

Environmental Protection Agency

Environmental Assessment Checklists and Guidelines

Non-Regulatory

Forest Harvesting Operations

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1. Introduction

The growth of environmental movement in the second half of the twentieth century has also raised new issues for the forestry. It is recognized that forestry should be organized on the principles of sustainability. At the same time, environmental degradation and global environmental issues have profound impact on the forest production. Sustainable forestry needs to be in the context of global environmental issues such as loss of the biodiversity, increased demand for land to produce food for rapidly growing population, impact of acid rain on vegetation, and the global warming due to greenhouse gases.

1.1 Scope of the Guidelines

Within the framework of sustainable forest management, the present guidelines cover the management of forests for wood production from the forests of NWFP-Pakistan using environmental friendly harvesting operations. The timber and other wood products from forests of NWFP are in high and continuing demand

countrywide. Careful management ensures profitable production on sustainable basis and integrity of forest ecosystem values at the same time. The environmental and social considerations are important in planning a balanced approach to sustainable management of these forests for wood production. The environmental concerns covers issues related to soil, water and biological diversity conservation and the interests of forest dependent communities.

The guidelines do not provide a comprehensive presentation of technical methodologies that are being used for forest management. The aim has been to keep the focus on project components for which risks are relatively high. There are two strong arguments in support of sustainable management for the production of wood in natural forests. The first is that there is no ecologically satisfactory alternative land use to natural forests because they are too infertile for agriculture. Secondly, good quality wood in large quantities required to meet present and future industrial requirements cannot be

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produced from intensively managed plantations on the same infertile sites. This is an economic perspective of forests; there is however an ecological perspective which is rather more complex to manage. Forests role in hydrology, soil stability, and habitat suitability for multitude of life are also key concerns in forest.

1.2 How to use these guidelines

These guidelines will supplement all existing technical manual and guidelines for forest harvesting.

The guidelines are produced for general information. No approval from the Environmental Protection Agency for forest harvesting is required.

1.3 Glossary

Abutment: End support for bridge, culvert or similar structure.

Adverse grade: Grade up which a loaded log truck must travel.

Annual plan: Plan of harvesting for one year's operation. It is often a long term plan.

Back-cut: The final cut involved in felling a tree. The back-cut should be higher than the scarf.

Ballast water: Water loaded into a ship to provide weight when sailing without a cargo.

Batter: Inclination or shape of side slope of walls, banks, cuttings.

Berm: Heap of soil associated with the side of a road or skid track.

Biodiversity: The range of species of plants and animals in an ecosystem.

Borrow pit: An excavation outside the limits of road construction for obtaining fill used for roadway construction.

Buffer zone: Area of vegetation retained around a sensitive area or site. Harvesting and disturbance is excluded from these areas.

Butt: The stump end of a log.

Buttress: A ridge of wood that develops in the angle between a lateral root and the base of a stem to provide lateral root stability to the stem.

Cable logging: Any haul system using a machine with powered drums, spars, blocks, wire rope and butt rigging to haul logs from the felling site to the landing. Also called Cable Yarding System.

Cadastral: This term refers to land extent, value or ownership.

Camber: The amount of crossfall on a road.

Canopy gap: A break in the leaf canopy of a forest. Gaps permit light to reach the forest floor. The amount of light is an important factor in forest regeneration, particularly in rainforests. Usually recorded on a percentage scale (0-100% light reaching the ground).

Catch drain: A drain constructed above a batter to prevent erosion of the batter by surface water.

Catchment: The area which yields run-off water to a given point.

Chain brake: A safety device on a chainsaw designed to stop the chain in the event of a kickback.

Chaps: Chainsaw chaps are safety trousers which are cut resistant and contain material designed to protect against chain saw cuts.

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Clearfelling: Felling and removal, of all or nearly all commercial trees and the trees in the size classes immediately below the merchantable category which provide the next harvest, from a specific area in one operation.

Competency: A concept that focuses on what is expected of a person in the workplace rather than on the learning process. It embodies the ability to transfer and apply skills and knowledge to new situations and environments.

Conservation area: Areas protected from harvesting by National or Provincial legislation.

Cording: Laying of suitable logs, bark or vegetation on the soil to separate machine tyres or tracks from direct soil contact.

Coupe: A defined sub-unit of the harvesting area.

Cross-cut: Cutting through a felled log. Also called **bucking**.

Cross-drain: Drain constructed across a track to divert water to a stable disposal area.

Cultural area: Area of social, cultural, historical or anthropological importance indigenous populations. Includes villages, gardens and sites which are culturally sensitive.

Culvert: A channel or conduit carrying water across a road.

Cutting cycle: In selection (polycyclic) harvesting systems, the planned number of years between successive harvests on an area of forest. The harvesting activity occurs at the end of the cutting cycle. It is also referred to as **felling cycle**.

Dabob: Diameter above buttress over bark.

Dbh: Diameter at breast height.

