तापषेंब बसते

## Government of India <br> Ministry of Environment and Forests

REPORT ON<br>INVENTORY OF FOREST RESOURCES<br>OF MANDYA DISTRICT<br>(KARNATAKA)

## FOREST SURVEY OF INDIA SOUTHERN ZONE <br> BANGALORE <br> (1995) 2002

Contents

## PREFACE

The inventory of Forest Resources of Mandya district of Karnataka was taken up during the year 1993-94 by the Forest Survey of India, Southern Zone, Bangalore with an objective to have both qualitative and quantitative data on forest resources of the district, which could be used both for state and national level planning. The report gives details of the area inventoried, methodology of survey and findings with regard to the forest resources of the district.

The net forest area of the district is 271.528 sq.km. which includes 250.64 sq.km. of tree forest and $13.295 \mathrm{sq} . \mathrm{km}$. of scrub forests. The total number of stems of all species in the forest area is 2.395 million with an average of 95.56 stems/ha. The total standing volume of the tree forest area is $2,89,184$ cubic metres with an average of 11.538 cubic metres/ha. The growing stock is dominated ( 40.34 \%) by three species viz. Hardwickia binnata (23.57\%), Eucalyptus spp. $(11.5-\%)$, and Pterocarpus santalinus (5.62 \%).

The forest area is subjected to heavy biotic pressure and $77 \%$ of the area is degraded due to this factor. Regeneration is absent in $69.23 \%$ of the area and is inadequate in $25.64 \%$ of the area.

The survey work was carried out by the field party consisting of Sri K.S.Reddy, Junior Technical Assistant S/Shri Thanasekar, H.P.Ranganath, Fieldmen and Channabasappa, Driver under the overall supervision of Shri Devendra Kumar, IFS., Deputy Director and Sri M.Muni Reddy, IFS., Joint Director. The data processing was done by staff of MDMU., FSI.,

Dehradun. The maps and diagrams were prepared by Sri K.V.Narayana, Junior Draftsman. The report has been prepared by Shri Devendra Kumar, IFS., Deputy Director and Dr.B.Shivaraju, IFS., Joint Director.

We thankfully acknowledge the co-operation extended by the officers and staff of Karnataka Forest Department, which was helpful in timely completion of field work. It is hoped that this report will be useful in future planning and development initiatives in the district and will also help in strengthening the interest of forest conservation.

Dated:
Director
Forest Survey of India, Dehradun-248195

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## SUMMARY

The report on inventory and forest resources of Mandya district of Karnataka is based upon the field survey conducted by Forest Survey of India, Southem Zone, Bangalore during the year 1993-94. It gives a complete account of state of soil, vegetation cover and growing stock of the forest area of the district. The report contains background information of the surveyed area, methodology of the survey and results of the inventoried data. The salient features of survey can be summarised as under.
$>$ The district contains net forest area of $271.528 \mathrm{sq} . \mathrm{km}$. including $250.64 \mathrm{sq} . \mathrm{km}$. of tree forest area and $13.295 \mathrm{sq} . \mathrm{km}$. of scrub forests. Young crop of forestry species comprises $62.66 \mathrm{sq} . \mathrm{km}$.

D The forest of the district is miscellaneous and scrub type.
$>$ About $64 \%$ of the forest area is devoid of any humus layer, whereas $36 \%$ of area is having shallow humus layer with thickness of less than 5 cm .
$>$ Around $51.28 \%$ of the forest area has medium soil depth i.e. from 30 to 90 cm ., whereas in $48.72 \%$ of the area the soil depth is more than 90 cm .
$>$ In about $72 \%$ of the forest area the soil is heavily eroded whereas moderate soil erosion was noticed in $28 \%$ of the area.
$>$ Around $46.16 \%$ of the forest area has natural forest of seed origin and $12.82 \%$ of the forest area of coppice origin. One third of the forests of the district are man made forest.
$>$ The forests of the district are inferior and mainly consist of pole crop and regeneration crop and have no big size timber trees. The extent of the area covered under pole crop and regeneration crop is 146.207 sq.km. ( $53.85 \%$ ) and $62.66 \mathrm{sq} . \mathrm{km}$. ( $23.08 \%$ ), respectively.
$>$ The forest area is subjected to heavy biotic pressure and about $77 \%$ of the area is degraded on this count. Grazing in different intensities was noticed in $97.44 \%$ of area whereas $92 \%$ of the area is subjected to fire incidence.
$>$ Regeneration is absent in $69.23 \%$ of the area and is inadequate in $25.64 \%$ of the area.
$>$ The total number of stems of all species in tree forest area is 2.395 million with an average of 95.56 stems/ha.
$>$ The total standing volume of the tree forest area is $2,89,184$ cubic metres which comes to 11.538 cubic metres/ha. Around $40.34 \%$ of the growing stock is comprised of three species namely Hardwickia binnata (23.57\%), Eucalyptus spp. (11.15 \%) and Pterocarpus santalimus ( $5.62 \%$ ).
$>$ The bamboo is present only in $\mathbf{1 2 . 8 2} \%$ of the forest area and that too scattered in distribution. Bamboo regeneration is noticed in $6.69 \mathrm{sq} . \mathrm{km}$. of area in a scattered manner.

## CHAPTER - I

## BACKGROUND INFORMATION

The project of Inventory of Forest Resources of Mandya district of Karnataka State was undertaken by the Forest Survey of India, Southern Zone, Bangalore during the year 1993-94. The main objective of the project was to collect qualitative as well as quantitative information on forest resources so that data could be useful in State and National level planning. The inventory taken up by the Forest Survey of India comes under the category of National Forest Inventories in which estimation of all the elements of forest characteristics such as forest types, characteristics of trees, land on which they grow and estimation of growing stock etc., are made. All these details are necessary for effective resource management.

The survey work was started in April 1993 and was completed in February 1994. The design followed in the survey was systematic cluster sampling selected in a random manner.

### 1.1 GEneral features of the survey area:

### 1.1.1 Location

The survey area consists of entire forest areas of Mandya district which is located in the Central belt of the southern sector of the Karnataka State. The boundaries of the district encompass a compact area of 4961 square kilometres in an irregular shape lying between the east longitude of $7619^{\prime}$ and 7720'. and the north latitude of $1213^{\prime}$ and 1304 '. The district is


## MAP OF KARNATAKA

SHOWING FOREST INVENTORIED AREA

bounded by Hassan district on the North-west, Tumkur district on the North and the North-east, Bangalore district on the east and Mysore district on the south and the South-West. It contains 7 taluks and one Forest Division, namely Mandya Forest Division.

### 1.1.2 Physical Features

The area in which the district is situated has been physiographically classified as the Southern Maidan (plains) region of Karnataka. The lands of the district form an undulating plain situated at an average elevation of 750 to 900 metres above MSL. There are a few sporadic outcrops of rocky hills and a few fertile, but shallow valleys. The Biligiri Rangana Betta range hills of the adjoining Mysore district extend over the south-eastern parts of Mandya district as well and taper off into the plains. The Melukote range of hills form a broken series of conspicuous peaks which reach the altitudes of 1159 metres, 1064 metres, 1050 metres and 1046 metres above the mean sea-level.

The important rivers of the district are Cauvery, Shimsa, Hemavati, Lokapavani and Vira Vaishnavi - all of which flow south and finally eastwards. The drainage is towards the east. The rivers of the district are not navigable. The river beds are generally rocky and shallow.

The rock formations of the district belong to the most ancient period of earth's history and are of two groups -Dharwar Schists and the Peninsular Gneisses and Granites. The soils which are derived from granites and gneisses interspersed with occasional patches of schists, range from red sandy loams to red clayey loams.

### 1.1.3 Climate and Rainfall

Mandya district is endowed with an agreeable climate all through the year. April is generally the hottest month with maximum day temperature around $35^{\circ} \mathrm{C}$. With the onset of the south-west monsoon in June, the temperature drops considerably and weather turns pleasant both during the day and at night. December is generally the coldest month during which the mean daily maximum and minimum temperature are about $28^{\circ} \mathrm{C}$ and $16^{\circ} \mathrm{C}$ respectively.

The average rainfall in the district is about 700 mm with an average of 45 rainy days in a year. The district receives rainfall both from the southwest monsoons as well as from retreating monsoons, covering the period from mid-June to mid-November. The heaviest rainfall occurs between midSeptember and mid-October. The rainfall is generally uniform throughout the district except in the western sector where it is slightly intense. The rainfall and climate of the district are quite congenial to those who work on farm and fields as-well as to those who attend to the rearing of mulberry silkworm.

