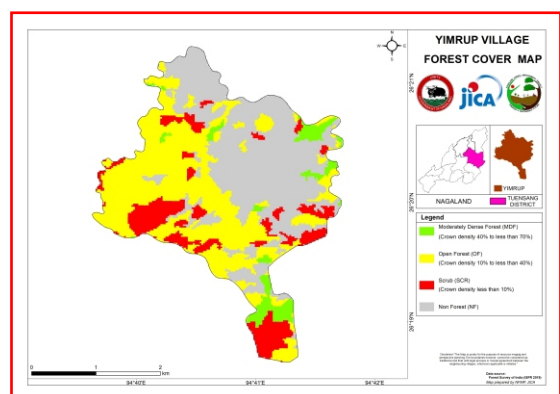
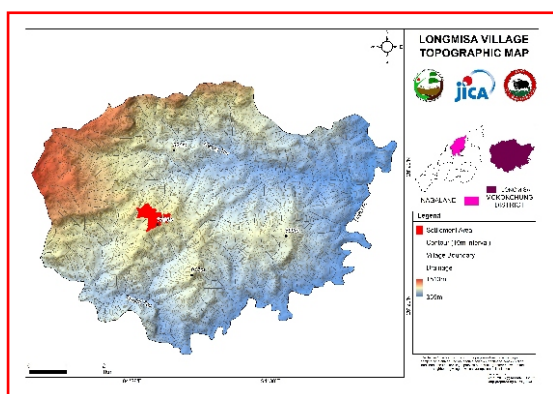
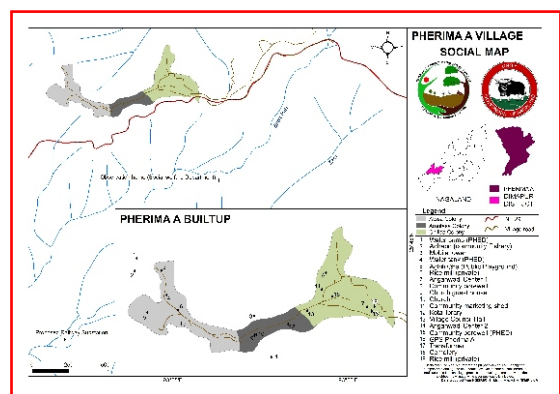




Guidelines for Forest Land Management,
Planning and Monitoring through Remote Sensing & GIS,
GPS Survey and Demarcation
Nagaland Forest Management Project (NFMP)



Project Management Unit (PMU)
Nagaland Forest Management Project



**CHIEF MINISTER
NAGALAND
KOHIMA
MESSAGE**

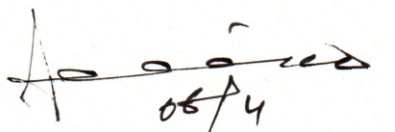
6th April, 2021

I am happy to know that the Nagaland Forest Management Project (NFMP), a Japan International Cooperation Agency (JICA) assisted program under Department of Environment, Forest and Climate Change, Government of Nagaland, is bringing out manuals which will ensure dissemination of knowledge and effective implementation of the project.

I am confident that these Manuals will facilitate proper execution of the project activities in a transparent and participatory manner and help guide all stake-holders, ranging from officials to village communities as well as the field NGOs and SHGs.

The Nagaland Forest Management Project (NFMP) is a process driven and result oriented approach through the use of modern scientific technologies including GIS and MIS for planning, implementation and monitoring of various activities and it is being implemented by the Communities in Villages. The concept of implementation is laudable, and I am sure that this will go a long way in improving forest ecosystems, support income generation through rehabilitation of Jhum areas and enhance the livelihood opportunities.

I wish the Nagaland Forest Management Project a grand success.


(NEIPHIU RIO)

FOREWORD

The Nagaland Forest Management Project (NFMP) is being implemented with the financial assistance from Govt. of India and the loan assistance from Japan International Cooperation Agency (JICA). This project is being implemented in all the districts of the State from 2017-18 to 2026-27.

The objectives of the project are to strengthen conservation through community participation, livelihood improvement for enhanced household income through convergence, and institutional strengthening.

This manual is prepared to guide the project staff to understand the purpose of GIS (Geographic Information System), facilitate the staff operating at different levels and to help in demarcating the treatment areas.

It is expected that this guidelines would serve as an important guiding document for the Facilitators and the Field Surveyors in demarcating the treatment area and in preparing a comprehensive forest treatment map with a special focus on forest conservation, bio-diversity protection and sustainable forest management and in achieving the objectives of the project in a sustainable manner.

Dharmendra Prakash
PCCF & HOFF
Chief Project Director and CEO

Abbreviations

| | |
|-----------|---|
| AOI | Area of Interest |
| CCA | Community Conservation Areas |
| CF | Conservator of Forests |
| DEM | Digital Elevation Model |
| DEFCC | Department of Environment, Forest and Climate Change |
| DGPS | Differential Global Positioning System |
| DMS | Degree-Minute-Second |
| DMU | Divisional Management Unit |
| DSS | Decision Support System |
| EC | Executive Committee (EC) |
| FMU | Forest Management Unit |
| FSI | Forest Survey of India |
| GB | General Body |
| GIS | Geographic Information System |
| GPS | Global Positioning System |
| JAF | Jhum Agro-forestry |
| JCC | Jhum Conversion to Conservation Area |
| JCF | Jhum Conversion to Forestry |
| JFF | Jhum Fallow Forestry |
| JFM | Joint Forest Management |
| JFMC | Joint Forest Management Committee |
| JICA | Japan International Cooperation Agency |
| MOD | Minutes of Discussion |
| NFMP | Nagaland Forest Management Project |
| NGIS &RSC | Nagaland GIS and Remote Sensing Center |
| NRSC | National Remote Sensing Center |
| NTFP | Non-Timber Forest Products |
| PEC | Protection and Expansion of Community Conservation Area |
| PMU | Project Management Unit |
| POI | Point of Interest |
| PRA | Participatory Rural Appraisal |
| SHG | Self Help Group |
| SOI | Survey of India |

Contents

| | |
|---|-----|
| Chief Minister's Message..... | i |
| Foreword..... | ii |
| Abbreviations..... | iii |
| CHAPTER-1..... | 1 |
| 1. Background..... | 1 |
| 1.1. Nagaland Forest Management Project..... | 1 |
| 1.2. Project Goals & Objectives | 1 |
| 1.3. Forest Intervention and Biodiversity Conservation Models..... | 2 |
| CHAPTER-2..... | 5 |
| 2. Planning Approach at Different Levels..... | 5 |
| 2.1. Planning at the PMU level..... | 5 |
| 2.2. Planning at the DMU level..... | 8 |
| 2.3. Planning at the FMU level..... | 10 |
| 2.4. Planning at JFMC level..... | 13 |
| 2.4.1. Survey and Demarcation Guidelines at JFMC level..... | 13 |
| 2.4.2. Steps to be followed for Survey and Demarcation..... | 14 |
| CHAPTER-3..... | 15 |
| 3. Sample Work Plan for Demarcation of Treatment Area Planning..... | 15 |
| 3.1. Planning of the Survey Work..... | 15 |
| 3.2. Collecting GPS data using Garmin eTrex device..... | 18 |
| 3.3. Points to remember during the Treatment area survey and demarcation..... | 22 |
| 3.4. Different kinds of errors to be checked at DMU level..... | 25 |
| CHAPTER-4..... | 27 |
| 4. Maps to be prepared for JFMC Treatment areas..... | 27 |
| 4.1. Information Sources..... | 27 |
| 4.2. Map preparation process..... | 28 |
| 4.2.1. Step-1- JFMC area mapping using remote Sensing and GIS technology..... | 28 |
| 4.2.2. Step-2- Socio-economic baseline Survey..... | 30 |
| Pre- field Maps required before Micro-plan preparation according to MOD..... | 35 |
| Maps to be prepared for Micro-plan according to the MOD..... | 36 |
| GPS Data Collection Checklist for Demarcation of JFM Treatment Area under NFMP..... | 37 |

List of Table

| | |
|--|----|
| Table 1: Roles and Responsibilities at DMU and Field level | 9 |
| Table 2: Proposed Work Schedule..... | 17 |
| Table 3: Information sources of GIS Data..... | 27 |
| Table 4: GIS Data required for “Base/Location” Map..... | 29 |
| Table 5: GIS Data required for "Landscape and Vegetation " Map..... | 29 |
| Table 6: GIS Data required for “Soil-Hydrology-Vulnerability” Map..... | 29 |
| Table 7: GIS Data required for “Base/Location Map” for Micro-plan..... | 30 |
| Table 8: GIS Data required for “Social Map” for Micro-plan | 31 |
| Table 9: GIS Data required for “Resource Map” for Micro-plan..... | 32 |
| Table 10: GIS Data required for “Present Forest Map” for micro-plan..... | 33 |
| Table 11: GIS Data required for “Before Plantation Treatment Map” for micro-plan..... | 34 |
| Table 12: GIS Data required for “After Plantation Treatment Map” for micro-plan..... | 34 |
| Table 13: Pre-Field Maps required before Micro-plan preparation according to MOD | 35 |
| Table 14: Maps to be prepared for Micro-plan according to MOD..... | 36 |
| Table 15: GPS Data Collection Checklist for Demarcation of JFM Area under NFMP | 37 |

List of Figures

| | |
|---|----|
| Figure 1: Survey and Demarcation Steps | 14 |
| Figure 2: Different kind of GPS Device | 18 |
| Figure 3: GPS device Initial Screen | 18 |
| Figure 4: Collecting a point through GPS Device | 19 |
| Figure 5: Collecting a line through GPS Device..... | 20 |
| Figure 6: Recording way points at different locations | 22 |
| Figure 7: Way points distance and line of sight..... | 23 |
| Figure 8: Feature inside the feature | 23 |
| Figure 9: Over measure and under measure | 23 |
| Figure 10: Error Type: boundary curves not captured..... | 25 |
| Figure 11: Error Type: Unsystematic field survey..... | 26 |

CHAPTER-1

1. Background

Nagaland, situated on the north-eastern part of India, bordering with Myanmar is rich in forest resources within the Indo-Burma biodiversity hotspot. Almost 60% of the state's population is engaged in Jhum (slash and burn) cultivation, meeting approximately 60% of food demand in the state. It is, however, reported that Jhum cycle has been reduced particularly in eastern part of state, and the state has lowest yield per hectare from Jhum Cultivation among the North Eastern states, estimated at 702 kg per hectare while that in other North Eastern states it is app. 1,193 kg per hectare.