Designated watercourses: Those required to be marked on harvesting plans. They include all classes of streams and gullies where vegetation buffers are to be marked and retained.

Directional felling: Felling a tree in a particular direction.

Drilling: Inserting a vertical cut into the stem with a chainsaw to determine the presence of internal defect. Defect is indicated by discoloured sawdust or soft wood.

End haul: Excavation and removal of spoil to another site. End haul is used where side casting of material is not appropriate.

Endangered: Flora and fauna species in danger of extinction.

Enrichment planting: Planting trees within a partial forest canopy to increase the representation of the selected species in the forest.

Environmental sensitivity: Classification of the importance of a particular area of land or forest to degradation.

Exclusion area: Area which is excluded from harvesting.

Feeder road: A road connecting landings to a main road.

Felling jack: Tool inserted into the backcut during felling to provide leverage to force the tree to fall in a particular direction.

Flume: An open channel or conduit of timber, concrete, metal or flexible material such as plastic to carry water across unstable areas.

Flute, fluting: Supporting buttresses at the base of some species.

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Forest authority: A forest agency authorised by relevant legislation to administer one or more of the forest regulations.

Forest officer: Employee of the forest agency or other agency authorised, under the relevant legislation, to administer one or more of the forest regulations.

Formation width: The width of a road, excluding batters.

Future crop trees: Trees, which will provide merchantable timber in the future. See Potential Crop Trees (PCT).

Geographic information system: A computerized mapping system and database, which uses layers to store information which can be retrieved as required.

Geotextile: A material sheet placed on road surfaces to assist in drainage and road stabilization.

Guard log: Log along the outside of bridge, above the main stringer logs to prevent gravel from falling from the bridge into a watercourse.

Gully: Gullies are steep-sided channels. The slope of at least one bank exceeds 15°. Depth of the bank adjacent to the bed may be 30 cm or more. Vegetation may be growing in the gully bed. Water will flow for less than 2 months in most years.

Habitat tree: Tree used primarily for animal dwellings.

Harvesting contract: Legal agreement negotiated between landowners (State, private or customary) and harvesting companies for the harvesting of forests.

Harvesting debris: Broken logs, branches, vines or other tree material created as a result of felling and skidding.

Harvesting supervisor: Company officer responsible for the management of harvesting operations in the field.

Harvesting unit: See coupe.

Haul tracks: Tracks linking roads and landings and used for haulage of logs on trucks. May also be called a spur track.

Head wall: A retaining wall at the inlet end of a culvert.

Hinge wood: The quantity of wood remaining between the scarf and back-cut during tree felling

Hung-up tree: A tree which has not completely reached the ground following cutting.

Integral arch: An extension to the winch of a harvesting tractor which gives lift to one end of the log.

Landing: Area where logs are stored prior to transport to the log pond.

Line planting: Planting of trees in lines through forest or regrowth.

Log cluster: Group of 3 or more logs placed in a triangular fashion to act as a culvert.

Log pond: Main storage area for logs awaiting shipment or processing.

Log scaling: Measurement of logs for the purpose of determining volume.

Logging arch: See **integral arch**.

Main road: A permanent or semi-permanent road carrying large volumes of timber.

Management information system: A computerized system involving GIS used for the management of a forest enterprise.

Operational plan: Plan providing precise details of harvesting proposals, including location of roads, landings and

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skid tracks. Operational plans usually cover relatively small areas.

Outlet wall: Retaining wall placed at the outlet end of a culvert.

Out-slope: Sloping the surface of a track to shed water to the downhill side.

Owner includes a Court of Wards in respect of property under the superintendence or charge of such court

Permanent road: A road, which will be maintained after harvesting is finished.

Planning officers: Company officers responsible for the planning of harvesting operations.

Plantation: A forest crop or stand raised artificially by sowing seed or planting seedlings or clones raised in a nursery.

Potential crop trees: These are the stems, which make up the residual stand and form the basis of subsequent cutting cycles

Production forests: Forests, which are being managed for the production of wood and other products on a sustainable basis

Protected forests: Forest areas, which are excluded from harvesting for any reason

Protection zone: Area of forest excluded from harvesting in an operational plan.

Reduced impact guidelines: These are mechanisms by which a code of harvesting practice is implemented with particular emphasis on protecting soil, water and forest stand values

Reforest: To establish a tree crop on forest land.

Regenerating forests: Forests which have been disturbed and altered from

their natural state but are growing back to that natural state.

Regeneration: Seedlings of tree species.

River includes any stream, canal, creek or other channels, natural or artificial

Road crown: To shape a landing, road or track so that it is higher in the centre than the outside, allowing water to drain to the sides.

Rotation: The planned number of years between the formation or regeneration of a crop of trees and the time when the same crop is felled for final harvest.

Saddle: A low point on a ridge or spur.

Scarf: Two cuts to remove a wedge usually made to assist directional felling.