### 1.1.4 Forests

As per the records of Karnataka Forest Department the district is having 272.79 square kilometres of forest which is $5.42 \%$ of its geographical area, out of this $138.19 \mathrm{sq} . \mathrm{km}$. is Reserved Forest, $6.06 \mathrm{sq} . \mathrm{km}$. Protected Forest and the rest is unclassed forests. The forest of the district is mainly Dry Deciduous and Scrub type. As per Champion \& Seth's (1968) classification the forest of the district falls under the following categories:

1. Southern Tropical Dry Deciduous Forests (5A/C2)
2. Dry Deciduous Scrub. (6A)

Southern tropical dry deciduous type is characterised by poor site quality with shallow hard soil, relatively low rainfall and stunted growth of trees with open canopy. The vegetation comprises of Hardwickia binnata, Pterocarpus marsupium, Pterocarpus santalinus (planted), Albizzia spp., Chloroxylon swietenia, Acacia spp., Anogeissus latifolia, Bauhinia sppi, Terminalia paniculata

The scrub type is characterised by stunted tree growth, growing in shallow hard soil with practically no organic matter with an open canopy admitting large amount of light to the forest floor. Main species found are Albizzia spp., Acacia spp., Pterocarpus marsupium, Gymnosporia montana, Lantana spp., etc.

Eucalyptus species have been planted in the forest areas of the district.

### 1.1.5 Area and Population.

As per 1991 census the total area of the district is 4961 sq.km. with a total population of $16,44,374$. Around $83.77 \%$ of the population lives in rural areas. It has population density of 331 per sq.km., sex ratio 963 and literacy $48.15 \%$. Of the total population, $38.65 \%$ are full time workers, $5.85 \%$ marginal workers and remaining $55.50 \%$ are non-workers. Out of the full time workers, $53.22 \%$ are cultivators, $24.96 \%$ are agricultural labourers and $21.82 \%$ are other workers.

### 1.1.6 Land Use Pattern

The following table shows the land use pattern in Mandya district:-

| SI.No. | Land use | Area in <br> sq. $\mathbf{k m}$ | \% of total <br> land use |
| :--- | :--- | :---: | :---: |
| 1. | Geographical area (as per village records) | 4982.44 |  |
| 2. | Forest area ( as per village records) | 237.65 | 4.77 |
| Land not available for cultivation |  |  |  |
| 3. | Land put to non agricultural use, | 606.17 | 12.17 |
| 4. | Barren and uncultivable land | 216.83 | 4.35 |
| Other cultivated land excluding fallow land |  |  |  |
| 5. | Cultivable waste | 393.86 | 7.90 |
| 6. | Permanent pasture | 392.87 | 7.89 |
| 7. | Land under trees and groves | 31.50 | 0.63 |
| 8. | Fallow land | 411.11 | 8.25 |
| 9. | Net area sown | $2,692.45$ | 54.04 |
|  | Total | $4,982.44$ | 100.00 |

Source: Karnataka at a glance 1993-94, Directorate of Economics \& Statistics, Governments of Karnataka, Bangalore.

### 1.1.7 Other Socio-economic Features

About $21 \%$ of the land of the district is covered under irrigation mainly by canals. Paddy, sugarcane and Ragi (finger millet) are main agricultural crops grown in the district.

The rearing of silkworms is one of the important occupation of the people. The cocoon produced in the district provides bulk of the raw material used in silk industry of the district

## CHAPTER - II

## Design and Methodology of the survey

The toposheets prepared by Survey of India was taken as base map for carrying out inventory work. The map used was of $1: 50,000$ scale. In these maps the extent of forest areas is shown in green colour. The toposheet of the above scale was divided into 36 grids of $21 / 2 \times 2 \frac{1}{2}$ ' intervals, which formed basic sampling units. Data were collected from the two plots of 0.1 ha. falling in each grid, only in forest areas. Thus the sampling design adopted was a Cluster Sampling, in which grids were taken as cluster. Actually, the sampling design was cluster sampling of unequal size, because of this fact, in many grids, only one plot was laid. The survey work was carried out as per prescriptions contained in the field manual prepared by the Forest Survey of India, Dehradun and the technical terms used in the reports are as defined in the manual.

### 2.1 Forest area defined

The following categories of lands were treated as Forest Area for the purpose of the forest inventory:

* All those areas shown in green wash on Survey of India toposheets.
* All such areas in which words such as thick jungle, thick forest, dense jungle, open forest with bamboo etc, are mentioned.
* All those areas indicated by dotted line or spotted line or a pillar line as forest areas
* Any other area reported to be forest area by local Dịisisional Forest Officers.


### 2.2 Sampling Design

After dividing the toposheet of $1: 50,000$ scale into 36 grids of $21 / 2^{\prime} x$ $21 / 2$ ' each, the length ' X ' and width ' Y ' of each grid was measured to the smallest convenient scale. The length (d) of the side of the plot on the map corresponding to 0.1 ha. of square plot on the ground was calculated. After subtracting the side ' $d$ ' from length and width of the grid, the number $X=(X-$ d) and $\mathrm{Y}^{\prime}=(\mathrm{Y}-\mathrm{d})$ was obtained. From the random table, two numbers in the range of 0 to $\mathrm{X}^{\prime}$ and 0 to $\mathrm{Y}^{\prime}$ were selected. Let it be P 1 and P 2 . To these numbers, half of the plot side ( $\mathrm{d} / 2$ ) was added to get x and y coordinates of the first plot centre, considering left hand bottom (S-W) corners of the grid as the origin. To get the centre of the second plot in the same grid, the centre of the first plot was joined with grid centre and was extended in the opposite direction to a distance equal to the distance between the grid centre and the first plot centre. This point became the centre of the second plot.

Qualitative and quantitative data were collected from the sample plots falling in the forest areas only. The quantitative data regarding tree characteristics, terrain, soil, tree canopy and bamboo etc. were collected from the plots. Qualitative data such as forest types, topography, érosion status, etc. were collected by observing 2 ha. area surrounding the plot centre.

### 2.3 Methodology

The field data were collected by field parties each headed by a Junior Technical Assistant who worked as Crew Leader. The crew leader was assisted by two fieldmen. The crew leaders were provided with necessary camp equipments, a set of topo sheets and instruments used in


DIAGRAM SHOWING MARKING OF PLOT IN $21 / 2^{\prime} \times 21 / 2 \quad$ Grid
( $X$ and $Y$ afe the distonees along $x$ and $y$ axes with sw corner os the origins


DIAGRAM=
DIAGRAM SHOWING LAY-OUT OF PLOT
survey work such as Silva Compass, Blume leiss hypsometer, caliper, measuring tape etc.

After selecting the plots to be surveyed on any particular day, the crew leader along with his crew members and the local forest staff proceeded to the reference point located on toposheet and identified the same on the ground. After reaching the reference point, the crew leader took the bearing of that reference point and measured the distance of the plot centre from that point on toposheet. The crew leader proceeded to the plot centre traversing the same distance in the same direction as indicated by its bearing to the reference point.

After reaching the plot centre, a square plot of 0.1 ha. with diagonal measuring 44.72 metres in NS-EW direction was laid on the ground. The required data was collected from the plot in the following prescribed forms. The sketch showing layout of the plot on the ground is appended in the report.

## Plot Approach Form

This is filled by the crew leader when he starts from the camp to the sample plot and also while retuming to the camp. It is not used in data processing. It is used in locating the plot during verification or resurvey in future.

## Plot Description Form

By observing 2 ha. around the plot centre, the qualitative data such as land use, tree crops composition and its density, erosion status, intensity of fire and grazing, regeneration status, bamboo data etc. are recorded in the form,

## Plot Enumeration Form

The trees and bamboo in 0.1 ha plot are enumerated and recorded in the form. Only the trees which are of 10 cm . diameter and above at breast height over bark are enumerated. The dead trees having utility less than 70 \% are not enumerated. The diameter of a bamboo clump is measured at its base.

## Sample Tree Form

Sample tree form is filled after filling the plot enumeration form. The data of trees with diameter 10 cm . and above at BHOB are collected from 14 h of the total plot, starting from NW quadrant. For each sample tree, diameter at ibreast height, bark thickness, tree height, length of clear bole, form of tree etc. are recorded. Abstract of this information is written on the Sample Tree Card which is nailed to the respective tree. This facilitates the checking by the supervising officers.