There is increasing pressure on the forests for commercial exploitation to augment income of rural population due to the above reasons, resulting in degradation of the forest resources and biodiversity. According to the latest India State of Forest Report (ISFR, 2015) forest cover in the state was 12,966 sq. km which is more than 78% of its total geographical area, but more than half of it is in open forest category (having canopy density less than 0.40). Jhum cultivation is one of the reasons cited for forest degradation.

The biodiversity of state is not only valuable for their intrinsic value, but also provides critical ecosystem services such as food sources, water sources, soil formation, nutrient cycling and primary production. Thus, sustainable restoration and rejuvenation of Jhum area is essential for restoration of forests and conservation of biodiversity in the state.

1.1. Nagaland Forest Management Project

Nagaland Forest Management Project (NFMP) started during 2017-18 with the financial assistance from Japan International Cooperation Agency. The main objective of the project is to improve forest ecosystem and support income generation by rehabilitation of Jhum areas and provision of livelihood support, thereby contributing to sustainable forest and environmental conservation and livelihood improvement in the target villages of the state.

1.2. Project Goals & Objectives

The project has three main objectives:

1.2.1 Strengthening Conservation regime through Community Participation

This is the main objective of the project which envisages to expand area under tree cover, increase tree density in selected areas and to conserve (and augment) the biodiversity of the state through community participation.

1.2.2 Livelihood Opportunities for Enhanced Household Incomes through Convergence

The project shall also strive to promote and strengthen livelihood opportunities for enhancing household incomes, while seeking active synergy and convergence with other

governmental and non-governmental programs. This will also aid food security and vulnerability to climate change while reducing pressure on natural resources.

1.2.3 Institutional Strengthening

The project will support extension and strengthening of infrastructure at various levels. The project shall develop, build and strengthen existing community and institutional capacities for efficient planning, monitoring, implementation and decision making in forestry management. For the monitoring and implementation of the project, Geographic Information System (GIS) and allied technologies such as Remote Sensing and GPS will play an important role

GIS is a useful tool for the development of forestry datasets digital repository which helps in forest land and resources management. It can provide digital maps with logical representation, query interface and generate reports, as well as reproduce them as and when required.

GIS and Remote Sensing help in remote monitoring of the improvement status of the forest lands and their environmental assessment. High resolution multi spectral satellite images assist in identification of the proposed sites with precise analysis of ground conditions, land use, vegetation type and vegetation density. High precision survey is performed through DGPS/GPS for the accurate delineation of the forest treatment boundary pillar coordinates with sub-meter accuracy level. GIS then integrates all this information into a scientific and accurate forestry geo-database. It is possible to generate different kinds of thematic maps with the help of the GIS. These maps and information are of great use for Micro-plan preparation by the concerned communities and members of Non Governmental Organizations (NGO) teams as well as Field Management Unit (FMU) officials. The geo-database also facilitates generation of ad-hoc queries and can act as updatable Forest Data Repository to assist the decision makers to arrive at quick, unbiased, and scientifically correct and accurate decision.

Geospatial data of the treatment areas procured at different years (3 times for the entire project duration) provide scope for the Change Detection Analysis which reflects changes in vegetation type and density before and after intervention in the treatment areas in an unbiased and reliable manner.

1.3. Forest Intervention and Biodiversity Conservation Models

There are five models to be applied for the plantation activities viz. JAF, JFF, JCF, JCC and PEC as Model 1, 2, 3, 4 & 5 respectively. In Model 1, 2 and 3, Forestry Intervention Models aim to promote sustainable Jhum cultivation with increasing tree cover and enabling economic return. In Model 4 and 5, Biodiversity Conservation Models shall be conducted for the purpose of Biodiversity Conservation and expansion of Community Conservation Area (CCA's) to carve out conservation corridors or clusters, providing and enabling environment for wildlife conservation and ecosystem services. The models are elaborated below:

A. Jhum Agro-forestry (JAF) Model-1: Agro-forestry during cultivation period

A minimum of about 800 trees/live tree stump are to be maintained as different age gradation per hectare through nurturing of natural regeneration of tree seedling, retaining and managing existing trees (coppicing, stump dressing, pollarding, pruning etc.) and augmentation through plantation (Artificial regeneration by planting 400 plants per hectare) for soil amelioration, better nutrient recycling, increased production of fuel wood, fruits and Non Timber Forest Products (NTFP), which will provide growth advantage during fallow period and overall optimized bio-physical and socio-economic interactions and ecological sustainability.

B. Jhum Fallow Forestry (JFF) Model-2: Agro-forestry during fallow period

To improve the biological and economic productivity of the fallows while maintaining ecological resilience and cultural connections. Tree density and diversity shall be augmented during fallow period to enhance production of timber, NTFP, faster soil enrichment and carbon stock. A minimum number of 2000 of trees need to be maintained per hectare with different age gradation, with at least half, having ability to respond positively coppicing/lopping/pollarding. Besides, augmentation needs to be done through Planting of 625 new trees per hectare. Attention shall also be given to regeneration and augmentation of non-trees (shrubs, climbers, herbs, tubers etc.) to enable enhanced local access to culturally preferred food, medicine, and forest products for nutrition, consumption and income.

C. Jhum Conversion to forestry (JCF) Model-3: Conversion to Forest Block

Jhum fallows, which have already been discontinued (abandoned) or can be discontinued (proposed to be) by the community decision shall be put under permanent forestry to meet/augment the livelihood and income of the community and also to enhance the ecosystem. The purpose of reserve shall not be absolute conservation but to have a forest with different species of timber (which can be harvested as part of working schemes in future following certain rotation), NTFP along with non-trees to provide income livelihood, food and medicine. Depending on the location, these forests can also provide watershed services and help slope stabilization to prevent landslide.

D. Jhum Conversion to Conservation Area (JCC) Model-4

This model shall be same as JCF, except the removal of economic return shall be completely avoided. Only extraction of food, cultural consumption items, bona fide needs shall be allowed to very poor households and/or highly dependent communities/households identified during the preparation of micro-plan. The objective here is to conserve flora and fauna and conservation of catchments for enhanced and sustained watershed services.

E. Protection and Expansion of Community Conservation Area (PEC) Model-5

PEC model shall expand existing conservation area to reinforce ecological system without economic return. This model shall be applicable to area where communities have already initiated conservation, to recognize and incentivize sustainable and

equitable conservation. Objectives and approaches shall be same as JCC model, with an additional focus on expanding, clustering and connecting Community Conservation Areas (CCAs). In case there are patches of discontinuity with other land-use like Jhum cultivation, etc., concerned groups and communities can be approached to be part of the cluster. Incentives and other compensations to assist them in addressing the cost of conservation shall be extended through suitable institutional mechanism (JFMC or Cluster).

CHAPTER-2

2. Planning Approach at Different Levels

2.1. Planning at the PMU level

Villagers are not formally trained foresters. Therefore, one of the biggest challenges of community-based forest management is adoption of scientific forest planning and management. The project requirement is to identify the present vegetation within the demarcated JFM treatment areas through the interpretation of satellite images and ground truthing.

Basic spatial information for NFMP project to generate different pre-field maps required for the preparation of micro-plan at PMU level are procured from NGIS&RSC. Different years' forest cover maps as remotely sensed forest information are procured from FSI and temporal satellite images for change detection analysis are procured from NRSC. The GIS Cell under Project Management Unit (PMU) prepares the DGPS/GPS based survey layers of different points and boundaries. Thereafter the various thematic layers based on remote sensing and ground truthing are used for the selection of proper forest treatment models.

Forest geospatial data layers required:

- A. Topography
- B. Forest administrative boundaries
- C. Forest Management Units (Hypothetical Polygon boundaries describing the Area of Administration of FMUs and DMUs)
- D. Forest infrastructure
- E. Forest Working Plan data (Different thematic data layer prepared by Working Plan division for different projects)
- F. High resolution satellite images (to accurately delineate the ground features, vegetation type and density through land use analysis)
- G. DGPS/GPS survey layers (to execute control surveys and accurate geo-referencing of the forest area, boundaries for JFM treatment areas, and the forest infrastructure.)

The above-mentioned geospatial data also helps to develop a GIS based Decision Support System (DSS) for planning and monitoring of the JFM treatment areas. DSS helps in identification of the degraded forests, selection of treatment areas, monitoring of the JFM implementation activities, temporal analysis of the satellite imagery showing improvement/changes under the project.

The data collected through the GPS and other sources should be sent to the central server for dissemination of the real-time information to the concerned forest officials for immediate action.