Sediment trap: See **silt trap**.

Selection harvesting: Harvesting systems in which crop trees are removed on a cycle based on a cycle of felling entries that occur more frequently than one rotation based on cutting limits or other criteria.

Shoreline: Limit of high tide; limit of mangrove growth.

Shoulder: See **verge**.

Side cast: Pushing material to the side, usually during road or track construction.

Side drain: Drain which diverts water from a table drain.

Sight distance: The distance along a road or track that a driver can see other objects (usually other vehicles).

Silt trap: Hole dug to catch sediment in run-off water flowing in drains. Log or rock bars may also be used.

Skid track: Track along which a log is pulled by a tractor.

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Skidding: The pulling of logs from the felling point to a landing.

Skyline yarding system: A cable yarding system which makes use of a heavy wire rope (the skyline) which is stretched between two spars (or spar trees) and used as a track for a skyline carriage. The system enables the log to be fully suspended during extraction.

Spur tracks: See **haul tracks**.

Stakeholders: Individuals or groups of individuals who have an interest in, or an impact on, the outcomes of a decision as well as groups or individuals dependent to some degree on the outcome for their personal or institutional goals.

Strategic plan: Long term plan which provides broad description and broad details of future harvesting and forest management plans. More than one strategic plan can be used to allow planning across a range of time periods.

Stream: Stream is a watercourse where water may flow for more than 2 months in most years. The beds are generally characterized by the presence of clean, water-washed stone, gravel, or exposed bedrock materials.

Class 1 stream: width of the stream base is more than 20 m

Class 2 stream: width of the stream base between 10 to 20 m

Class 3 stream: width of the stream base is less than 10 m.

Susceptibility class: Land classification of susceptibility to degradation.

Sustainable forest management: The process of managing permanent forest land to achieve one or more clearly specified objectives of management with regard to the production of a continuous flow of desired forest products and services without undue reduction in its

inherent values and future productivity and without undue undesirable effects on the physical and social environment. (Definition of the International Tropical Timber Organisation)

Swamp: Surface water present for six months of the year.

Table drain: The drain parallel to and at the side of a road.

Task planning: Undertaken by the harvesting company and details particular jobs such as construction of a landing.

Temporary crossing: A watercourse crossing which will be removed after harvesting.

Timber includes trees when they have fallen or have been felled, and all wood whether cut up or fashioned or hollowed out for any purpose or not; and

Tree includes palms, bamboos, stumps, brush-wood and canes

Tree crown: Leaves and branches which make up the top of the tree.
Understorey: That part of the forest vegetation growing below the forest canopy.

V-drain: "V"-shaped table drain.

Verge: The part of the road construction continuous and flush with the pavement on either side. It is generally only used by passing vehicles but may be used for travel by track machines.

Village: A cluster of dwellings in a rural environment.

Water bar: See **cross-drain**.

Water body: Surface water area such as a lake, lagoon or ocean.

Watercourse: Defined line that receives and conducts concentrated overland flow for some period in most years. Flows

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may be permanent or periodic.

Watercourse includes a stream, gully and a waterway. Classes are defined in terms of permanency of flow, bed material, bed width and side slope.

Wedge: A high impact plastic or aluminium wedge driven into the back-cut to assist directional felling.

Winch rope: Flexible wire rope used to winch logs towards the skidding tractor.

Wing wall: Side walls provided at a culvert or bridge to retain road fill material.

1.4 Reference:

- ▶ Khattak, G. M. (1987) Forest Management, Pakistan Forest Institute-Peshawar.
- ▶ Qureshi, M. A. (1999) Hand Book of Forestry, A-one Publishers, Lahore
- ▶ www.fao.org/docrep.htm
- ▶ www.harvest.com/forests/onlinefor esters

2. Forestry Sector in NWFP

North West Frontier Province of Pakistan covers 4.94 million ha of richly diverse ecological systems, from snowy-forested covered mountains in north to arid rangelands in the south, and from barren hills of tribal areas to fragile agricultural Peshawar valley. Forests cover about 17% of land. Important coniferous trees are deodar (*Cedrus deodara*), blue pine (*Pinus wallichiana*), chir pine (*Pinus roxburghii*), fir (*Abies pindrow*) and spruce (*Pecea smithiana*). Legally forests are categorized as:

State/Reserve Forests: These are exclusive property of state and bear only minor concessions like right of way, collection of fuelwood and livestock grazing to the local communities. These forests constitute around 6% of total forest area and are situated in Hazara Division.

Protected Forests: These forests were inherited from princely states of Chitral, Dir and Swat. Declared as state property, however 60-80% royalty on

sale of timbre is paid to local right holders.

Guzara Forests: These are property of local owners. Its management, originally vested to deputy commissioners, was delegated to Forest Department via the Guzara rules of 1952.

Other Forests: These include plantations and tress on farmlands owned by local communities.