## Bamboo Enumeration \& Clump Analysis Form

The data of individual culm occurring in the selected clumps are recorded in this form. The clumps bearing serial no. $1,9,17,25,33$,etc. (first and every eighth clump there after) of each bamboo species are:selected for detailed analysis. The number of bamboo culms per clump classified on the basis of age, greenness and soundness are recorded:

## Bamboo Enumeration'Form (non clump forming)

Information is collected in this form for non clump forming bamboos occuring in the sample plot. For the purpose of counting the culms only $1 / 8$ th area of the sample plot touching northern semi-diagonal is taken. counting is done in NW quadrant only ie., in 0.0125 ha. Culms are classified on the basis of soundness, age, and greenness.

## Bamboo Weight Form

For determining the correlation between green and dry weight of the utilizable length of bamboo culm, sample pieces of matured culms are cut and weighed at regular intervals of time, till a constant air dry weight is obtained. The green weight of utilizable culms of different dia. class ( $2<5$, $5<8$ and 8 and above) and that of 30 cms . long pieces obtained for each dia. class from the top, middle and bottom portions of the utilizable culms are recorded in this form.

This form is filled up for plots in which bamboo are found to occur in 2 ha. areas in and around the plot. Specimen of the above field forms have been given in Appendix.

### 2.4 Intensity of the survey

The extent of forest area represented by 40 sample plots marked on green wash area of toposheets of the district was calculated using dot-grid method which comes to $278.49 \mathrm{sq} . \mathrm{km}$. Hence the area weightage of each plot comes to $278.49 / 40=6.962 \mathrm{sq} . \mathrm{km}$. Out of these 40 plots, one plot was found under non-forestry use, making net forest area equal to 271.528 sq.km.

Therefore the intensity of survey

Area of sample plots
$=\longrightarrow \times 100$
Total extent of the forest area sampled
$=\frac{40 \times 0.1 \mathrm{ha}}{27152} \times 100$
$=0.01 \%$

## CHAPTER - II

## Data Processing

### 3.1 Sampling design

The existing design of carrying out Forest inventory surveys developed by Forest Survey of India was followed. During this survey, in order to adopt the above design, the grids were marked on Survey of India toposheets of $1: 50,000$ scale at an interval of $2.5^{\prime}$ latitude by 2.5 ' longitudeand two square sample pIots of 0.1 ha. each were selected. The first plot was laid out by random method and the second was selected in the opposite quadrant at an equal distance of the first plot from the grid centre.

### 3.2 Field Data

The basic data of the inventory survey were collected in Plot description forms, plot enumeration forms, sample tree forms, Bamboo enumeration forms etc. the field forms were precoded so that the data could easily be transferred to the floppy tape/disk directly. There were, 124 field forms requiring data entry of the following number of records in each card design in Mandya district.

| No | Card design | No of <br> records |
| :--- | :--- | :--- |
| 1 | Plot description forms | 40 |
| 2 | Plot enumeration forms | 37 |
| 3 | Sample tree forms | 37 |
| 4 | Bamboo enumeration forms | 5 |
| 5 | Bamboo Weight forms | 5 |
| $\cdots$ | Total | 124 |

### 3.3 Plot details in mandya district

There were 40 plots in Mandya district giving weightage to each plot by $6.962 \mathrm{sq} . \mathrm{km}$. Only one forest stratum i.e., Miscellaneous type of forest was present.

### 3.4 Data processing

The data processing involved the following operations.

### 3.5 Manual processing

Each entry in the field form was checked for consistency in the data. The maximum and minimum value of the codes were checked. The data was loaded on to the floppy/disk and verified. Then the listing were taken and checked manually. Sample statistics were calculated and checked with the computer output results. The programmes were developed according to the requirement of the data processing. Final computer output results were checked for consistency and relevance of results. Area tables were also prepared.

### 3.6 Processing on Mainframe Computer

The data was loaded on floppy/disk through direct data entry operation and verified. The listings of loaded data were taken to check the data. Volume of each tree was estimated with the help of the local volume equations developed by MDMU by using General Volume equations. as described in the para on Volume estimation.

Contribution of the volume of each enumerated tree per hectare was derived and stored in a tree/plot volume file created for future processing.

Using the tree/plot volume file, growing stock tables by species and diameter classwise under each crop composition were prepared and standard error of the estimated growing stock was calculated.

The data of this survey was processed on VAX 11/780 system at Dehradun.

### 3.7 Area

The geographical area and the forest areas are given as under.
Geographical Area $=4961.000$ sq.km.
Forested Area $=278.490 \mathrm{sq} . \mathrm{km}$.
Weightage per plot $=6.962 \mathrm{sq} . \mathrm{km}$.

In Mandya district weightage of each plot was calculated by dividing the total forest area by the total number of sample plots and the area under different parameters were estimated by multiplying the number of sample plots occurring in that class by the area weight of each sample plot.

The total forested area was calculated on the above basis and classified by land use classes and given in Table . 1 The actual tree forest area was classified by different parameters such as soil depth, soil texture, soil erosion, grazing incidence, fire incidence, plantation potential etc. are represented in Table. 2 to 29.

### 3.8 Volume Estimation

Felled tree data for developing general volume equation was not collected during the inventory, because of ban on felling of trees.

The following local volume equations for different spẹcies were borrowed from the earlier reports of FAO of Southern Zone.

## Local Volume Equations:

1. Acacia spp.

$$
V=-0.048108+5.873169 \mathrm{D}
$$

2. Albizzia spp.

$$
V=0.081467-1.063661 \mathrm{D}+6.452919 \mathrm{D}^{2}
$$

3. Anogeissus latifolia

$$
\sqrt{V}=-0.004378+4.575823 \mathrm{D}^{2}
$$

4. Bauhinia spp.

$$
V=0.081467-1.063661 D+6.452919 D^{2}
$$

5. Chloroxylon swietenia

$$
\mathrm{V}=0.081467-1.063661 \mathrm{D}+6.452919 \mathrm{D}^{2}
$$

6. Eucalyptus spp.

$$
\cdot \mathrm{V}=0.02894-0.89284 \mathrm{D}+8.73416 \mathrm{D}^{2}
$$

7. Hardwickia binnata

$$
V=0.081467-1.063661 \mathrm{D}+6.452919 \mathrm{D}^{2}
$$

8. Pterocarpus marsupium

$$
\sqrt{ } \mathrm{V}=0.175068+4.598243 \mathrm{D}-1.500562 \sqrt{ } \mathrm{D}
$$

9. Pterocarpus santalinus

$$
\sqrt{ } \mathrm{V}=0.175068+4.598243 \mathrm{D}-1.500562 . \sqrt{ } \mathrm{D}
$$

10. Terminalia paniculata

$$
V=0.081467-1.063661 \mathrm{D}+6.452919 \mathrm{D}^{2}
$$

11. REST OF SPECIES

$$
V=0.081467-1.063661 D+6.452919 D^{2}
$$

### 3.9 Enumerated tree volume

The volume of each enumerated tree of a species was estimated by substituting its breast height overbark diameter in a local volume equation of that species. The enumerated tree volumes were converted to per hectare
volumes and stored in a tree/plot volume file together with species code, diameter of the tree, parameters of plot description form, per hectare volume and stems and the volume of that plot. The elements of information stored in the above files were utilised to classify the tree by species and diameter class, estimates of number of the stems and volume per hectare and total by species and diameter classes were obtained for different.strata viz: district, crop compositions, etc.

### 3.10 Plot volume

The estimated volume of each enumerated tree in a plot when added up over the whole plot provided the plot volume. It was converted to per hectare volume and also stored in the tree/plot volume file. The per hectare plot volumes were used to estimate volume under different classes of desired parameters: The plot volumes were also used to estimate the sampling error of the growing stock for each crop composition.

### 3.11 Stand tables

The elements of tree/plot volume file were utilised to classify the tree by species, diameter, crop composition etc. Estimates of the number of stems per hectare and total stems by species and diameter class were obtained for the Miscellaneous crop. The number of stems per hectare and total stems for Miscellaneous crop composition were also derived.

### 3.12 Stock tables

Estimates of volume per hectare and total volumes by species and diameter classes were obtained for Miscellaneous crop composition from the tree/plot volume file.