It is difficult to introduce such a scientific and logical approach to village based preparation of micro-plan. Therefore, following actions needs to be implemented, in a chronological manner for planning and monitoring of the treatment areas:

A. Preparation of the initial list

Preparation of the initial list of proposed treatment areas sent by the respective DMUs based on the Survey of India (SOI) toposheets on 1:50,000 scale.

B. Detailed analysis

It includes field information as well as past interventions under other programs of participatory forest management, dependency of the communities and existence of willing JFMCs.

C. Procurement of Satellite Imagery and FSI Maps

The preparation of large-scale maps for village level planning and subsequent technology-based monitoring requires high resolution satellite imagery to represent the vegetation type and density. These cloud free satellite imageries procured from NRSC and Forest cover and Forest type maps procured from FSI data are required for the concerned DMUs to delineate the treatment areas.

D. Preparation of Pre-field Maps

The GPS observations/track data of the proposed site obtained during the reconnaissance survey should be plotted on the geo-referenced satellite image. Land use, Land cover, base maps (including village location, drainage, roads, etc.) and forest cover map of the AOI (Area of Interest) prepared with the help of data from NGIS&RSC, NRSC and FSI serve as the Pre-field maps. A validation of these maps is required during the DGPS/GPS survey. List of the Pre-field maps is available in Annexure-1.

E. Generation of geospatial database and thematic maps

The final boundary coordinates obtained through the post-processing of the DGPS/GPS survey, ground validated land use/ forest cover map along with geo-rectified satellite imagery and the corresponding topographic maps should be used to prepare the spatial data layers of the treatment area. The site-specific spatial data should also link to their corresponding attribute data collected during the field survey to generate site specific geo-database.

The geospatial database generated in the above process should be logically organized with appropriate linking to the corresponding attribute dataset. These datasets and

thematic layers must be logically related and composed together to generate to produce a set of five maps as listed in Annexure-2.

The maps must contain the grid lines (e.g. 7.5 second latitude-longitude grid lines in Degree-Minute-Second (DMS) format representing 4 ha.) for better appreciation of the vegetation extents depicted and also to record modifications required (if any).

For better understanding of the terrain, the elevation information should be represented on the maps after DGPS/GPS elevation data are correlated with Digital Elevation Model (DEM). A detailed description on Treatment Map Preparation is described in Chapter - 4.

F. Change analysis

Temporal comparisons of the satellite data are required for all JFMC areas to assess the changes that have taken place after the planned intervention in the forest areas in accordance with the Micro-plan. With respect to these sites, vegetation density in the treatment area before and after implementation of planned interventions should be analyzed. Cloud free multi spectral satellite imageries of different years should be used and the difference in vegetation density should be derived for each site.

G. Capacity building of field staff and communities

Continuous efforts are required from PMU to acquaint DMU and FMU officials with the use of technology, data verification through the intermediate outputs and utilization of the final outputs for preparation of the Micro-plan. Pre-survey training sessions should be organized at DMU headquarters to acquaint the field staffs with the approach, technology and methodology with demonstrative field survey and output generation for better appreciation.

Focused trainings are required for the post-survey procedures including map reading, field verification and map-based information retrieval for use during the preparation of Micro-plan. Site specific reports depicting its general condition, land use, vegetation, survey details with geo-tagged photographs, etc. must be prepared for quick and ready reference for micro planning/ monitoring.

In addition to building capacities of the forest officials, special emphasis is required on training the participating communities (JFMC leaders and selected members) for using the maps in planning interventions through transect surveys which must be done with the help of these maps during preparation of Micro-plan.

2.2. Planning at the DMU level

Involvement of JFMC from the stage of area selection/demarcation/development of Micro-plan helps in a big way to create a sense of ownership. There is a close relationship of villagers with the forests. So, they know about forests more intimately and have better appreciation of resources. GIS and remote sensing-based assessment of resources is quite useful for the project and the treatment proposed for the treatment areas. This is possible only when JFMC Members/FMU staffs are in tune with the technical support at DMU and PMU level. Being an innovative approach, it takes time for the JFMC to comprehend its role and responsibility and only with the help of different trainings and workshops it can deliver optimum results. Following actions need to be implemented for planning and monitoring of the treatment areas at DMU level:

A. DGPS/GPS survey planning

To plan out the required resource allocation, manpower deployment and auxiliary facilitation required for reconnaissance/joint inspection and DGPS/GPS surveys, joint meetings and workshops are suggested. Specific survey plan for the treatment areas should also be carried out for DGPS/GPS observation with reference to the recent period satellite almanac data.

A workshop should be organized to review all the data and maps required for selection. Following are the main areas of planning where training of the project staff, NGO's and JFMC members is required:

- a. Participatory process for situation analysis and planning for fostering sense of ownership.
- b. Demarcation of JFM area through participatory transect walk and perimeter survey.
- c. Using DGPS/GPS for treatment area mapping based on satellite data with ground truthing and production of map.
- d. Orientation of the NGOs and forest officials about the micro planning strategy under the project.
- e. Preparation of first draft Micro-plan (this includes Treatment Plan Mapping using GPS), review and approval by JFMC Executive Committee (EC) and JFMC General Body (GB) and revision of micro-plan, if necessary.

B. Formation of the Survey Team

A survey team should be constituted at DMU Level to conduct all the surveys and data collection work in a scientific manner. The proposed survey team members and their responsibilities associated in survey team are listed below:

Table 1: Roles and Responsibilities at DMU and Field level

| SL. No. | Designation | Responsibilities |
|---------|--------------------------------------|--|
| 1 | Asst. DMU Head | <ul style="list-style-type: none"> • Time bound planning of survey to be carried out in the JFMCs as per advisory from PMU • Quality checking of the data with the help of Computer Operator before sending the data to PMU • Submission of data to PMU through DMU head |
| 2 | Computer Operator | <ul style="list-style-type: none"> • Creation of Polygon using open source GIS application • Measuring the area and comparison with proposed area to be mapped/surveyed • Plotting of polygon on Google Earth Pro • Directing for resurvey/rectification if there is a significant difference |
| 3 | Documentation Assistant | <ul style="list-style-type: none"> • Survey and Mapping of JFMC Areas (treatment area, plantation area, photo point monitoring etc.) using GPS along with Range officers and 4-5 JFMC Members including Field Facilitator • Sharing GPS data with Computer Operator • Ensuring safe custody and storage of data, reports, photos and maps |
| 4 | Range Officers (from project ranges) | <ul style="list-style-type: none"> • Facilitating the Documentation Assistant and NGO Team during survey and mapping of JFMC • Checking quality of GPS data w.r.t. model-wise area and location |
| 5. | NGO Team | <ul style="list-style-type: none"> • Coordination with JFMC and ensuring the presence of JFMC members during survey and mapping works • Assisting Survey Team in survey and mapping of JFMC area • Checking quality of GPS data w.r.t. model-wise area and location |
| 6. | Field Facilitators | <ul style="list-style-type: none"> • Coordination with JFMC and ensuring the presence of JFMC members during survey and mapping works • Assisting Survey Team in survey and mapping of JFMC areas |

2.3. Planning at the FMU level

Baseline data of vegetation/forest type and land use of intervention areas is required before the implementation of the project. The necessary data/map collection and their compilation are to be done by FMU at range level. Preparation of first draft Micro-plan including treatment area mapping (using GPS), review and revision of Micro-plan are responsibilities of FMU Staff. It also includes review and approval by FMU head, taking suggestions from DMU and Conservator of Forests (CF). Revision and re-approval of the same Micro-plan can be done as and when required. Primary and secondary data collection is required for the treatment area mapping of the target villages through document review, key informant interviews and focus group discussions. Planning for qualitative information and community maps is also required through Participatory Rural Appraisal (PRA) during Micro-planning.

Below mentioned work should be done by the Survey team formed at DMU level along with FMU staff and JFMC members:

A. Reconnaissance/Joint Inspection

Reconnaissance/Joint inspection survey of the proposed treatment areas should be conducted by the forest officials and the survey team to understand the Area of Interest (AOI) or treatment sites and its surrounding in a 500m buffer zone. The periphery should be recorded using GPS in **track** mode. This exercise ascertains the extent of proposed treatment area.

B. DGPS/GPS Survey of the treatment area

Coordinate observation of the treatment area boundary's pillar posting should be carried out by survey team through DGPS/GPS devices. Simultaneously DGPS/GPS observations for each of the pillar positions should be made. In addition to the boundary pillars, DGPS/GPS observations should also be carried out for auxiliary permanent features such as places of worship, forest bungalow, school, hospitals and other important infrastructure.

C. Treatment area planning using advanced technologies

The GIS maps prepared at PMU level should be verified by JFMC through reconnaissance and transect walk of entire JFM treatment areas. After the verification, the GIS map should be modified as and when necessary. This process requires time, effort and resources. Adequate technical and labor inputs shall be provided by the various units under the project.

The logical relation between the forest cover map and treatment map, though appears to be simple, is difficult to understand for JFMC members and some frontline project staff members. Also, if the treatment models are not understood properly at the initial stage, certain areas will be untreated or treated by inappropriate treatment model. The introduction of such approach requires intensive orientation and field demonstration. The establishment of few demonstration sites for the purpose would also be helpful.

Apart from vegetation, other factors influence forest treatment and management, which cannot be shown on a map. Because of which, there could be cases of discrepancies between forest coverage and treatment models.

The influencing factors are:

- a. Traditional forest rights and customary ownership over forest patches.
- b. Village boundary issues.
- c. Lack of laborers in the village.
- d. Lack of manpower at the field project offices.