There are 98 protected areas in NWFP covering about 781,000 *ha* and 10.5% of the NWFP land area. These include three National Parks, three Wildlife Sanctuaries, thirty six Game Reserves, fifty one community Game Reserves, three Wildlife Parks and two Wildlife Refuges.

The basic forestry operations in NWFP are timber harvesting, afforestation, and infrastructure development.

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2.1 Sector Profile

Harvesting of trees is the backbone of all the forest operation, and involves following steps:

Marking of Trees: As explained earlier marking is done according to the working plan. Inventories are made by the Forest Department and yearly marking list is provided to FDC.

Felling Operations: The most hazardous occupation is presently done either by traditional axes, or through mechanized saws carried out by well-trained workers. FDC has established three training centres at Sheringal, Kalam and Malakandi. Around 1,100 persons have been trained at these centres.

Extraction Operations: It involves debarking, conversions into desirable volumes, and transport to landing sites. Skidding by trained workers, vehicle-mounted road transport, and cable carne system are the options being used for transportation to the Depot (landing site). Depending on the feasibility, any one or combination of 2-3 options is adopted.

Landing: Landings (Depot) are collection areas to which logs are delivered during the extraction process and represent the interface between extraction and transport. Their location and design are carried out during harvest planning. At landing sites logs are temporarily stored for the following reasons:

- ▶ Delays in extraction process if loading is carried out simultaneously
- ▶ To ensure continuous timber supply during road transport to *Mandi*.

- ▶ Loss of log weight during period of storage.
- ▶ Separation of tree species or utilization groups.

Transportation: Finally the extracted wood is transported to the *Mandi* (wholesale market).

2.2 Existing Arrangements for Forest Harvesting

Prior to 1973, the Forest Department sold standing timber directly to contractors who were responsible for harvesting, transporting and selling it. Contractors abused this system by cutting more than the authorized volume and disregarding damage to the forest ecosystem (Qureshi, 1999). A separate exploitation wing within the Forest Department was developed in 1973 to carry out forest operations departmentally. This arrangement did not succeed for many reasons viz; insufficient working capital and training. Forest Development Corporation (FDC) was established through an act in 1977 and reconstituted through NWFP FDC Ordinance 1980. The act specifies following main functions for FDC:

- ▶ Economic and scientific exploitation of forests
- ▶ Sale of forest products
- ▶ Establishing of primary wood processing units
- ▶ Regeneration in areas specified by Forest Department

Since its development FDC has improved the system and made impressive achievements in revenue collection, forestry development, human resource development and infrastructure development.

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Briefly present arrangements for harvesting operations are:

- ▶ The Forest Department develops a working plan for a specified period. The plan addresses harvesting potential, development and management of forest.
- ▶ Following the plan recommendation, the Forest Department mark the trees on silvicultural basis. Each year a marking list is provided to FDC.
- ▶ The FDC officer assesses feasibility for harvesting, which includes access, wood estimation, distance to road, transportation to depot and to Gohar Abad (Mandi). The feasibility assessment provides recommendation for mechanical or traditional harvesting based on suitability.
- ▶ The feasibility report is submitted to FDC head office for approval.
- ▶ The tender is announced in Newspaper for timber extraction and transportation.
- ▶ The operation is carried out through contractors and subcontractors, which are continuously monitored and instructed through FDC field staff.
- ▶ The FDC field staff works under Assistant Forest Manager or Deputy Forest Manager. It is usually composed of Forest Supervisor, Forest *Munshi* (Clerk), Deputy *Munshi* and Assistant *Munshi*. All field staff is hired on contractual basis for 88 days a year.

3. Environmental Aspects

Major environmental concerns associated with various phases of harvesting operations are described below

3.1 Harvesting Plan and Marking

Normally harvesting in the forest is done for those trees, which are marked by the Forest Department on silvicultural basis considering regeneration potential and deterioration of the environment. Harvesting not only produces revenue, it also enhance health of forests by reducing resource competition, and by reducing risks of disease and fire by extracting dead and decaying trees. However excessive harvesting without considering regeneration may cause

irreversible change in land use, that will have serious bearings on environment through:

- ▶ Deforestation
- ▶ Change in hydrological regime
- ▶ Reduction in soil's binding capacity, making it more susceptible to erosion
- ▶ Destabilization of strata
- ▶ Disruption of drainage pattern
- ▶ Degradation of ecosystem and loss of biodiversity

The following conflicts with local communities could arise:

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- ▶ Issues of royalty between Forest Department and communities, and among tribes/clans
- ▶ Land acquisition
- ▶ Compensation

Harvest planning merely based on sivicultural considerations could affect sensitive habitats and ecosystems. It could also devastate the objectives of legally notified PAs.

3.2 Felling Operations

Unplanned felling could cause:

- ▶ Damage and felling of additional trees
- ▶ Damage to new sprouting and ground vegetation
- ▶ Trees hung up in climbers or dense canopy may cause additional damage
- ▶ Erosion and other hazards like sliding of boulders
- ▶ Damage to streams and flow pattern

The damaged residual trees will have high risk of insect and fungus attack and become susceptible to disease.

