failed in others, with herders breaking down fences. Research is being conducted by RNR-RC Yusipang to address this issue, focusing on the social and participatory elements of this problem.

18. 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 Operations					
1. Watershed Areas					
a) erosion	*a) downstream economic losses*	9			
b) siltation	*b) downstream economic losses*	9			
c) hydrology	*c) increased peak and flood flows*	9			
d) water quality	*d) loss of downstream beneficial uses*	9			
2. Relation to other dedicated land uses					
a) conservation areas	*a) impaired ecological and recreational opportunities*	9			
b) economic ventures	*b) possible economic loss*	9			
3. Traditional forest uses	3. Impaired beneficial uses	9			
4. Rehabilitation	4. Social problems	9			
5. Relation to regional/ national forestry plans	5. Possible conflicts with established management policies	9			
6. Critical environmental areas	6. Downstream economic losses	9			
a) erosion	*a) downstream economic losses*	9			
b) siltation	*b) downstream economic losses*	9			

c) hydrology	*c) increased peak and flood flows*	9			
d) water quality	*d) loss of downstream beneficial uses*	9			
7. Precious ecology	7. Loss of ecological values	9			
B. Considerations Regarding Planning and Design					
1. Cost/benefit analysis					
2. Operations and maintenance	2. Diminished project efficiency and objectives if lack of funds			9	
3. Data base for decision		9			
4. Road network design					
a) erosion	*a) downstream economic losses*	9			
b) siltation	*b) downstream economic losses*	9			
c) hydrology	*increased peak and flood flows*	9			
d) water quality	*d) loss of downstream beneficial uses*	9			
5. Design of logging activities	5. Unnecessary damage to residual stand			9	
6. Critical environmental areas					
a) erosion	*a) downstream economic losses*	9			
b) siltation	*b) downstream economic losses*	9			
c) hydrology	*c) increased peak and flood flows*	9			
d) water quality	*d) loss of downstream beneficial uses*	9			
7. Precious ecology	7. Loss of ecological values	9			
C. Considerations Regarding Project Operations					
1. Road construction					
a) erosion	*a) downstream economic losses*	9			
b) siltation	*b) downstream economic losses*	9			

c) hydrology	*c) increased peak and flood flows*	9			
d) water quality	*d) loss of downstream beneficial uses*	9			
2. Felling					
a) erosion	*a) downstream*	9			
b) siltation	*b) downstream*	9			
c) hydrology	*c) increased peak and flood flows*	9			
d) water quality	*d) loss of downstream beneficial uses*	9			
3. Log conveyance and					
a) erosion	*a) downstream economic losses*	9			
b) soil compaction	*b) increased runoff*	9			
c) log floatation	*c) impede navigation*	N.A.			
d) allocation	*d) less than optimum economic benefits*		9		
4. Logging in riparian zones	4. Degradation of waterways/fisheries	N.A.			
5. Socio-economics					
a) employment opportunities		9			
b) loss of traditional forest use	*b) economic and cultural losses*	9			
D. Considerations Regarding Post-Project Activities					
1. Rehabilitation and		9			
2. Road shutdown		9			
II. REFORESTATION/AFFORESTATION					
Considerations Regarding Project Operation					
1. History of forest abuse	1. Negation of project goals if not effectively controlled			9	
2. Relation to other dedicated					
a) conservation areas		9			
b) economic ventures	*b) Interference with more profitable ventures*	9			
c) regional/national forestry plans		9			
3. Rehabilitation	3. Social Problems	9			

4. Siting in degraded forest	4. Possible unnecessary loss of ecological values	9			
Considerations Regarding Planning and Design					
1. Cost/benefit analysis		9			
2. Selection of tree species	2. Diminished project objectives	9			
3. Precious ecology		9			
a) wildlife		9			
b) fisheries		9			
c) plants		9			
d) soil and water		9			
4. Allocation of benefits to locals					
a) employment opportunities	*a) social conflict if local people not significantly involved*	9			
b) training		9			
c) non-wood products		9			
5. Operations and maintenance	5. Diminished project efficiency and objectives if lack of funds			9	
6. Data base for decision making		9			
7. Project financing and reservoirs		9			
8. Appropriate technology	8. Diminished project objectives if inappropriate	9			
9. Relation to other dedicated land uses	9. Potential social and economic conflicts	9			
a) extensive land use modification					
10. Road network design	10. Increased erosion	9			
11. Use of grasslands		9			
C. Consideration Regarding Project Operations					
1. Commercial logging	1. Same as in Commercial Logging A and B	9			

2. Reduced water supplies	2. Socioeconomic losses	9			
3. Chemicals and fertilizers	3. Impaired fisheries and aquatic systems	9			
4. First-year operations	4. Increased erosion due to soil disturbance	9			
5. Soil conservation benefits					
a) erosion			9		
b) sedimentation		9			
c) soil capacity		9			
d) soil surface moisture		9			
e) soil nutrients		9			
6. Socioeconomic benefits					
a) employment opportunities			9		
b) fuel-wood			9		
c) enhanced fisheries		9			
d) enhanced recreation/ tourism		9			
7. Water resources benefits		9			
a) minimized overland flows		9			
b) reduced flood peaks		9			
c) water quality		9			

Source: Forestry Sectoral Guidelines, NEC (1999).18. FINANCIAL AND ECONOMIC APPRAISAL

18.1 Economic Analysis

Investments in forest management are made with the expectation of high financial as well as economic returns. Economic benefits can be in the form of socio-economic development of the community or the people and at the same time improving the quality of the forests.

Technically, good forest management by using prescribed Silvicultural treatments can improve the existing stands of forests, thereby yielding better growth and also promoting better regeneration of principal species.

The forest road is going to act as the lifeline towards developmental projects for accessing communities in future. The objectives of good forest management cannot be derived without a proper and sound financial and economic analysis. And this has been taken into consideration during the management planning.

18.2 Financial Analysis

A ten year financial forecast has been drawn for the Korilla FMU. The financial forecast approximately forecasts the revenue earned, costs incurred and royalties collected and paid. The figures used are based on the information made available by the RM's office Zhonggar Division, taking into account the latest rates. The figures used for the calculation are in the Table No. 28 below: and the calculations subsequently.

The financial forecast is only for 10 years and does not include the profitability of the FMU in the long run. But all developmental activities within the FMU will be beneficial in the future. This financial forecast is based on assumptions available and only a projection of a possible cash flow scenario. **This is not a valid/legal statement and therefore should only be used as a guide. The rates are not finalized rates.** They were obtained from average figures available at NRDCL. Therefore the figures are subject to change while calculating with final rates for the Division.

With the road network to the valley, rural allotment is expected to increase and royalty from rural timber and firewood allotment is also going to fetch good revenue to the DFO office. This has not been worked out due to unpredictability of trend in rural demand in coming years.

Table 35: Figures used for Financial Forecast

Assumptions	Figures	
M to cft	35.31	
Volume Recovery NRDCL	40%	
Road construction (Nu/Km)	12,00,000	
Length of propose new road construction (km)	3	
Length of existing road (km)		
New road construction (km/yr)	0.3	
Road maintenance (Nu/km/yr)	12,000	
Distance to Depot (km)	11	
Haulage Costs (Nu/cft/km) (Nu/m^3		
Cable Crane (Nu/cft) (Nu/ m^3)	14.93	527.188
Royalty from rural allotments by DBH, however an average is used for the calculation (Nu/yr), based form the previous plan and adjusted form the current AAC		
Average compensation (penalties and fines) Nu.		
All costs from DFO are taken an average from the last plan period.		
OPE	4.378	
Rural Allotments		
Regeneration maintenance (Nu/ha)		
area that require planting immediately	0	
area that require planting per year	3 ha	
Coupe regeneration establishment		

Creation of plantation (Nu/ha)	106000.00
Plantation maintenance (Nu/ha)	3322371.00
existing plantation in the FMU that require maintenance	33.32ha.

Table 36: Summary of the Financial Forecast

Financial summary for the Plan Period	
Total Revenue for NRDCL	31024778.00
Total Costs for NRDCL	15031260.00
Total Royalty for NRDCL	3177900.00
Total Revenue- Total Royalty- Total Costs NRDCL	**12,815618.00**

Table 37: 10 years Financial Forecast for Korilla FMU (2017-2026)

				2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	10 Years
	AAC (m³)	Rec Vol (m3)	Nu/cft	Nu	Nu	Nu	Nu	Nu	Nu	Nu	Nu	Nu	Nu	Nu
Revenue: NRDCL														
Commercial Timber	1500	600	146.44	3102477.8	3102477.8	3102477.8	3102477.8	3102477.8	3102477.8	3102477.8	3102477.8	3102477.8	3102477.8	31024778
Rural Timber	2500													
Total Rev. NRDCL				3102477.8	3102477.8	3102477.8	3102477.8	3102477.8	3102477.8	3102477.8	3102477.8	3102477.8	3102477.8	**31024778**
Cost NRDCL														
Road Construction						1000000				2000000				3000000
Road Maintenance				216000	216000	216000	228000	228000	228000	228000	252000	252000	252000	2316000
Marking cost			0.08	1692	1692	1692	1692	1692	1692	1692	1692	1692	1692	16920
Inventory cost			0.8	16948	16948	16948	16948	16948	16948	16948	16948	16948	16948	169480
Felling & crosscutting cost			2.5	52965	52965	52965	52965	52965	52965	52965	52965	52965	52965	529650
Cable craning			14.93	316306.98	316306.98	316306.98	316306.98	316306.98	316306.98	316306.98	316306.98	316306.98	316306.98	3163069.8
Transportation to depot			6.5	137709	137709	137709	137709	137709	137709	137709	137709	137709	137709	1377090
Recruits/Regeneration Maintenance (Nu/Ha)			3500	72905	72905	72905	72905	72905	72905	72905	72905	72905	72905	729050
Artificial Plantation			75000/ha	225000	225000	225000	225000	225000	225000	225000	225000	225000	225000	2250000
Estblished Regeneration/Plantation maintenance			4500/ha	148000	148000	148000	148000	148000	148000	148000	148000	148000	148000	1480000
Total Cost NRDCL				1187526	1187526	2187526	1199526	1199526	1199526	3199526	1223526	1223526	1223526	**15031260**
Total Rev. Less Total Cost NRDCL				1914951.8	1914951.8	914951.82	1902951.8	1902951.8	1902951.8	-97048.18	1878951.8	1878951.8	1878951.8	15993518
Royalty Commercial			15	317790	317790	317790	317790	317790	317790	317790	317790	317790	317790	**3177900**
Total Rev: Revenue less Cost less Royalty) NRDCL				1597161.8	1597161.8	597161.82	1585161.8	1585161.8	1585161.8	-414838.18	1561161.8	1561161.8	1561161.8	**12815618**

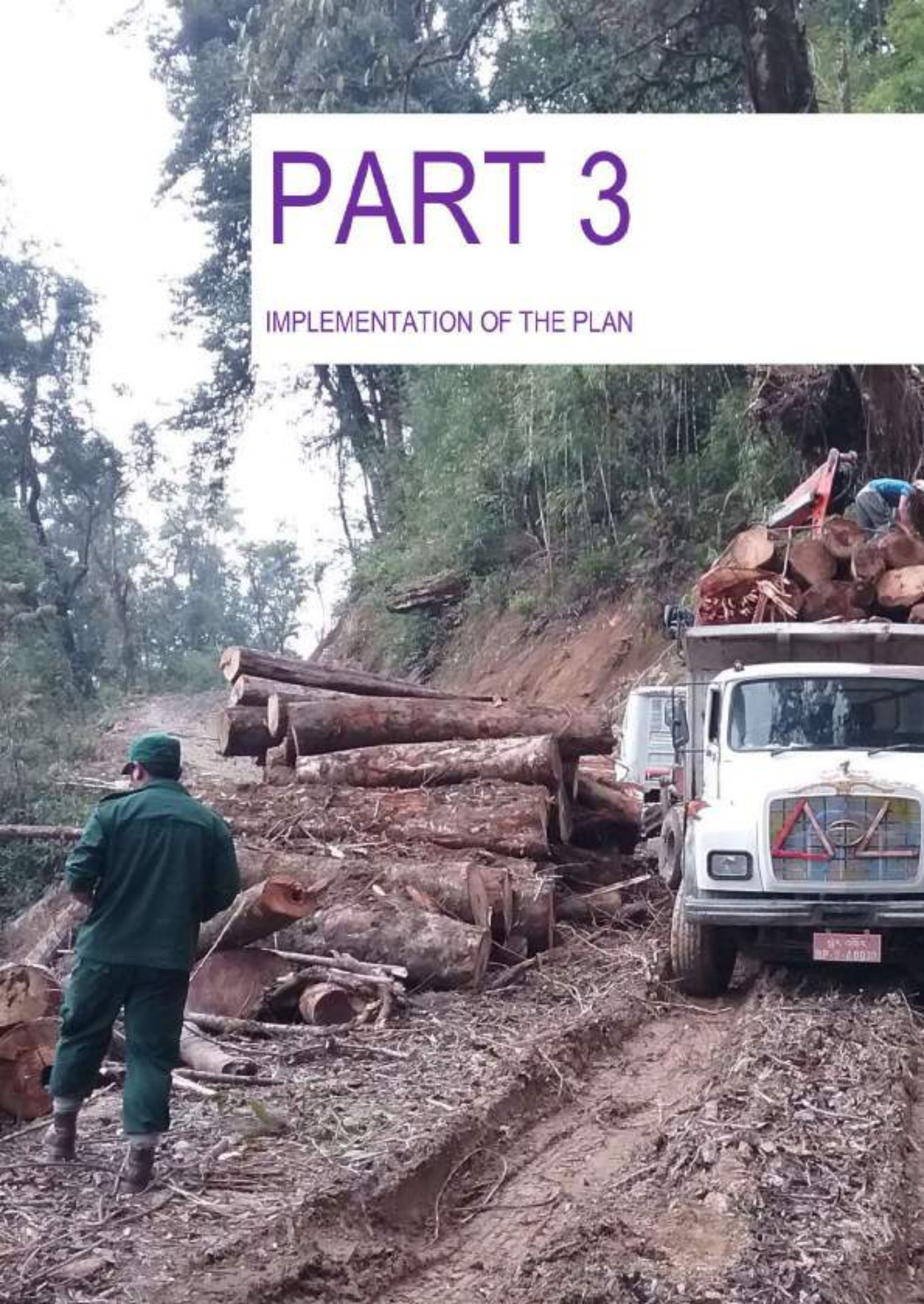
19. RESEARCH

Research programs will be taken care by RNR RC, and the DFO/FMU staff may collaborate as appropriate. The areas identified for the research activities in the last plan will be taken up on priority bases. The other areas of research are:

1. Revive older research site within the FMU.
2. Utility and treatment packages for the less priority species.
3. Domestication of Nationally important NWFPs, which are under risk of local extinction.
4. Study on the Epiphytes, an increase trend within the FMU. It deteriorates the quality of the timbers.
5. Study on mistletoe attacks on Chir pine trees along Chaskar road.
6. Impact of commercial harvesting on wildlife.
7. Change of forest composition in the operated areas.
8. Human wildlife conflicts due to harvesting operation.

PART 3

IMPLEMENTATION OF THE PLAN



20. IMPLEMENTING AGENCY

The Department of Forests is charged with the responsibility of protection and management of the forest resources in Bhutan. It will discharge this responsibility through the Territorial Division. The DFO Mongar, as the senior territorial officer, will be responsible for the implementation of this Management Plan, assisted by the Unit In-charge and other support staff.

20.1 Cutting Cycles

For future return it is felt that proper spacing between cable line layouts must be kept. This has resulted in areas being over harvested, with no chance for future cutting cycles. The forest will be sustainable if the cable line spacing is properly laid so that subsequent passes can be achieved. To ensure two passes in the future, a minimum of 60m needs to be kept in between the cable lines. Mixed broad leaf forest has a rotation period of 100 years, this means that two cable lines that will be implemented in the future are occurring at year 33 and year 66. Figure 14.6 depicts the cable layout. The original line will be revisited in the year 100. This ensures every aspect of sustainability, before the forests are put into management regime. Understandably, terrain in Bhutan possess a problem for layout. The layout in the field must be tailored to suit the terrain, but to the best possible the guidelines must be followed.

20.2 Annual Coupe

Coupe for harvesting in the operable area must be accessible, minimum environmental problems and they should fulfill following conditions:

- Based on the Silvicultural System the annual coupe will follow required spacing designed.
- The Unit In-charge will determine the extent of cable lines in the compartment to be harvested annually. All prescriptions and restrictions laid down in the plan must be considered and adhered completely.
- Unit In-charge will arrange to mark the trees as prescribed in Section 20.3.
- Alignment of cable lines in any way for safety, stand composition, environment and cost consideration could be done in consultation with unit in-charge.
- Cable line may transverse slopes greater than 100% but extraction should not be carried out.

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.