### 3.13 Sampling error

The sample was considered as a systematic cluster sample having two sample plots in each cluster. In order to estimate the sampling error the sample was considered to constitute simple random sample of equal clusters and ratio method of estimation was used as in many grids, only one plot was enumerated.

Let $\quad \mathrm{n}=$ Total number of clusters (grids) in the sample
$Y_{i}=$ Sum of per hectare volumes in the grid
$\mathrm{X}_{\mathrm{i}}=$ Number of plots in the grid
X $=1 / n \sum_{i=1}^{n} X_{i}=$ Average number of plots per grid


Estimate of Variance of R



$$
\operatorname{Var}(\bar{R})=\frac{1}{n(n-1) X^{2}}\left(\sum_{j=1}^{n} Y_{i}{ }^{2}-2 \bar{R} \sum_{i=1}^{n} X_{i} Y_{i}+\bar{R}^{2} \sum_{i=1}^{n} X_{i}{ }^{2}\right)
$$

Estimate of the Standard Error (SE) of R

$$
\begin{aligned}
& \mathrm{SE} \quad=\sqrt{\mathrm{V(R)}} \\
& \mathrm{SE} \%=\frac{\mathrm{SE}}{} \times 100
\end{aligned}
$$

R
Standard Errors have been estimated for the growing stock in each forest type and over the entire area irrespective of the strata.

## CHAPTER = IV

## Results of the inventory

Based upon the data collected from forest area of Mandya district, the results of the inventory is presented below.

### 4.1 Land Use Pattern

The pattern of land use of the surveyed area is indicated in the following table.

Table. 1: Land Use Pattern in Mandya district

| SI.No. | Land Use | No. of <br> Plots | Area in <br> sq. $\mathbf{k m}$. | \% |
| :---: | :--- | :---: | :---: | :---: |
| 1. | Dense to open forest | 27 | 187.981 | 67.50 |
| 2. | Young crop of forestry spp. | 9 | 62.660 | 22.50 |
| 3. | Scrub Forests | 2 | 13.925 | 5.00 |
| 4. | Grass lands | 1 | 6.962 | 2.50 |
| 5. | Cultivation | 1 | 6.962 | 2.50 |
|  | Total | $\mathbf{4 0}$ | $\mathbf{2 7 8 . 4 9 0}$ | $\mathbf{1 0 0 . 0 0}$ |

Out of $271.528 \mathrm{sq} . \mathrm{km}$. of net forest area, the tree forest area of the district consisting of dense to moderately dense forest, open tree forest and young crop of forestry species has been found to be 250.64 whereas 13.925 sq.km. of area has scrub forests.

## LAND USE PATTERN



1. Dense to Open Forest
$67.5 \%$
2. Young crop of forestry spp.
22.5 \%
3. Scrub Forests
5.0 \%
4. Grass Lands
$2.5 \%$
5. Cultivation
$2.5 \%$

### 4.2 Legal Status

Reserve forests comprise of $89.75 \%$ of the net forest area. The rest of the area are protected forests $(7.69 \%)$ and private forests. Table. 2 indicates the distribution of forest area as per legal status.

Table. 2: Distribution of forests in Mandya district by Legal Status

| SI.No. | Legal Status | No. of <br> Plots | Area in <br> sq.km. | $\%$ |
| :---: | :--- | :---: | :---: | :---: |
| 1. | Reserve Forests | 35 | 243.679 | 89.75 |
| 2. | Unclassed Forests | 3 | 20.887 | 7.69 |
| 3. | Private Forests | 1 | 6.962 | 2.56 |
|  | Total | $\mathbf{3 9}$ | $\mathbf{2 7 1 . 5 2 8}$ | $\mathbf{1 0 0 . 0 0}$ |

### 4.3 Topography

$51.28 \%$ of the forest area of the district is having topography classification as 'gently rolling'. $46.16 \%$ of the forest area is hilly as the break-up of different categories is as undër:

Table. 3: Topography of Forest Area in Mandya distrcit

| SI.No. | General Topography | No. of <br> Plots | Area in <br> sq. $\mathbf{k m .}$ | \% |
| :---: | :--- | :---: | :---: | :---: |
| 1. | Flat | 1 | 6.962 | 2.56 |
| 2. | Gently Rolling | 20 | 139.245 | 51.28 |
| 3. | Hilly | 18 | 125.321 | 46.16 |
|  | Total | $\mathbf{3 9}$ | 271.528 | $\mathbf{1 0 0 . 0 0}$ |

### 4.4 Slope

About $61.54 \%$ of the area is having slope ranging from $6 \%$ to $30 \%$ and $35.9 \%$ of area have slope between 0 to $5 \%$. Table. 4 gives the distribution of area in different slope classes.

Table. 4: Distribution of forests of Mandya district by Slope class.

| Sl.No. | Slope Class | No. of <br> Plots | Area in <br> sq.km. | \% |
| :---: | :--- | :---: | :---: | :---: |
| 1. | $0-5$ | 14 | 97.472 | 35.90 |
| 2. | $6-30$ | 24 | 167.094 | 61.54 |
| 3. | $31-45$ | 1 | 6.692 | 2.56 |
|  | Total | $\mathbf{3 9}$ | $\mathbf{2 7 1 . 5 2 8}$ | $\mathbf{1 0 0 . 0 0}$ |

The following table indicates the position on slope in the forest area.

Table. 5: Position on slope in forest area of Mandya district

| Sl.No. | Position on Slope | No. of <br> Plots | Area in <br> sq.km. | \% |
| :---: | :--- | :---: | :---: | :---: |
| 1. | Upper one third | 6 | 41.773 | 15.38 |
| 2. | Middle one third | 6 | 41.773 | 15.38 |
| 3. | Lower one third | 10 | $\mathbf{6 9 . 6 2 3}$ | 25.64 |
| 4. | Valley bottom | 2 | 13.925 | 5.13 |
| 5. | Flat Land | 2 | 13.925 | 5.13 |
| 6. | Plateau | 13 | 90.509 | 33.34 |
|  | Total | $\mathbf{3 9}$ | $\mathbf{2 7 1 . 5 2 8}$ | $\mathbf{1 0 0 . 0 0}$ |



### 4.5 Rockiness

The following table shows the status of rockiness in the forest area.
-Table. 6: Rockiness in forest area of Mandya district

| Sl.No. | Rockiness | No. of <br> Plots | Area in <br> sq.km. | $\%$ |
| :---: | :--- | :---: | :---: | :---: |
| 1. | Medium | 2 | 13.925 | 5.13 |
| 2. | Low | -32 | 222.792 | 82.05 |
| 3. | No Rock | 5 | 34.811 | 12.82 |
|  | Total | 39 | 271.528 | 100.00 |

It is evident from the above table that $82.05 \%$ of the forest area is with low rockiness and $12.82 \%$ is having no rock. It indicates that sufficient soil cover exists in the area to support the forest vegetation.

### 4.6 Humus Layer

About $64.1 \%$ of the forest area have no humus whereas $35.9^{\circ} \%$ of the area is having shallow humus layer (less than 5 cm thick). Table. 7 indicates the pattern of humus layer in the forest area.

Table. 7: Humus in forest area of Mandya district.

| Sl. $\overline{\text { No. }}$ | Humus | No. of <br> Plots | Area in <br> sq.km. | $\%$ |
| :---: | :--- | :---: | :---: | :---: |
| 1. | Shallow | 14 | 97.472 | 35.90 |
| 2. | No Humus | 25 | 174.056 | 64.10 |
|  | Total | 39 | 271.528 | $\mathbf{1 0 0 . 0 0}$ |



### 4.7 Soil Consistency

About $97.44 \%$ of the forest area is having soil which comes under the category of 'slightly compact', whereas $2.56 \%$ of the area is having compact soil. Table. 8 gives the state of soil consistency in forest area.

Table. 8: Soil Consistency in forest area of Mandya district

| SI.No. | Soil Consistency | No. of <br> Plots | Area in <br> sq.km. | \% |
| :---: | :--- | :---: | ---: | ---: |
| 1. | Slightly Compact | 38 | 264.566 | 97.44 |
| 2. | Compact | 1 | 6.962 | 2.56 |
|  | Total | 39 | 271.528 | 100.00 |

### 4.8 Soil Texture

The texture of soil in the forest area is indicated in the following table.