Micro-planning using the advanced technologies faces certain difficulties at the beginning stage and requires midcourse corrections. For this, the Micro-plans must be revisited and rectified where necessary one year after the formulation.

D. Validation of land use and forest cover

During the preparation of pre-field maps and the land use/vegetation map tentative boundary pillar positions (prior to correction) are supposed to be plotted on the maps. During the DGPS/GPS survey these pillar points must be validated for ground accuracy. Ground truthing also include study of vegetation type along the multiple transacts lines. The survey 'field book' should be used to record the field topography, land use, vegetation type/density and existence of other important land features such as reserve forest boundary pillars, ridge line, valley line, electric line, culvert/ bridge, well/ tube well, hutment, place of worship etc.

For baseline and benchmark establishment, the following project works should be completed at FMU level:

A. Socio-economic profile of village, including a set of maps as:

1. Base Location map
2. Transect map
3. Village social map
4. Village resource map
5. Seasonality diagram
6. Venn diagram
7. Participatory wealth ranking
8. Livelihood opportunity analysis

B. Forest development plan, including a set of maps as:

1. Present forest map (GIS map based on RS technology)
2. Proposed forest treatment map (using GPS)
3. Village perspective development plan
4. Annual action plan

5. Record of activities undertaken

Note: Verification of maps must be conducted jointly by the FMU officials and JFMC members in presence of the survey team to check correctness of physical features, land use/ land cover, vegetation density, treatment area pillar positions along with the location of auxiliary permanent locations.

2.4. Planning at JFMC level

Boundary demarcation involves discussion with community members to determine the treatment areas which could cater the project objectives. A meeting between JFMC members and field staff will assist in performing the tasks by following the guidelines given below:

- A. Identify the area and legal status of the forest area. Be sure to speak with both women and men, as well as with different tribal groups.
- B. Determine if any conflicts exist including inter-village and intra-village, and the nature of the conflict (i.e. politics, boundary dispute, restriction of access, theft, encroachments, court cases, harassment etc.). How are village members dealing with existing conflicts?
- C. Discuss the area of forest the JFMC will manage. Determine the existing area under protection.
- D. Is it an appropriate area given the size and location of the village?
- E. Can the village effectively protect and manage the area?
- F. Do they need more or less area?
- G. Is the area they are claiming used or protected by a neighboring village?
- H. Are neighboring villages involved in protection?

2.4.1. Survey and Demarcation Guidelines at JFMC level

Before the demarcation starts the following preliminary planning is necessary:

- A. Identification of treatment areas to be allotted to JFMC should be done with the consultation and discussion with the JFMC members/village communities.
- B. Different kind of pre-field maps listed in Annexure-1 should be ready.
- C. Rough sketching, through the sketch pen or highlighter, of the treatment areas which has to be allotted to JFMC on the available maps.
- D. Demarcation should be completed by JFMC members. Foresters from the respective DMUs/FMUs will assist them during the demarcation process.
- E. Handheld GPS (For e.g. GARMIN eTrex) which are available with all the FMUs would be used for preliminary survey and demarcation (pillar posting, area calculation, etc.).
- F. Installation of Treatment Area Boundary Pillars is very much important for two reason:

- i) It creates a kind of self-belongingness within the community about the treatment area.
- ii) It helps in physical recognition of outer limit of the project target area with respect to JFMCs and correlation of GIS based maps and orientation in the field.

For Phase-I, during survey work at least some temporary pillars should be established on ground such as stack of stones, trees, etc. having marked numbers with the help of paint and brush in the direction of the transect walk clock-wise order. Gaps between pillars can be based on the Line of Sight concept (from any given pillar, the next pillar should be visible through naked eye on ground.)

2.4.2. Steps to be followed for Survey and Demarcation

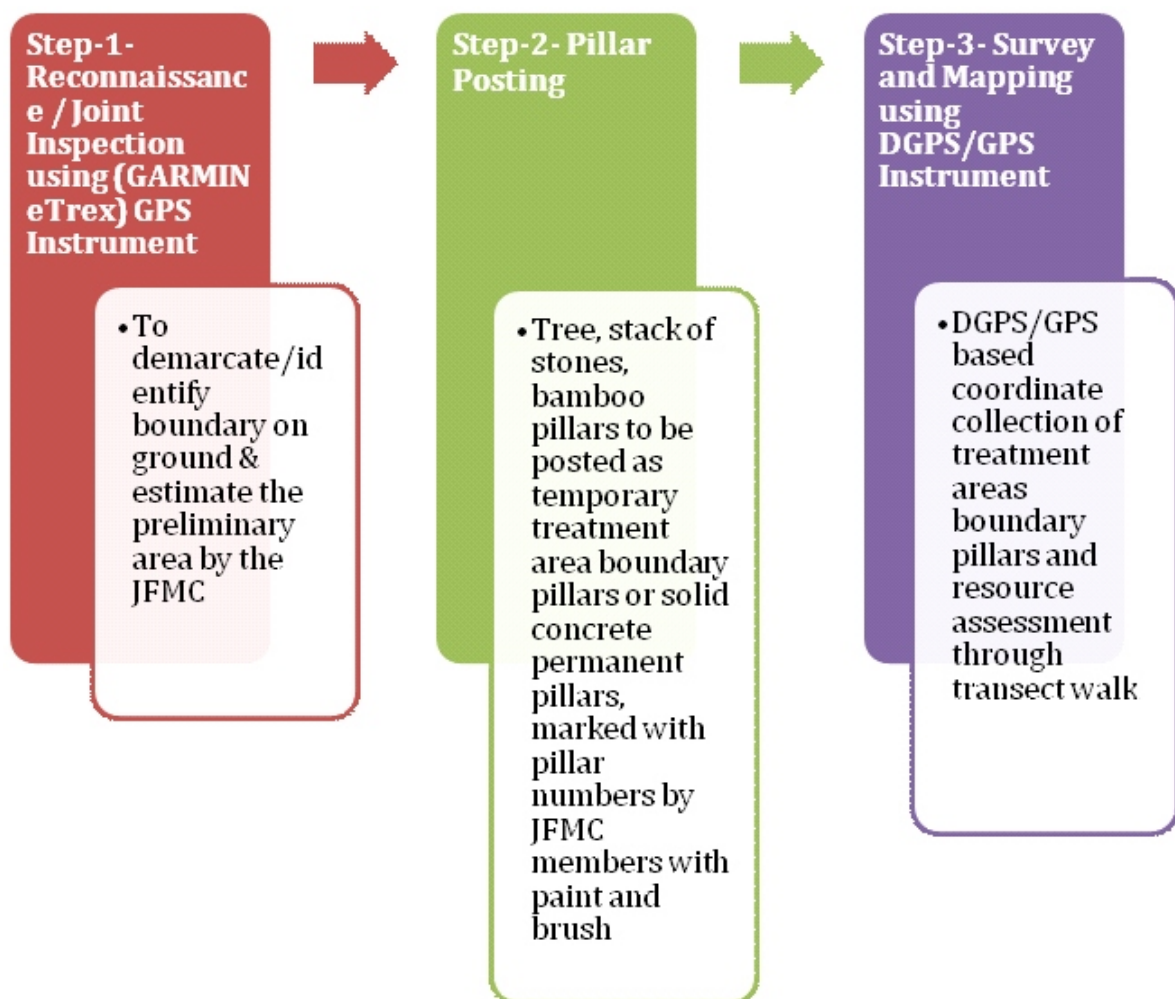


Figure 1: Survey and Demarcation Steps

CHAPTER-3

3. Sample Work Plan for Demarcation of Treatment Area Planning

Following are the responsibilities of different units for survey work under the project:

3.1. Planning of the Survey Work

Responsibility:

DMU/FMU (One Day)

- A. Make a work plan to determine priority by FMU for demarcation of area. This work will be coordinated by DMU Heads.
- B. Advice JFMC and Field Facilitator two days in advance of arrival.
- C. Advice foresters and forest guards of the work program and duration.
- D. Arrange transportation for fieldwork.
- E. Confirm 4 to 5 JFMC Members to accompany Survey Team for GPS survey of each mapping session.

Pre-Field Visit

Responsibility:

FMU (One day before field visit)

- A. Confirm all personnel are available for weekly work program.
- B. Identify and confirm the treatment areas to be mapped. Review program as required to ensure efficiency of field visit.
- C. Ensure that the batteries of all electronic devices (such as GPS devices, Camera, smart phones, etc.) are sufficiently charged before field visit.
- D. Ensure that the previous field data are properly saved and the device memory is emptied for fresh data collection.
- E. Ensure all pre-field maps are ready.

Field Visit

Responsibility:

Survey Team (Range Officer and Documentation Assistant -Two days)

- A. On arrival meet with JFMC members, forest protection watcher, forest guard and field facilitator at agreed meeting point for discussion and identification of treatment area.
- B. Sketching on the pre-field maps to determine location of treatment areas, which is mutually agreed with JFMC members and plan for demarcation of treatment area boundary.
- C. Establishment of treatment area boundary pillars (permanent/temporary).

Responsibility:

JFMC Members and survey team (forester/ forest guard and documentation assistant) (one day)

- A. Turn on GPS device for survey of treatment area.
- B. Turn on GPS Device and ensure that at least 1 satellite is visible in each quadrant (i.e. total 4 or more satellites) to start data logging.
- C. Check the battery meter and ensure it is full.
- D. Mark the waypoints/tracks, rename it as 'start point' and mark other waypoints from pillar to pillar. In case of temporary pillars/points like, hills, river, water logging, roads, Bamboo grove, etc., mark them as the boundary of treatment area, if available.
- E. Start the demarcation, moving clockwise throughout the targeted area and mark place/point for the identification of measurement starting point.
- F. Collect field data and keep accuracy in mind. Think about what you are doing, before starting the data capture session.
- G. Ensure all features are mapped before departing for field. Compare total mapped area with records. If there is a discrepancy with these records, discuss with Ranger/Forester/Forest Guard and make a note using keypad in the appropriate feature.
- H. The area will be approximate for Reconnaissance / Joint Inspection but actual for DGPS/GPS Survey and will be lot closer to the preliminary survey area.
- I. DO NOT attempt to amend the areas mapped to match the records by increasing or decreasing the actual area. Differences should be noted on a book.