- Species listed for protection if encountered are protected as per Forest and Nature Conservation Rule 2003.
- No marking will be done 30 meters on each side of the perennial streams.
- In addition to 30 m buffer for perennial streams another 15 m is left along the streams sources where the local water supply protection felt necessary.
- Dead, dying, diseased and malformed trees will be given preference for marking.
- Marking must be done only by trained staff, with authorised hammer only.

20.4 Harvesting

To avoid wastage the trees will be cut 10 cm above ground. The hauling method for transporting logs from the coupe to road head will be done by skyline cable system. Contractors must be well- informed about the stumps height. Damaged trees left behind through bad falling techniques, even if not marked, must be salvaged.

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

- The layout of the cable lines should be planned well in advance of the harvesting operations after the coupe has been demarcated.
- The cable corridors should be as prescribe by the silvicultural system.
- Only chain saws and hand saws will be used for felling, cross- cutting, de-limping purposes, while axe could be used only for fuel wood splitting.
- Species that need debarking should be carried out at the earliest for safety purposes for any reasons.
- Measurements are to be recorded in the Log Yard Register. The Register should be up-to- date and ready to produce for any Government related purposes and the same to be submitted to the CFO.
- Records of all the trees marked and issued for rural and commercial use or for conversion within the forest, will be maintained and furnished monthly to the CFO through compartment record forms.
- Fuel wood will be collected from the harvested residues. It is important to collect from the entire cable line rather than allotting green trees, once the accessible area is finished collecting. To avoid excessive environmental damage the practice of manual rolling of logs will be discouraged, and may only be used on sites where the slope is gentle (<25%).

20.5 Reforestation of Harvested Sites

The harvested coupe or site must be cleaned to enable easy planting or natural regeneration to take place. One of the main reasons for wasteful and inefficient utilisation of forest resource and equipment is the lack of supervision of the harvesting operation. The CFO and his staff will ensure that all phases of harvesting by the NRDCL and other users are properly supervised.

It is crucially important that harvested areas are effectively regenerated as soon as possible after harvesting. Artificial regeneration in the broad leaved forest and Natural regeneration is given priority in the Conifer forest in the FMU. But if natural regeneration fails either enrichment or complete stocking by planting must be carried out in the Conifer forests. Monitoring of regeneration stocking is part of this process. If the monitoring of regeneration indicates poor stocking, remedial action must be taken in the planting season following harvesting.

The FMU, UIC will ensure that stocking of natural regeneration is monitored following completion of the harvesting operation. Enrichment planting, and Fencing, to protect regeneration will be carried out by NRDCL, in consultation with the FMU, UIC.

The harvested area must be reforested immediately after the harvesting operations. Prior to plantation, nurseries for local viable species should be raised in advance. The area shall be planted with commercially viable local specie. There is a need for heavy maintenance of plantation. Number of wage personnel (chowkidars) to look after plantation and nurseries should be increased. Number of weeding should also be increased as per field experiences rather than literature and plan prescriptions. 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 adopted in FRMD, it is recommended that regeneration surveys be conducted every three years, until the regeneration has reached a height that will ensure its survival. If the second survey (6^{th} year) indicates poor stocking, remedial action must be taken in the planting season following. The FMU, UIC will ensure that stocking of

natural regeneration is first monitored within three years following completion of the harvesting operation. The factors that limit the success of regeneration include; grazing pressure, protracted 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 reforestation as clearing and replanting a failed area would cost much more than the initial

tending for natural regeneration.

20.6 Road Construction

Roads need to be constructed to allow harvesting of the production Compartments. For this plan period, the proposed road construction will follow the existing road at Korilla block equivalent to 0.6 km and Kharnang block equal to 2.40 km as depicted in the map. Road extension will give full access to Forest areas of various stockings. During the preliminary field visits, the continuation of forest road to harvest the production areas are Kharnang 3 and 4 and Korilla 2a found feasible. However, while continuing the road in Kharnang Block, there is an obstacle in the form of a steep rock at the end of the existing road. Feasibility and potential studies needs to be conducted during the operational planning to plan the road construction in order to harvest the production area. For this planning, the same road has been proposed which is subject to final recommendations in the field.

Figure 15: Existing road and production areas in Kharnang block

Figure 16: Existing road and production areas in Korilla Block

Road construction in the FMU requires extra precautions to achieve environmental best practice. See Annex 2, for more details. The basic necessity in forest road construction is to avoid steep and fragile areas, to provide a proper drainage system, especially for safe discharge of run-off water during the monsoon, with enough culverts and cross drains, to have an efficiently draining compacted road surface.

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

A set of road standards have been developed by the Forest Engineers of TFDP, incorporating experience and observations over the eight years of the project. These are available from TFDP or FRMD.

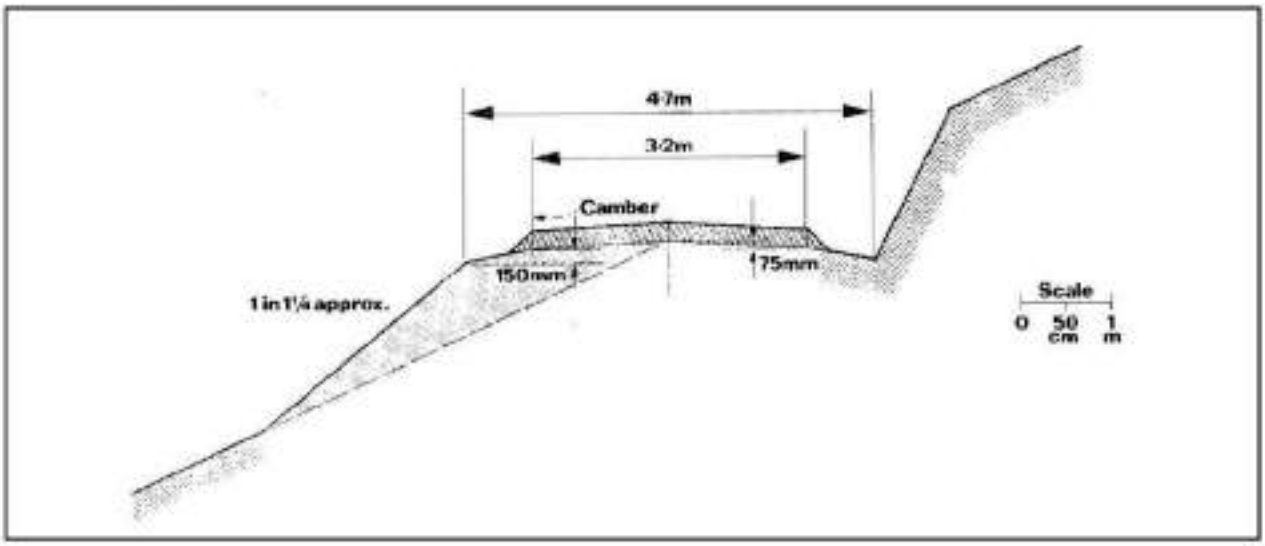


Figure 17:Recommended Road Profile

21. PLANNING

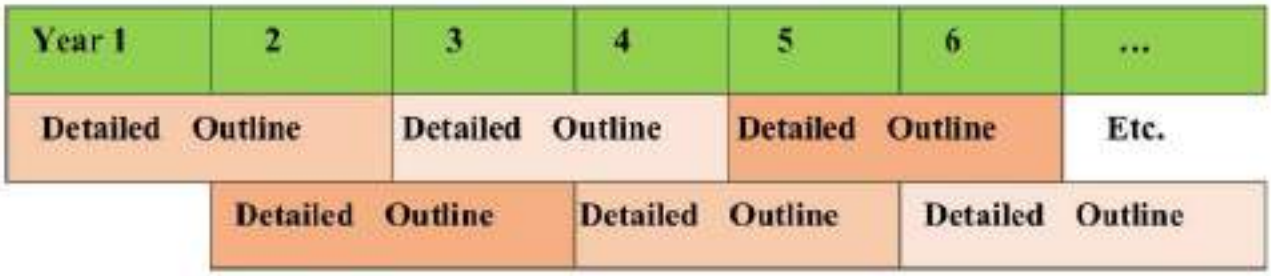
21.1 Operational Plan and implementation

A Biannual Operational Plan will be prepared by the CFO Mongar to facilitate the timely implementation of this Management Plan. Guidelines for the preparation of such Operational Plans have been prepared by FRMD (2002), and are available in all territorial Divisions. The Operational Plan will spell out in detail the sequence of operations for each of the activities envisaged in the overall Management Plan, including the start and end dates for accomplishing them. The Operational Plan is also the tool used to provide for changes that cannot be foreseen or allowed for in the FMU plan, such as insect and disease outbreaks, severe fires, etc. If and when these occur, the current Operational Plan should be immediately reviewed and areas and /or methods of operation modified to deal most efficiently with possible changes in the sustainable level of harvest.

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

The Rolling Operational Plan will include detail of activities for the coming year (year 1) and an outline of activities for the following year (year 2). Guidelines for Operational Planning prepared by FRMD UIC offices also. The Guidelines is user-friendly and contains detailed process for preparing and implementing the Operational Plan. FRMD will continue to update the changes.

The operational planning has important implication in budgeting. It allows participatory process since planning is carried out a year before the start of the activity. The primary aim in preparing the OP is to determine and to co- ordinate the timely input of resources.



Concept of Rolling Plan

Operational Plans will be prepared before NRDCL financial year begins so that the budget for OP can be presented before the management committee. It is therefore, recommended the OP be prepared as recommended by the Forest Management Code of Bhutan. The timing and the schedule of steps for Management Planning and Op writing is given below:

The OP will be prepared in consultation with all the agencies and parties. Inclusion of a consultation process with local communities in the preparation of the Plan is particularly important so that potential issues concerning communities in the forthcoming operational areas are worked through, before the plan is implemented. The process for preparing and implementing the OP is given below

Table 38: Implementation through Operation Plans

PREPARATION AND IMPLEMENTATION OF OPERATIONAL PLANS

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

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

Activity (Planning Step)	Objective	Output	Responsibility (lead)	Comments
9. OP approved by Director DoFPS	To approve the OP for implementation	Approved plan and budget	Approval by FRMD and Director DoFPS	OP approval linked with sanctioned budget for all planned activities
10. OP implementation by NRDCL	To carry out planned activities	Harvested timber; protected area; roads; fuel wood etc	According to responsibilities identified in the operational plan e.g. FMU, UIC, NRDCL, DzFO etc.	Each activity with a specific responsibility and budget
11. Monitoring of activities	To assess the level of achievement of planned activities	Information for FMU annual report	FMU, UIC	DoFPS responsibility is to monitor the implementation of activities carried out by NRDCL Monitoring also has a cost which needs to appear in the OP
12. DoFPS, UIC prepares FMU annual report	To report progress against planned activities To highlight any problems being encountered in implementation	FMU Annual report	FMU, UIC	Prepared annually Progress is reported against each FMP objective and the associated activities
13. Prepare the next year's operational plan (steps 2-5)	To prepare the next operational plan taking into account progress over the past year	Operational plan	FMU, UIC	Operational plans may alter in response to Forest Management committee suggestions and recommendations

21.2 Mid -Term and Final Review

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. The evaluation should be based around a review of the objectives and options, to see how well the management plan is being implemented. If objectives are not being achieved this should be examined, reasons determined and activities redefined if appropriate.

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

The results of Mid-term Review should be discussed with the FMU Level Management Committee. **Mid-term Review must be conducted in November-December 2021.**

21.3 FMU Level Management Committee

The FMU level Management Committee Meeting should be chaired by the CFO Mongar to ensure the smooth implementation of the Management Plan.

Therefore, the Committee consists of:

1. CFO, Mongar Territorial Division, Chairperson
2. FRMD Representative
3. RM, Zhonggar Division, NRDCL
4. FMU, UIC, Korilla FMU
5. Unit Manager, Korilla FMU, NRDCL
6. DzFO, Mongar Dzongkhag
7. Gups and Mangmis of Ngatshang, Chaskar and Mongar Geog
8. Key Village Elders

Terms of Reference for the FMU Level Management Committee:

During FMU Management Plan Preparation:

- To support the interest of the stakeholder groups during the planning process.
- To discuss and agree upon FMU forest management objectives for different parts of the forest based on national priority and specific local condition and needs.
- To consult (along with FRMD) with specific groups of stakeholders likely to be significantly affected by proposed activities such as road construction and timber harvesting ensuring that their interest are effectively accommodated in the final Plan.
- To review and endorse the draft Forest Management Plan before it is presented to Director General, DoFPS and Minister, MoAF for final approval.

During Operational Planning, Implementation and Monitoring:

- To represent the interests of identified stakeholders group during planning and review of activities under Ops.
- To review achievements during the past year (based on annual report submitted by the UIC) and advice and act on any issue identified.
- To make recommendation for changes in the proposed OP for the coming year based on previous year's experience and on the need to achieve the agreed objectives in the Forest Management Plan.
- To review and endorse the draft OP before submission to the Director General, DoFPS for approval.
- To participate in the 5-year mid-term review of the Forest Management Plan.
- To hold additional meetings as required in response to specific issues arising from the implementation of the Forest Management Plan and OP.

21.4 Staff

The CFO, Mongar Division is the overall controlling Officer of the area. The Forest Range officer and the FMU, UIC will have direct responsibility in control and management of FMU. They will be under the administrative control of the CFO, Mongar Division. The Divisional Forest Officer is the direct representative of DoFPS in the field and as such he is solely responsible for all forestry activities, both technical and administrative in his jurisdiction.

22.4.1 Responsibility

For the smooth implementation of the plan in the FMU, following staff is the minimum required;

Unit In-charge	1
Deputy Ranger	1
Asst. Forester	4

The UIC will be responsible for the day to day implementation of the plan under the overall guidance of the Divisional Forest Officer. The UIC will keep records of all the works, supervise and initiate other silvicultural activities as envisaged in this plan. The UIC will be responsible to CFO, Mongar.

Deputy Ranger will be responsible for carrying out operational inventory, help to prepare the OP, supervise road construction and maintenance and keep the track of regeneration of the harvested areas. Deputy Ranger will also be responsible for supervising the tree marking and felling, timber extraction, transport of logs to depot and reporting the coupe clearance. He will also be responsible for marking of thinning, fire and pest activities. The Asst.Foresters will be assigned to help the Deputy Ranger.

21.5 Buildings

The office and the staff quarters are constructed long time ago and it requires maintenance. The office building was very poorly electrified, therefore a major renovation on the same was done in the fiscal year 2015-2016 which improved electrifying the building. The two unit staff quarter are in dilapidated condition and at present not occupied by FMU staff, it needs to be renovated.

21.6 Vehicles and Equipment

Lack of mobility is the main cause of inadequate implementation and supervision pertinent to field activities by the Departmental staff. This is hindering smooth implementation of management plan.

With assistance from the FRMD the FMU would be supplied with one number bike to ease implementation of field activities. The office is supplied with computer from FRMD and now it has two computers.

22. MONITORING AND EVALUATION

The primary focus of the Royal Government of Bhutan's Forest Policy is to ensure conservation of the environment and, only thereafter, to allow the derivation of economic benefits (such as commercial timber production) from the forest.

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

Standard forms for monitoring and evaluation were prepared and are available from the FMCB, 2004. The forms for monitoring were subdivided into Physical, Financial and Environmental sections that contained an exhaustive set of questions and the forms for evaluation were also subdivided into Evaluation form A and Evaluation form B.

The TFDP working closely with the FRMD developed a new monitoring and evaluation process in 1999, for use on FMUs in Bhutan. Different forms were developed on different time scales; **Monitoring Form A** for the annual monitoring process, **Evaluation Form A** for the five year evaluation, **and Evaluation Form B** for the once only Evaluation. The field data collection forms used, consists of **Physical and Financial Forms1-3, Environmental Forms 4-11** and the **Physical, Financial and Environmental Summary Form.**

The necessary Monitoring and Evaluation Forms is available with DFO office or at FRMD.

22.1 Record Keeping

The records should be kept by blocks and compartments. This would ensure that each activity that occurs is recorded in the format and easy to find format. Totals of the AAC allotment would then be submitted monthly to the DFO - 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 allotments can be followed. Although record keeping may not seem as important as some management activities, it is the backbone of future management decisions 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 Divisions 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 Plan

The Head, FRMD, 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 management at every level of implementation, of an activity to ensure that input deliveries, work schedules, targeted output and other required actions are proceeding according to the Plan. The CFO, TD will ensure that monitoring is carried out on an annual basis according to the guidelines issued by FRMD. In the context of FMU implementation, *inputs* includes machinery availability and staff skills and availability, while *outputs* include operational plan completion, road construction, production of forest produce, and the like.

It is essential that monitoring forms are recorded regularly and are handed over for review. The plan must be monitored to obtain the best practice of forest management.

22.4 Evaluation

Evaluation is the examination of whether objectives are being achieved. In the context of FMU evaluation, sufficient time has to elapse before a realistic assessment can be made of progress towards fulfilling objectives (Incoll 1999). Evaluation must be carried out at five-year intervals, 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 obtained from FRMD.

Corrective action, if it is necessary, may require changes to a range of inputs or to implementation methodology. Staffs that are independent of field activities will carry out the evaluation.

The Director, DOFPS, will appoint the Evaluation Team

The Evaluation Team must conduct the evaluation in April 2011.

23. CONSTRAINTS AND RISKS

Constraints to forest conservation and management planning are:

- Lack of mobility leading to an inability of the staff to supervise any management activities in the FMU.
- Lack of skilled and trained forest workers.
- Uncertainty of recruit establishment due to grazing pressure and undergrowth competition.
- Potential negative effects of cattle grazing on regeneration success.
- Lack of internet connectivity facility in the FMU office.
- Lack of research information.

24. DEVIATIONS FROM PLAN PRESCRIPTIONS

The annual harvested area should be managed to allow for unforeseen situations. For these and any other *bona fide* reasons, the annual coupe may vary ±10%. However, the total volume harvested over successive five years period must be no more than five times the AAC volume.

Unforeseen other circumstances may warrant deviation from the Plan prescriptions. In such an event, the CFO Mongar must obtain prior written approval from the Director General, DoFPS. Any such request for Plan deviation(s) must be fully justified and such approved deviation(s) entered into the Management Plan during its next scheduled revision. The National Environment Commission Secretariat (NECS) or the Competent Authority established by the Ministry must be informed of the plan deviations approved by the Head of Department if any.

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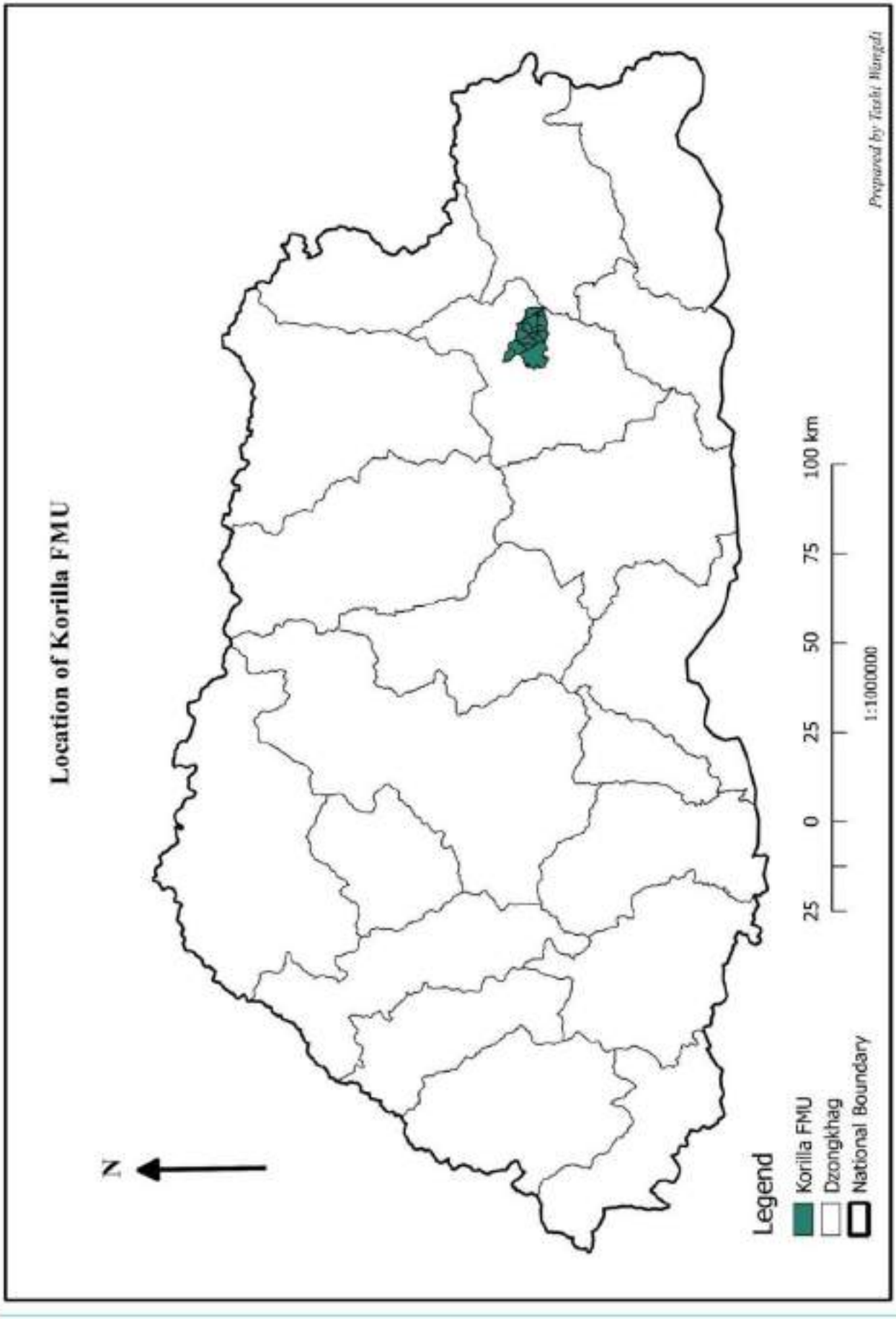
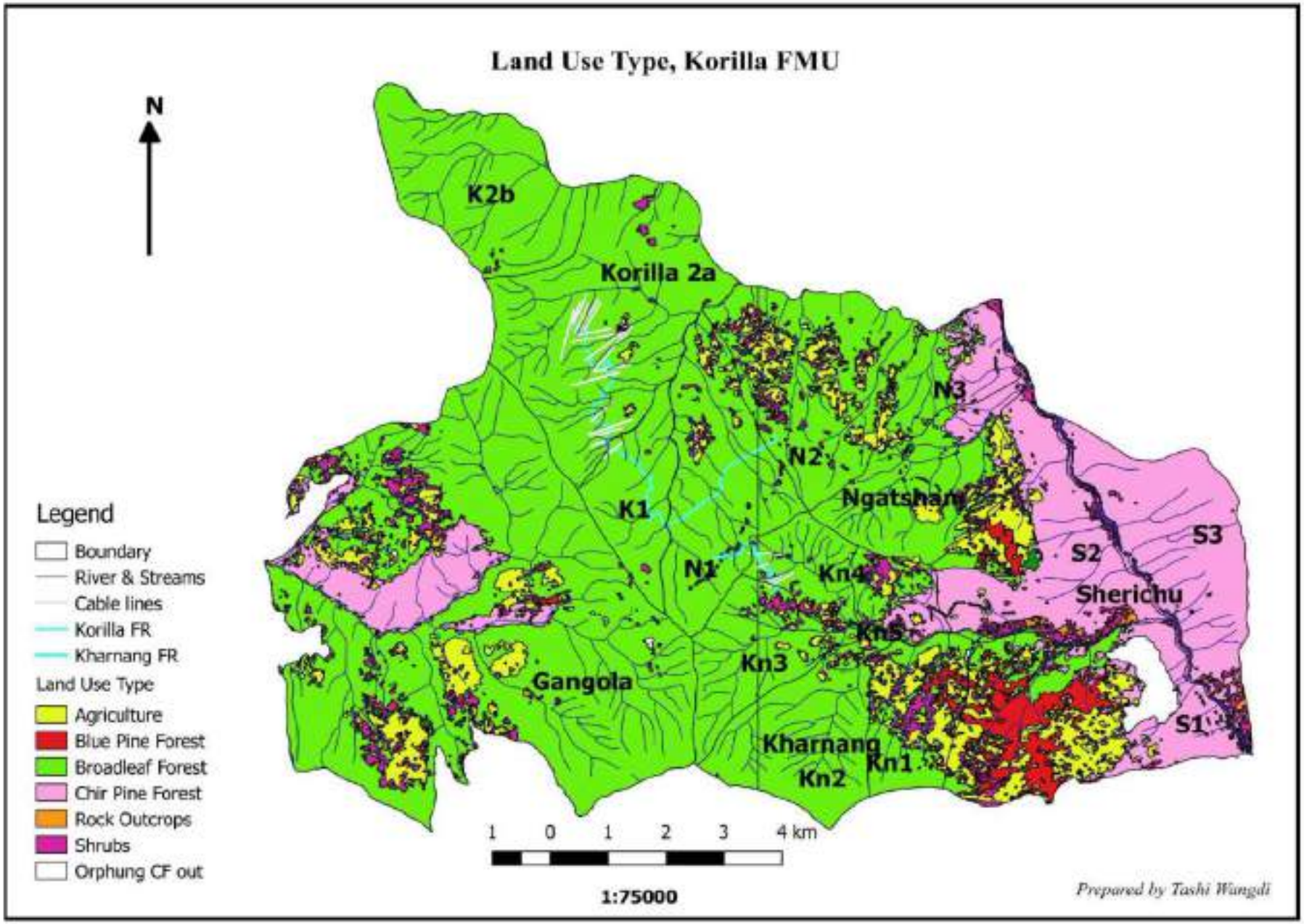
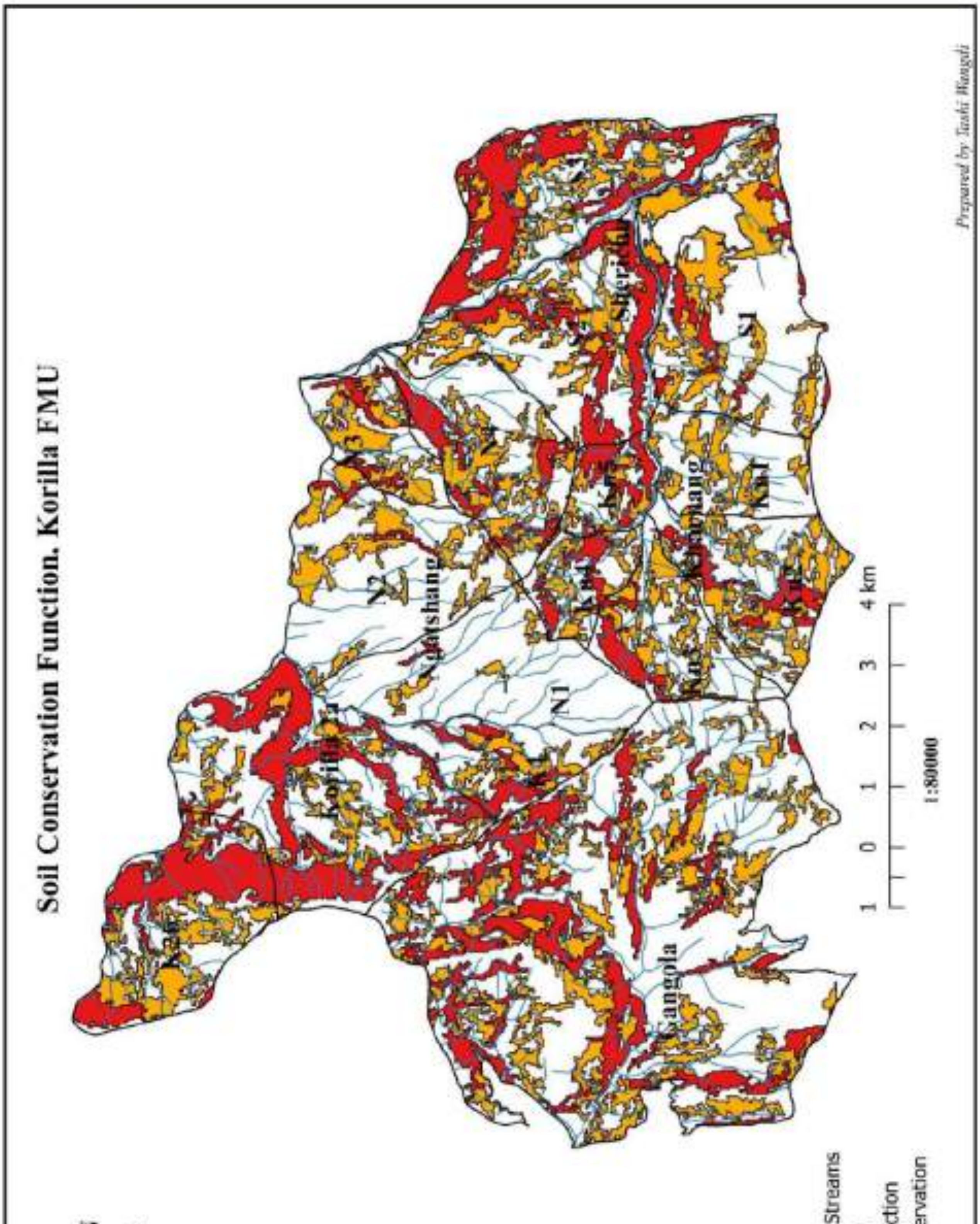
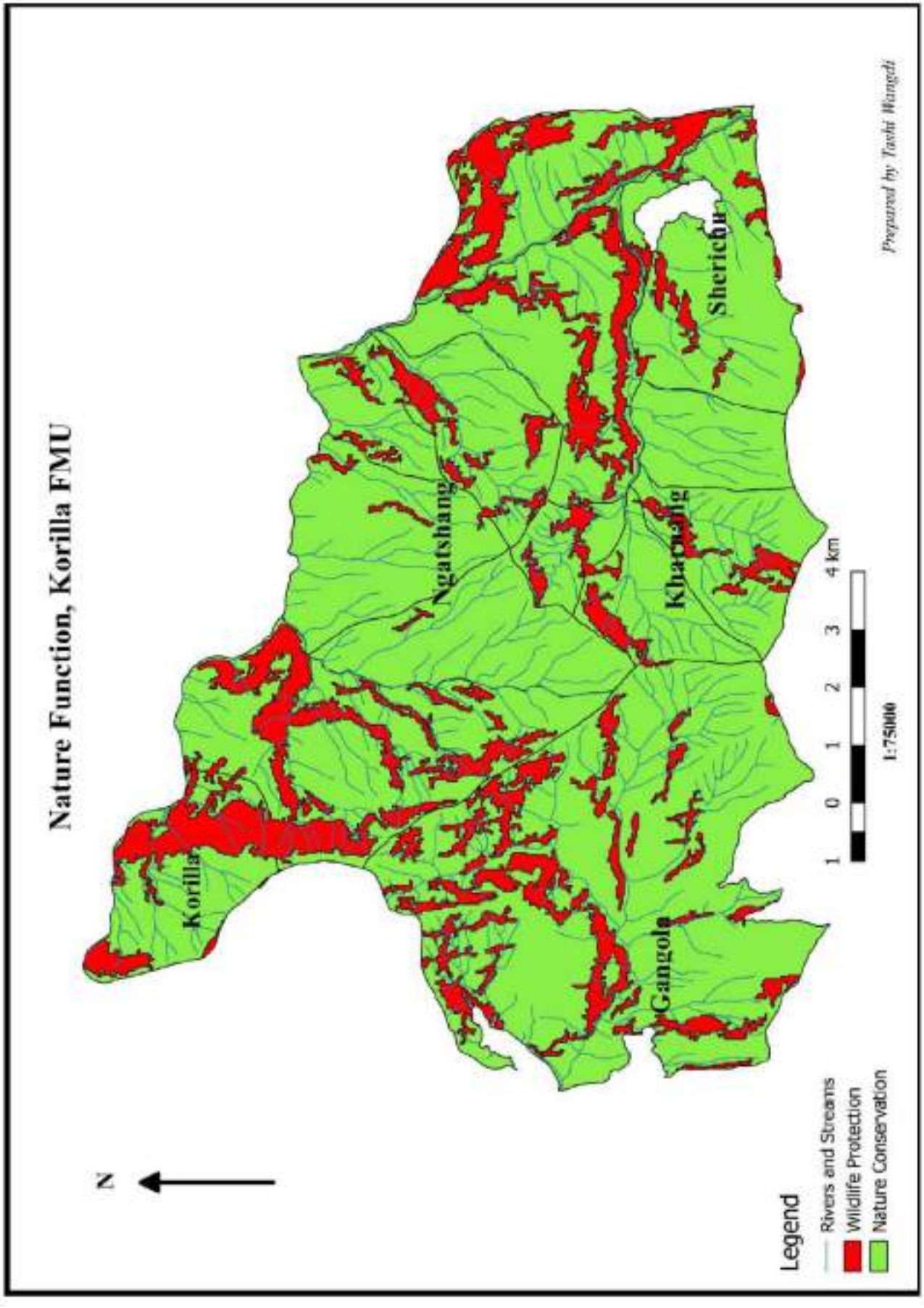
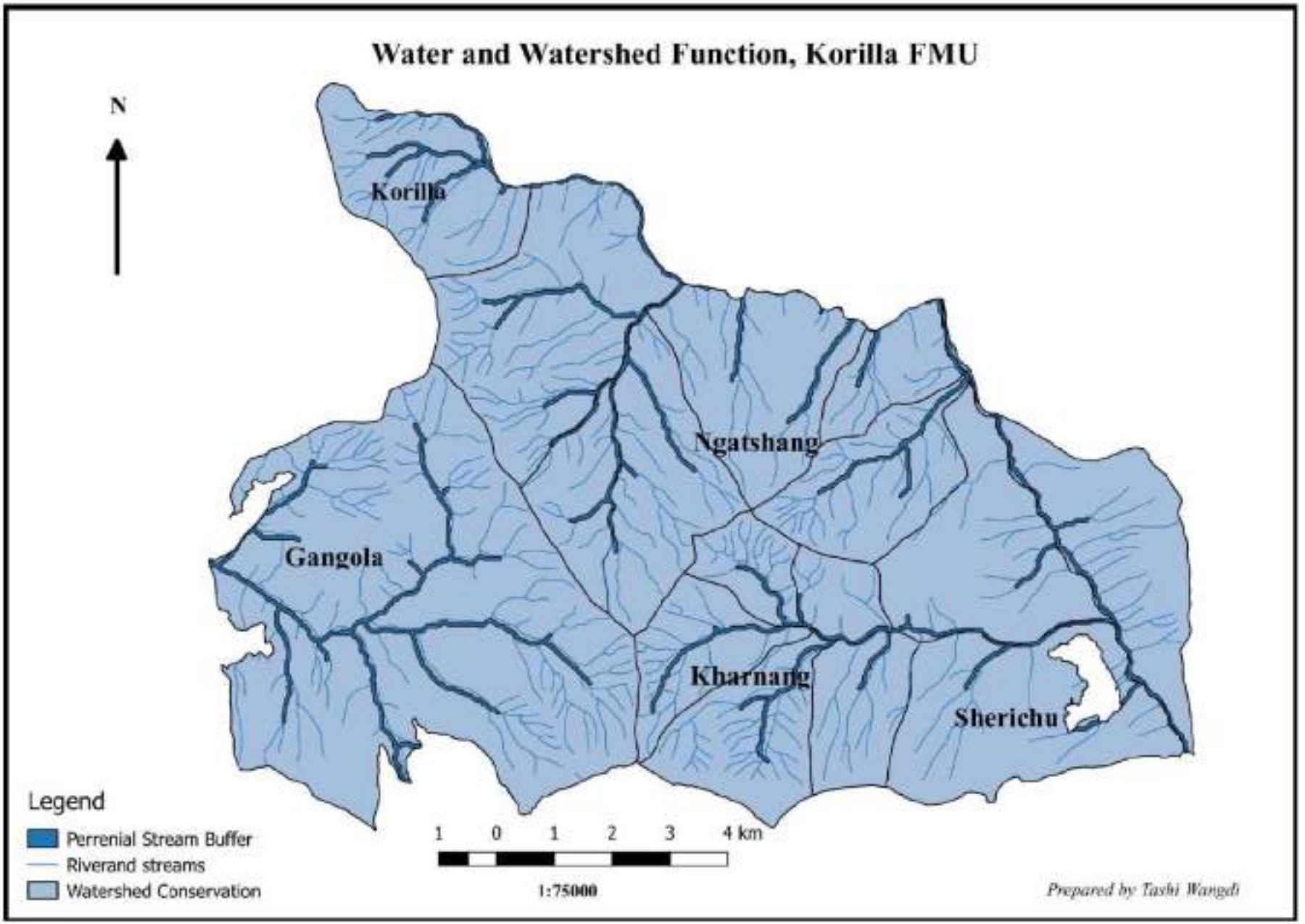
Annexure 1: Maps of Korilla FMU

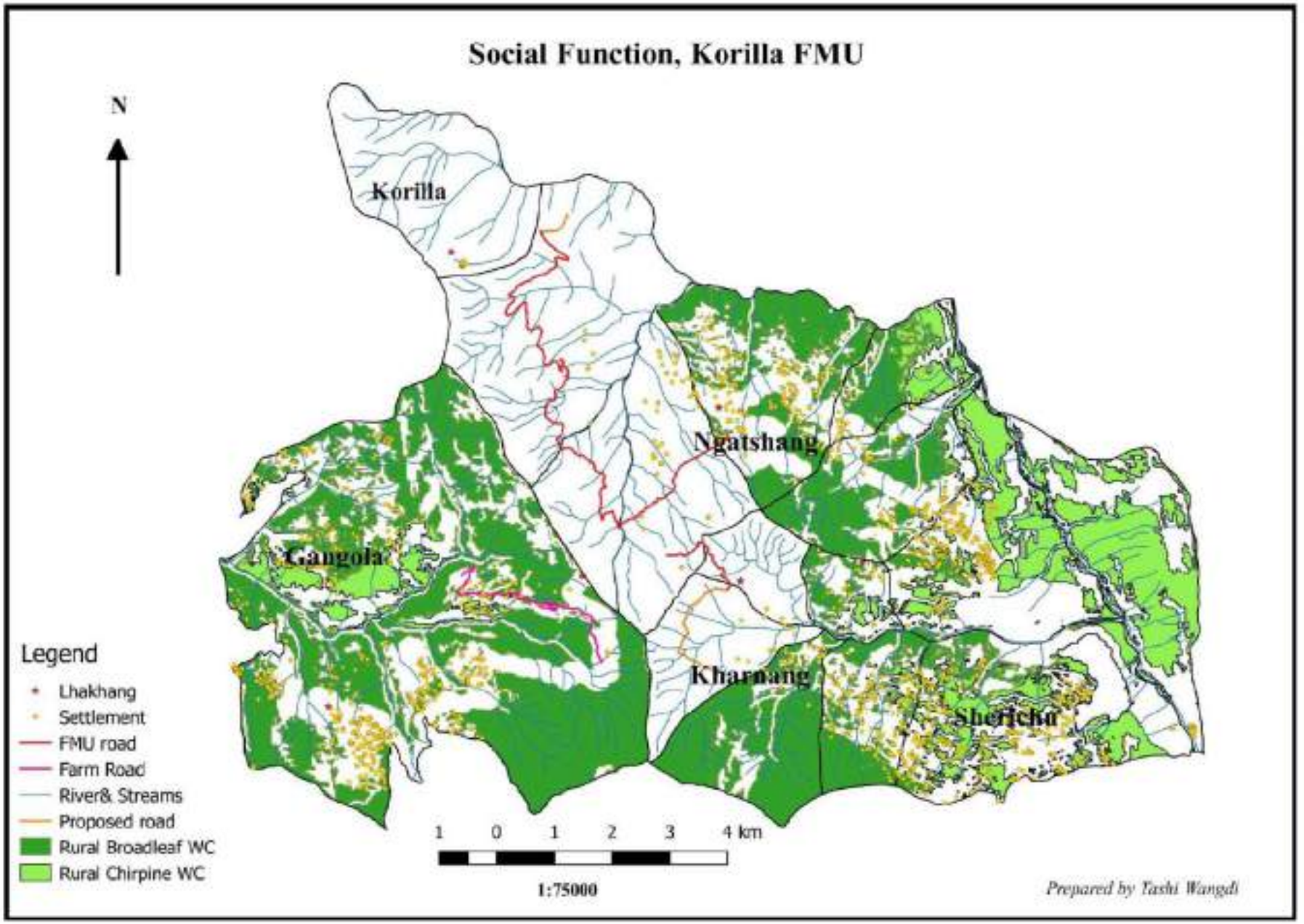


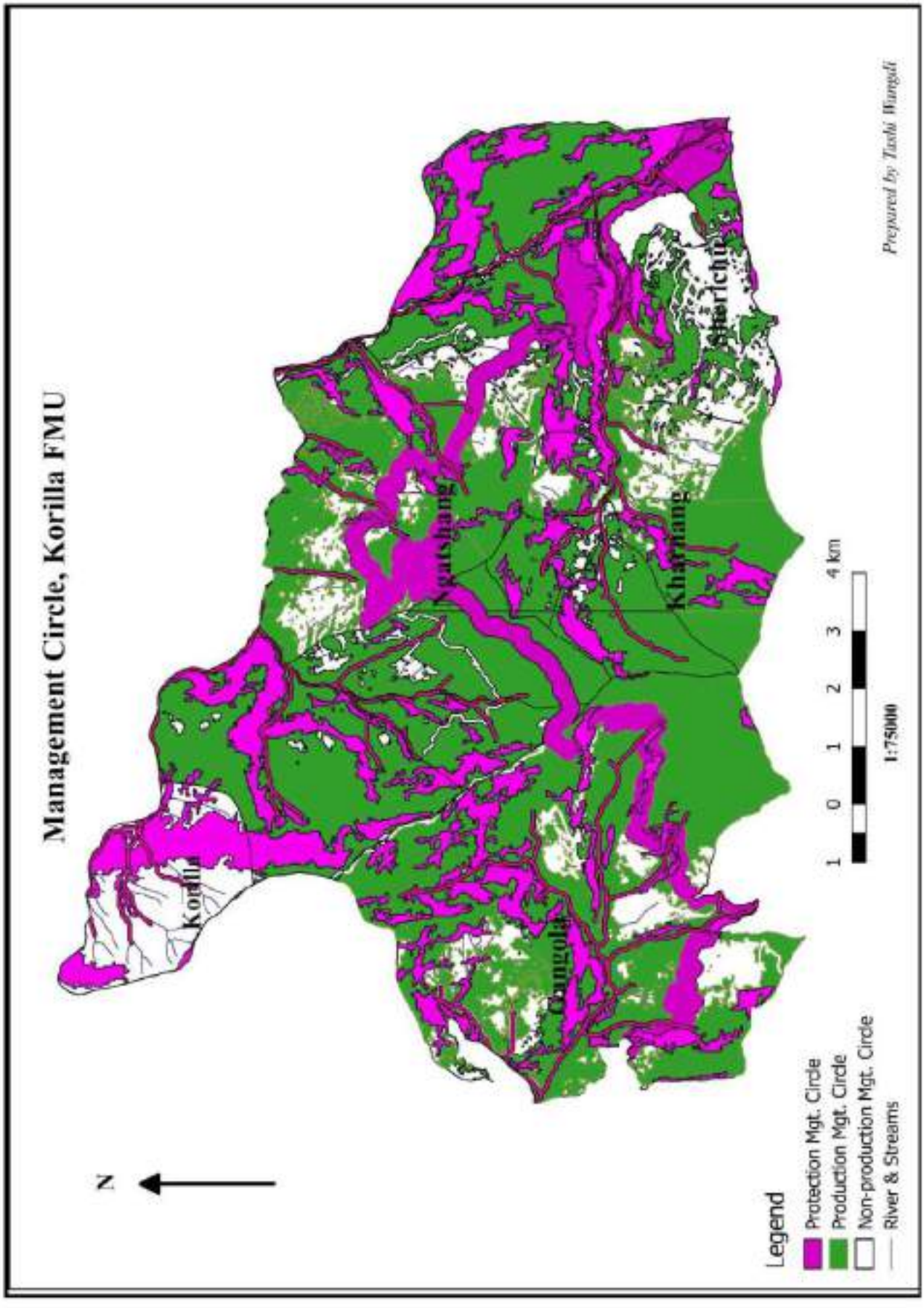

Land Use Type, Korilla FMU
N
K2b
Korilla 2a
N3
N2
Ngatsham
K1
S3
S2
N1
Kn4
Sherichu
Kn5
Kn3
Gangola
S1
Kharnang
Kn1
Kn2
Legend
Boundary
River & Streams
Cable lines
Korilla FR
Kharnang FR
Land Use Type
Agriculture
Blue Pine Forest
Broadleaf Forest
Chir Pine Forest
Rock Outcrops
Shrubs
Orphung CF out
1 0 1 2 3 4 km
1:75000
Prepared by Tashi Wangdi

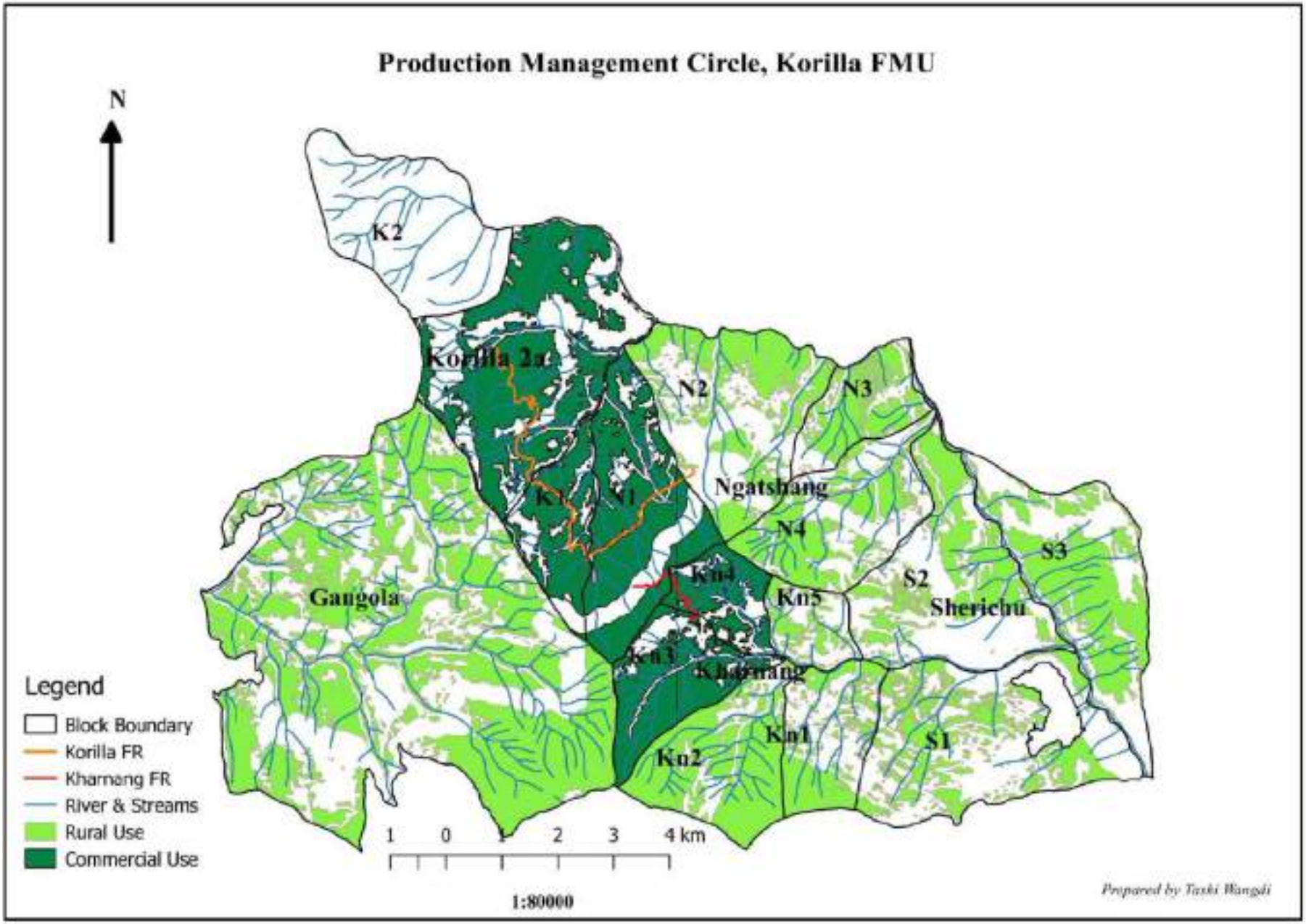

Soil Conservation Function, Korilla FMU
N
Legend
Rivers_& Streams
Boundary
Soil Protection
Soil Conservation
1 0 1 2 3 4 km
1:80000
Gangola
N1
N2
N3
N4
S1
Prepared by Tashi Wangdi

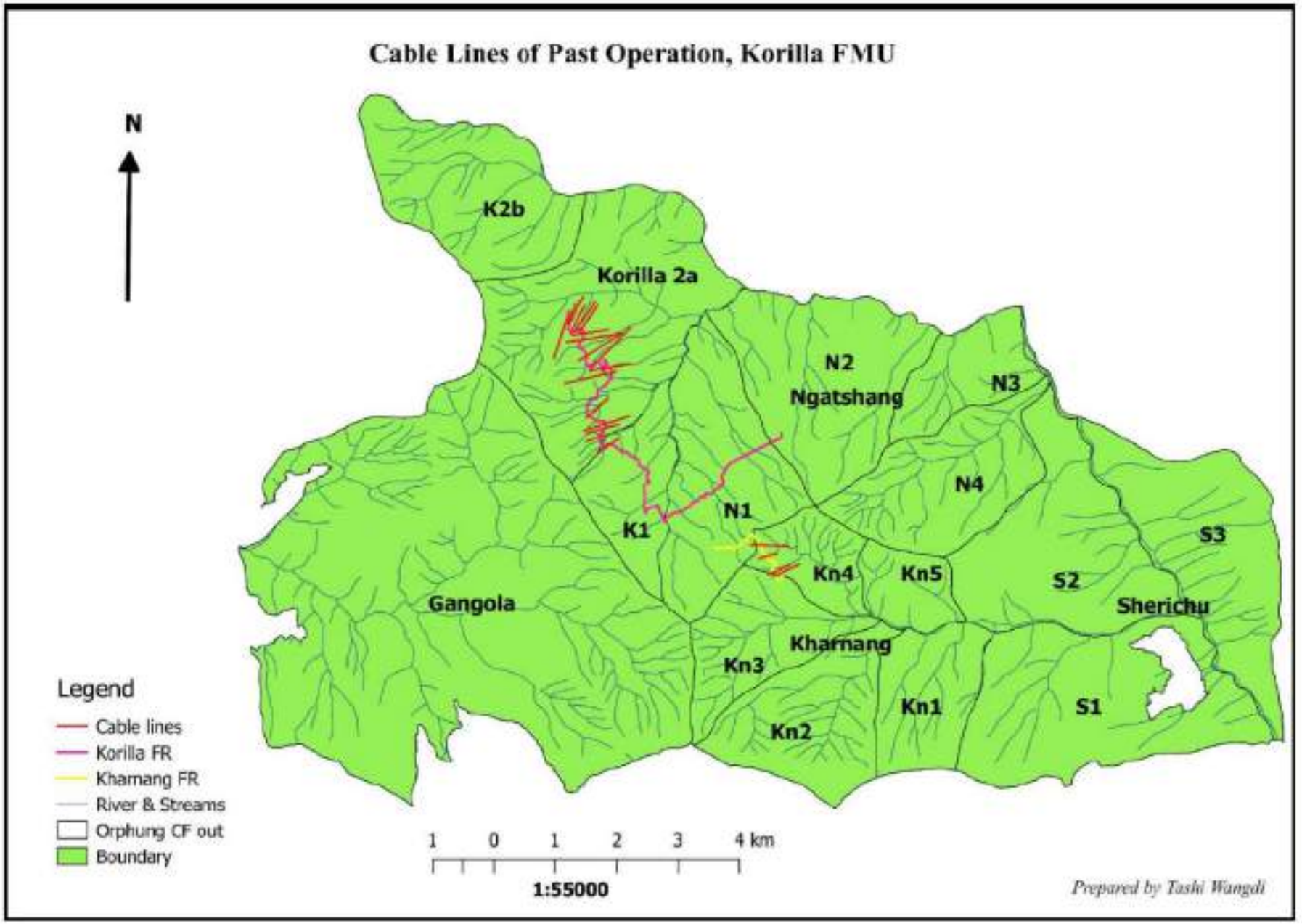

Nature Function, Korilla FMU
Korilla
Ngatshang
Kharchang
Sherichu
Gangola
N
Legend
Rivers and Streams
Wildlife Protection
Nature Conservation
1 0 1 2 3 4 km
1:75000
Prepared by Tashi Wangdi

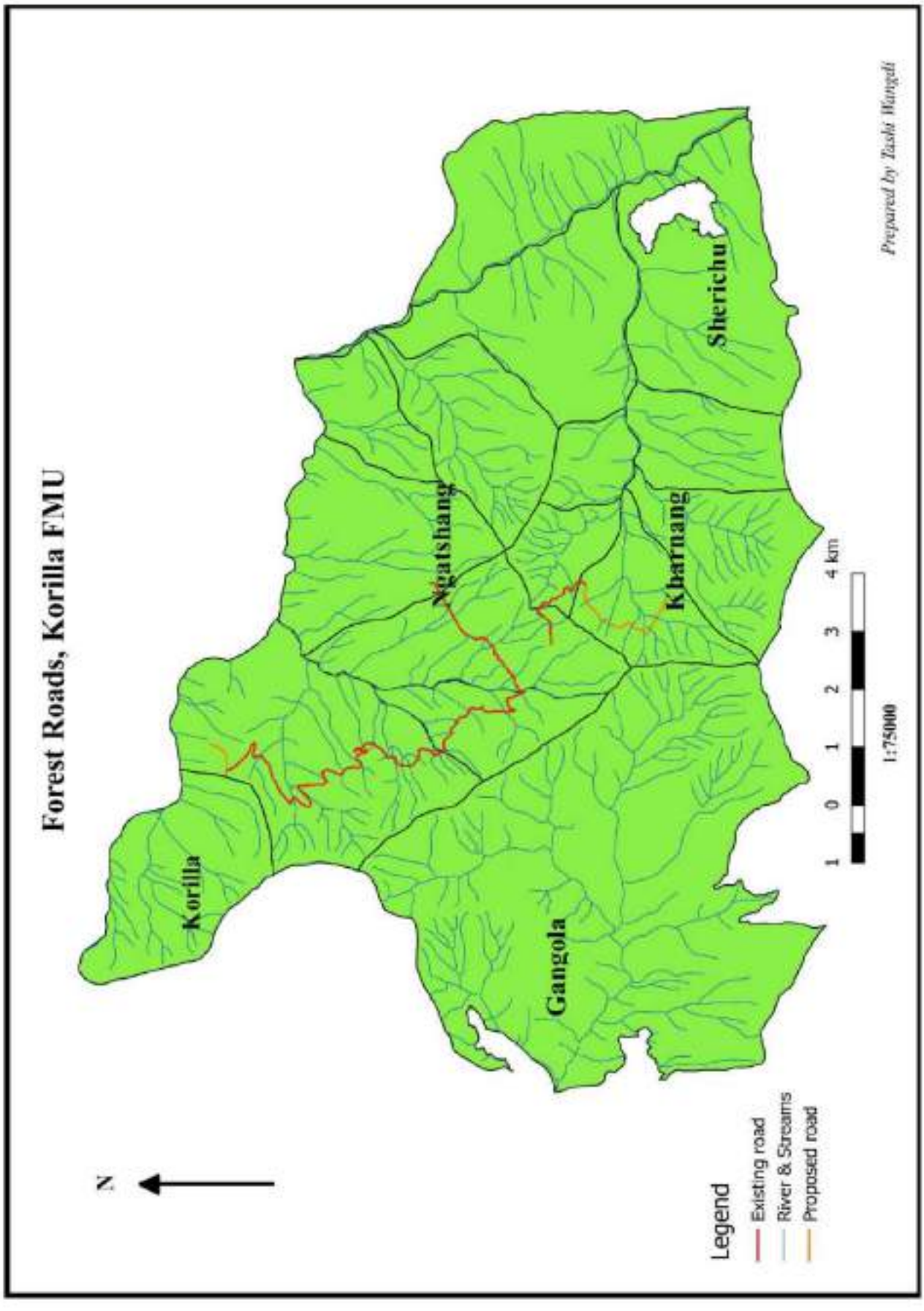

Water and Watershed Function, Korilla FMU
N
Korilla
Ngatshang
Gangola
Kharnang
Sherichu
Legend
Perrenial Stream Buffer
Riverand streams
Watershed Conservation
1 0 1 2 3 4 km
1:75000
Prepared by Tashi Wangdi


Social Function, Korilla FMU
N
Korilla
Ngatshang
Gangola
Kharnang
Sherichu
Legend
Lhakhang
Settlement
FMU road
Farm Road
River& Streams
Proposed road
Rural Broadleaf WC
Rural Chirpine WC
1 0 1 2 3 4 km
1:75000
Prepared by Tashi Wangdi


Management Circle, Korilla FMU
Korilla
Ngutshang
Khamlang
Sherichu
Gongola
N
Legend
Protection Mgt. Circle
Production Mgt. Circle
Non-production Mgt. Circle
River & Streams
1 0 1 2 3 4 km
1:75000
Prepared by Tashi Wangdi


Production Management Circle, Korilla FMU
N
K2
Korilla 2a
N2
N3
K1
S1
Ngatshang
N4
S3
Kn4
S2
Kn5
Gangola
Sherichu
Kn3
Kharnang
Kn1
S1
Kn2
Legend
Block Boundary
Korilla FR
Kharnang FR
River & Streams
Rural Use
Commercial Use
1 0 1 2 3 4 km
1:80000
Prepared by Tashi Wangdi


Cable Lines of Past Operation, Korilla FMU
N
K2b
Korilla 2a
N2
Ngatshang
N3
N4
N1
K1
S3
Kn4
Kn5
S2
Sherichu
Gangola
Kharnang
Kn3
Kn1
S1
Kn2
Legend
Cable lines
Korilla FR
Kharnang FR
River & Streams
Orphung CF out
Boundary
1 0 1 2 3 4 km
1:55000
Prepared by Tashi Wangdi


Forest Roads, Korilla FMU
Korilla
Ngatshang
Gangola
Khamang
Sherichu
N
Legend
Existing road
River & Streams
Proposed road
1 0 1 2 3 4 km
1:75000
Prepared by Tashi Wangdi

Annexure 2 : Compartment Review and Prescriptions

Concept: The compartment review and prescriptions were done with visual experience, walking through the each compartment. This was done in consultation with the field staff during the field visit. These reviews and prescriptions therefore, might be very general in some cases. Therefore, during the operational planning, detailed prescriptions should be laid out.

During the prescriptions followed, the forest functions as described in the function maps should be strictly adhered to. The restrictions mentioned in respective forest functions should be strictly followed.

BLOCK: Sherichu

COMPARTMENT: I

Aspect: North to South East

Forest description: The Area is mostly for local use only. Major area, particularly towards the river falls under river or road buffer. The area is very prone to fire and grazing pressure in the area is quite high. It is quite sensitive to erosion and there are forms of land degradation seen such as formation of small gullies, etc.

Prescription: The area should be mainly kept for local use only. Soil conservation measures, protection from fire and sokshing management should be carried out in the areas.

BLOCK: Sherichu

COMPARTMENT: II

Aspect: Mostly northeast

Forest description: The compartment falls under Yadi settlement area. Forest type is mostly chirpine till Yadi, and falls under road buffer areas. Patches of Bhutan pine are found above Yadi either in pure form or mixed with broadleaf species. Pine needle and NWFP collections are done from this area. Chirpine stands along Chaskar road have been affected by mistletoe/Loranthus. There has been recent incidences of fire in the area but have not had much affect on the forest

Prescription: The area can be opened to lemon grass, pine needle and other NWFP collections. Rural markings done should take care of road buffer as prescribed in the forest function mapping. Strict vigilance and patrolling should be in place to prevent outbreak of fire in the area. Fire lines may be created and maintained. Protection measure against mistletoes needs to be done, referring to literature or seeking advices from research centres.

BLOCK: Sherichu

COMPARTMENT: III

Aspect: Southeast

Forest description: The area could be considered as protection zone because it is not as accessible. Wherever feasible and accessible can be opened for limited rural allotment. Production forests are found towards ground level. Potential area for lemon grass production. Many areas are quite steep and prone to erosion and land degradation in monsoon season. The area is also prone to frequent fires. Recent fires in the area have destroyed patches of forests and can be seen along the Tashigang highway.

Prescription: Measures to protect the area from fires, erosion, etc. should be taken. Limited rural allotment from the area can be done; otherwise the area can be designated as protection zone. The area is also potential for lemon grass production particularly at the ground level.

BLOCK: Ngatshang

COMPARTMENT: I

Aspect: Mostly North

Forest description: This Compartment is harvested and one of the main concerns when we talk of Korilla FMU. Operated cable lines up to Cable Line No. 43 exists in the Compartment. Up to Cable Line No. 6, there is a good survival of seedlings and canopy closure is taking place as well. Cable line Nos. 7, 8 and 9 has been kept as Research Blocks, to study the natural regeneration in broadleaf forests. But unfortunately, not much work has been done in the Lines. Sources said that it has been discontinued due to budget constraints. These cable lines are clearly visible from the opposite aspects as wide and undesired plant species grown up. The area needs regenerated artificially by the NRDCL. The DFO should discuss with the concerned research officials and draw immediate attention on this. The fact that this area is operated and also there are many cow sheds is the main problem area when we talk about issues in Korilla FMU. But generally speaking, natural regeneration is not a problem in this area as one can see other viable species also coming up in association with the plantation species. There is a very good nursery maintained by NRDCL in the area. Seedlings of *Exbluckandia, walnut, champ, Acer and Nyssa species*, etc are spread in approximately 35 well maintained beds @ 18000 seedlings.

Walnut plantations have been tried in Cable line nos. 10 to 14, but seeds have been destroyed by rodents and fencing by the cattle. However, some seeds have survived and sprouted into promising seedlings. Walnut can be a very promising plantation if seeds are protected and germination allowed to establish.

One of the distinct openings is the first cable line (cable line no.1) A Power Transmission line has traversed through the line, just below the road. And this has hampered the existing regeneration taking place there, and opened the area to grazing. Otherwise the

regeneration is doing well after the immediate vicinity from the road. Established seedlings of planted species like Exbluckandia, Acer, Nyssa, Walnut, Schima etc. are seen and the seedlings have attained appreciable height and canopy closure is expected after few years.

Prescription: Grazing must be controlled in the area. The DFO and NRDCL should find possible means to control grazing, either by increasing watchmen (chowkidars) or creating awareness to local people etc. Heavy maintenance of plantation is necessary; the promising seedlings should be nurtured till they are established. Rural allocation from the interlines must be restricted. Weeding must be carried out entailed by the norms and standards of plantation circulated by the Social Forestry and Extension Division. Failure of plantation must be followed by beating up or re-planting.

The Research works on Cable line nos. 7, 8 and 9 should be followed up immediately or the artificial regeneration taken up in the aforesaid harvested areas.

BLOCK: Ngatshang

COMPARTMENT: 2

Aspect: North to North East

Forest description: The compartment had been exploited in the past due to easy accessibility (near the road) and also a sawmill existed in the area. Afforestation programs were initiated by the Dzongkhag. According to local sources, there has been over-exploitation of Champ trees in the past. Champ and other locally viable species in the area have been overtaken by Dephniphyllum species now. The area falls within the highway zigs. Ngatshang village settlements fall within this compartment. At the foothills, near the river, patches of chirpine forests are found.

Prescription: Soil conservation measures should be taken in the area. The DFO and NRDCL in collaboration with the Dzongkhag should look at the maintenance of the existing plantation. Grazing issues and regeneration problems in the area also needs to be discussed and overcome.

BLOCK: Ngatshang

COMPARTMENT: 3

Aspect: North East

Forest description: The Compartment is mostly settlement areas of Ngatshang community. The adjoining forests are also mostly sokshing for the local community. Patches of chirpine are found at the lower altitudes towards the river. The area should be kept for local use. There is heavy invasion of Dephniphyllum species.

Prescription: The area will be designated mostly for local use in the plan. Soil conservation measures and grazing regulation needs attention in the area.

BLOCK: Ngatshang

COMPARTMENT: 4

Aspect: East and North West

Forest description: The Compartment forms the Yaori Catchment Area. Majority of the area is the settlement area, comprising of Yadi village under Ngatshang geog. Most of the areas are therefore for sokshing and local use areas. Pure stands of chirpine forest are found towards the river. Around the settlements, forest condition is usually good and particularly the around the catchment area.

Prescription: The area will be mostly designated for local use only. Soil and water conservation measures should be undertaken. Regulation of grazing is also a necessary prescription. The area is also prone to forest fire, so strict vigilance must be in place. The rural allocation from the local use area should be monitored to ensure watershed conservation.

BLOCK: Korilla

COMPARTMENT: 1

Aspect: North

Forest description: Operated Cable Line nos. 15 to 26 falls under this compartment. There is intensive cattle browsing in the area. Survival of plantation seedlings is very low. Deliberate openings of fencing and freeing the cattle by the local people are a common sight. Forest condition is good at the interlines, except for few rural markings which can cause threats to sustainability. The cable lines below the road are performing better than those above the road. Below the road, there is no much grazing pressure and natural regeneration is doing well. The main constraints leading to low success of plantation are; grazing pressure, destruction of seedlings by heavy rain (planted at the onset of monsoon as per the plantation norms), tremendous pressure of weeds etc.

Prescription: There should be a strict vigilance and grazing should be controlled. Allocation of rural timber from the interlines is not permissible as per the prescriptions and this must be strictly adhered to. There should be heavy maintenance of plantation and wherever survival is low or not successful, immediate beating up should follow or the area should be replanted.

BLOCK: Korilla

COMPARTMENT: 2a

Aspect: Eastern

Forest description: There are steep areas towards Pangtot, which should be considered as Soil Protection areas. Near pangtot, towards Basakhar, the area is potential for commercial harvesting of timber. Since the area is quite steep, and the whole area falls either under

Soil Protection or Soil Conservation, there should be no ground based skidding in the area. The existing road at the Korilla Block 1 can be extended to this compartment, but adjustments should be made based on field conditions (taking care of the steep areas and gullies encountered).

Prescription: The area is potential for commercial production of timber. Since the Silvicultral System should shift from Strip Clear Cut to Patch cut system, it is expected that regeneration problems in the area will be reduced as compared to existing plantation. However, plantation should be carried out as per the norms and experience and should be maintained. There are few cow sheds and cow herds in the areas so the area is also prone to grazing.

BLOCK: Kharnang

COMPARTMENT: 1

Aspect: Northern

Forest description: The Block boundary is not as clear. Permanent topographic features have not been taken as Block boundary. It is a small compartment. Kharnnag settlement area falls under this compartment. Bhutan pine and Oak sokshing are found around the settlement areas.

Prescription: The area should be kept mainly for local use. Sokshing management/improvement can be possible areas of interest in the area. Soil Conservation and Land management activities should be carried out in the area.

BLOCK: Kharnang

COMPARTMENT: 2

Aspect: Northern

Forest description: The description is similar to Kharnang Compartment 1. A patch towards the north could be considered as a protection block since the area is quite steep. The compartment forms the Gudari catchment area. There is production feasibility towards compartment 3, since the stand is good.

Prescription: The area should be kept mainly for local use. Sokshing management/improvement can be possible areas of interest in the area. Soil Conservation and Land management activities should be carried out in the area.

BLOCK: Kharnang

COMPARTMENT: 3

Aspect: Mostly Southeast

Forest description: The compartment mainly comprises of steep areas and is not feasible for production. Production is potential towards the gully and compartment-2. The stand there

is quite good and is feasible for commercial production; however, whenever during the Operational planning, if steep areas are encountered such areas should be delineated as Soil Protection areas.

Prescription: Forest functions such as soil protection etc. should be added or completed during operational planning. Land management and soil conservation activities should be encouraged in this area.

BLOCK: Kharnang

COMPARTMENT: 4

Aspect: South to South west

Forest description: The compartment encompasses the Gudari water catchment towards the gully there are steep areas. Along the forest road entering inside this compartment, cable line survey has been done. Tree enumeration has also been completed. However, the area is dominated by Quercus species, which does not have good market.

Prescription: The existing forest road needs heavy maintenance. Landslides, blockage by trees on the forest road has been neglected, making the road unstable. A buffer should be maintained on unstable terrains, and harvesting of timber should be restricted. Since there are more Quercus species in the region, firewood coupes can be allotted from the compartment.

BLOCK: Kharnang

COMPARTMENT: 5

Aspect: Mostly Southern

Forest description: The majority of the area can be considered as Protection areas. There are few settlement areas and few degraded areas falling in the compartment.

Prescription: The steep areas will mapped out in the function maps and prescriptions drawn as in the plan. Forest fire prevention and land management activities are necessary in the compartment.

BLOCK: Gangola

This Block was designated as Watershed Working Circle during the 2nd Forest Management Plan. The objective in the previous plan was "protecting the natural environment, specially aiming at catchment hydrology in relation to the water supply to Mongar town.

As the block was utilized for local use with single tree selection system, it has been designated as local use area in this plan period.

Annexure 3: Forest Inventory Results

FOREST INVENTORY

The first inventory of Korilla FMU was carried out in 1990, the second inventory for the revision was done in 2001 and third inventory in 2012 with the objective of preparing a medium term management plan. The standard FMU inventory technique was used, with data being collected for trees larger than 30cm diameter on plots of 0.05ha, 10-30 cm trees on plots of 0.01 ha and for regeneration on plots of 0.004 ha. Data were also recorded on the site and wildlife observations were made. A total of 202 plots were used in the inventory calculations. These sample plots were laid systematically on the grids of 500 x 450 m between the lines and the plots on a line. On the base map scale of 1:25,000, this results in a 20mm x 20mm grid. The stratification of the forest types in the operable areas is done bearing in mind the homogeneity of the forest types and similar management needs.

The division of FMU into blocks, compartments and sub-compartments is maintained as such in the first plan for easy references and follow up for the field personnel. These are essentially water catchments and therefore follow ridgelines. Compartments were created for easy orientation within each block. Compartment boundaries generally follow easily identifiable topographic or physical features like main streams or roads. In some cases sub-compartments have also been created for orientation and management purposes. In most cases these boundaries follow forest types to indicate a uniqueness of an area for management purposes.

Forest Inventory Results

The standard inventory technique was used, with data being collected for trees >=10 cm DBH over bark on plots of 0.05 ha, and for regeneration on plots of 0.004 ha. Data were also recorded on the site and wildlife observations were made. A total of 223 plots were measured but of these only 134 were used for production planning as the remaining plots were located in the protection and non production zones. These 134 plots were used for AAC calculation.

Overall inventory result of Korilla FMU

	Result type	Results	Standard Error	Margin of Error percent	Confidence Interval low at 90 percent	Confidence Interval high at 90 percent
1	Total Area of FMU(ha)	13137	NA	NA	NA	NA
2	Number of plots	223	NA	NA	NA	NA
3	Total number of trees	1810903	Not Estimated	6	1698035.95	1923770.14
4	Total basal area(m2)	211237.9	Not Estimated	9	192047.51	230428.3
5	Total growing stock of Korilla FMU(m3)	805570.5	200072.13	32	548402.43	1062738.52

	Result type	Results	Standard Error	Margin of Error percent	Confidence Interval low at 90 percent	Confidence Interval high at 90 percent
6	Number of trees per hectare	138	Not Estimated	6	129.26	146.44
7	Basal area per hectare(m2)	16.08	Not Estimated	9	14.62	17.54
8	Volume per hectare(m3)	61.32	15.22	32	41.74	80.9

Commercial production inventory result of Korilla FMU

	Result type	Results	Standard Error	Margin of Error percent	Confidence Interval low at 90 percent	Confidence Interval high at 90 percent
1	Total Area of Production area(ha)	1999.06	NA	NA	NA	NA
2	Number of plots	42	NA	NA	NA	NA
3	Total number of trees	997028319.2	Not Estimated	130	-301201005.58	2295257643.98
4	Total basal area(m2)	51257.9	Not Estimated	19	41481.88	61033.91
5	Total growing stock of Production area(m3)	165920.6	84383.5	66	56007.39	275833.73
6	Number of trees per hectare	498749	Not Estimated	130	-150671.32	1148168.46
7	Basal area per hectare(m2)	25.64	Not Estimated	19	20.75	30.53
8	Volume per hectare(m3)	83	42.21	66	28.02	137.98

Rural production inventory result of Korilla FMU

	Result type	Results	Standard Error	Margin of Error percent	Confidence Interval low at 90 percent	Confidence Interval high at 90 percent
1	Total Rural Area of FMU(ha)	4974.09	NA	NA	NA	NA
2	Number of plots	92	NA	NA	NA	NA
3	Total number of trees	682315.4	Not Estimated	9	617978.57	746652.21
4	Total basal area(m2)	69118.1	Not Estimated	13	60009.64	78226.61
5	Total growing stock of Rural(m3)	369094.8	89880.42	31	253066.02	485123.61
6	Number of trees per hectare	137	Not Estimated	9	124.24	150.11
7	Basal area per hectare(m2)	13.9	Not Estimated	13	12.06	15.73
8	Volume per hectare(m3)	74.2	18.06	31	50.88	97.53

Annexure 5: FMU Level Management Committee

Korilla FMU Level Management Committee

As stated in the Forest and Nature Conservation Rule the FMU Level Management Committee has been established in order to have wider view in the management planning process. The Committee consists of :

1. CFO, Mongar
2. RM, Zhonggar
3. UIC, Korilla
4. UM, Korilla
5. DzFO Mongar
6. Gups and Mangmi of Ngatsang, Chaskhar and Mongar Geog.
7. Tsogpas of the Village
8. The management Planner

The Committee can co-opt any members they feel important for the management planning.

Term of References for the FMU Level Management Committee

A. During Forest Management Plan Preparation

- To represent the interest 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 (management circles and zonations), based on national priorities and combined with specific local conditions and local needs.
- To consult (along with FRMD), with specific groups of stakeholders likely to be significantly affected by the proposed activities such as road construction and harvesting and ensure that their interests are effectively accommodated in the final version of the management plan.
- To review and endorse the draft forest management plan before it is presented to Director, DoFPS, and Minister of Agriculture for final approval.

This will require four FMU, Level Management Committee meetings during the year, when the MP is being prepared.

B. During Operational Planning, Implementation and Monitoring

- To represent the interest of identified stakeholder groups during annual planning and review of activities under Ops.
- To review achievements during the previous year (based on the FMU annual report submitted by the FMU, UIC) and advice and act on any issues identified in the report.
- To make recommendations for change 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 arrangements within the draft OP before submission to Director General, DOFPS.
- To participate in the mid-term evaluation of the FMP.
- To hold any additional meetings as required in response to specific issues arising from FMP and OP implementation.
- To participate in the final (10 year), Evaluation of the FMP.

This will require at least one annual meeting of the FMU Level Management Committee during each year of FMP implementation. Meetings need to be timed to ensure consistency with the annual planning cycle and financial year.

Stakeholder Analysis for Korilla Forest Management Unit

Stakeholder	Interest	Impact of FMU management	Importance rank (1-5)	Representation on FMU management committee
Local herders	Grazing	-ve initially then +ve	2	Through Gup and Dzongkhag extension agent
Local residents	Rural timber, firewood, flag posts, leaf litter, NWFPs, medicinal plants, mushrooms, water, sang (incense), fodder, stones sand rock	all = except rural timber, firewood & flag posts (+ve)	1	Through Gup
Migratory herders	Grazing, firewood	=	2	Through Dzongkhag extension agents
Community	Sokshing rights	=	2	Through Gup
Religious community (local)	Firewood, incense, flag posts	Firewood & flag posts +ve; incense	3	Through Gup

Stakeholder	Interest	Impact of FMU management	Importance rank (1-5)	Representation on FMU management committee
Religious community (non- local)	Timber (large dimensions)	+ve	5	Not now required
NRDCL	Timber, jobs, forest development (e.g. roading, plantation, protection), profits, meet state timber needs	+ve	1	NRDCL representatives
Wood using industry	Wood chips, Firewood, Timber, Residues, Profits	+ve	1	Through NRDCL representatives and a representative nominated by wood users association
Contractors	Profits	+ve	3	Through NRDCL
Labour	Employment (jobs)	+ve	1	Through Gup and NRDCL
DOFPS Territorial Division FRMD	Protection of the environment and biodiversity Ensure timber supplies to rural people and govt. departments sustainably Control over activities	Environment and biodiversity = Otherwise +ve	1	Through DOFPS and FRMD representatives
Tourists (local) Tourists (non-local) Tour operators	Scenery, nature Scenery, nature Scenery, nature, profits	Profits +ve Others =	4	Through Dzongkhag
Researchers	Protected area, Production area, Information	all +ve	2.5	Through DOFPS

+ve denotes a positive impact on the "stake" of the forest management operations

-ve denotes a negative impact on the stake of the forest management operations

= denotes that the stake is unaffected by the forest management operations

1 = most important stakeholder

5 = least important stakeholder

Agreed composition of the Forest Management Committee Members

Organisations	Description
NRDCL	RM & UM
FRMD	Nominated by head FRMD
DOFPS	CFO (chair) & UIC
Gups	Covering the majority of the forest adjacent population
Wood industry	Representative to be nominated by the wood users association
Dzongkhag	RNR extension agents

Stakeholder Analysis carried out on 11th March 2016

Participants

1. Mr. Kado Tshering (CFO Mongar)
2. Mr. Tandin Wangchuk (RM Zhonggar)
3. Mr. Kuenzang Thinley (UIC, Korilla)
4. Mr Norbu Wangdi (DzFO, Mongar)

Annexure 6: Record Keeping Forms for the FMUs

Record keeping within the FMUs has been identified as a critical area that needs evaluation and constant monitoring to ensure that proper records of all activities are maintained. To date records have been kept in ledgers in the territorial offices, these records although thought to be comprehensive appear to be lacking some vital information. Furthermore, the information from the same areas seems mismatching and incomplete.

This annexure intends to direct the way in which records will be maintained from now on. Records from the check post will be maintained as usual but records for the activities within the FMU will now be maintained on a **Sub-compartment basis** as recommended and endorsed in the **Second national Level Management Committee Meeting.** Thus, the forms are available for easy references any time.

Required Backup Information

It is recommended that all the records within the FMU be transferred to these formats so that all the operations that have taken place in the Korilla FMU are concise and contained within a consistent format. Some vague information from the past are suggested to update and record the necessary information. Although record keeping may not seem as important as some of the management activities, it is the backbone of future management decisions and the importance must be stressed.

Updating and Safekeeping Maps.

Along with the new formats, it is important that proper maps and all field notes of the area are maintained. Maps of the FMU can be obtained from FRMD or enlarged topographic map sheets can be acquired from the Survey Department. New activities within the FMU should be record and information should be submitted to FRMD for map updating.

How to Complete and Maintain the Forms.

Three separate formats have been endorsed: **for Rural Allotment, for Commercial Allotment and For Stand and Regeneration activities.** These are meant to maintain important information in a summarised way. They do not have to be only records maintained, other records are important and must maintain them.

There is not a section within these forms for totaling activities. The monthly and yearly totals should be compiled in the regular reports to the CFO. Copies of these reports should be maintained in a folder in the Divisional Office.

There will be three forms for each sub-compartment. These forms should be photocopied (three for each compartment or sub-compartment) and stored in a ring binder so that extra sheet can be inserted where and when needed. The Unit Office must maintain records in the soft copies in computer.

Filling up the Forms:

Recording of information should be done after each activity. The Block, Compartment and Sub- Compartment can be listed, and the forms will then be active for that sub-compartment until the sheet is full. This may mean for the entire ten-year period, or longer, will be on the same sheet. All forms require that the Management Circle (MC) and Working Circle (WC) be recorded.

Management Circle (MC)- Production(P), Protection (Pt) or Non Production (NP) state the acronym of the management circle in which the activity is taking place.

Working Circle (WC)- Blue Pine (BP), Hardwood(H), Mixed Conifer(MC), Fir (F), state the acronym of the working circle in which the activity is taking place. More than one WC can be recorded.

Further information required on the **Rural Allotment** form is mainly the name and address of the permit holder along with the permit number, marking book number, species, product type provided and quantity. In the Comment column record any relevant information, this should include permit holder's name and may also include area description or stem per hectare remaining etc.

Information required on the **Commercial Allotment** form is the designated cable line number (year and number, i.e. 2016-01), the length of the cable line and the azimuth of the line. The number of groups per line must be recorded along with the area of the cable line. The number of tree marked in the cable line and group must be recorded with the total standing volume, NRDCL's recovery volume is recorded in the next column. The Other Activities column is for any activity that does not fit anywhere else. The marking book number is recorded next to this column. The Comment column must include a description of the cable line location as indicated by the traverse notes, including the tie point, for example: 283m WNW (Tenzin Wangpo) from the junction of Korilla top.

Further information required on the **Stand Tending and Regeneration** form if the cable line number, the activity completed (Eg: thinning), including the year and area, for regeneration, natural should be indicated for future regeneration survey results (this will be recorded on the same line in the future). If beating up of the artificial regeneration is required the species must be noted. When surveying, the result must recorded along with whether a resurvey must be done, the year for the next survey can be noted under the Comment column. This column should also contain details of the plantation or thinning locations.

Annexure 7: Tree marking Rules

Marking Rules for Single Tree Selection System

- Selection System will be used on sensitive and exposed sites where other Silvicultural system cannot be applied.
- Trees marked for harvesting will be evenly distributed throughout the stands.
- Mature and over mature trees should be given preference for removal.
- Dead, dying, diseased and malformed trees will be marked on a priority basis. However, care should be taken so that no large openings are created in the stands by marking these trees.
- In a mixed stand, even distribution of species should be left standing as future crop.
- Where cable cranes are to be used, the extraction line will be as narrow as possible, not wider than four meters.
- Trees damaged during harvesting will be marked and removed during the subsequent coup cleaning operation.

Marking guidelines for Chir pine under the seed tree system

The following guidelines in carrying out seeding (or first) felling are not intended to be applied rigidly, but may be taken as a basis for the framing of site specific prescriptions.

- Seed tree system will be applied to Chir pine stands or mixed stands in which conifer is the predominant species both in numbers and special distribution.
- The larger trees (DBH OB >30cm), with sound, well-developed crowns, should be selected as seed-bearers (seed trees) and should be spaced at about 15-20 trees per hectare (i.e. approx. 22 to 26 ms apart). If no such trees are available smaller trees (more trees per hectare) should be retained.
- Smaller trees and poles, if thinly scattered, should be felled to create blanks for regeneration. But well-stocked groups of promising stands should be left to form part of the future crop.
- Well-established advanced growth of both saplings and poles should be completely freed from overhead cover.
- This system will not be applied to areas with heavy undergrowth of competing shrubs or herbaceous layer unless ground seedbed preparation is undertaken, prior to or soon after the felling operation.
- This system should not be applied to stands on steep and over-exposed slopes or on south facing slopes. In the case of gentle south facing slopes, the cable lines may be oriented southwest with corresponding reduction in corridor width to

reduce over-exposure to sunlight. On hot aspects it may be advisable to leave considerably more trees per hectare or the felling may be made in patch or in comparatively small groups.

- In mixed stands with a predominance of Chir pine, silvicultural treatment will favour the regeneration of pines.
- Slope condition, wind firmness of surrounding and retained seed-bearers as well as the visual stand value will be considered whilst using the system.
- Diseased, malformed, dying, non-wind firm and fire/resin-tap damage stems will be cut on a priority basis.
- Retained seed bearers should have a complete canopy, capable of bearing viable cones, disease-free, wind firm and reasonable form.
- Retained stems should not be the oldest or tallest in the stand. Over-mature trees should be felled on a priority basis.
- The configuration of the area selected for felling under this system may be irregular in shape.
- Maximum size of a contiguous area harvested should not exceed one hectare in extent.
- Advanced growth should be retained and protected where possible during felling.
- No logs that have not been debarked and lops and tops should be retained; to avoid bark beetle infestation or build-up of fungal infection.
- No resin tapping will be permitted on retained seed bearers, which will be marked prior to felling.

Marking guidelines for blue pine under the seed tree system

- The seed tree system is used in pure pine stands or mixed stands consisting of mixture of pine and spruce with pine predominating.
- The seed tree system will be used in the above stands only on suitable sites.
- The system will not be used on steep and exposed, south or south west sites
- In mixed stands an equal distribution of pine and spruce will be left standing.
- Slope characteristics, wind firmness and aesthetic values will be considered.
- About 20 to 25 trees per hectare (i.e. approx. 22 to 26 m apart) will be left standing.
- Diseased, malformed and dying trees will be cut on priority basis.
- Trees left standing will be of good health and form to ensure good seed source.

- Trees left standing will not be the oldest or tallest in the stand. Over mature trees will be cut on priority basis.
- The shape of the area chosen for the seed tree system can be irregular.
- Maximum size of a contiguous area harvested using this system should not exceed one hectare.

Marking guidelines for patch clear-felling (Group Selection System for Broadleaf forests)

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

- Create several patch or group openings along a line totaling 2-3 Ha per sub-coupe (including sky-line corridor), and with each opening separated by patch of intact forest (of at least 10-20m)
- 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 or dying trees or those showing symptoms of decay or damage (snags, scars, conk, etc.) will be retained between patches, and in the interline spaces, to safeguard flora and fauna niches or habitats, but not in the harvested patches themselves, where there is the risk of wind throw and danger to personnel working underneath and where their value as refuges in such open spaces is questionable (Note; guidelines such as this one should be based on specific management objectives and current understanding of practical measures of biodiversity conservation).
- The totally protected *Taxus baccata* (Yew) shall not be marked for felling under any circumstance and all species listed for protection under the Forest and Nature Conservation Act (1995) must also be protected if encountered.

Marking Rules for Thinning in Young Blue Pine Stands.

- Thinning will be carried out in immature stands. The objective of the thinning is to increase growth and quality of the stands and at the same time provide small dimension timber to the local people. Healthy, vigorous trees will be released by cutting suppressed, diseased and malformed trees. Considering the fact that there is great variation in the age, density condition of the immature stands.
- The stands for thinning will be identified from the forest type map and verified in the field.
- The stands identified for thinning, if falls within the harvestable limit of the cable cranes, will be subjected to thinning.
- Marking of trees for thinning will depend on the number of stems per hectare, age

or size classes, and the spatial distribution.

- In stands less than 10 m in average height the target spacing should be approximately 4.5 m X 4.5 m or about 500 trees per hectare.
- In stands with pole crop (average height 10-20 m) the spacing of the trees after the thinning should be more than 5-6 m or approximately 300 to 400 trees per hectare.
- In stands which, at present, have less than desired trees density and spacing, only trees, which grow in cluster, very close together and therefore, compete for light and nutrients can be removed. Diseased trees, especially those infected with mistletoe should be removed.
- Care must be taken not to create large openings in the thinned stands.
- Diseased, malformed and suppressed trees will be thinned on a priority basis.
- Under no circumstances the marking officer should give in to pressure from potential local users to mark good quality, healthy and best trees in the stands.

Marking for Rural Uses

- It is necessary that the marking for rural use whether for timber or fuel wood, should be done under standard Silvicultural system.
- Firewood marking when necessary should be done under Single Tree Selection System from Local Use (only) forest area.
- Flag posts, fence posts and poles demand should be met by marking for thinning in the pole crop high density stands thereby subjecting the stands to Silvicultural thinning.

Annexure 4: Road Standards

As stated before, the road standards developed in the east by TFDP will be implemented for design, drainage and construction of all forest roads in the FMU. Following are the standards:

Road Design

1. Road lengths and density should be minimised, consistent with access requirements to reduce environmental impacts and enhance access economics.
2. Where possible locate roads in areas with low side slopes, the maximum side slopes allowed in all areas except rock is 100%.
3. 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.
4. Roads should be planned in such a way as to balance cut and fill to minimise transport of construction materials.
5. 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.
6. Roads should be kept as narrow as possible to reduce damage to the environment and to reduce costs.
7. 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.
8. Minimum radius formed by curves or corners should be 15 ms and should where possible fit the topography of the land.
9. Roads should be located on elevated areas where possible to minimise side cutting, width of clearing and drainage problems.
10. Side cutting should be carried out leaving a stepped batter, each step no more than 3 m in vertical height and no more than 100% gradient with a 1.5 m horizontal step.
11. Convex road surface should be maintained at all times with the centre line 30cm higher than the edges.
12. Stabilise and re-vegetate cut and fill slopes with shrubs, grasses and legumes as soon as possible after construction.
13. 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 minimise stream river crossings.
- Roads should not be constructed in areas, which are prone to flooding in the monsoon seasons.
- In areas where side slopes of 70% or greater extend for a distance of 100 m or more above the proposed road catch drains should be constructed to divert surface water into culverts. Side drains or table drains should be at least 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 intervalsalong the road. The following table gives the minimum spacing required according to road gradient. Should the roadside drain be composed of erodable material then the distance between the culverts must by reduced by 50%.

Road gradient %	Distance between culverts (ms)
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 50 m before a watercourse.
- Sumps or silt traps should be places in drains every 50 m in erodable soils and must be cleaned regularly.

Road Construction

1. 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).
2. Primary excavation should be done in such a manner as to remove the topsoil and place it on the downward slope of the road. This will allow vegetation to regenerate and stabilise the slopes.
3. Where side slopes of 70% or more extend more than 100 m downhill no side casting of spoil should be allowed. In this situation end haul methods must be used.
4. Forest roads should only be constructed on stable soil types where there is no possibility of slippage.
5. All road construction on side slopes of over 50% or difficult terrain, such as boulder fields, must be carried out using excavators.
6. Batter and fill slopes should not exceed 100%
7. 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).
8. 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.
9. The adverse gradient should not exceed 10%. However, grades of up to 12% will be allowed for distances of up to 300 m if this substantially reduces road length. Following this incline a minimum distance of 100 m of grades of 10% or less must be maintained.
10. The favourable gradient should not exceed 12%. However, grades of up to 15% for distances of up to 300 m will be allowed if this substantially reduces road length. These grades should be followed by grades of less than 10% for distances of 100 m or more.

Annexure 8: Environmental Imoact Assessment Report of Proposed Forest

NRDCL

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Natural Resources Development Corporation Limited
ROYAL GOVERNMENT OF BHUTAN
THIMPHU, BHUTAN

No. NRDCL/HQ/Engg-Sec/03/2016/ 877 April 21, 2016

The Regional Manager
Zhonggar Regional Office
NRDCL: Mongar

Sub: **Environment Impact Assessment Report of Korila FMU**

Ref: **NRDCL/Zhong/Road-01/2016/99 dated February 2, 2016**

Sir,

With reference to the above cited letter, enclosed please find herewith the Environment Impact Assessment Report for road for revision of Korila FMU Plan along with Environment Management Plan, google earth images showing the tentative alignment of road, dump site & labour camp location and 1:50,000 topo map showing the road alignment tentatively.

The scan copy of the detail EIA report will also be emailed to you for your reference and record.

You are instructed to forward the copy of the detail EIA report to concern authority for their immediate action.

(Karma Dukpa)
Chief Executive Officer

Copy to:

1. The Chief Forestry Officer, FRMD, DoFPS, for kind information.
2. Dy. Chief Forestry Officer, FRMD, DoFPS along with a copy of the EIA report.
3. The Chief Forestry Officer, Territorial Division, DoFPS Mongar, for kind information.
4. Dy. General Manager, Production Division, NRDCL HO, for necessary action.

The nation's premier supplier of natural resources as construction materials at the most affordable rates and in sustainable manner
Post Box No. 192, Telephone - CEO: 00-975-2-322615, EPABX: 00-975-2-323834/323868/ 328959,
Fax No.: 00975-2-325585, E-mail: info@nrdcl.bt website: www.nrdcl.bt

ole fax Sent 21/4/16

Road

ENVIRONMENTAL IMPACT ASSESSMENT REPORT FOR CONSTRUCTION OF FOREST ROAD AT KORILA FMU, KORILA BLOCK, MONGAR DZONGKHAG

1 Name of the applicant : Natural Resources Development Corporation Ltd

2 Name of project : Construction of forest road

3 Present mailing address : Chief Executive Officer, NRDCL Thimphu, P.O. Box no. 192, Tel. no. 325749, EPABX no. 00975-02-323834/323868. Fax no. 00975-02-325585. Email: info@nrdcl.bt

4 Name of environmental focal person : Mr. J.K.Nepal, Engineer, Production Division, NRDCL HQ, Thimphu. Tel. no. 02-323834/323868. Email: jknepal@nrdcl.bt

5 Project objectives : Timber harvesting & afforestation of harvested areas

6 Relevence to overall planning : Revision of Forest Management Plan

7 Funding and costs : Funded by NRDCL, Thimphu
Nu. 3,601,200.00 (Estimated)

8 Project description

8.1 Project location : From 14.00km point of existing road of the FMU.

Table 1: Road location details by Dzongkhag and Geog

Road chainage		Dzongkhag	Gewog	Town	Village
From	To				
0 + 000	1 + 200	Mongar	Ngatshang	Nil	Pangtoe

1:50,000 Topo map attached.

8.2 Category of road : Access road

8.3 Road specification

Table 2. Road Specification/Quantities

Item	Unit	Specification/Quantities
Right of way clearing	m	10.00
Formation Width	m	5.00
Pavement Width including edging	m	3.50
Pavement material (Edging, soling & agttes)	m^3	1,314.00
Volume of excavated material		
a) Excavation in soil all type	m^3	2,919.41
b) Excavation in rock all type	m^3	5,107.60
Average road gradient	%	±7
Maximum road gradient	%	±11
Cross drain	no	NIL
Box/Hume pipe culvert	no	NIL
Bridges	no	NIL
Total length of bridges	m	NIL
V-shaped side drain diamensions		
In soil (horizontal x vertical)	cm	40CM X 30 Cm
In rock (horizontal x vertical)	cm	30 CM X 20 CM
Total length of v-shaped drain	m	1,198.50
Box shaped side drain diamensions (lengthxbreadthxheght)	cm	NIL
Total length of box drain	m	NIL

8.4 Excavated Materials : The excavated material will be managed and disposed off safely at designated locations through the use of excavator and tipper trucks or hydraulic tractors.

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

Sl. No	Particulars	Quantity
1	Safety fuse	144 coils (Approx)
2	detonator	252 Nos. (Approx)
3	D-chord	204mtrs. (Approx)
4	Jelatine	324 kgs (Approx)

Control single shot blasting technique will be adopted with the engagement of a trained & certified blaster.

9 Alternatives : NIL

10 Public Consultation : Public consultation meeting conducted

11 Project site Physical Environmental details

11.1 Topography and Geology

Table 3: Topography and observations along the road

Chainage(Km 0+000)		distance (m)		Side slope %	Observation on geology & possible problem	Method of slope & terrain stabilization Above & Below road
From	To					
0 + 000	1 + 200		1,200.00	20-100	Daling formation (Samchi/Shumar) & no problem foreseen	Normal Bio-engineering + Retaining & Breast wall structure works wherever required
	Total		1,200.00			

11.2 Water Course Crossings

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

Chainage at which road crosses water course		Name of water course	Type of crossing	If bridge, Length of bridge (m)	Down stream water users- details		
					Name of community or individual	House hold (no)	Type of use
From	To						
0 + 000	0 + 0573	N A	H/pipe culvt	NIL	Nil	Nil	Nil

12 Project Site Ecological Description

12.1 Land Use/Vegetation

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

Chainage from take o		Land use	Area (M^2)	Tenure	Affected House hold no
From	To				
0 + 000	1 + 200	Mixed hard wood forest	12,000.00	10 years	Nil

Table 6: Areas Required for Project Facilities

Facility	Land use	Area (m^2)	Tenure/ownership	Remarks
Labour camp	Mixed Hard wood forest	1000 per annum	Govt. reserve forest	Till project completes
Others				

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

13 Project social environment

13.1 Population

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

Dzongkhag	Gewog	Households (No)
Mongar	Ngatshang	2 house hold of Pangtoe village

Source of information: as per attached No Objection letter of the Gup, Geog

13.2 Loss of Houses, Services, Infrastructure and Cultural Heritage Sites

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

13.3 Aesthetics

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

14 Project Impacts and Mitigation Measures

Type of negative impact	Mitigation measures	Estimated metigation costs
Blockage of water canal	NIL	NIL
House	NIL	NIL
Infrastructure	NIL	NIL

14.1. Monitoring Program

Monitoring of the construction works will be done by Site supervisor, Korila Unit, NRDCL, including time to time monitoring by the Unit Manager, Korila Unit under Zhonggar Regional Office, Mongar. The Regional Manager, Zhonggar Regional Office, NRDCL Mongar, shall also carry out the frequent monitoring works. Also the Engineer, from Engineering Section, NRDCL HO shall carry out the monitoring works as & when required.

(J. K. Nepal)
Engineer
Production Division, NRDCL HQ

PRELIMINARY COST ESTIMATES FOR KMS

Sl. No.	Particulars of work	Quantity	Unit	Rate	Amount (Nu)	Remarks
1	**EARTH WORK**					BSR 2013,
1.1	Right of way clearing	12,000.00	sqm	6.99	83,880.00	CG0002, P. 4
1.2	Formation cutting					BSR 2013,
	a) Excavation of all types of soil	2,919.41	cum	59.71	174,317.97	EW0013, P.62
	b) Excavation of all types of rock with or without blasting	5,107.60	cum	211.21	1,078,776.20	BSR 2013, RW0014, P. 62
2	**MASONRY WORKS**					
2.1	Excavation in foundation trenches for construction of hume pipe culvert					BSR 2013,
	a) Excavation of all types of soil	0.00	cum	95.67	0.00	EW0105, P. 6
	b) Excavation of all types of rock with or without blasting	27.77	cum	398.49	11,066.07	BSR 2013, EW0107, P. 6
2.2	Providing & laying NP2 class RC pipes including collars					BSR 2013,
	a) 600mm dia with 45mm wall thick	6.25	m	2,946.13	18,413.31	DR0093, P. 9
2.3	Providing & laying dry rubble masonry with hard stone in catch pit, retaining wall, appron etc.	7.76	cum	1,660.08	12,882.27	BSR 2013, SM0050, P. 21
2.4	Filling of trenches	3.53	cum	61.62	217.52	BRS 2013, EW0195, P. 7
3	**ROAD WORKS**					BSR 2013,
3.1	Preparation of sub grade	4,380.00	sqm	9.93	43,493.40	EW0002, P. 5
3.2	Providing & laying hammer dressed stone edging 150mm x 300mm	2,400.00	m	81.36	195,264.00	BSR 2013, SM0073, P. 22
3.3	Providing & laying stone soling	804.00	cum	1,270.67	1,021,618.68	BSR 2013, SM0072, P. 22
3.4	Providing & laying base course	402.00	cum	1,754.64	705,365.28	BSR 2013, RW0147, P. 65 (+) MT0069, P. 3
3.5	Providing & laying shoulder filling	180.00	cum	67.77	12,189.60	BSR 2013, EW0096, P.6
3.6	Digging & providing V shaped earthen side drain	2,400.00	m	18.39	44,136.00	BSR 2013, RW0107, P. 64
3.7	Consolidation of road surface	4,020.00	sqm	6.98	28,059.60	RW0123, P. 64
TOTAL					3,429,679.85	
Add 5% contingency					171,483.99	
GRAND TOTAL					3,601,163.84	
Or SAY					**3,601,200.00**	

Prepared & submitted by:

(J. K. Nagel)
Engineer
Production Division, NRDCL HQ

PRELIMINARY COST ESTIMATE 1.80 KMS

Sl. No.	Particulars of work	Quantity	Unit	Rate	Amount (Nu)	Remarks
1	**EARTH WORK**					BSR 2013,
1.1	Right of way clearing	18,000.00	sqm	6.99	125,820.00	CG0002, P.
1.2	Formation cutting					BSR 2013,
	a) Excavation of all types of soil	4,543.12	cum	59.71	271,209.70	RW0013,
	b) Excavation of all types of rock with or without blasting	10,677.50	cum	211.21	2,255,194.78	BSR 2013, RW0014,
2	**MASONRY WORKS**					
2.1	Excavation in foundation trenches for construction of hume pipe culvert					BSR 2013, EW0105,
	a) Excavation of all types of soil	31.51	cum	95.67	3,014.56	P. 6
	b) Excavation of all types of rock with or without blasting	110.18	cum	398.49	43,905.63	BSR 2013, EW0107,
2.2	Providing & laying NP2 class RC pipes including collars					BSR 2013, DR0093, P.
	a) 600mm dia with 45mm wall thick	43.75	m	2,946.13	128,893.19	9
2.3	Providing & laying dry rubble masonry with hard stone in catch pit, retaining wall, appron etc.	53.26	cum	1,660.08	88,415.86	BSR 2013, SM0050, P. 21
2.4	Filling of trenches	22.63	cum	61.62	1,394.46	BRS 2013, EW0195,
3	**ROAD WORKS**					BSR 2013,
3.1	Preparation of sub grade	6,570.00	sqm	9.93	65,240.10	EW0002,
3.2	Providing & laying hammer dressed stone edging 150mm x 300mm	3,600.00	m	81.36	292,896.00	BSR 2013, SM0073, P.
3.3	Providing & laying stone soling	1,206.00	cum	1,270.67	1,532,428.02	BSR 2013, SM0072, P.
3.4	Providing & laying base course	603.00	cum	1,754.64	1,058,047.92	BSR 2013, RW0147, P. 65 (+)
3.5	Providing & laying shoulder filling	270.00	cum	67.72	18,284.40	BSR 2013, EW0096,
3.6	Digging & providing V shaped earthen side drain	1,789.50	m	18.39	32,908.91	BSR 2013, RW0107,
3.7	Consolidation of road surface	6,030.00	sqm	6.98	42,089.40	BSR 2013, RW0123,
TOTAL					5,959,802.91	
Add 5% contingency					297,990.15	
GRAND TOTAL					6,257,793.06	
Or SAY					**6,257,800.00**	

Prepared & submitted by:

(J. K. Nepal)
Engineer
Production Division, NRDCL HQ

ENVIRONMENTAL MANAGEMENT PLAN FOR CONSTRUCTION OF 1.20 + 1.80KMs FOREST ROAD AT KORILA FMU UNDER ZHONGGAR REGIONAL OFFICE, NRDCL, MONGAR DZONGKHAG.

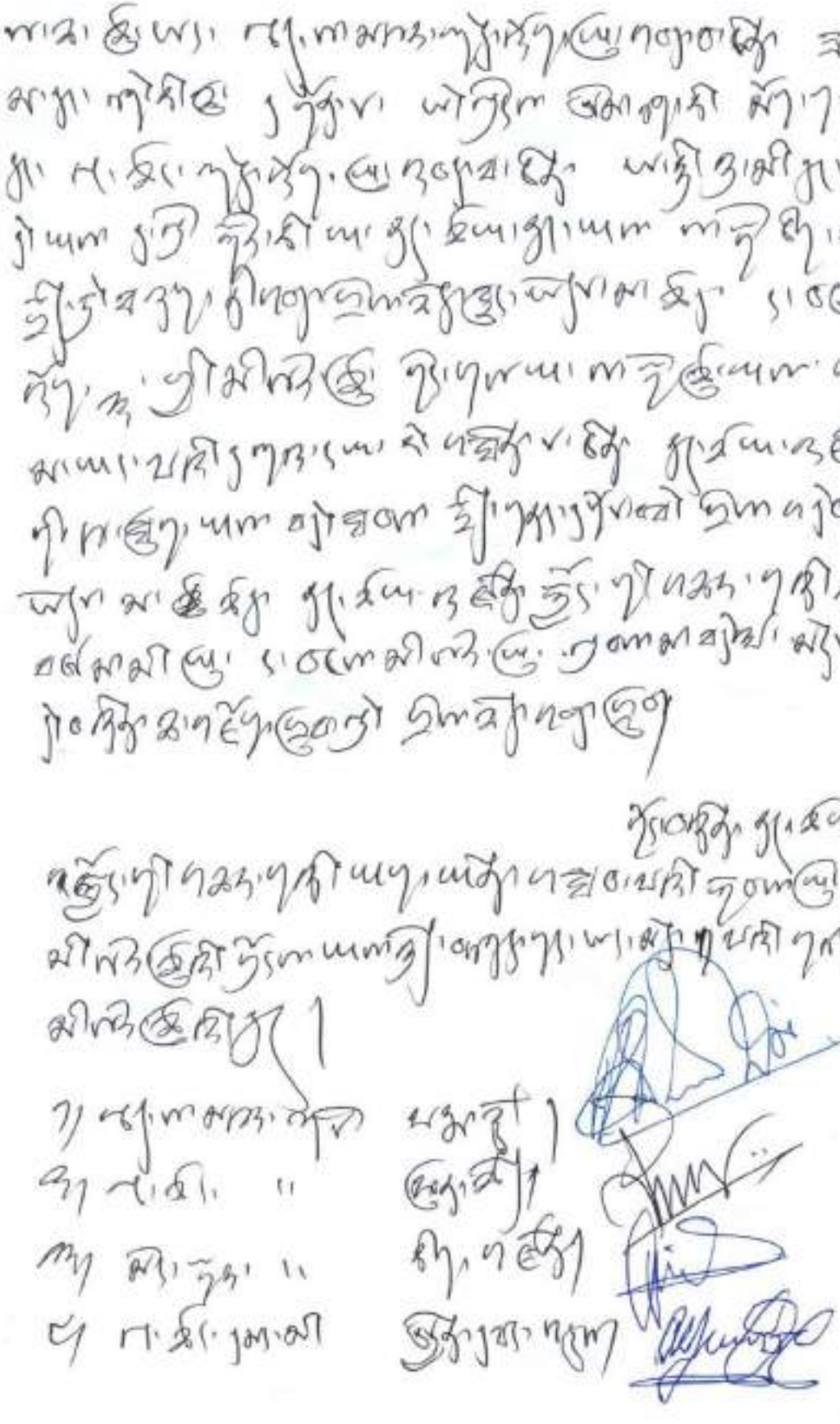
Sl. No.	Activity	Potential Negative Environment Impact	Mitigation Measures	Public Participation and Coordination	Socio-Economic and cultural considerations	Budgeting	Supervision	Monitoring
1	Work camp location, operation & closure, restriction on workers (sanitation, fuel wood collection, poaching etc.)	• Garbage, oil & grease pollution Damage to vegetation & wildlife	• Provide sanitary facilities and restore • Provide fuel to workers	• DoF&PS • Awareness of labours	• Consider local culture and compensate, if required	• Incorporated	• Unit Manager • Site supervisor	• Regional Manager • Engineer, NRDCL HQ • External team
2	Explosive & toxic waste management	• Fire & explosion hazard • Ground & surface water pollution	• Do not store near surface water • Use plastic sheeting under hazardous material • Collect waste properly & dispose off safely	• Contact Ministry of Home & Cultural Affairs in case of hazard or needing material innihilation	• Consider local drinking water sources	• Incorporated	• Unit Manager • Site supervisor	• Regional Manager • Engineer NRDCL HQ • External team
3	Water Management	• Sedimentation of surface water • Slope failure • Creation of new gullies • Water seepage	• Build check dams • Tap excess water by catch drains and dispose off to natural gullies	• Involve locals when deciding about discharge location • Dzongkhag administration	• Irrigation channel and drinking water supplies need consideration	• Will be incorporated if required.	• Unit Manager • Site supervisor	• Regional Manager • Engineer NRDCL HQ • External team

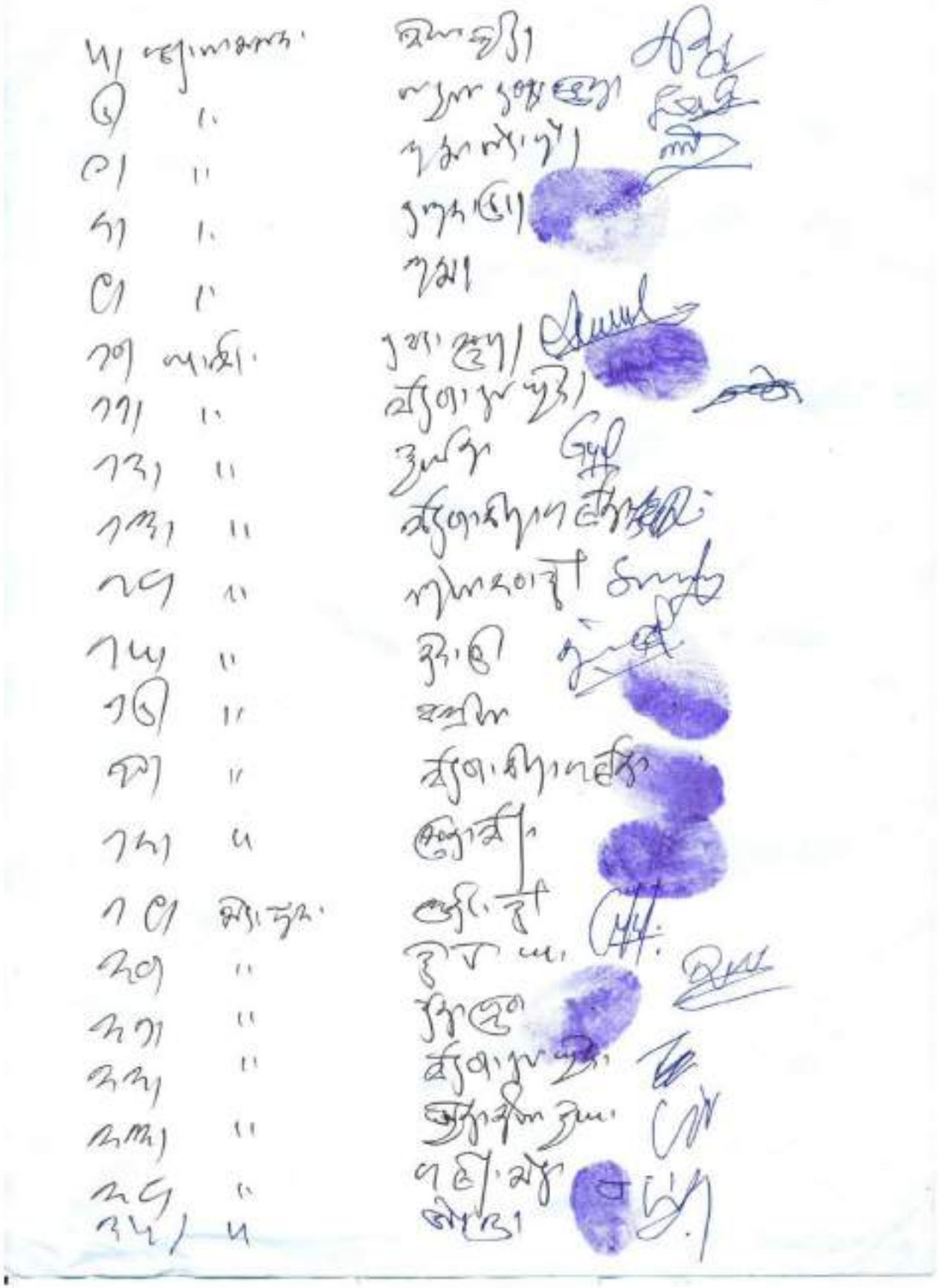
(J.K. Nepal)
Engineer
Production Division, NRDCL HQ


Existing road
Dumping site
Google earth

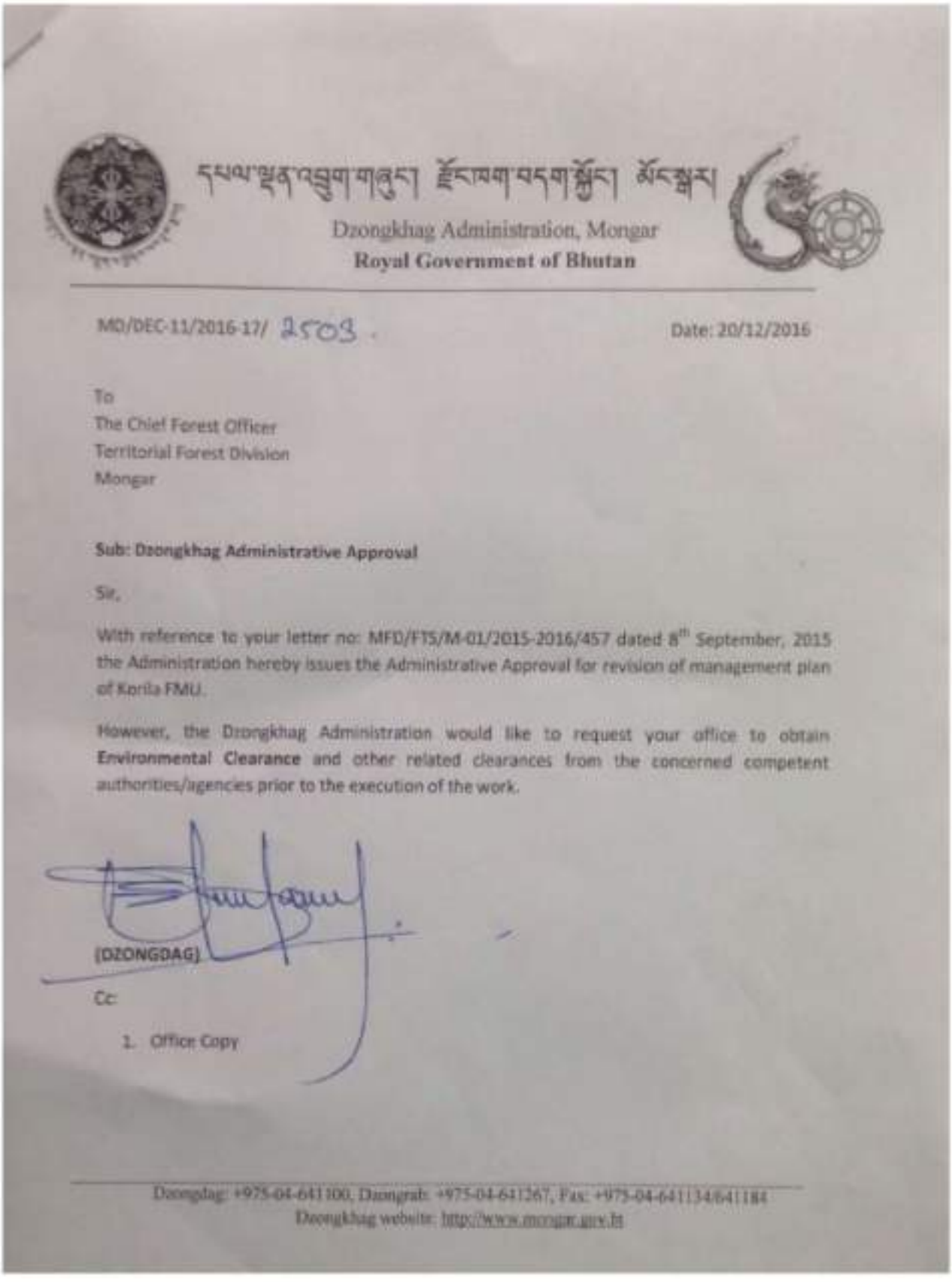

Lakhay Gompa

Annexure 9: Public Consultation Meeting





Annexure 10: Dzongkhag Administrative Approval



དཔལ་ལྡན་འབྲུག་གཞུང་ རྫོང་གཞག་བདག་སྐྱོང་ མོང་སྒར།

Dzongkhag Administration, Mongar

Royal Government of Bhutan

MD/DEC-11/2016-17/ 2503 . Date: 20/12/2016

To
The Chief Forest Officer
Territorial Forest Division
Mongar

Sub: Dzongkhag Administrative Approval

Sir,

With reference to your letter no: MFD/FTS/M-01/2015-2016/457 dated 8th September, 2015 the Administration hereby issues the Administrative Approval for revision of management plan of Korila FMU.

However, the Dzongkhag Administration would like to request your office to obtain **Environmental Clearance** and other related clearances from the concerned competent authorities/agencies prior to the execution of the work.

(DZONGDAG)

Cc:

1. Office Copy

Dzongdag: +975-04-641100, Dzongrab: +975-04-641267, Fax: +975-04-641134/641184
Dzongkhag website: http://www.mongar.gov.bt

Annexure 11: Compartment Record Sheet

Block:.....Compartment:.....
Sub-Compartment:.....

Year	Harvesting		Tending		Planting		Other	Remarks
	Area (ha)	Vol. (m3)	Area (ha)	Vol. (m3)	Area (ha)	Species		
2015								
2016								
2017								
2018								
2019								
2020								
2021								
2022								
2023								
2024								

Annexure 12: Rural Allotment

Block:...Compartment:.....................
Sub-Compartment:.........................

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

Annexure 13: Commercial Allotment

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

MC	WC	Year of Activity	Commercial Activities					Volume (m^3)				Other Activities	TMB #	Comments (Include
			Cable Lines			Groups/Patches/ Other		Marked		Extracted (FDC)	Firewood (lops/tops)			
			Line #	Length (m)	Azimuth	Total #	Total Area (ha)	# of trees	Vol.					

Annexure 14: Stand Tending and Regeneration

Block:.....Compartment:.....
Sub-Compartment:.....

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