Table. 9: Texture of soil in forest area of Mandya district

| SI.No. | Soil Texture | No. of <br> Plots | Area in <br> sq.km. | $\%$ |
| :---: | :--- | :---: | :---: | :---: |
| 1. | Clayey Loam | 7 | 48.736 | 17.95 |
| 2. | Loam | 32 | 222.792 | 82.05 |
|  | Total | 39 | 271.528 | $\mathbf{1 0 0 . 0 0}$ |



### 4.9 Soil Depth

About $51.28 \%$ of the area is having medium soil depth ie., from 30 to 90 cm . whereas in $48.72 \%$ of the area, the soil depth is more than 90 cm . The distribution of area under different categories of soil depth classes are indicated in the following table.

Table. 10: Soil depth in forest area of Mandya district

| Sl.No. | Soil Depth | No. of <br> Plots | Area in <br> sq.km. | \% |
| :---: | :--- | :---: | :---: | :---: |
| 1. | Medium | 20 | 139.245 | 51.28 |
| 2. | Deep | 19 | 132.283 | 48.72 |
|  | Total | $\mathbf{3 9}$ | 271.528 | $\mathbf{1 0 0 . 0 0}$ |

### 4.10 Soil Erosion Status

About $71.79 \%$ of the forest area is heavily eroded whereas moderate erosion was seen to occur in $28.21 \%$ of the area. Table. 11 gives the erosion status in forest area.

Table. 11: Soil erosion status in forest areä of Mandya district

| Sl.No. | Soil Erosion | No. of <br> Plots | Area in <br> sq. $\mathbf{k m}$. | \% |
| :---: | :--- | :---: | :---: | :---: |
| 1. | Moderate Erosion | 11 | 76.585 | 28.21 |
| 2. | Heavy Erosion | 28 | 194.943 | 71.79 |
|  | Total | 39 | 271.528 | 100.00 |



### 4.11 Origin of Stand

About $46.16 \%$ of the forest area has natural forest of seed origin and $12.82 \%$ forest are of coppice origin. One-third of the forests of the district are man made forest. The extent of area covered under different categories is given below:

Table. 12: Origin of stand in forest area of Mandya district

| SI.No. | Land Use | No. of <br> Plots | Area in <br> sq. $\mathbf{k m}$. | $\%$ |
| :---: | :--- | :---: | :---: | :---: |
| 1. | Natural Forest of seed origin | 18 | 125.321 | 46.16 |
| 2. | Natural Forest of coppice origin | 5 | 34.811 | 12.82 |
| 3. | Man-Made Forest | 13 | 90.509 | 33.33 |
| 4. | Not Recorded | 3 | 20.887 | 7.69 |
|  | Total | $\mathbf{3 9}$ | $\mathbf{2 7 1 . 5 2 8}$ | $\mathbf{1 0 0 . 0 0}$ |

### 4.12 Crop Composition

The tree forest (excluding scrub \& barren land) of the district are miscellaneous type only. Total area covered under miscelaneous forest is indicated in the following table

Table. 13: Tree forest area of Mandya district by forest type

| Sl.No. | Crop Composition | No. of <br> Plots | Area in <br> sq.km. | $\%$ |
| :---: | :--- | :---: | :---: | :---: |
| 1. | Miscellaneous | 36 | 250.641 | 100.00 |
|  | Total | $\mathbf{3 6}$ | $\mathbf{2 5 0 . 6 4 1}$ | $\mathbf{1 0 0 . 0 0}$ |

### 4.13 Canopy Layer

The area covered under various categories of canopy layer is indicated in the following table:

Table. 14: Canopy layer in forest area of Mandya district

| SI.No. | Canopy Layer | No. of <br> Plots | Area in <br> sq.km. | \% |
| :---: | :--- | :---: | :---: | :---: |
| 1. | No Storey | 9 | 62.660 | 23.08 |
| 2. | One Storied Forest | 16 | 111.396 | 41.03 |
| 3. | Two Storied Forest | 11 | 76.585 | 28.21 |
| $4:$ | Not Recorded | $\mathbf{3}$ | 20.887 | 7.68 |
|  | Total | $\mathbf{3 9}$ | $\mathbf{2 7 1 . 5 2 8}$ | $\mathbf{1 0 0 . 0 0}$ |

### 4.14 Top Height

The top height is arrived at by taking the average height of dominant trees occuring in the plot/surrounding area of 2 ha.

The following table indicates the distribution of forest area under different top height classes.

Table. 15: Forest area of Mandya district by Top height classes

| Sl.No. | Top Height (in mts.) | No. of <br> Plots | Area in <br> sq.km. | $\%$ |
| :---: | :--- | :---: | ---: | :---: |
| $\mathbf{1 .}$ | $0-10$ | 14 | 97.472 | 38.89 |
| 2. | $11-20$ | 21 | 146.207 | 58.33 |
| 3. | $21-30$ | 1 | 6.962 | 2.78 |
|  | Total | 39 | 271.528 | 100.00 |



It is seen from the table 15 that the total forest of the district exists in three height levels with a maximum percentage $58.33 \%$ in 11-20 metre class.

### 4.15 Size Class

The trees in the sample plots were classified into various size classes depending upon predominance of diameter classes. Parameters adopted are:

## Size Class

a) Regeneration crop
b) Pole crop
c) Small timber
d) Big Timber
e) Mixed size class

## Diameter class (cm.)

upto 10
10-20
20-30
30 and above
Tree crop with no marked domination of any size class

The following table. 16 shows the distribution of forest crop into different size classes.

Table. 16: Size class in forests of Mandya district

| SI.No. | Size Class | No. of <br> Plots | Area in <br> sq.km. | $\%$ |
| :---: | :--- | :---: | :---: | :---: |
| 1. | Regeneration Crop | 9 | 62.660 | 23.08 |
| 2. | Pole Crop | 21 | 146.207 | 53.85 |
| 3. | Mixed Size Class | 6 | 41.774 | 15.38 |
| $\mathbf{4 .}$ | Not Recorded | 3 | 20.887 | 7.69 |
|  | Total | $\mathbf{3 9}$ | $\mathbf{2 7 1 . 5 2 8}$ | $\mathbf{1 0 0 . 0 0}$ |



It is evident from the above table that the forest of the district is inferior one which consists of mainly pole crop and regeneration crop. It has no big timber class.

### 4.16 Intensity of Regeneration

For assessing the intensity of regeneration, established regeneration of all economically important species with a diameter of 2 to 10 cm at breast height was counted in a plot of 4 metre $\times 4$ metre at the centre of the sample plot. The regeneration status was classified on the basis of number of seedlings of the above categories present in the plot. The intensity of regeneration was classified into three categories. These were:

| S.No | Status | Regeneration |
| :---: | :--- | :--- |
| 1. | Adequate | 8 or more seedlings |
| 2. | Inadequate | Upto 8 seedlings |
| 3. | Absent | No regeneration |

Table. 17 indicates the intensity of regeneration in the surveyed area.

Table. 17: Intensity of Regeneration in forests of Mandya district

| Sl.No. | Intensity of Regeneration | No. of <br> Plots | Area in <br> sq.km. | $\%$ |
| :---: | :--- | :---: | :---: | :---: |
| 1. | Adequate | 2 | 13.925 | 5.13 |
| 2. | Inadequate | 10 | 69.622 | 25.64 |
| 3. | Absent | 27 | 187.981 | 69.23 |
|  | Total | $\mathbf{3 9}$ | $\mathbf{2 7 1 . 5 2 8}$ | $\mathbf{1 0 0 . 0 0}$ |

It is seen from table. 17 that the regeneration is adequate only in 5.13 $\%$ of the forest area. In rest of the area either it is inadequate or absent. $69.23 \%$ of the area is devoid of regeneration.

### 4.17 Injuries to Crop

The extent of forest area subjected to different types of injuries is given below.

Table. 18: Injuries to crop in forests of Mandya district

| SI.No. | Injury to crop | No. of <br> Plots | Area in <br> sq.km. | \% |
| :---: | :--- | :---: | ---: | ---: |
| 1. | Borer attack | 1 | 6.962 | 2.56 |
| 2. | Top Drying | 1 | 6.692 | 2.56 |
| 3. | Girdling \& Illicit felling | 20 | 139.245 | 51.28 |
| 4. | Lopping for fodder | 2 | 13.925 | 5.13 |
| 5. | Other injuries | 8 | 55.698 | 20.52 |
| 6. | No Injury | 5 | 34.811 | 12.82 |
| 7. | Not recorded | 2 | 13.925 | 5.13 |
|  | Total | $\mathbf{3 9}$ | $\mathbf{2 7 1 . 5 2 8}$ | $\mathbf{1 0 0 . 0 0}$ |

It is evident from the above table that the forest of the district is having high biotic pressure and about $75 \%$ of the area is affected by it.