Post Field Visit

Responsibility:

Survey Team (Computer Operator - One day)

- A. Download data to data file on computer. This may need to be done after every field demarcation.
- B. Check if the files are complete and compare areas with stated progress reports. Note any discrepancies.
- C. Delete old rover files from GPS unit.
- D. Send data to PMU by disk or by email attachment.
- E. Recharge batteries of GPS units.
- F. Ensure safekeeping of GPS units in secure place.

Proposed Work Schedule

| S. No. | Activities | Number of Days | | | | | | |
|--------|--|----------------|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 1 | Planning (DMU/FMU): Preparation of work program; intimation to JFMC and field facilitator about the field visit | | | | | | | |
| 2 | Before Field Visit (FMU): Checking of GPS Device | | | | | | | |
| 3 | Field Visit (FMU): Discussion with JFMC members, forest guard and field facilitator for identification of Treatment Area and preparation of sketch Maps, establishment of pillars | | | | | | | |
| 4 | Field Visit (Survey Team): Reconnaissance/Joint Inspection of Treatment Area through GPS Device | | | | | | | |
| 5 | Field Visit (Survey Team): Final Survey of JFM Area through DGPS/GPS Device | | | | | | | |
| 6 | After Field Visit (FMU): Collection of GPS Device, data transfer to the computer, checking of data, data sent to DMU | | | | | | | |

3.2. Collecting GPS Data Using Garmin eTrex Device

Turning on the GPS

- A. Turn on the GPS by holding down the POWER button.
- B. If you have trouble seeing the screen, press the POWER button twice to turn on the light, then press the “QUIT/PAGE” button once to return to the main screen.
- C. Press MENU/FIND twice to get to the main menu.
- D. From the main menu, press the ROCKER button in to get to the “Satellite” screen.



Figure 2: Different kind of GPS Device

- E. For the GPS unit to work accurately, ensure that there are no overhead obstructions (like canopy cover, tree trunks, etc.). Look at the number on the top left of the screen, under “Location”. This number is the accuracy of the GPS unit. If the accuracy is greater than $\pm 10\text{m}$, it means that the accuracy of the GPS device is low.

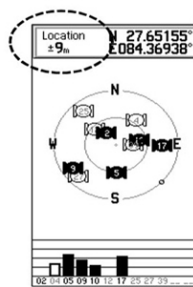


Figure 3: GPS device Initial Screen

- F. Wait until the accuracy (under “Location” on the satellite screen) is ± 5 to ± 8 or lesser before you start collecting data.

Collecting a Point

- A. Turn on the GPS and check the accuracy (see the section above).
- B. To collect a point, hold down the ROCKER button until the “Mark Waypoint” screen appears.

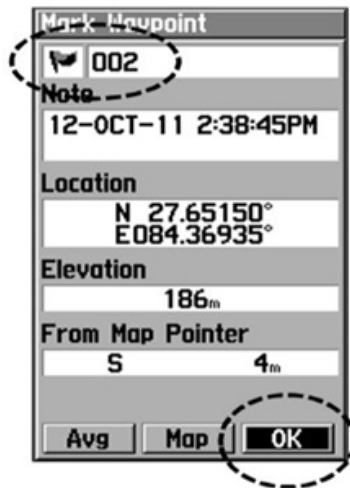


Figure 4: Collecting a point through GPS Device

- C. In your notebook, write down the name of the waypoint and the waypoint ID [the three-digit number next to the flag icon at the top left of the screen. (For example, write “002: DDC Office”)]
- D. To save the point, use the rocker button to navigate to the “OK” button, and then push in the rocker button.

Collecting a Line

- A. Turn on the GPS and check the accuracy.
- B. Press MENU/FIND twice to get to the main menu.
- C. From the main menu, use the ROCKER button to navigate to the “Tracks” screen.
- D. If this is the first time you are using the track log, you need to setup the GPS:
 - a. On the “Track Log” use the ROCKER button to navigate to the “Setup” page.
 - b. On the “Setup” page, change the “Record Method” to “Time” using the ROCKER button.
 - c. On the setup page, change the “Interval” to 00hrs00min01sec using the ROCKER button.
 - d. Press the “QUIT/PAGE” button once to return to the “Track Log” screen



Figure 5: Collecting a line through GPS Device

E. Procedure for line data collection:

- a. Make sure that the track log is turned off. Your screen should look like the screen given in the Figure 5. The “Off” at the top right of the screen should be filled in. If the track log is turned on, use the ROCKER button to turn off the track log.
- b. Use the ROCKER button to navigate to and press the “Clear” button.
- c. Walk to the point where you want the line to start and stand on top of the point (for example, initial pillar points, landmark, etc.
- d. Turn on the track log using the ROCKER button.
- e. Walk along the length of the feature you want to record. The GPS will record one point every second while you walk.

Note: While the GPS is recording you have to stay on the feature you are recording. For example: you cannot walk away from the road. When you want to stop recording, 'turn off' the track log using the ROCKER button.

- f. Use the ROCKER button and navigate to “Save” and press the ROCKER button in.
- g. When asked “Do you really want to clear the track log?” click “Yes” using the ROCKER button.

Use the ROCKER button and navigate to “Save” and press the ROCKER button in.

- h. When asked “Do you want to save the entire track?” click “Yes” using the ROCKER button.

- F. In your notebook, write down a description of the track and the name of the track on the GPS unit. e.g.: “East-west Highway 12-OCT-19 03”.
- G. To save the track, use the ROCKER button to navigate to “OK”.

Collecting a Polygon/ Boundary of Treatment Area

- A. With the Garmin eTrex GPS device, polygons are collected using the same process as collecting a line.
- B. The collected track enclosing the treatment area can be demarcated as a polygon by converting a polyline/track into a polygon using Quantum GIS.

When you are collecting waypoints for a treatment area, the track describing the polygon must be enclosed. It means your end point of the polygon **MUST** be the exact same point as your start point (where you started collecting data), before you turn the “track log” off and save the track (using the same process described above for a line).

Do's and Don'ts for Treatment Area survey using GPS

Do's

- A. Before recording coordinates in the field for treatment area boundary, refer the available treatment maps/sketches.
- B. Collect coordinates in Clock-Wise direction only. The coordinates need to be recorded so as to maintain natural curves of the boundary.
- C. Before storing the coordinate, make sure GPS is tracking and receiving signals from at least 5 satellites for better accuracy.
- D. Along with treatment areas (boundary of various interventions) also record GPS coordinates of Boundary pillar locations along with their IDs and Reference Number.
- E. Record the coordinates in a Hard Copy Data Record Sheet for GPS Mapping of Treatment Areas during the field survey itself.
- F. Immediately after completing the survey work, download the GPS file and store the file. Send a digital copy of the file along with hard copy filled in Data Record Sheet to respective Circle Office.

Don'ts

- A. Never delete the GPS data before successfully downloading from the GPS to the computer/system.
- B. Never forget to record the details of every recorded GPS location point in the Hard Copy Format.

3.3. Points to Remember during the Treatment Area Survey and Demarcation

- A. During the survey process, carry the different pre-field maps highlighting the forest/project area.
- B. The Range/Beat Officer should make the necessary arrangement for the company of three to four JFMC members to assist the survey team.
- C. Create one data file for each Treatment Area in the GPS device. The survey points and their attributes should be recorded under that file.
- D. Properties/Legends/Landmarks (viz. Lake; Pond; Village Road, Link Road; Highway; Private Land; Paddy Land; Community land; Infrastructure Buildings [school; temple; educational institutional etc.) inside and outside the treatment area should be written in the columns given in the table provided in Annexure-3.
- E. In case of any existing plantation which is inside or outside the project area, the year of plantation, species and status of the plantation should be recorded in the format of Annexure-3.
- F. In case of landmark or important locations, record the details with respect to the corresponding GPS location.

Mapping Techniques

- A. Identify the initial pillar point of the proposed treatment area as decided by the team. Mark its location on the GPS device as the starting point /pillar which could be represented by trees, roads, footpath, etc. Move outskirts of the boundary of the Treatment Area.

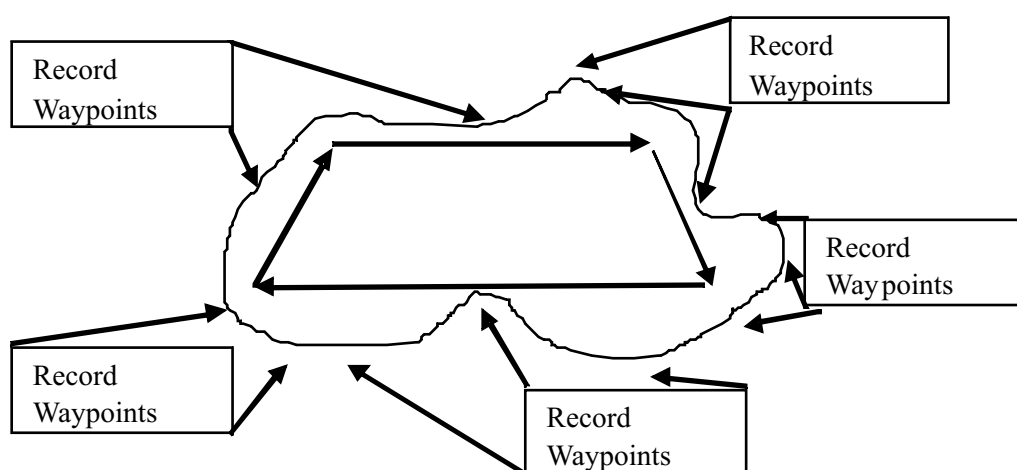


Figure 6: Recording way points at different locations

- B. When recording the GPS coordinates along a route, click on Waypoint to record a minimum of one waypoint on the pillar (temporary/permanent). Again, click on Waypoint to record furthermore points for the next pillars. Continue this process until GPS survey of the area is completed.

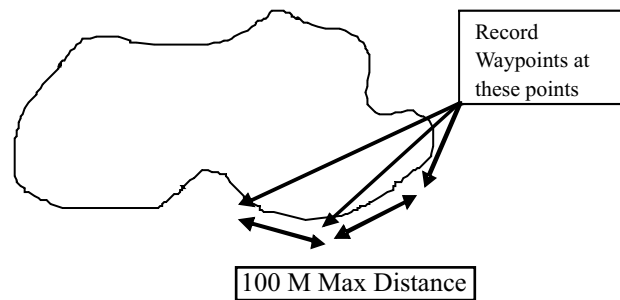


Figure 7: Way points distance and line of sight

- C. When you have a feature with a 'hole', such as water logging or treatment area model inside another treatment area model (JAF under JFF), etc. In this situation it is advised to initially measure the outer treatment area and then proceed with the inner feature or treatment area.

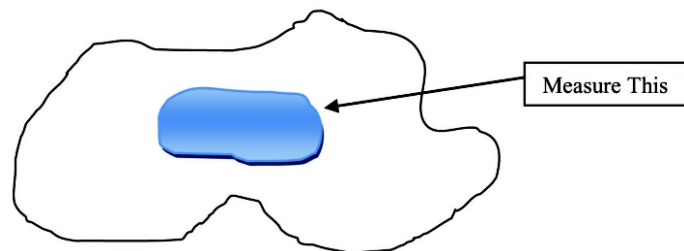


Figure 8: Feature inside the feature

- D. Do not make arbitrary adjustments to the inside of the area (under-measure) to compensate when you over-measure outside the area. This will only compound the error. Start logging the feature from the start, or back track to the last point on the boundary and recommence data logging.

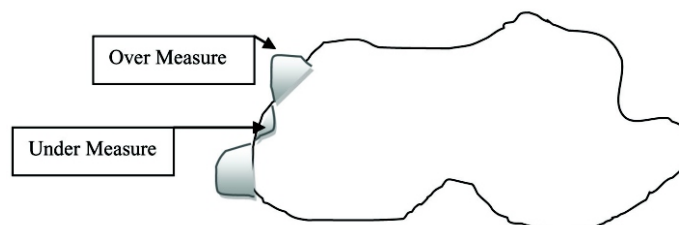


Figure 9: Over measure and under measure

- E. Whenever a road is passing through the treatment areas, some discretion is required depending on the importance and the dimension of the road. Where a Treatment Area is divided by a metalled road or an unmetalled road greater than 6m, then a separate polygon should be mapped for each side of the road, even if it described as the same Treatment Area. Where a Treatment Area is divided by an unmetalled road less than 6m, it can be mapped as one polygon.

3.4. Different kind of errors to be checked at DMU level

There are different kinds of errors which are commonly committed by survey teams and DMU staff members during survey. Below are the few examples to check them during GPS field survey.

A. Boundary curves not captured properly:

Usually it is very rare that a Treatment Area boundary is so linear. It is obvious from the example depicted in Figure 10, that the boundary is not captured properly. DMU and Survey team should capture the GPS Points in such a way that such kinds of errors are avoided.

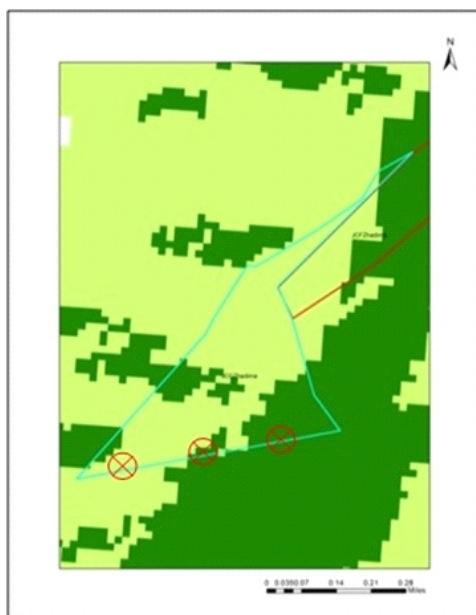


Figure 10: Error Type: boundary curves not captured

In the above example it is suggested to capture the GPS point on every curve of the boundary and after less than 50-meter distance.

B. Unsystematic field survey:

The below mentioned surveyed treatment area as in Figure 11, boundary is full of errors. Outer extremity of boundary is not clear Polygon as it is not closed. It is advised that boundary to be surveyed in one single day itself

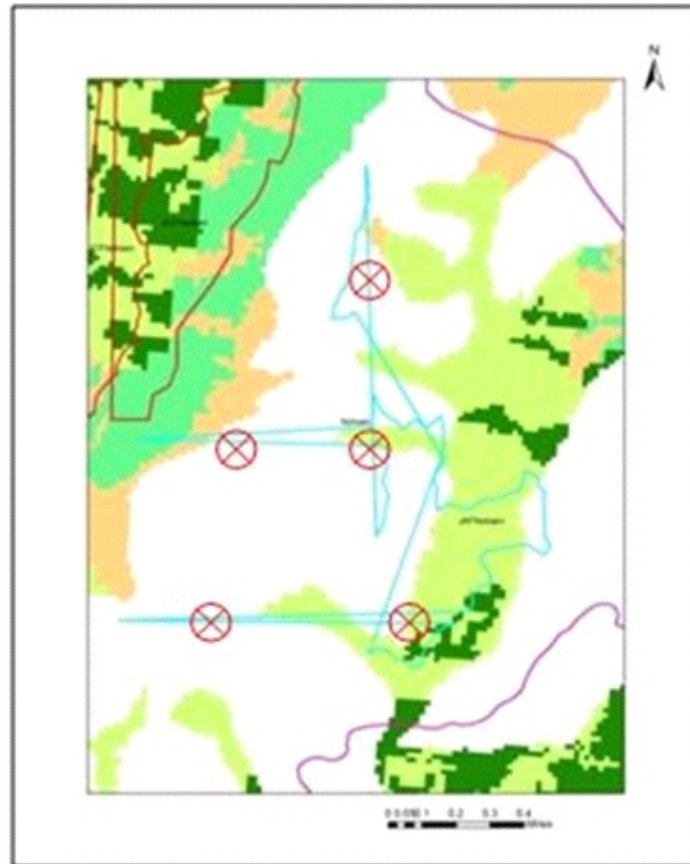


Figure 11: Error Type: Unsystematic field survey

In the above example it is suggested that the survey team should capture the GPS point in a chronological order. If they have stopped taking points at some place due to any reason then they should start capturing GPS points again from the same point they left.

CHAPTER-4

4. Maps to be prepared for JFMC Treatment areas

4.1. Information Sources

Any existing surveyed database available within Department of Environment, Forest and Climate Change(DEFCC) and other Government departments like the Planning and Co-ordination Department [Nagaland GIS and Remote Sensing Center (NGIS&RSC), Department of Land Resources, Forest Survey of India, Department of Agriculture and ICAR-National Bureau of Soil Survey & Land Use Planning (Jorhat, Assam), etc.] shall be utilized if the geographical coordinates are available for the traverse point locations.

Multiple layers of GIS Data are required for the in-depth analysis. The basic types of data are described below.

Table 3: Information sources of GIS Data

| S. No. | Data Source | Description |
|---------------|------------------------------|--|
| 1 | DGPS/ GPS Survey Data | The data generated through GPS survey done at the village level superimposed on various layers. |
| 2 | Satellite Images | LISS - IV imagery (multispectral), DEM |
| 3 | SOI Layers | Layers from digitized topographical maps of Survey of India like Communication, Infrastructure, Hypsography (Contour, Spot Height), Hydrography (Rivers, Stream, canal, drain, Tank, lake, waterfall, embankment), Boundaries (Division boundary, Boundary Pillars), Utility (Transmission Lines, Pipelines), Habitation (Building, Hut, Cave), Land use& Land cover, Vegetation, Vital installations (Civil Vital Installation, Military Vital Installation) etc. |
| 4 | Forest Cover Map | Forest Cover, Forest Type information from Forest Survey of India (FSI) |
| 5 | Other relevant layers | Like Soil map from Soil and Land use survey (Department of Agriculture, cooperation and farmers welfare), Geology layers from Bhukosh portal of GSI, Layers available from other sources like different department and organizations. |

4.2. Map preparation process

Basic Steps for the preparation of different maps:

- A. Preparation of guideline and orientation
- B. Data collection (GPS survey on the ground)
- C. Plotting on the map
- D. Data calculation, quality checking and layer finalization
- E. Cross-checking with existing JFM area maps and non-spatial data
- F. Rectification and other necessary actions (such as re-allotment of project fund, etc.)

For baseline survey and benchmark establishment, following project works are expected under:

4.2.1. JFMC area mapping using remote Sensing and GIS technology

Baseline data preparation regarding location, soil, vegetation/forest type and land use of intervention areas should be done before the implementation of the project. For the generation of different kind of maps for JFMC Treatment Area, base data will be prepared in the GIS Lab at PMU with the help of secondary data available from different departments and Working Plan Division under Forest Department.

The data generated through DGPS/GPS survey done at the village level shall be superimposed on latest LISS - IV imagery, layers from digitized topographical maps of Survey of India (Sol), forest cover/forest type information from Forest Survey of India (FSI) and any other relevant layers available from other sources.

A minimum of three kinds of maps (Base/location map, Landscape and Vegetation Map, Aspect and Slope Map) shall be generated. These maps will provide information about area under different landscape, vegetation type, crown density, slope class, standing biomass, soil and hydrology, vulnerable areas to land-slides etc.

Pre-field Maps required for Micro-plan preparation according to MOD

A minimum of three kinds of pre-field maps are required with the help of GIS and Remote Sensing for the preparation of Micro-plan.

A. Base/Location map

Geo-coded database of village locations, stock map as baseline, Base/Location of benchmark Pillars and different boundaries generated from GPS survey with the help of JFMC members, records of the Forest Department and survey of the JFMC area using GPS Location. According to MOD for the preparation of the Base/Location Map, following data is required.

Table 4: GIS Data required for “Base/Location” Map

| S. No. | Layer | Description |
|--------|----------------|--|
| 1 | Point Layers | POI (Places of Worship, School, College, University, Sport Facility, Police Station, Post Office, Community Hall, Telecommunication Tower, Museum, Park, Tourist Point, , Tube-well/ Pump house, Single Overhead tank, Hand pump, Light Poles, Transformers, Traffic signals, Settlement Point, eco-heritage points etc. |
| 2 | Line Layers | Roads, Rails, Drainage lines, Canals, Utility Lines |
| 3 | Polygon Layers | River, Lakes, Ponds, Fisheries, Stadium, Airports, Sport Complex, Parks, Community Land, Built-up Area, District/Division Boundary, Village Boundary, Range/Beat Boundary, JFMC Area Boundary |

B. Landscape & Vegetation Map

Forest land use & land cover, vegetation type, crown density, standing biomass are the base data requirements for the Landscape and Vegetation Map. According to MOD for the preparation of the Land use& Vegetation Map, following data is required.

Table 5: GIS Data required for “Landscape and Vegetation” Map

| S. No. | Layer | Description |
|--------|----------------|---------------------------------------|
| 1 | Point Layers | Settlement Points, Surveyed Trees |
| 2 | Line Layers | Roads, Canals, Drains |
| 3 | Polygon Layers | FSI level 1, 2, 3 Classification Map. |
| 4 | Raster Layer | FSI Map Image files |

C. Soil-Hydrology-Vulnerability Map

Soil-Hydrology-Vulnerability map is based on the aspect, slope class, soil type, geology, hydrology (drainage lines), rainfall, vulnerable areas to land-slides etc. According to MOD for the preparation of the Soil- Hydrology Vulnerability Map, following data is required.

Table 6: GIS Data required for “Soil-Hydrology-Vulnerability” Map

| S. No. | Layer | Description |
|--------|----------------|--|
| 1 | Point Layers | Important location points |
| 2 | Line Layers | Drain, Stream, Roads |
| 3 | Polygon Layers | Soil Map, Rainfall Map, River, Vulnerability Map |
| 4 | Raster Layer | Slope Map, Aspect Map |

4.2.2. Socio-economic baseline Survey

Benchmark data need to be collected through baseline survey based on socio-economic conditions of target villages / households and control villages. Under this process two hard copies of the maps prepared in step -4.2 would be developed at a scale of 1: 5,000 and shared with JFMC and FMU members for field verification. The DMU and PMU shall get the data in soft copies. Corrected maps shall be provided to villagers/JFMC members and this information would be used for Micro-plan formulation and future monitoring. Socio-economic data collected through baseline surveys, periodical impact assessment and other socio-economic surveys/researches shall also be integrated into the GIS database to facilitate better decision making, monitoring and impact analysis.

Maps to be depicted in the Micro-plan

Socio-economic profile of village, including a set of maps as:

- A. Base/Location map
- B. Village social map
- C. Village resource map

Forest development plan, including a set of maps as:

- D. Present forest map (GIS map based on RS technology)
- E. Proposed forest treatment map (using GPS)

A. Base/Location map

The spatial databases shall use the Geo-coded database of village locations and stock map as the baseline for the project. Base/Location of benchmark pillars and different administrative and forest boundaries generated from different GIS layers or by GPS survey are also included. Records of the Forest Department and survey of the JFMC area using GPS Location with the help of JFMC members are also part of GIS Database. Important Village locations, Connecting Roads and different boundaries of Village are included in Map representation. For the preparation of the Base/Location Map, following data is required.

Table 7: GIS Data required for "Base/Location Map" for Micro-plan

| S. No. | Layer | Description |
|--------|----------------|---|
| 1 | Point Layers | Point of Interest, Police station, Petrol pumps, Bus stops etc. |
| 2 | Line Layers | Roads, Rails, Drainage lines, Canals, Utility Lines |
| 3 | Polygon Layers | District Boundary, Division Boundary, Range Boundary, JFMC Boundary, River Polygon, Stadium, Airports, Railway Stations, Compartments Boundary, FSI Class 1 Land use. |

B. Village Social Map

Social mapping is one of the most popular methods for such kind of project. The focus here is on the depiction of habitation patterns and the nature of housing and social infrastructure: roads, drainage systems, schools, drinking water facilities, etc.

Social map is different from other regular maps in significant ways. For one, it is made by local people and not by experts. For another, it is not drawn to scale. It depicts what the

local people believe to be relevant and important for them. Thus, it reflects their perceptions of the social dimensions with their reality that has high degree of authenticity.

In spite of there being many overlaps, a social map is different from a resource map. The latter depicts the natural resources land, water sources, flora and fauna, etc.

Applications

The chief feature of a social map is that it is a big help in developing a broad understanding for the various facets of social reality, viz., social stratification, demographics, settlements patterns, social infrastructure, etc. The diverse applications of social maps include:

- a. Developing a comprehensive understanding of the physical and social aspects of village life.
- b. Collecting demographic and other required information householdwise.
- c. Providing a forum of discussion to unravel the various aspects of social life.
- D. Serving as a monitoring and evaluating tool.

Social Map Preparation

Social Map includes village infrastructure like school, health center, roads, community centers, post offices, market etc., community institutions like clubs, SHGs etc., habitation like location of hamlets, houses with house numbers, social category, economic status (poorest, poor, average, better off), type of house, any other significant information like JFMC members house or work locations, social and religious organizations like NGOs, worship committees, church committees, education and health committee and the connecting roads or streams of these locations for the complete social overview of the entire area. For the preparation of the social map, following data is required.

Table 8: GIS Data required for “Social Map” for Micro-plan

| S. No. | Layer | Description |
|--------|----------------|--|
| 1 | Point Layers | Location Type- Worship Place (Temple, Masjid, Church, Gurudwara), School, College, University, Police Station, Post Office, Community Hall, Telephone Tower, Museum, Park, Tourist Point |
| 2 | Line Layers | Road Types- National Highway, Major Roads, Other Roads, Village Roads, Road Names- Road to way, Rail |
| 3 | Polygon Layers | Community Area, Clan area etc. |

C. Village Resource Map

At the village level, baseline data related to socio-economic, natural resource, land use and stock map for the project shall be collected and compiled for all target villages.

Applications

Resource maps have been used for depiction of various aspects related to the natural resource management of a locality including:

- a. Topography, aspect and slope.
- b. Forest, vegetation and tree species.
- c. Soil-type, fertility, erosion and depth.
- d. Land use, command area, tenure, boundaries and ownership.
- e. Water bodies, irrigation sources and drainage.
- f. Watershed development, various soil and water conservation measures, inundated areas, etc.
- G. Agricultural developments, cropping pattern, productivity, etc.

Resource maps have been found especially useful because they provide a focused spatial structure for discussion and analysis.

Resource Map Preparation

Resource map is one of the most common maps next to social map. While the social map focuses on habitation, community facilities, roads, places of worship, etc., the resource map focuses on the natural resources in the locality and depicts land, hills, rivers, fields, vegetation, etc. A resource map may cover habitation as well. At times, the distinction between the resource and social map may get blurred. A resource map is also not drawn to scale. It is done not by experts, but by the local people.

The local people are considered to have an in-depth knowledge of the surroundings where they have settled for a long time. Hence the resource map drawn by the local people is considered to be accurate and detailed. It is important to keep in mind, however, that it reflects the people's perception rather than precise measurements to scale. Thus, a resource map reflects how people view their own locality in terms of natural resources. For the preparation of the Resource Map, following data is required.

Table 9: GIS Data required for "Resource Map" for Micro-plan

| S. No. | Layer | Description |
|--------|----------------|--|
| 1 | Point Layers | Settlement Points, Surveyed Trees |
| 2 | Line Layers | Roads, Rails, Canals, Drains, Streams |
| 3 | Polygon Layers | FSI level 1, 2, 3 classification Map, Soil Map, Rainfall Map, River, Vulnerability Map |
| 4 | Raster Layer | FSI Map Image files, Slope Map, Aspect Map |

D. Present Forest Map

It will include the forest cover map including different admin boundaries.

Table 10: GIS Data required for "Present Forest Map" for micro-plan

| S. No. | Layer | Description |
|--------|----------------|---|
| 1 | Point Layers | No point layers |
| 2 | Line Layers | Roads, Canal, Drain etc. |
| 3 | Polygon Layers | Treatment Areas depicting different proposed Models |

E. Treatment Map

Villagers are not formally-trained foresters; therefore, one of the biggest challenges of community-based forest management is adoption of scientific forest planning and management. In order to realize scientific and need-based planning, advanced technologies are adopted, such as remote sensing and GIS to-

- a. Identify the present vegetation within the demarcated JFM areas through the interpretation of satellite imagery and ground truthing.
- B. Select the proper forest treatment models for different vegetation

In this process 2 types of treatment maps will be generated.

1. Before Plantation Treatment Map

It should be prepared for the planning for the application of different models in the Treatment Areas. It should reflect the treatment areas for the different kind of proposed models and plantation selected. It is part of the planning of the different treatment areas and the models applied on those areas.

A proposed treatment map should have detailed transect with GPS coordinates indicating all the intervention areas/sites by overlaying the information on the reproduced forest map. Interventions required are to be identified and the proposed treatment map should be updated accordingly.

The FMU and JFMC members shall jointly prepare a Proposed Treatment map. The Proposed Treatment Map is a visual representation of what changes are to be made in the existing land-use in coming years. They shall use the Resource Map as a reference for discussion, regarding the proposed activities to be carried out for afforestation, water resource management, agriculture development, community infrastructure developments etc.

The Proposed Treatment Map of the Area shall represent the information on the type of models/activity to be carried out, per area and per year.

The boundaries for Jhum areas (the current Jhum and the fallow Jhum), the area under community reserves and other land use (if any) shall be mapped. From these thematic mapping GIS layers will be generated as baselines against which changes due to project interventions shall be monitored. This information shall be an integral part of micro-plan. For the preparation of the Before Plantation Treatment Map, following data is required.

Table 11: GIS Data required for “Before Plantation Treatment Map” for micro-plan

| S. No. | Layer | Description |
|--------|-----------------------|---|
| 1 | Point Layers | GPS Points of nurseries, buildings etc. |
| 2 | Line Layers | Roads, Canal, Drain etc. |
| 3 | Polygon Layers | Treatment Areas depicting different proposed Models |

2- After Plantation Treatment Map

It should be prepared for the review of actual implementation after plantation in the Treatment Areas.

These GIS maps should be verified by JFMC through reconnaissance and transect walk of the entire JFM area. After the verification, these GIS maps should be modified as required. The logical relation between the forest map and treatment map, though appears to be simple, is difficult to understand for JFMC members and some frontline project staff members. Some of the factors that influence the boundary of the Treatment Area and the management process are:

- a. Traditional forest rights and customary ownership over forest patches
- b. Village boundary conflict

Discrepancies between planned forest treatment and actual treatment are inevitable during execution of work in some cases. For this, re-survey of treatment areas/plantations is recommended using GPS. The updated FSI maps will confirm the transformation within the treatment areas. The post plantation maps of Treatment areas will be generated based on the re-surveys using GPS handsets and change detection analysis of the areas on satellite imagery. For the preparation of the After-Plantation Treatment Map, following data is required.

Table 12: GIS Data required for “After Plantation Treatment Map” for micro-plan

| S. No. | Layer | Description |
|--------|-----------------------|---|
| 1 | Point Layers | GPS Points of planted trees, Plots etc. |
| 2 | Line Layers | Roads, Canal, Drain etc. |
| 3 | Polygon Layers | Treatment Areas depicting result after plantation |
| 4 | Raster Layers | Change Detection thematic map, Satellite Imagery |

Annexure - 1

Pre- field Maps required before Micro-plan preparation according to MOD

Below mentioned table describes the data requirements of different kind of maps, which must be prepared for the planning of the Micro-plan.

Table 13: Pre-Field Maps required before Micro-plan preparation according to MOD

| S.No. | Map | Representation | Scale | Layers required |
|-------|---|--|--------------------|---|
| 1 | Base/Location Map | Geo-coded database of village locations, Stock map as baseline, Base/Location Points (Bench Mark), different forest and administrative boundaries and JFMC areas using GPS Location. | 1:5000/ 1:10000 | Point Layers- Point of Interest as GPS points, Worship Place, Educational institutes, Sport Facility, Police Station, Post Office, Community Hall, Telephone Tower, Museum, Park, Tourist Point, , Tube-well/ Pump house, Single Overhead tank, Hand pump, Light Poles, Transformers, Traffic signals, Bench Mark etc. |
| | | | | Line Layers- Roads, Rails, Drainage lines, Canals, Utility Lines |
| | | | | Polygon Layers- River, Stadium, Airports, Sport Complex, Parks, Community Land, Built-up Area, (District, Village, Division, Range, Beat, JFMC)Area Boundary |
| 2 | Landscape & Vegetation Map | Land use and Land cover (LULC) Vegetation type, Forest Type, Crown density, Standing biomass. | 1:50000 | Point Layers- Settlement Points, Surveyed Trees |
| | | | | Line Layers- Roads, Drainage |
| | | | | Polygon Layers- FSI level 1, 2, 3 classification Map. |
| | | | | Raster Layer- FSI Map Image files |
| 3 | Soil-Hydrology-Vulnerability Map | Aspect, Slope, Soil type, Geology, Hydrology, Rain fall, Vulnerable areas to land-slides etc. | 1:25000 1:50000 | Point Layers- Important location points |
| | | | | Line Layers- Drainage |
| | | | | Polygon Layers- Soil Map, Rainfall Map, River, Vulnerability Map |
| | | | | Raster Layers- Slope Map, Aspect Map, DEM |

Maps to be prepared for Micro-plan according to the MOD

Below mentioned table describes the data requirements of different kind of maps, which must be enclosed with Micro-plan.

Table 14: Maps to be prepared for Micro-plan according to MOD

| S.No. | Map | Type | Scale | Description |
|-------|-------------------------------|--|--|--|
| 1 | Base/ Location Map | Generated with the help of GPS | On Scale 1:5000 | <ul style="list-style-type: none"> • River, Roads and (District, Division, Range and Beat, Treatment Area) Boundary • The Geo-coded database of village locations and stock map |
| 2 | Village Social Map | Hand Made Interventions on the 1:5000 Hardcopy Map | Interventions made on hardcopy Maps are not to scale | <ul style="list-style-type: none"> • Village infrastructure – school, health center, roads, community centers, post offices, market etc. • Community institutions – Clubs, Self Help Groups (SHGs) etc. • Habitation – location of houses with House numbers, Social category, Economic status (poorest, poor, average, better off), Type of house, Any other significant information • Location of different hamlets – Number of households, JFMC members • Social and Religious organizations – NGOs, Worship committees, Church committees, Education and Health committees |
| 3 | Village Resource Map | Hand Made Interventions on the 1:5000 Hardcopy Map | Interventions made on hardcopy Maps are not to scale | <ul style="list-style-type: none"> • Topography, aspect and slopes • Natural forest- Area, Legal Status, Species, Current use, Information on plantation within the forest – marking of area and year of plantation • Plantation outside the forest- Area, Legal Status, Species planted, Year of plantation, any product collected from the plantation area • Location of different natural and physical resources of the JFMC Village • Water resources/water bodies - Type of water body, Location, Approximate Area, Ownership, Use • Agriculture/Farm land- Location of agricultural land, Approximate Area, Irrigation infrastructure, Cropping pattern • Soil-type, fertility, erosion and depth |
| 4 | Present Forest Map | GIS map based on RS technology | On Scale 1:5000 | <ul style="list-style-type: none"> • FSI Forest Cover Map, Forest Type Map (FTM), • Village boundaries for Jhum areas (the current fallow, those under plantation and those under cultivation) • Area under community reserves and other land use (if any) |
| 5 | Proposed Forest Treatment Map | GIS map updated using GPS | On Scale 1:5000 | <ul style="list-style-type: none"> • Map representing different treatment areas and the models applied on them |

Annexure - 3

GPS Data Collection Checklist for Demarcation of JFM Treatment Area under NFMP

This format should be filled while creation of the waypoints during the demarcation of JFM Treatment Areas.

Table 15: GPS Data Collection Checklist for Demarcation of JFM Area under NFMP

| Division: | | Range: | |
|------------------|------------------------------|-------------------------------|---------------|
| Point No. | Remarks | | |
| | Inside Treatment Area | Outside Treatment Area | Others |
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Disclaimer:

The contents of this document have been prepared by Nagaland Forest Management Project Society (NFMPs) for use under JICA supported Nagaland Forest Management Project (NFMP) implementation. This document has been prepared with reasonable skill, care and due diligence and information based on the observations, field visits and interviews with stakeholders. The views expressed in this document are primarily to be used for NFMP implementation. Neither NFMPs nor any shareholder undertakes any responsibility arising in any way whatsoever to any person or organization in respect of information set out in this document, including any errors or omissions therein arising through negligence or otherwise however caused.

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ABOUT NAGALAND FOREST MANAGEMENT PROJECT

The Project is an Externally Aided Project supported by an International Agency i.e. Japan International Cooperation Agency (JICA) aiming to improve forest ecosystem and support income generation by rehabilitation of Jhum area and provision of livelihood support, thereby contributing to sustainable forest and environmental conservation and livelihood improvement in the target villages in Nagaland State. The project has a target to cover 185 villages involving all Districts of the state and 22 Forest Range & Beats and will be spread over a period of 10 years.

This project has following three components:

- * Forestry interventions and biodiversity conservation
- * Livelihood improvement and community development &
- * Institutional strengthening