The safety of surrounding communities could be at risk. Noisy equipment will cause disturbance to communities and wildlife. Felling may destroy nesting sites on ground and trees as well. Felling of all dead trees and snags without assessing their ecological role may destroy habitat of many important fauna. The dead trees provide cavities, excavated by woodpeckers, to cavity dwellers such as bats, flying squirrel, martens, and birds like tits, barbets and many other insectivorous and granivorous birds.

3.3 Extraction Operations

Debarkation and conversion of the logs into desirable size, produces a huge amount of the wastage/ garbage of the cut material, which require proper disposal.

Damage to regenerations, residual tress and natural flow and soil erosion. The skidding trail and cable crane may create permanent corridors, which may become watercourses during rains. It will accelerate erosion and destabilization of strata. Transportation through water may block or divert natural water flows.

Extraction operations have potential safety risks for surrounding communities. Land acquisition, compensation and alignment of extraction trails may cause conflict with communities. The extraction trails may block or interfere in daily movement routes of community. This may restrict their access to water, fuel-wood and livestock grazing areas. Contamination of soil and water from oil spillage.

Vegetation clearing along the skidding trail, clearing and damage along the cable crane corridor, and damage on the felling areas may pose serious threat to the population and survival of rare and threatened plant species. Most of the birds in NWFP breed from April to July depending on the altitude. As the harvesting operations overlap with the breeding season therefore there is risk of damage to breeding sites. The extraction operations may change ecological pattern and avian pattern as well. Dense canopy loving species like thrushes may be replaced and open forest birds like flycatchers may invade. In this way population balance of species is disturbed. Dispersal of young birds usually take place in small flocks, which stray in the area in search of food.

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Logging may impact the growth of youngs and change their feeding pattern.

3.4 Landing

- ▶ Conflicts with communities regarding location
- ▶ Land acquisition and compensation issues
- ▶ Gender- related issues:
 - ▷ Restriction on women's mobility
 - ▷ Exposure to non-local men, and the attendant cultural issues of the veil and privacy
- ▶ Vegetation clearing from landing site
- ▶ Destruction of dens, breeding and roosting sites

3.5 Transportation

- ▶ Soil erosion
- ▶ Dust emissions
- ▶ Accidental killing of wildlife
- ▶ Disturbance due to light and noise
- ▶ Risk of accident for surrounding communities
- ▶ Restriction on women's mobility and exposure to non-locals
- ▶ Pollution and detritions of air quality

3.6 General Concerns

- ▶ Effluents released as a result of harvesting activities, if not contained properly, may contaminate the soil. Water quality is likely to deteriorate if pollutants or contaminated soil mix with surface runoff during the rains and are carried downhill to water

bodies. If allowed to leach into the ground, the contaminants may also pollute groundwater. Potential sources of pollution in such cases include:

- ▷ Domestic waste (sanitary and kitchen discharge)
- ▷ Oil and grease from the machinery
- ▷ Fuel
- ▶ Improper waste disposal
- ▶ Emissions generated during harvesting operations are likely to include:
 - ▷ Dust emissions from felling, extraction and transport
 - ▷ Emissions from generators and other machinery
- ▶ Improper toilets and hygiene conditions
- ▶ Improper kitchen and cooking utensils
- ▶ Improper accommodation
- ▶ Wood and shrubs used as fuel
- ▶ Noise and light may disturb, harass and dislocate animals.
- ▶ Staff may indulge in killing, capturing or harassing the wildlife.
- ▶ Staff may buy game birds or animals from local trappers or hunters.
- ▶ Improper disposal of waste will change wildlife behavior which may become threat for staff or animals itself. For example large predators like bears relate food to human presence if get debris in vicinity of settlement/tents. They make regular visits to these sites and may attack humans during accidental encounter or for snatching food.

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4. Mitigation Measures

4.1 Harvesting Plan and Marking

The harvesting plan should not exceed the regeneration potential of forests. The Forest Department and FDC have well developed technical guidelines for tree selection, which do not need to be reproduced here.

Effective afforestation measures of the indigenous trees will be done in the harvested areas. No felling on slopes steeper than 70%. Dense groups in sloppy areas should be retained to avoid land sliding. Harvesting in notified National Parks and Wildlife Sanctuaries will not be done. Breeding season on birds will be avoided as much possible. Ten percent of the dead trees in a forest will be maintained considering their vital ecological role.

All resource allocation and management in the form of royalty, employment, compensation, and social welfare will be transparent, open, objective, and in written form. A compensation policy based on the local property-rights system and national and international practices will be developed.