### 4.18 Fire Incidence

The details of the forest area affected by fire incidence are given below:
Table. 19: Fire incidence in forests of Mandya district

| Sl.No. | Fire Incidence | No. of <br> Plots | Area in <br> sq.km. | \% |
| :---: | :--- | :---: | :---: | :---: |
| 1. | Heavy | 1 | 6.982 | 2.56 |
| 2. | Moderate | 8 | 55.698 | 20.52 |
| 3. | Occasional | 27 | 187.981 | 69.23 |
| 4. | No fire | 3 | 20.887 | 7.69 |
|  | Total | $\mathbf{3 9}$ | $\mathbf{2 7 1 . 5 2 8}$ | $\mathbf{1 0 0 . 0 0}$ |

About $92 \%$ of the forest area is subjected to different types of fire incidence. In $23 \%$ of the area it is moderate to heavy whereas on $69 \%$ of the area fire incidence is occasional.

### 4.19 Grazing Incidence

The table. 20 indicates the extent of grazing incidence in the forest area.

Table. 20: Grazing incidence in forests of Mandya district

| Sl.No. | Grazing Incidence | No. of <br> Plots | Area in <br> sq.km. | \% |
| :---: | :--- | :---: | :---: | :---: |
| 1. | Heavy | 13 | 90.509 | 33.33 |
| 2. | Moderate | 18 | 125.321 | 46.16 |
| 3. | Light | 7 | 48.736 | 17.95 |
| 4. | No Grazing | 1 | 6.962 | 2.56 |
|  | Total | $\mathbf{3 9}$ | $\mathbf{2 7 1 . 5 2 8}$ | $\mathbf{1 0 0 . 0 0}$ |

It is clear from the above table that $97.44 \%$ of the forest area is affected by grazing in different intensity. $\mathbf{3 3 . 3 3} \%$ of the area is heavily grazed whereas grazing occurs in moderate form in $46.16 \%$ of the area. Heavy pressure of grazing has resulted in very poor regeneration in the forest area.

### 4.20 Presence of Weeds

Existence of weeds was found throughout the forest area. They occur in dense to very dense form in $69.23 \%$ of the area. Occurrence of weeds is indicated in the following table.

Table. 21: Presence of weeds in forests of Mandya district

| Sl. $\overline{\text { No }}$. | Presencc of weeds | No. of <br> Plots | Area in <br> sq.km. | \% |
| :---: | :--- | :---: | :---: | :---: |
| 1. | Very Dense | 5 | 34.811 | 12.82 |
| 2. | Dense | 22 | 153.170 | 56.41 |
| 3. | Moderate | 5 | 34.811 | 12.82 |
| 4. | Scanty | 7 | 48.736 | 17.95 |
|  | Total | $\mathbf{3 9}$ | 271.528 | $\mathbf{1 0 0 . 0 0}$ |

### 4.21 Presence of grass

Grass is found to be present throughout the forest area. In $53.85 \%$ of the area it is found in very dense form whereas $28.21 \%$ of the area consists of dense grass. Occurrence of grass is indicated in the following table. 22.

Table. 22: Presence of grass in forests of Mandya district

| Sl.No. | Presence of Grass | No. of Plots | Area in sq.km. | \% |
| :---: | :---: | :---: | :---: | :---: |
| 1. | Very Dense | 21 | 146.207 | 53.85 |
| 2. | Dense | 11 | 76.585 | 28.21 |
| 3. | Moderate | 5 | 34.811 | 12.81 |
| 4. | Scanty | 2 | 13.925 | 5.13 |
|  | Total | 39 | 271.528 | 100.00 |

### 4.22 Plantation Potential

Plantation potential in the entire forest land was assessed considering land class, aspect, soil depth, drainage, crop density and crop composition. Biotic and climatic factors were also considered while assessing the potential. For areas with crown density $30 \%$ or more, plantation potential is insignificant and hence such areas, have been put under 'Not applicable' category. The following table 23 indicates the plantation potential in the forest area of the district.

Table. 23: Plantation potential in forest area of Mandya district

| Sl.No. | Plantation potential | No. of <br> Plots | Area in <br> sq.km. | \% |
| :---: | :--- | :---: | :---: | :---: |
| 1. | Plantable | $\frac{9}{62.660}$ | 25.00 |  |
| 2. | Not applicable | 27 | 187.981 | 75.00 |
|  | Total | $\mathbf{3 6}$ | $\mathbf{2 5 0 . 6 4 1}$ | $\mathbf{1 0 0 . 0 0}$ |

### 4.23 Accessibility

The Table. 24 indicates the extent of the area covered under different accessibility zones.

Table. 24: Accessibility (road) of forests of Mandya district .

| Sl.No. | Distance to road | No. of <br> Plots | Area in <br> sq.km. | $\%$ |
| :---: | :--- | :---: | :---: | :---: |
| 1. | Distance $<1 \mathrm{Km}$. | 22 | 153.169 | 56.41 |
| $\overline{2}$. | Distance $>1 \&<3 \mathrm{Km}$. | 15 | 104.434 | 38.46 |
| 3. | Distance $>1 \&<5 \mathrm{Km}$. | 2 | 13.925 | 5.13 |
|  | Total | .39 | 271.528 | $\mathbf{1 0 0 . 0 0}$ |

### 4.24 Occurrence of Bamboo

The bamboo is present only in $12.82 \%$ of the forest area and that too in scattered and sparsed manner. Total area covered under bamboo is 34.811 sq.km. The distribution of area is indicated in the following table.

Table. 25: Density of Bamboo in forests of Mandya district

| Sl.No. | Bamboo Density | No. of <br> Plots | Area in <br> sq.km. | \% |
| :---: | :--- | :---: | :---: | :---: |
| 1. | Scattered. | -1 | 6.962 | 2.56 |
| 2. | Sparse | 4 | 27.849 | 10.26 |
| 3. | No Bamboo | 34 | 236.717 | 87.18 |
|  | Total | 39 | 271.528 | $\mathbf{1 0 0 . 0 0}$ |

The bamboo present are of quality III whose average culm height is 2 metres or more but less than 4 metres. Regeneration of bamboo is confinied only to about $6.692 \mathrm{sq} . \mathrm{km}$. of area that too in a scattered manner.

### 4.25 Degradation of forest

The extent of degradation of the forest area was assessed from two angles; one due to natural calamities such as landslides, flood, rainfall etc., and other due to biotic factors like grazing, fire, pollarding, illicit cutting and lopping.

The tables 26 and 27 indicate the extent of degradation due to both the factors.

Table. 26 Degradation of forests due to Human factors

| Sl.No. | Degradation due to Biotic <br> Factors | No. of <br> Plots | Area in <br> sq.km. | $\%$ |
| :---: | :--- | :---: | :---: | :---: |
| 1. | Heavily degraded | 2 | 13.925 | 5.13 |
| 2. | Moderately degraded | 5 | 34.811 | 12.82 |
| 3. | Mildly degraded | 23 | 160.131 | 58.97 |
| 4. | Not degraded | 7 | 48.736 | 17.95 |
| 5. | Not recorded | 2 | 13.925 | 5.13 |
|  | Total | $\mathbf{3 9}$ | $\mathbf{2 7 1 . 5 2 8}$ | $\mathbf{1 0 0 . 0 0}$ |

Table. 27. Degradation of forests due to Natural factors

| Sl.No. | Degradation due to <br> Natural CalamitiesNo. of <br> Plots | Area in <br> sq.km. | $\%$ |  |
| :---: | :--- | :---: | ---: | ---: |
| $\mathbf{1 .}$ | Mildly degraded | 13 | 90.509 | 33.33 |
| 2. | Not degraded | 24 | 167.094 | 61.54 |
| 3. | Not recorded | 2 | 13.925 | 5.13 |
|  | Total | $\mathbf{3 9}$ | $\mathbf{2 7 1 . 5 2 8}$ | $\mathbf{1 0 0 . 0 0}$ |

It is seen from the above table that $76.92 \%$ of the forest area is degraded due to biotic interference, whereas $33.33 \%$ of the area is degraded due to factor of natural calamities although degradation is mild on this count.

### 4.26 Growing stock

### 4.26.1 Growing Stand (Stem)

All trees above 10 cm diameter at breast height over bark except dead trees having utility less than $70 \%$ were enumerated in the sample plot. Based upon this enumeration, the number of stems in the forest area has been arrived. The entire tree forest area (excluding scrub and barren) of the district i.e. 250.641 sq.km. contains miscellaneous forest. The following table indicates the number of stems/ha and the total number of stems of each species.

Table. 28
Stems/ha and the total number of stems in Mandya district

| Sl. <br> No | Name of species | No. of <br> Stems $/ \mathbf{h a}$. | Total no. of <br> stems | $\%$ |
| :---: | :--- | :---: | :---: | :---: |
| 1. | Eucalyptus spp. | 28.333 | $7,10,149$ | 29.65 |
| 2. | Pterocarpus santalinus | 9.444 | $2,36,716$ | 9.88 |
| 3. | Hardwickia binnata | 7.778 | $1,94,943$ | 8.14 |
| 4. | Anogeissus latifolia | 6.111 | $1,53,169$ | 6.40 |
| 5. | Pterocarpus marsupium | 2.778 | 69,622 | 2.91 |
| 6. | Chloroxylon swietenia | 2.500 | 62,660 | 2.62 |
| 7. | Bauhinia spp | 2.500 | 62,660 | 2.62 |
| 8. | Albizzia spp. | 2.222 | 55,698 | 2.32 |
| 9. | Acacia spp. | 1.944 | 48,736 | 2.03 |
| 10. | Terminalia paniculata | 0.278 | 6,962 | 0.29 |
| 11. | Rest of species | 31.667 | $7,93,697$ | 33.14 |
|  | Total | $\mathbf{9 5 . 5 5 6}$ | $\mathbf{2 3 , 9 5 , 0 1 2}$ | $\mathbf{1 0 0 . 0 0}$ |

Diameter class wise distribution of species is given in Annexure I \& II.

The total number of stems in the tree forest area of the district is 2.39 million with an average of 95.56 stems per hectare. Eucalyptus species comprises of $29.65 \%$ of growing stand which is mainly regenerated artificially under various plantation programmes. Major species found in the natural forests are Pterocarpus santalinus ( $9.88 \%$ ), Hardwickia binnata( $8.14 \%$ ) and Anogeissus latifolia ( $6.40 \%$ ) which together contains 24.4 \% of the growing stock of the district. Other important species are Pterocarpus marsupium, Chloroxylon swietenia and Bauhinia spp.

Analysis of growing stand data reveals that about $86 \%$ of the stems are of $10-20 \mathrm{~cm}$ diameter class and about $95 \%$ of stems are distributed upto 30 cm diameter class.

### 4.26.2 Growing Stock (Volume)

The growing stock of the standing forest of the district has been assessed in terms of total standing volume and volume per hectare. The assessment is based upon the enumeration data of all the trees above 10 cm . diameter of sample plot excluding dead trees with utility less than $70 \%$. The following table gives the distribution of species in total growing stock of the district.

Table. 29
Species wise distribution of growing stock (Volume) in Mandya district

| $\begin{array}{\|l\|l} \text { Sl. } \\ \text { No } \end{array}$ | Name of species | Total standing volume in cum. | Volume/ ha. | \% |
| :---: | :---: | :---: | :---: | :---: |
| 1. | Hardwickia binnata | 68,148 | 2.719 | $2 \overline{3} .57$ |
| 2. | Eucalyptus spp. | 32,225 | 1.286 | 11.15 |
| 3. | $\overline{\text { Pterocarpus santalinus }}$ | 16,267 | 0.649 | 5.62 |
| 4. | $\overline{\text { Albizzia spp. }}$ | 10,056 | 0.401 | 3.48 |
| 5. | $\overline{\text { Pterocarpus }} \overline{\text { marsupium }}$ | 7,296, | 0.291 | 2.52 |
| 6. | Chloroxylon swietenia | 6,825 | 0.272 | 2.36 |
| 7. | Acacia spp. | 6,316 | 0.252 | 2.18 |
| 8. | Bauhinia spp | 3,492 | 0.139 | 1.20 |
| 9. | Anogeissus latifolia | 2,339 | 0.093 | 0.81 |
| 10. | Terminalia paniculata | 364 | 0.015 | 0.13 |
| 11. | Rest of species | 1,35,856 | 5.421 | 46.98 |
|  | Total | 2,89,184 | 11.538 | 10.0 |

The distribution of species in different diameter class has been given in annexure III $\&$ IV.

Three species constitutes $40.34 \%$ of the growing stock. These species are Hardwickia binnata ( $23.57 \%$ ), Eucalyptus species (11.15\%) and Pterocarpus santalinus (5.62 \%).

About $37 \%$ of the growing stock is contributed by trees having diameter between $10-20 \mathrm{~cm}$ and about $51 \%$ of the stock is comprised of trees with diameter up to 30 cm .

### 4.27 STANDARD ERROR

The standard error in respect of parameter volume per hectare has been found to be $33.7 \%$.

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ANNEXURE - I
Table showing the Growing Stand per hec. in forests of MANDYA district

| Species | Name of species | Diameter Class in cm. |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Code |  | 10-15 | 15-20 | 20-25 | 25-30 | 30-35 | 35-40 | 40-50 | 50-60 | 60-70 | 70.80 | $80+$ |  |
| 072 | Anogeissus latifolia | 3.611 | 1.667 | 0.833 | 0.000 | 0.000 | 0.000 | 0.000 | - 0.000 | 0.000 | 0.000 | 0.000 | 6.111 |
| 348 | Eucalyptus spp. | 26.667 | 1.667 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 28.333 |
| 722 | Pterocarpus marsupium | 1.111 | 1.389 | 0.278 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2.778 |
| 723 | Pterocarpus samtalinus | 8.611 | 0.278 | 0.278 | 0.000 | 0.278 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 9.444 |
| 441 | Hardwickia binnata | 3.889 | 1.389 | 1.111 | 0.000 | 0.278 | 0.000 | 0.556 | 0.278 | 0.000 | 0.000 | 0.278 | 7.778 |
| 869 | Terminalia paniculara | 0.278 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.278 |
| 014 | Acacia spp. | 0.556 | 1.111 | 0.278 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.944 |
| 051 | Albizzia spp. | 0.556 | 0.278 | 0.833 | 0.556 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | .2 .222 |
| 118 | Bauhinia spp. | 1.944 | 0.556 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2.500 |
| 206 | Chloroxylon swieteria | 1.667 | 0.556 | 0.000 | 0.000 | 0.278 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2.500 |
| 944 | Rest of species | 18.056 | 6.389 | 2.778 | 1.389 | 0.833 | 0.556 | 0.833 | 0.278 | 0.556 | 0.000 | 0.000 | 31.667 |
|  | Total | 66.944 | 15.278 | 6.389 | 1.944 | 1.667 | 0.556 | 1.389 | 0.556 | 0.556 | 0.000 | 0.278 | 95.556 |

ANNEXURE - II
Table showing the Growing Stand (in '000) in forests of MANDYA district

| Spec. <br> Code | Name of species | Diameter class in cm. |  |  |  |  |  |  |  |  |  |  | Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | 10-15 | 15-20 | 20-25 | 25-30 | 30-35 | 35-40 | 40-50 | 50-60 | 60-70 | 70-80 | 80+ |  |
| 072 | Anogeissus latifolia | 90.519 | 41.773 | 20.887 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 153.169 |
| 348 | Eucalyptus spp. | 668.376 | 41.773 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 710.149 |
| 722 | Pterocarpus marsupium | 27.849 | 34.811 | 6.962 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 69.622 |
| 723 | Pterocarpus santalinus | 215.830 | 6.962 | 6.962 | 0.000 | 6.962 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 236.716 |
| 441 | Hardwickia binnata | 97.471 | $34 . \overline{811}$ | 27.849 | 0.000 | 6.962 | 0.000 | 13.924 | 6.962 | 0.000 | 0.000 | 6.962 | 194.943 |
| 869 | Terminalia paniculata | 6.962 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 6.962 |
| 014 | Acacia spp. | 13.924 | 27.849 | 6.962 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 48.736 |
| 051 | Albizzia spp. | 13.924 | 6.962 | 20.887 | 13.924 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 55.698 |
| 118 | Bauhinia spp. | 48.736 | 13.924 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 62.660 |
| 206 | Chloroxylon swietenia | 41.773 | 13.924 | 0.000 | 0.000 | 6.962 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 62.660 |
| 944 | Rest of species | 452.546 | 160.132 | 69.622 | 34.811 | 20.887 | 13.924 | 20.887 | 6.962 | 13.924 | 0.000 | 0.000 | 793.697 |
|  | Total | $\begin{aligned} & 1672: 910 \\ & 1677.91 \end{aligned}$ | 382.924 | 160.132 | 48.736 | 41.773 | 13.924 | 34,811 | 13.924 | 13.924 | 0.000 | 6.962 | 2395.012 |