Conflicts with the communities will be avoided as much possible. In case of any conflicts, traditional conflict resolution mechanism will be adopted. Temporal leadership and district government involvement will also reduce compensation conflicts and provide a conflict-resolution and mitigation forum to address compensation issues. Given the potential conflict arising from harvesting activities and the area's tribal leadership,

FDC will adopt a joint decision-making approach. To help build trust and confidence between the local leader, the tribal leader, and FDC/Forest Department, the corporation will continue to build on its relationship with the tribal leadership, villager elders, and communities.

Forest Department and FDC will adopt a transparent recruitment process. Members of local communities and district residents living near the harvesting area will be given preference when hiring for unskilled and semi-skilled jobs. In case of unavailability of skilled labor, unskilled workers will be trained for future projects. Technical and semi-skilled jobs will also be advertised in the local newspaper. Special care will be taken to represent the minority tribes.

During land acquisition and construction activities, the grazers will be compensated for the period during which they have to relocate their livestock and housing assets. The compensation will consist of temporarily relocating them to another grazing area and installing them in huts or housing similar to their own, as well as providing watering points for livestock and humans.

4.2 Environmentally Sound Felling

- ▶ Considering its low environmental concerns, directional felling is recommended. Directional felling involves marking trees with

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- predetermined felling direction and should be such that:
- ▷ Minimize damage to the felled tree and the standing trees.
 - ▷ There should be easy log extraction and minimum ground disturbance.
 - ▷ Avoid disturbance to buffer areas, watercourses and exclusion areas and
 - ▷ Prevent trees from hanging up during felling.
- ▶ Following preparation is recommended for sound felling:
- ▷ There should be no dead limbs or “Hung Up” branches. Cut the climbers that are on the tree bole before felling.
 - ▷ Clear two alternative routes before felling for the extraction of the logs.
 - ▷ Cut climbers, shrub and sapling from the base of tree to provide adequate space.
- ▶ The trees should be felled along the existing canopy gaps to reduce damage to other vegetation. Trees considered to be unsafe will not be felled.
- ▶ Felling will be done in upward direction, wherever possible, as down slope felling has potential of more damage.
- ▶ Felling will not be done against a convex structure, logs, stumps etc which may break the log. The broken logs may roll down, cause soil erosion and rolling of stones.
- ▶ Stumps will not be removed in order to ensure soil stabilization.
- ▶ The felling will not damage stream banks or block natural flow.
- ▶ All equipment will be maintained, and mufflers will be used to reduce noise.
- ▶ Area of Disturbance should be kept minimum as much as possible.
- ▶ A botanist will survey the felling area and make list of all species. The botanist will also identify rare and threatened species which will be given special protection.
- ▶ A wildlife specialist will survey the area and will prepare list of birds, mammals and reptiles. He will also identify active dens, nests and roosting sites. All these sensitive features will be given special protection.
- ▶ The felling operations will be carried out at a safe distance from the settlements, not less than one kilometer. Prior to the operation neighboring communities will be consulted and briefed about the operation.
- ▶ Hung up tress should be removed before any more trees are harvested. If they cannot be removed immediately, the area should be well marked to signal the danger to the other people.

4.3 Extraction of Logs from the Forest Areas

- ▶ Always use that equipment which produces low ground pressure to reduce soil compaction
- ▶ The wastage/ garbage of the cut material produced from debarkation and conversion of the logs, should be collected and either transported for to use as fuel or buried under the soil. It should not be done in sloppy areas or in areas of loose soil.

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- ▶ Minimum area should be disturbed
- ▶ A botanist will survey the skidding trail/cable corridor and make a list of all species. The botanist will also identify rare and threatened species which will be given special protection.
- ▶ A wildlife specialist will survey the area and will prepare list of birds, mammals and reptiles. He will also identify active dens, nests and roosting sites. All these sensitive features will be given special protection.
- ▶ The skidding trail, or cable corridor will not pass over or close to the settlements, archeological, cultural and religious sites. A minimum of two kilometers from settlements, and one kilometer from archeological, cultural and religious sites will be maintained.
- ▶ The operation will not affect mobility of neighboring communities, especially children and women.
- ▶ Prior to the construction of skidding trail/cable corridor neighboring communities will be consulted and briefed about the operation. A written agreement for the alignment will be signed.
- ▶ The staff will keep contact with the local communities to a minimum. They will not visit the villages nor seek any acquaintance or intimacy with the local men, women, or children under any circumstances. The staff will respect the privacy of the local women by informing them in advance of project activities, and taking into account the daily work activities of women related to agriculture and water-

and wood-collection when planning extraction activities.

- ▶ All staff will be fully briefed on local customs and traditions. Migrant labor will be given specific training regarding sensitive issues involving culture and gender. FDC will ensure that all staff, including the FDC and the contractor, are fully trained and aware of gender and cultural issues.
- ▶ The access road will avoid mosques and graveyards, and project staff will be instructed to respect the sanctity of such places.
- ▶ Following Guidelines will be followed for Selecting extraction system

<i>Soil Erosion</i>	<i>Slope Class</i>			
	0-15%	15-35%	35-60%	60+%
Low	C1-5	C1-5	C1, C5,	C5,
Moderate	C1-5	C1-5	C1, C5,	C5,
High	C2-5	C2-5	C5,	No Logging
Very High	C2-5	C5	No Logging	No Logging

Legend:

- | | |
|-----------------------------------------|----------------------------------|
| C1: Crawler Tractor | C2: Skidder/Forwarder |
| C3: Slides/Low Ground Pressure Tractors | C4: Draught Animals/Human Beings |
| C5: Aerial rope ways | |

- ▶ Following measures will be taken for skidding:
 - ▷ Tractor blades should be raised or removed when traveling and skidding.
 - ▷ Retain vegetation litter along tracks.
 - ▷ Lift the end of the log off the ground, to avoid soil damage

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- ▷ due to log drag. Logging arches will assist with this action.
- ▷ Avoid damage to soil and standing trees and regeneration along skid track edges. Sacrificial trees may be used to minimize damage.
- ▷ Crosscut long logs to reduce skidding damage.
- ▷ Crossing points will be constructed on watercourses and streams.
- ▷ Maximum recommended downhill slope of between 25 and 35% should be adopted for horses logging.
- ▷ Maximum recommended uphill slope of between 10 and 15% should be adopted for human beings logging.
- ▶ Following measures will be taken for aerial logging
 - ▷ It should be done only through experienced operators.
 - ▷ It should have an effective communication system between starting and end point on ground.
 - ▷ Fell undergrowth trees to prevent the long line snagging as it is being lowered.
 - ▷ Avoid felling future other trees.
 - ▷ Clear canopy along the cable corridor.
 - ▷ Animal skidding should use short extraction distances
 - ▷ To reduce ground disturbance: Maximize log lift; Maximize spar height; use intermediate supports; and reduce log size or the number of logs per pull.
- ▶ Recommended measures for water transport:
 - ▷ Logs with high density should be allowed to dry out if possible to reduce weight prior to transporting by water.
 - ▷ Logs tied together in rafts should be secured adequately to avoid loss and damage to other vessels on the waterway.
 - ▷ As organic matter reduces oxygen demand and causes pollution, depositing log off cuts and bark in rivers should be avoided.
 - ▷ Soil damage to riverbanks at loading ponds should be minimized.
 - ▷ Logs should not damage or block the watercourses

4.4 Landing

- ▶ For land acquisition, FDC will adequately and fairly compensate the communities after verifying the identity of the owner of the land, and will ensure prior consent and arrange a written agreement before acquiring land.
- ▶ A botanist and a wildlife expert will inspect the site and identify sensitivities. Identified sensitive species or sites will be given special protection.
- ▶ The landing site (Depot) must not be close to settlement, mosque, shrine etc.
- ▶ Reduce log stockpiles in the forest by proper planning of the removal of logs soon after they are cut.
- ▶ Avoid stockpiling logs that are susceptible to decay or insect attack.
- ▶ Load and haul logs safely.

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- ▶ Inspect logs and apply appropriate control measures if insect or fungal attack is observed.
- ▶ Avoid stockpiling logs for more than 2 months.

4.5 Guidelines for Road Transport

- ▶ Grapple excavators and loader should be used for loading logs where possible.
- ▶ Trucks must not be loaded in excess of their design capacity.
- ▶ Side stanchions on trucks must be vertical after loading.
- ▶ All loads are to be secured with at least two approved load binders.
- ▶ Each log must be secured by at least one approved log binder.
- ▶ Protruding limbs or trailing material must be removed before the truck departs the loading point.

4.6 Transportation

- ▶ Logging equipment can assist loaded trucks to:
- ▶ Move from the landing to the road; and
- ▶ Climb steep sections of road constructed according to an approved harvesting plan.

4.7 Trucking

- ▶ Observe posted speed limits and maximum (tare) weights for roads.
- ▶ The load should be checked regularly in between route.

4.8 Unloading

- ▶ Check that the side stanchions are secure before removing log binders.
- ▶ All logs are to be removed by loaders or grapple excavators where possible.
- ▶ All people other than the loader operator are to stay at least 20 meters from the truck during unloading.

4.9 Weather Limitations on Harvesting

The responsibility for defining when weather conditions restrict harvesting operations lies with the on-ground supervisor/manager (FDC). However, if they fail to comply with procedures, the Forest Department should take appropriate action to avoid operations at times of high safety risk or to prevent operations where ground conditions are so wet as to cause severe and long-lasting damage to the soil and water values.

Operating when conditions are excessively wet causes extreme damage to soil and water. It is also inefficient and often dangerous. Areas most likely to be workable in wet weather are those with less than 25% slope on stable soil types.

Felling should cease when:

- ▶ Wind strength prevents accurate and safe directional felling
- ▶ Ground conditions are too slippery to allow the chainsaw operator to move safely and quickly away from the falling tree
- ▶ Rivers are too low in the dry season to permit water transport of logs.

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Skidding and road construction should cease when:

- ▶ Soils are saturated and muddy water or mud is flowing down a skid track for more than 10 metres
- ▶ Blading of mud or soil is necessary to continue skidding (the affected section of the skid track must not be by-passed by opening up a new skid track or road)
- ▶ Soils are rutted to a depth of more than 30 cm below the original ground level over a section of 10 meters or longer
- ▶ Water is ponded on the surface of the log landing in any area that is being worked
- ▶ Trucks cannot move unassisted along the roads because of slippery conditions
- ▶ Muddy water or mud runs in wheel ruts, which are more than 10 cm below the road surface, for a length greater than 50 meters;
- ▶ No suitable areas are available;
- ▶ The Forest Authority has issued a provisional completion certificate.

4.10 Post-harvesting Activities

The objective of managing the post-harvesting activities are:

- ▶ to leave the harvesting area in a condition that encourages forest regeneration and protects other environmental values.
- ▶ To leave the forest area in a safe condition.
- ▶ To prevent deterioration of downstream soil and water values.

4.10.1 Harvest Area

- ▶ Any tree hang-ups should be removed.

4.10.2 Skid Tracks and Haul Tracks

- ▶ Remove all temporary crossings, using an excavator where practicable.
- ▶ Avoid disturbance to the watercourse banks and buffer zones.
- ▶ Place material at least 10 meters from the watercourse.
- ▶ Do not increase the width of tracks by blading or pushing material in from the side in order to cover the track surface.
- ▶ Place cross-drains:
 - ▷ at changes in slope;
 - ▷ within 10 metres of a watercourse;
 - ▷ at other locations so that the spacing between cross-drains is equal to or less than the maximum allowed.
- ▶ Cross-drains are to have:
 - ▷ a bank height of at least 30 cm and a batter length of 1.5 m;
 - ▷ the bank is to be accompanied by a cut into the surface of the track;
 - ▷ a crossfall of 1-3%;
 - ▷ an angle of 45° to track alignment;
 - ▷ a stable vegetated disposal area, log barriers or scour pads.
- ▶ Box cuts are to be avoided if possible, but are to have earth dams (water bars) constructed at a spacing equal to or less than the maximum allowed for cross drains.

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The bank height is to be equal to the depth of the cut.

4.10.3 Landings

- ▶ Rip landings at right angles to the drainage direction, or construct a berm around the landing and/or replant with a forest growing crop of grass, shrub or tree species.
- ▶ Remove or bury waste.
- ▶ Stabilise the batters of cuts and fills. Drain all areas where water may pond to stable disposal points and not directly into watercourses. The grade of drains is to be 1-3%.

4.10.4 Watercourses

- ▶ Remove any harvesting debris that has entered buffer zones and/or designated watercourses.

4.10.5 Roads

- ▶ Check all bridges and culverts, including decking foundations and side walls. They must be secure and safe.
- ▶ Any debris that has been pushed into the watercourse must be removed by excavator or by hand.
- ▶ Water must be able to flow freely beneath bridges.
- ▶ Clean all silt traps.
- ▶ Road formations are to be in good condition. There are to be no ruts in the surface. Crossfall is to be 1-3%. Surface grading and compaction may be required to ensure the road is in a stable and well-drained condition.
- ▶ All table drains, side drains and cross-road drains must be left in

good working condition. Surface grading may be required.

- ▶ Soil, vegetation and other material that would obstruct water flow must be cleared from road drains.

4.10.6 Quarries and borrow pits

- ▶ Remove or bury all rubbish.
- ▶ Stabilise steep cuts:
 - ▷ batters should be less than 100% slope
 - ▷ cuts more than 3 m high should be stepped at 3 m vertical intervals.
- ▶ Re-grade the drain on the uphill side and make sure that runoff cannot enter the quarry or borrow area and is diverted to a stable disposal point.
- ▶ Drain the surface of the quarry if water is likely to pond. These drains must empty to stable disposal areas.

4.10.7 Log ponds and wharves

- ▶ All material able to be used by the local community should be stockpiled free of soil.
- ▶ Drainage within the log pond and on the wharf should be put in good working order so that water will not pond for extended periods of time.
- ▶ The road to the wharf should be drained to prevent runoff reaching the sea.
- ▶ All log debris (e.g., bark and log ends) should be removed from the wharf.

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4.10.8 Refuse dumps

- ▶ Dumps should be filled in level with the surrounding areas to prevent water from ponding.
- ▶ Fill should be compacted to prevent settling.

4.10.9 Camp areas (base and field)

- ▶ All refuse should be removed.
- ▶ All areas where water is likely to pond should be drained. Drains should not empty directly into water bodies.
- ▶ The area should be left in a clean and tidy condition (including removal of all temporary buildings and machinery).