ANNEXURE - III

| Spec. | Name of species | Diameter class in cm. |  |  |  |  |  |  |  |  |  |  | Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Code |  | 10-15 | 15-20 | 20-25 | 25-30 | 30-35 | 35-40 | 40-50 | 50-60 | 60-70 | 70-80 | 80+ |  |
| 072 | Anogeeissus latifolia | 0.017 | 0.034 | 0.042 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.093 |
| 348 | Eucalyptus spp. | 1.06 | 0.217 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.000 | 1.286 |
| 722 | $\overline{\text { Pterocarpus marsupium }}$ | 0.067 | 0.167 | 0.057 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.291 |
| 723 | Pterocarpus santalinus | 0.342 | 0.027 | 0.073 | 0.000 | 0.207 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.649 |
| 441 | Hardwickia binnata | 0.197 | 0.115 | 0.199 | 0.000 | 0.139 | 0.000 | 0.561 | 0.386 | 0.000 | 0.000 | 1.122 | 2.719 |
| 869 | Terminalia paniculata | 0.015 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.015 |
| 014 | Acacia spp. | 0.009 | 0.177 | 0.066 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.252 |
| 051 | Albizia spp. | 0.031 | 0.028 | 0.160 | 0.183 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.401 |
| 118 | Bauhinia spp. | 0.097 | 0.042 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.139 |
| 206 | Chloroxylon swietenia | 0.088 | 0.045 | 0.000 | 0.000 | 0.139 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.272 |
| 944 | Rest of species | . 0.855 | 0.580 | 0.489 | 0.405 | 0.398 | 0.329 | 0.724 | 0.419 | 1.223 | 0.000 | 0.000 | 5.421 |
|  | Total | 2.787 | 1.432 | 1.086 | 0.588 | 0.882 | 0.329 | 1.284 | 0.805 | 1.223 | 0.000 | 1.122 | 11.538 |

ANNEXURE - IV
Table showing the Growing Stock (in '000 cum.) in forests of MANDYA district

| Spec. | Name of species | Diameter class in cm. |  |  |  |  |  |  |  |  |  |  | Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Code |  | 10-15 | 15-20 | 20-25 | 25-30 | 30-35 | 35-40 | 40-50 | 50-60 | $6 \overline{0} 70$ | 70-80 | $80+$ |  |
| 072 | Anogeissus latifolia | 0.430 | 0.851 | 1.058 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 2.339 |
| 348 | Eucalyptus spp. | 26.788 | 5.437 | 0.000 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 32.225 |
| 722 | Pterocarpus marsupium | 1.682 | 4.184 | 1.429 | 0.000 | 0.000 | 0.000 | $\overline{0.000}$ | 0.000 | 0.000 | 0.000 | 0.000 | 7.296 |
| 723 | Pterocarpus santalinus | 8.572 | 0.677 | 1.830 | 0.000 | 5.188 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 16.267 |
| 441 | Hardwickia binnata | 4.930 | 2.894 | 4.989 | 0.000 | 3.479 | 0.000 | 14.058 | 9.669 | 0.000 | 0.000 | 28.130 | $6 \overline{8.148}$ |
| 869 | Terminalia paniculata | $0 . \overline{364}$ | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.364 |
| 014 | Acacia spp. | 0.226 | 4.436 | 1.654 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | $0 . \overline{0} 00$ | 0.000 | 0.000 | 6.316 |
| 051 | Albizaia spp. | 0.775 | 0.690 | 4.005 | 4.587 | 0.000 | 0.000 | $\overline{0.000}$ | 0.000 | 0.000 | 0.000 | $0.00 \overline{0}$ | 10.056 |
| 118 | Bauhinia spp. | $\overline{2} .4 \overline{27}$ | 1.065 | 0.000 | 0.0000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 3.492 |
| 206 | Chloroxylon swietenia | 2.207 | 1.139 | 0.000 | 0.000 | 3.479 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | $\overline{6.825}$ |
| 944 | Rest of species | 21.420 | 14.537 | 12.248 | 10.152 | 9.974 | 8.236 | 18.137 | 10.509 | 30.643 | 0.000 | 0.000 | $\frac{135.867}{125.8}$ |
|  | Total | 69.821 | 35.910 | 27.213 | 14.738 | 22.120 | 8.236 | 32.195 | 20.178 | 30.643 | 0.000 | 28.130 | 289.184 |

## PLOT APPROACH FORM

1. Plot approach form must be filled in while the journry is in Progress.
2. While recording data it is essential to record month and year also-
3. If a plot is visited on more than one day, a separate form of each visit shall be filled up.
4. State and code . :
5. Division and code :
6. District and code :
7. Map sheet and code :
8. Grid code :
9. Crew Leader (Name) :
10. Name of camp :
11. Time (lirs) at which left the camp :
12. Distance covered by vehicle (Kms) :
13. Time taken in journey by vehicle Hour Minutes
14. Name of the place upto which journey was performed by vehicle (describe in brief).
15. Conspicuous features observed during the journey: by vehicle (describe in brief)
16. Tirne at which started on foot. :
17. Direction and distance covered on foot up the reference point ( Km ) :
18. Conspicuous features observed during the journcy on foot (describe in brief) :
19. Time (hrs) at which arrived at the reference point :
20. Description of the reference point (Describe in details) :
21. Compass bearing from reference pointto the plot approached for commencing survey (please give the plot-No. also) if any. :
22. Distance of, the plof from reference point (mts) :
23. Date and Time at which arrived at the plot $\vdots$ plot 1 plot 2
24. Time (hrs.) of leaving the plot
25. Time (hrs) at wich returned to the camp.
26. Compassing done by.
27. Distance measured by
28. Plot laid out by
29. Height measurement taken by
30. Tree enumeration done by
31. B. T. \& other measurement taken by
32. Bomboo enumeration done by
33. Bamboo weight taken by
34. Reference in the field written by
35. Remarks

Date $\qquad$

DIAGRAMS Etc.

## A

## Plot Description Form

| $\begin{aligned} & \text { Job } \\ & \text { No. } \end{aligned}$ | $\begin{gathered} \mathrm{Card} \\ \text { design } \end{gathered}$ | Zonė | Slate | District | Forest Division | Map Sheet No. | Crid No. | Plot No. | $\cdots \frac{\text { Legal }}{\text { Stalus }}$ | Land Use |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1-3 | 4-5 | 6 | 7-B | $9-10$ | - 11-12 | 13-18 | 19.22 | 23 | 24 | 25-.6 |
|  |  | * |  | - | - 1 | - | $*$ | ${ }^{\prime}$ |  | $\stackrel{\square}{ }$ |

Field Fórm-3




| Card <br> Design | Map Sheet <br> No. | Grid <br> No. | Plot <br> No. |
| :---: | :---: | :---: | :---: |
| 4 | $4-5$ | $6-11$ | $12-15$ |
|  |  |  | 16 |


Sample Tree Form


## BAMBOO ENUMERATION FORM

| - Job No. | Cald Denlan | Map Shatit Na, | Grid Wb.' Inlar Sectional No | Plat Mo. |
| :---: | :---: | :---: | :---: | :---: |
| 1-3 | 4-6 | 6-11 | 12-15 | 10 |
| - |  |  |  |  |

- ا-SZ-BANGALORE

Fic'd Formi

| Map sheel Number | $\left\lvert\, \begin{gathered}\text { Grid No.l } \\ \text { Inter Sectionl } \\ \text { No., }\end{gathered}\right.$ | Piot Number |
| :---: | :---: | :---: |
| 6-11 | 12-15 | 18 |
|  | F | \% |

## WHOI <br> 上 $\frac{1}{3}$ $\frac{1}{2}$ 3 <br> BAMBOO

I. S. Z. Bangalore.

(
Field Form No.:

