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# INVENTORY SURVEY

( Non - Forest Area )

OF

## KARNAL DISTRICT

( HARYANA STATE )

भारत सरकार  
Forest Survey of India  
कोलकाता-700 001  
Bengal Road, B. Dur.

# INVENTORY RESULTS

FOREST SURVEY OF INDIA

NORTHERN ZONE

SHIMLA-1

1995

## PREFACE

Forest Survey of India, for the first time, took up inventory surveys in the rural areas with the primary objective of assessing the distribution of trees and their Growing Stock in the rural areas and to have an overview of the various social forestry schemes implemented by the State Forest Departments. The inventory survey was carried out according to stratified random sampling methodology. One of the important points in this survey was to categorise various types of trees in a village. The categories were farm forestry, roadside plantations, village woodlot, block plantations, canals, railway lines, ponds and rest. This report pertaining to the district Karnal, Haryana is the first attempt made by the Northern Zone, Shimla. It presents the results of inventory of trees outside the traditional forest areas.

The geographical area of the Karnal District is 3721 Sq. Km. The survey was carried out during 1992-93 in the rural areas of the district covering an area of 3697.61 Sq. Km.

Out of the total species inventoried, twenty species on the basis of their predominance and commercial importance have been presented separately. Other species have been kept together as miscellaneous.

The total number of trees in the district have been assessed to be 46.47 lakh i.e. 12.57 trees/ha. and the corresponding volume has been assessed to be 7.86 lakh cubic meters i.e. 2.126 cum/ha *Acacia nilotica* (Babul) and *Eucalyptus* spp. (Safeda) were found to be the main species with 16.47 lakh trees (35.43%) and 12.06 lakh trees (25.95%) respectively.

It is hoped that this report will be used, not only by the State Forest Department of Haryana but also by others.

The inventory survey was carried out by the staff of Northern Zone of Forest Survey of India and the data was also processed by them. The work of the field staff and officers who were associated in carrying out the inventory survey, data processing and writing of this report, is appreciated.

Sd/-

(Dr. S.N. Rai)

Director,

Forest Survey of India

Dehradun.

## ACKNOWLEDGEMENTS

The State of Haryana is situated in the North-West part of India. It has extreme climate which is very cold in winter and very hot during summer. Besides this in many villages proper drinking water facility is also not easily available. The staff of the Northern Zone were engaged in carrying out the inventory survey of non-forest areas of Haryana with the co-operation of State Forest Department's officers and staff. The Panchayat Pardhans and members and also the villagers have been very kind to extend their co-operation in making our field work smooth and easy. The Deputy Commissioner and other staff of the Revenue Department of the district were very helpful and co-operative. I acknowledge with thanks for the co-operation and help extended by all concerned as mentioned above.

I am specifically grateful to Shri P. S. Malik, IFS, the Principal Chief Conservator of Forests of Haryana for directing the officers and staff of his department to extend full co-operation to our field staff. I am also thankful to Shri D. R. Ramesh Singh IFS, Conservator of Forests (HQ) and Divisional Forest Officers (territorial) Karnal and Ambala for providing us the required data and informations. Shri G. K. Ahuja, IFS, Divisional Forest Officer, Social Forestry, Panipat and Range Officers (territorial) and other field staff have also been very co-operative in extending all possible facilities.

I acknowledge with thanks, on behalf of Forest Survey of India (Northern Zone), to all the concerned as mentioned above but for their kind co-operation and help extended to this organisation it would not have been so easy to bring out this report successfully.

*Sd/-*  
(Manjit Singh, IFS)  
Joint Director

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## SUMMARY

1. To assess the availability of forest resources for production of timber, fuelwood and raw material for paper pulp, packing cases, essential oils and matchwood etc. in areas outside the traditional Reserved Forests and those forest areas which could not be covered while undertaking the regular Inventory Survey of Haryana State. The Inventory Survey has been carried out in the Karnal district of Haryana during 1992-93.

2. As per 1981 Census Karnal district had a total of 634 villages, having a total area of 3697.61 Sq. Km., out of which 18 villages were randomly selected and surveyed.

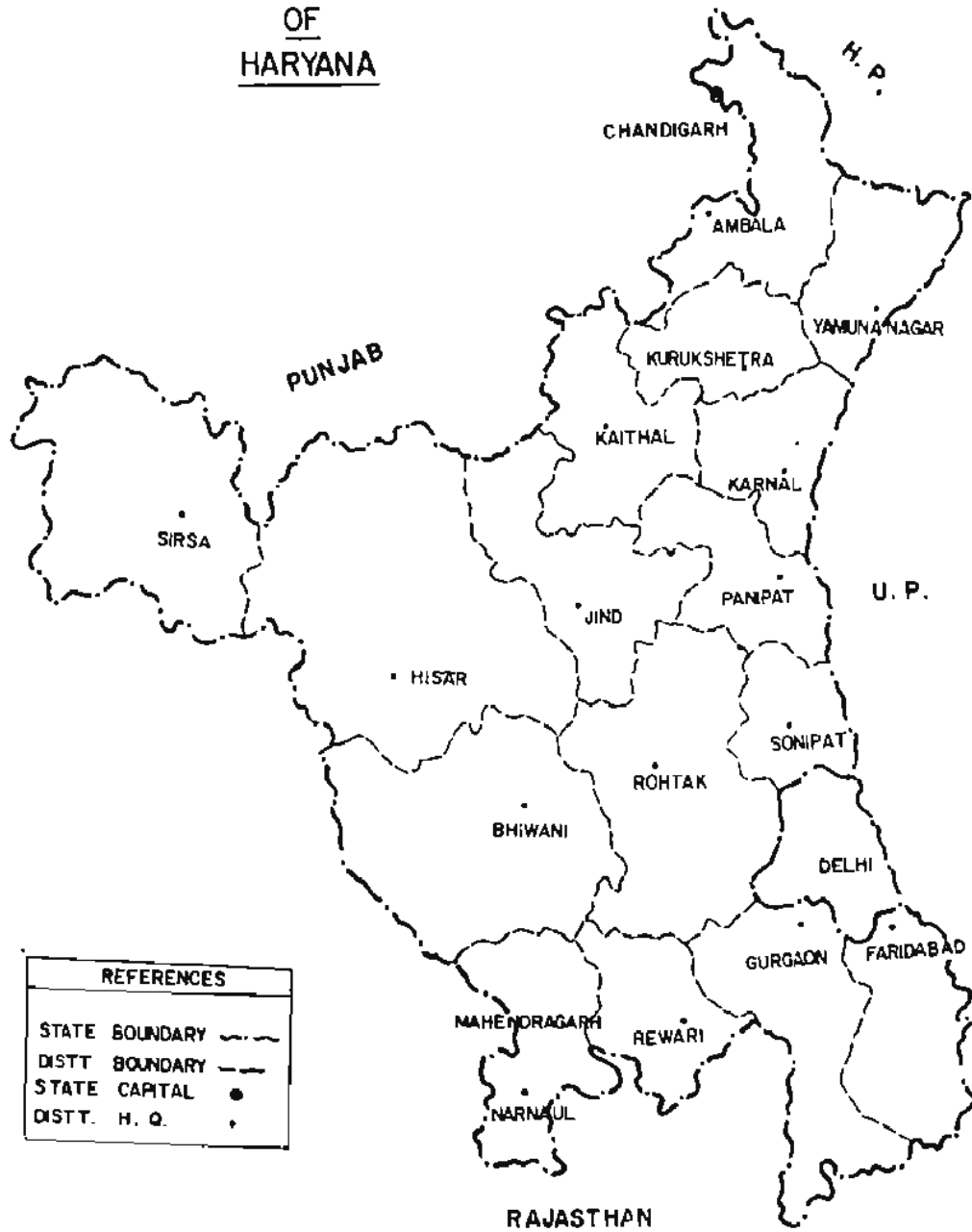
3. In the entire rural area of Karnal district 46.47 lakh trees (12.57 trees/hectare) have been estimated. The analysis shows that maximum number of the estimated trees are in 10-20 cms. dia-class i.e. 31.24 lakh trees (67.23%) and minimum in 40 cms. and above dia-class i.e. 1.17 lakh trees (2.52%).

4. The specieswise distribution of total number of estimated trees shows that *Acacia nilotica* (Babul) has the largest representation i.e. 16.47 lakh trees (35.43%) followed by *Eucalyptus* spp. 12.06 lakh (25.95%), *Populus* spp. 3.60 lakh (7.74%), *Morus* spp. 2.46 lakh (5.29%), *Dalbergia sissoo* (Shisham) 2.39 lakh (5.14%), *Mangifera indica* 2.10 lakh (4.53%), *Prosopis juliflora* 1.56 lakh (3.35%), *Melia azedarach* 1.24 lakh (2.67%), *Azadirachta indica* 1.08 lakh (2.32%), *Syzygium cumini* 0.92 lakh (1.99%) and *Ficus* spp. 0.56 lakh (1.20%).

5. The distribution of total number of trees categorywise and dia-classwise shows that the representation of trees is maximum in the Category-I - FARM FORESTRY i.e. 23.01 lakh trees (49.52%) and minimum in the Category-III - VILLAGE WOODLOTS i.e. 1.50 lakh (3.23%).

6. In the entire rural area of Karnal district total estimated volume of all species and dia-classes combined comes to be 7.86 lakh cubic meters and volume/hectare is 2.126 Cum.

MAP SHOWING DISTTS.  
OF  
HARYANA



REFERENCES	
STATE BOUNDARY	-----
DISTT BOUNDARY	-----
STATE CAPITAL	•
DISTT. H. Q.	•

# CHAPTER 1

## 1.1 Introduction

To assess the availability of forest resources for production of timber, fuelwood and raw material for paper pulp, packing cases, essential oils, match wood etc. in areas outside the traditional Reserved Forest areas and those forest areas which could not be covered while undertaking the regular Inventory Survey of Haryana State.

## 1.2 Description of the District

The district of Karnal is a part of the Eastern Haryana plain. It is named after the town of Karnal which according to the legends owes its name to Raja Karna who although an elder brother of Pandavas - born to Kunti of God Sun before her marriage, was a very close associate of Duryodhana and fought for him in the great Mahabharata war. The town stands on the high bluff of River Yamuna which once flowed in its immediate vicinity. The tract in which it is situated is dotted with ancient sites and almost every village and stream is connected with the legends of the Great Epic.

## 1.3 Location

The district lies between  $29^{\circ} 09' 50''$  and  $29^{\circ} 59'$  North latitudes and  $76^{\circ} 31' 15''$  and  $77^{\circ} 12' 45''$  East longitudes. On its North and North-West is the district of Kurukshetra. To its west is Jind District. Sonapat district lies on its south. The Yamuna river makes the eastern boundaries of the district and across the river are the districts of Saharanpur, Muzaffarnagar and Meerut of Uttar Pradesh. The area of the district is 3,721 Sq. Km. having a population of 1,322,826 as per 1981 Census.

## 1.4 Physical Features

### Soils, geology and topography

The district on the whole is divided into the following three sub-micro regions on the basis of soils and topography:-

#### (a) Assandh Plain

The region extends over Assandh tehsil except three villages Peont (11), Bansa (12) and Rer Kalan (19), three villages of Karnal tehsil viz. Gunana (304), Nisang (305) and Gondar (306) and a few villages in the western part of Panipat tehsil. From relief point of view, maximum height of the region is 243 metres above m.s.l. near village Gunana (304) in Karnal Tehsil while the minimum height is 235 metres near village Rattak (32) in Assandh Tehsil. The region is entirely a North-East to South-West. It is predominantly agricultural. A few patches of wasteland and scrub are seen in certain villages.

The old alluvium of 'Nardak' has low fertility as compared to the 'Bhangar' alluvium on account of Kankar formation in the former. The soil of the region is loam (Nardak). Soil as classified by NBSS and LUP (ICAR), Nagpur, the region has Aquepts - Ochrepts type of soil. Aquepts means Brown soils (Hydromorphic), Ochrepts means shallow black, brown and alluvial soils of the northern region.

With regard to communications and transportation facilities, the region is seen covered with all types of metalled roads. Assandh is the main town from where roads are radiating to all towns. Northern railways (Broad gauge) Jind to Panipat (Branch line) passes through the region.

#### (b) Karnal Bhangar

The region spreads over the major portion of Karnal and Panipat tehsil and also three villages viz. Peont (11), Bansa (12) and Rerkalan (19) of Assandh tehsil. It covers the central part of the district in North-South direction.



The region makes its boundaries with Assandh plain and Kurukshetra district in West and North, Yamuna Khadar in the East and Sonipat district in the South.

From relief point of view the maximum height of the region is 254 metres above m.s.l near village Nilokheri (rural) 65) and minimum height is 237 metres near village Malakpur (400). Both the heights are lying in Karnal tehsil. Bhangar area comprises the higher ground than the recent flood plain. Scrubby and bushy type of vegetation are seen scattered over the region.

A few patches of land are under swamps over the region, cultivated land is extensive besides some patches of scrubs. Western Yamuna canal (main branch) along with its distributaries is the main source to facilitate canal irrigation.

The soil of the region is loam (Bhangar). The soil found here is compact and stiff due to addition of silt. It is less granular. Soils as classified by the NBSS and LUP (ICAR), Nagpur found in the region are Ochrepts - Orthents and Aquepts - Ochrepts types of soils.

Ochrepts - Shallow black, brown and alluvial soils of the northern region.

Orthents - Recently formed soils

Aquepts - Brown soils (Hydromorphic)

With regard to means of communication and transportation facilities, all types of roads and two Broad gauge railway lines pass through the region. National Highway No. 1 (NH 1) also passes through the region on which well developed towns of Panipat, Gharaunda, Karnal, Traori and Nilokheri are located.

#### **(c) Yamuna Khadar**

The region extends over the eastern parts of the Karnal and Panipat tehsils of the district. It runs along the Yamuna river in the eastern part of the district from North to South as a linear track. The region makes its boundaries with Karnal Bhangar in the West, Kurukshetra district in the North, State of Uttar Pradesh in the East and Sonipat district in the South.

From relief point of view, the maximum height of the region is 257 meters above m.s.l near village Hanauri (161) in Karnal tehsil while the minimum height is 225 meters near village Bodhwal Majri (125) in the Panipat tehsil. The region is built and drained by the Yamuna river. So it contains various interlocked canals of streams, rivulets, ponds and swamps. The flood plain is low lying. It is highly undulating in topography and swamy in places.

The region consists of alluvial soils. The soil found in the region is silty loam (Khadar). Khadar of Karnal is throughout inferior being either the lightest sand or stiffest clay. The region is under cultivation except a few patches which are covered with bushes. Soils as classified by the NBSS and LUP (ICAR) Nagpur, the region has Aquepts - Fluvents types of soils.

Aquepts - Recently formed Hydromorphic alluvial soils

Fluvents - Alluvial soils (Recent alluvium)

With regard to means of communication and transportation facilities, the region is not much developed due to the riverian action. Mainly all the roads are interlinked with each other by 'Kuchcha' roads or footpaths. Indri and Samalakha towns are developing in the northern and southern parts of the region respectively.

## 1.5 Climate

The Karnal district lies in the Eastern Haryana plain which has Gangetic type, sub-tropical continental monsoon climate.

## 1.6 Rain

Monsoons bring rain from July to September. From October to June the weather is generally dry except a few showers from western cyclones. Within the district also rainfall varies. The northern part of the district gets more rainfall than the southern part due to its proximity to the mountains. Rainfall in the district varies from 650 mm in the south-western part to above 900 mm in north-eastern part of the district. The climate in the district is attributed to short wet months and long spells of dry months or weeks. Humidity is very high during the rainy season and very low during dry summer months.

## 1.7 Temperature

Due to its distance from the sea there is great difference between the temperatures of day and night as well as during winter and summer. The Maximum daily temperature during summer reaches as high as 45°C in May - June. Hot dry winds blow during the day due to its proximity to the semi-arid areas of Haryana and Rajasthan. During the winter the Minimum temperature falls below 5°C during December - January.

## 1.8 Frost, Fog and Hailstorms etc.-

Ground frost also occurs when there is snowfall in H.P. and U.P. hills. Foggy weather also prevails during the months of January - February. Occasional spells of hailstorms also take place during February to April. During May-June dust storms also occur in the district.

## 1.9 Socio-Economic Conditions

The economy of the district is primarily agricultural. At the time of 1981 Census, about 59% of the total main workers were cultivators and agricultural labours. Its industrial base has remained mainly agro-based. The large and medium scale units are engaged in manufacturing of fertilizers, sugar, rectified spirit, country liquor, dehydrated vegetables, steel pipes and tubes, card board etc. There are many small scale units also in Karnal district. These units manufacture metal products, food products, cotton textiles, chemicals and chemical products, rubber, plastic, petroleum and coal products, textile, leather and fur products, paper and paper products etc. Panipat is known as the home of quality handloom products which have become popular in foreign countries also.

Irrigation in the district is mostly done by tubewells. There is a good network of canals. Underground water level is comparatively high. Out of the total area 86.63% is cultivable and out of which 82.84% is irrigated. Among the food grains mostly wheat and rice are grown. Sugarcane and sunflower (oil seeds) are also grown in considerable areas. As per 1977 Census of live-stocks there are about 7,10,000 animals which includes cattles, buffaloes, horses and ponies, donkeys, sheep, goats, camels and pigs etc.

The people of Haryana are hardworking and enterprising. The per capita income of Haryana is second after Punjab among the states of the country. Wheat and rice are the main food. Milk consumption is about 500 gms. per person which is quite high as compared to the National average of about 137 gms.

Out of total population of the district 74% is rural population. Out of the total population 36.77% are literates. Literacy percentage among the male and female population is 47.27 and 24.49 respectively. Literacy percentage among the Rural and Urban population is 29.74% and 56.60% respectively. Out of the total population only 31% are workers while 69% are non-workers.

### 1.10 Uses

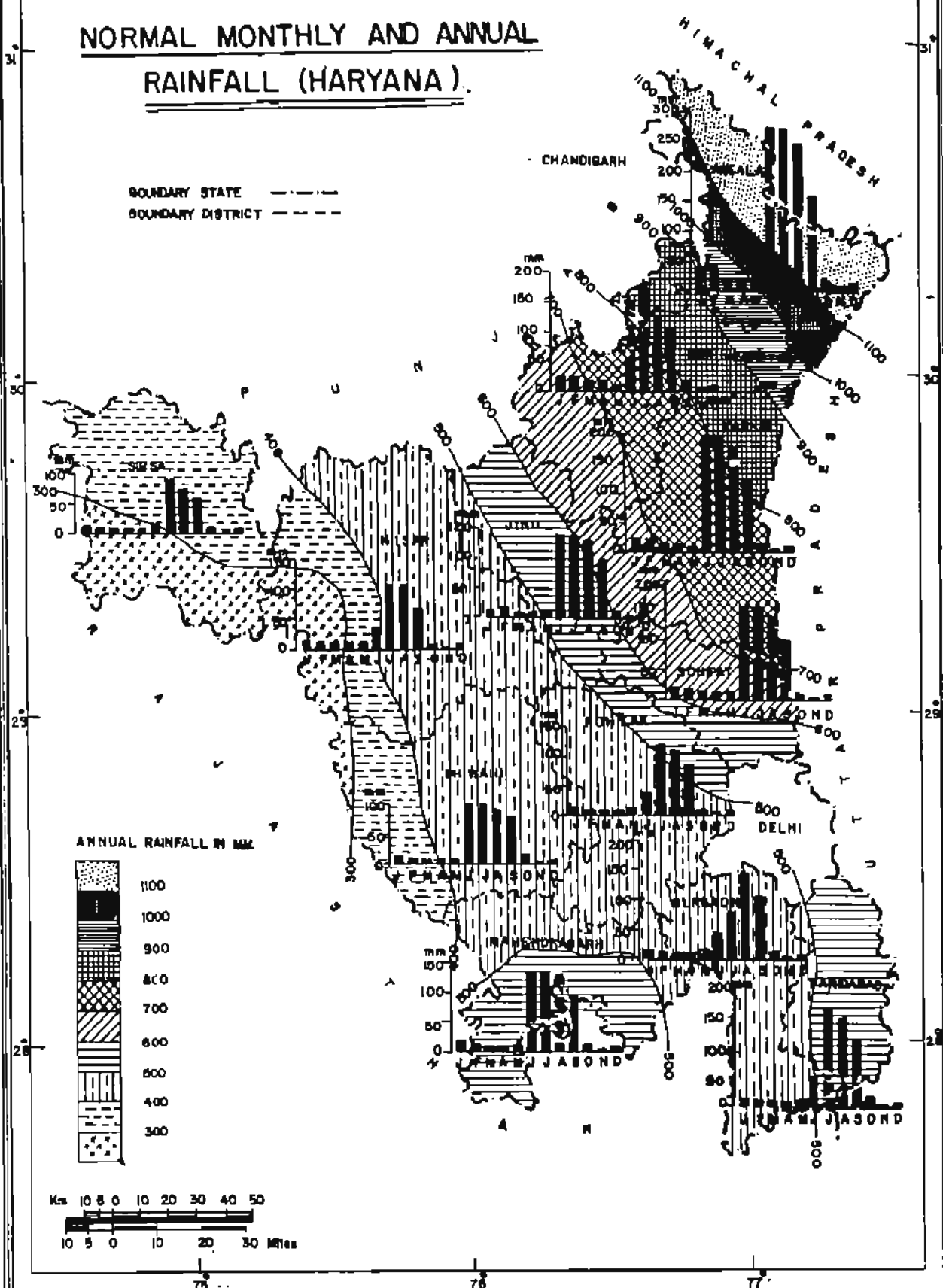
The trees provide mainly timber, fuel, fodder, fruits and shade. Timber is obtained mainly from *Dalbergia sissoo*, *Eucalyptus* spp., *Melia azedarach*, *Syzygium cumini*, *Morus alba*, *Mangifera indica*, *Azadirachta indica*, *Albizia* spp. etc. Small timber is obtained mainly from *Acacia nilotica*, *Acacia* spp., *Prosopis cineraria*, *Tamarix articulata* etc. All the above mentioned trees provide fuel wood also. Trees like *Prosopis juliflora*, *Acacia nilotica*, *Acacia tortilis*, *Albizia* spp., *Morus alba*, *Prosopis cineraria* also provide fodder in the form of leaves or pods. *Morus alba* provides wood for manufacturing hockey sticks and other sports goods. Poplars provide matchwood and Euclyptus paper pulpwood. Fruits are obtained from *Zizyphus* spp. and *Syzygium cumini*, Katha is extracted from *Acacia catechu*. Neem oil is obtained from *Azadirachta indica*.

It has been seen that with the ban on felling of green trees in Himachal Pradesh, packing cases for apple and other fruits/vegetables are supplied from Haryana which are constructed from Eucalyptus wood. *Eucalyptus* is also used for making cheap furniture and also as a fuel.



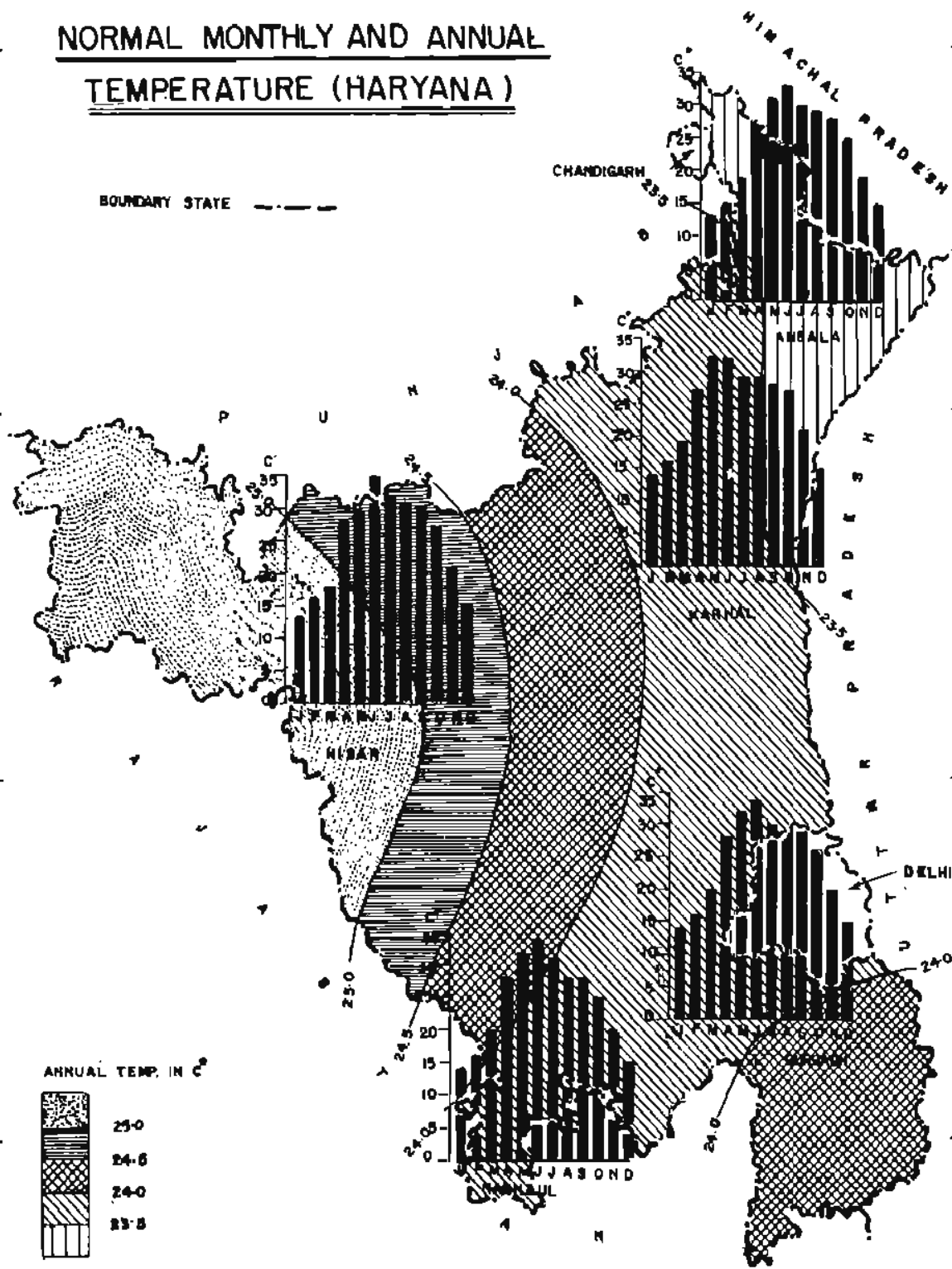
# NORMAL MONTHLY AND ANNUAL RAINFALL (HARYANA)

BOUNDARY STATE - - - - -  
BOUNDARY DISTRICT - - - - -

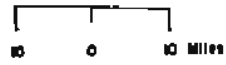
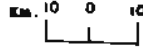


# NORMAL MONTHLY AND ANNUAL TEMPERATURE (HARYANA)




BOUNDARY STATE - - - - -

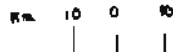
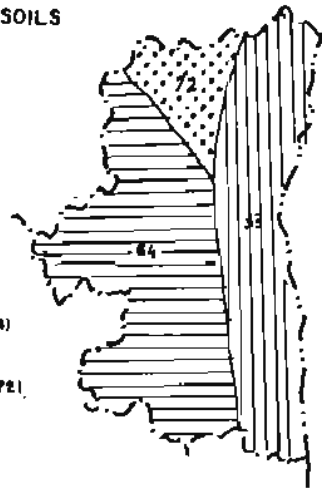


**TYPE OF SOILS & GEOLOGY**  
**DISTT. KARNAL (HARYANA)**

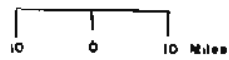


**SOILS**

-  AQUENTS-FLUVENTS (53)
-  AQUENTS - OCHREPTS (64)
-  OCHREPTS - ORTHENTS (72)



**GEOLOGY**



-  ALLUVIUM



## CHAPTER 2

### 2.1 Design and Methodology of Non-Forest Inventory Survey

District Census Books of Census Survey 1981 were used as basis of Inventory of Non-Forest Area. A list of villages in the district was prepared and each village was given a serial number.

### 2.2 Definition of non-Forest Area

For the purpose of this survey

(1) All those areas were taken which were outside the traditional Reserved Forest Areas.

2. All those areas which satisfied the following conditions were also excluded:

(a) All places within the Municipality, Corporation, Cantonment Board or a notified area Committee etc.

(b) All other places which satisfied the following criteria :-

(i) A minimum population of 5,000;

(ii) At least 75% of the male working population engaged in non-agricultural pursuits and

(iii) A density of population of at least 400 per Sq. Km. (1,000 per Sq. mile).

In addition to all municipal areas/Cantonment Board, four villages namely (1) Babiyal in Ambala district, (2) Smalakha in Karnal district, (3) Gurgaon (rural) and (4) Jharsa in Gurgaon district satisfying the above criteria had been treated as Census towns (non-municipal) in 1981 Census. Panchkula Urban Estate in Ambala district had also been treated as a town. The Faridabad Complex Administration consisting of Faridabad, Faridabad Township and Ballabgarh towns of 1971 and some surrounding villages in Faridabad district had been treated as towns.

### 2.3 Sampling Design and Method of Selection of Sample Villages.

The inventory survey was undertaken in the rural area (non-forest area only) of the state. The design followed in the field inventory was random sampling with the villages as sampling units. A list of villages of Karnal district was prepared according to 1981 Census and each village was given a serial number.

Firstly, the number of sample villages to be surveyed in the state was decided by taking a pilot survey such that the results of the survey at State level would be at the precision level of + 10% at 95% probability level.

For carrying out pilot survey, 2 to 3 villages were taken from each district of Haryana State. Total 31 villages were selected for pilot survey in Haryana State. A list of the villages selected for pilot survey is given in Appendix - I.

The villages selected for pilot survey were taken up one by one for carrying out complete enumeration of all the trees of 10 cms. and above diameter at B.Ht(OB). Each of these selected villages, with its area and boundaries as per the revenue records, was treated as a sampling unit.

After completing the pilot survey the data was processed for obtaining number of trees/Ha. in each village for calculation of sample size by using the formula

$$n = \frac{\left(\frac{2 \times c.v.}{10}\right)^2}{1 + \frac{1}{N} \left(\frac{2 \times c.v.}{10}\right)^2}$$

Where  $c.v. = \frac{s}{\bar{x}} \times 100$  and



$N$  = total no. of villages in the State,  
For large  $N$ , it will be equal to

$$n = \left( \frac{2 \times \text{c.v.}}{10} \right)^2$$

The method used was ratio method of estimation, the sample size obtained from pilot survey was 219 villages.

These 219 villages were distributed over all the districts proportional to the rural area of the district. A list of number of villages selected for each district is given in the Appendix-II.

These randomly selected villages in each district were taken up one by one for carrying out complete enumeration of all the trees of 10 cms. and above diameter. Each of these randomly selected villages, with its area and boundaries as per the revenue records, was treated as a sampling unit.

#### 2.4 Field Methodology

The field data is collected by a Crew, consisting of one Junior Technical Assistant (Crew-Leader), a Deputy Ranger, two Fieldsmen, Khalasi and unskilled labourers engaged locally wherever necessary for showing the boundary of the village as well as helping in the survey work.

Each Crew Leader is provided with a list of villages to be tackled alongwith a set of 1:50,000 scale maps with location of villages duly marked. The Crew Leader is required to find the nearest convenient route so that they can reach the village with minimum traverse by jeep or on foot. After reaching the village the next job is to determine the boundary of the village. For this purpose, the maps of the Revenue Department are referred and in addition the help of village level authorities are obtained. The unit of sampling is the whole of sample village. To begin the data collection it is necessary to select the starting/reference point preferably centre of the village. This reference point/centre is not necessarily to be the centre of the area. The details of the location of the reference point/centre and its description are recorded in the village description form. This is very important to enable the checking crew to reach this point and commence checking.

After fixing the starting/reference point, the enumeration work is started from the reference point by dividing the entire village into suitable sized angular quadrants with the help of compass in such a way that enumeration within each angular quadrant could be completed in one working day. The size of each angular quadrant is decided by the Crew Leader accordingly. Enumeration of trees/bamboo is commenced from the line marking due North from the centre/reference point and is proceeded in clockwise direction (i.e. North to East).

This procedure is important to avoid duplication/ommission of trees when the enumeration work is continued on the next day. Further, all the enumerated trees are suitably marked with chalk to achieve this objective. The informations regarding number of angular quadrants, the size of each angular quadrant and number of trees enumerated in each quadrant are recorded in the prescribed Field forms given below:

- (1) Village Description Form
- (2) Village Tree Enumeration Form
- (3) District Tree Form

Samples of the above field forms may be seen in the Appendix-VI. The field forms are briefly described below:

- (1) Village Description Form

The information regarding the conspicuous features of the point selected as the Centre for

starting the enumeration, number of angular, Size of each angular quadrant and number of trees enumerated in each quadrant are recorded in this form.

### (2) Village Tree Enumeration Form

In this form the data of all trees of 10 cms. and above diameter at breast height over bark [DBH (OB)] in a sampled village are recorded. The dead trees having utility less than 70% and all trees of less than 10 cms, diameter are ignored.

### (3) District Tree Form

This form has to be filled in for each sampled village selected in the district.

While carrying out the survey, i.e. enumeration and measurement of trees, the category of each tree-indicating the type of plantation it belongs to is also recorded in the columns of Village Tree Enumeration Form. The definitions used for this classification are as under:

Farm Forestry:	Trees along the farm bunds and in small patches up to 0.1 ha. in area.
Road side Plantation:	For trees planted along the road side.
Village Woodlot:	Naturally growing trees on community/private land.
Block Plantation:	Patches covering an area of more than 0.1 ha. and not falling in any of the above.
Ponds:	For trees planted in and around water ponds.
Railway Lines:	For trees planted along the railway lines.
Canals:	Trees planted along the canals.
Rest:	Trees not falling in any of the above categories.

## CHAPTER 3

### Data Processing

#### 3.1 Processing of the Data

After completion of field work, the field forms of the villages surveyed were consolidated and checked for any inconsistencies and Coding mistakes, if any. Forms for each village were then processed manually and information was filled in the tables. The species found in sample villages of Karnal district during survey are given in Appendix-III. Since many of the species in the region were having a very small number of trees, they were clubbed together under Miscellaneous species. Twenty main species were selected for calculating the number of stems on the basis of their numerical occurrence, commercial importance and regional importance. Two tree species which were not important for estimation of volume were not taken up for calculation of volume. After manual processing of the data the tabulated data was then transferred to the data files in the Personal Computer (PC) using suitable softwares. The data files were then processed for making various tables in desired formats required to be incorporated in the Report.

#### 3.2 Area Computation

Rural area of the district was calculated by adding up the areas of the villages given in the Census Book of 1981 of that district.

3.3 Collection of felled tree data has been discontinued by zones, for developing volume equations. The volume factors have been obtained from the Logging Divisions and Territorial Forest Divisions of the State Forest Department of Haryana.

3.4 The volume factors used for different tree species have been given in the volume table at the end of this chapter.

#### Estimation Procedure.

The estimation procedure is given below

Let

$x_i$  = area of the  $i$ th village

$y_i$  = volume/no. of trees for the  $i$ th village

$n$  = no. of sample villages in the district/state

$N$  = total no. of villages in the district/state

$$\bar{x} = \sum_{i=1}^n x_i/n = \text{average area per village in the sample}$$

$$\bar{X} = \sum_{i=1}^N x_i/N = \text{average area per village in the population (District/State).}$$

$$\bar{y} = \sum_{i=1}^n y_i/n = \text{average volume/no. of trees in the sample}$$

$\bar{Y} = \sum_{i=1}^N Y_i / N =$  average volume/no. of trees in the population (District/State)

$A = \sum_{i=1}^N x_i =$  total area of all villages in the population (District/State)

Then the mean volume/no. of trees per unit area for the population (District/State) is given by

$$\hat{R} = \frac{\bar{Y}}{\bar{x}}$$

The estimate of  $R$  is the sample ratio

$$\hat{R} = \frac{\sum_{i=1}^n y_i}{\sum_{i=1}^n x_i} = \frac{\bar{y}}{\bar{x}}$$

The estimate of total volume/no. of trees in the population (District/State) is given by

$$\hat{T} = \frac{A \times \bar{y}}{\bar{x}} = A \times \hat{R}$$

Estimated variance of  $R$  is given by

$$V(R) = \frac{N-n}{Nn\bar{x}^2} \times \frac{1}{(n-1)} \left[ \sum_{i=1}^n y_i^2 - 2\hat{R} \sum_{i=1}^n y_i x_i + \hat{R}^2 \sum_{i=1}^n x_i^2 \right]$$

When  $N$  is large, then

$$\hat{V}(\hat{R}) = \frac{1}{n(n-1)\bar{x}^2} \left[ \sum_{i=1}^n y_i^2 - 2\hat{R} \sum_{i=1}^n y_i x_i + \hat{R}^2 \sum_{i=1}^n x_i^2 \right]$$

Estimated variance of  $\hat{T}$  is given by

$$\hat{V}(\hat{T}) = A^2 \times \hat{V}(\hat{R})$$

$$S.E. \text{ of } \hat{R} = \sqrt{\hat{V}(\hat{R})} \text{ and } S.E.\% = \frac{S.E.}{\hat{R}} \times 100$$

$$S.E. \text{ of } \hat{T} = \sqrt{\hat{V}(\hat{T})} \text{ and } S.E.\% = \frac{S.E.}{\hat{T}} \times 100$$

Volume Table - specieswise and dia-classwise

S.No.	Name of Species	10-20	20-30	30-40	40+
1.	<i>Acacia catechu</i>	0.10	0.21	0.51	1.13
2.	<i>Acacia nilotica</i>	0.06	0.14	0.57	1.13
3.	<i>Acacia</i> spp.	0.06	0.14	0.57	1.13
4.	<i>Acacia tortilis</i>	0.06	0.14	0.57	1.13
5.	<i>Albizia</i> spp.	0.06	0.14	0.57	1.13
6.	<i>Azadirachta indica</i>	0.06	0.14	0.57	1.13
7.	<i>Dalbergia sissoo</i>	0.06	0.14	0.57	1.13
8.	<i>Eucalyptus</i> spp.	0.10	0.41	0.95	1.71
9.	<i>Ficus</i> spp.	0.06	0.14	0.57	1.13
10.	<i>Mangifera indica</i>	0.06	0.14	0.57	1.13
11.	<i>Melia azedarach</i>	0.06	0.14	0.57	1.13
12.	<i>Morus</i> spp.	0.06	0.14	0.57	1.13
13.	<i>Populus</i> spp.	0.07	0.35	0.73	1.26
14.	<i>Prosopis cineraria</i>	0.06	0.14	0.57	1.13
15.	<i>Prosopis juliflora</i>	0.06	0.14	0.57	1.13
16.	<i>Psidium guyava</i>	0.06	0.14	0.57	1.13
17.	<i>Salvadora</i> spp.	0.06	0.14	0.57	1.13
18.	<i>Syzygium cumini</i>	0.06	0.14	0.57	1.13
19.	<i>Tamarix articulata</i>	0.06	0.14	0.57	1.13
20.	<i>Zizyphus</i> spp.	0.06	0.14	0.57	1.13
21.	Misc. spp.	0.06	0.14	0.57	1.13

## CHAPTER 4

### Stand and Stock tables

As per 1981 Census Karnal district has a total of 634 villages having an area of 3,69,761 hectares (3,697.61 Sq. Km.). Out of these, 18 villages were randomly selected and surveyed (see Appendix - IV). The data collected (for trees having 10 cm. and above diameter) from these 18 villages has been statistically analysed for variability in respect of tree stock and tree volume parameters and "trees/hectare" and "volume/hectare". The analysis shows the estimate of 12.57 trees/hectare and corresponding volume of 2.126 Cum./hectare for the entire Karnal district.

The distribution of total stems and stems/ha. as well as total volume and volume/ha. have been estimated and are included as Table Nos. 1 to 6.

In the entire rural area of Karnal district 46.47 lakh trees have been estimated and the distribution thereof is discussed below:

1. The distribution of total number of estimated trees, dia- classwise and specieswise (all categories combined), is given in table no. 1. The analysis shows that maximum number of the estimated trees are in 10-20 cms. dia-class i.e. 31.24 lakh trees (67.23%) followed by 11.23 lakh trees (24.16%) in 20-30 cms. dia- class, 2.83 lakh trees (6.08%) in 30-40 cms. dia-class and 1.17 lakh trees (2.52%) in 40 cms. and above dia-class.

The specieswise distribution of total number of trees in the district has been estimated by ratio estimation method. It shows that in the rural area of Karnal district *Acacia nilotica* (Babul) has the largest representation i.e. 16.47 lakh trees (35.43%) followed by *Eucalyptus spp.* 12.06 lakh (25.95%), *Populus spp.* 3.60 lakh (7.74%), *Morus spp.* 2.46 lakh (5.29%), *Dalbergia sissoo* (Shisham) 2.39 lakh (5.14%), *Mangifera indica* 2.10 lakh (4.53%), *Prosopis juliflora* 1.56 lakh (3.35%), *Melia azedarach* 1.24 lakh (2.67%), *Azadirachta indica* 1.08 lakh (2.32%), *Syzygium cuminii* 0.92 lakh (1.99%) and *Ficus spp.* 0.56 lakh (1.20%). The representation of the rest of the species is less than 1% each.

2. The distribution of total number of trees estimated, categorywise and dia-classwise (all species combined), is given in table no. 2. It shows that the representation of trees is highest in the Category-I - Farm Forestry (49.52%) followed by Category-IV - Block Plantations (17.88%), Category-VII - Canals (15.08%), Category-II - Roadside Plantations (12.98%) and Category-III - Village Woodlots (3.23%) etc.

Analysis of the categorywise distribution of total number of estimated trees reveals that Farm Forestry has an estimated 23.01 lakh trees followed by 8.31 lakh trees in Block Plantations, 7.01 lakh trees in Canal side Plantations, 6.03 lakh trees in Roadside Plantations and 1.50 lakh trees in the Village Woodlots.

The distribution of stems per hectare is the largest in dia-class 10-20 cms. i.e. 8.45 followed by 3.04 in 20-30 cms., 0.76 in 30-40 cms. and 0.32 in 40 cms. and above dia-class.

3. The distribution of total number of trees estimated, specieswise categorywise (all dia-classes combined), has also been presented in table no. 3. The specieswise percentage and categorywise percentage of the estimated trees has already been mentioned in para 1 and 2 above.

The analysis shows that the specieswise total number of estimated trees (in order of decreasing numbers) in the various prescribed categories are as under:

#### Category I - Farm Forestry

As per the estimate, this category has a total number of 23.01 lakh trees which is the highest total of all the categories. It is mainly comprised of *Eucalyptus spp.* 7.07 lakh, *Acacia nilotica* 3.91 lakh, *Morus spp.* 2.33 lakh, *Dalbergia sissoo* 2.04 lakh, *Mangifera indica* 1.57 lakh, *Melia azedarach* 1.18 lakh, *Populus spp.* 1.10 lakh, *Azadirachta indica* 1.01

lakh, *Syzygium cumini* 0.87 lakh, *Prosopis juliflora* 0.58 lakh and *Ficus* spp. 0.38 lakh. the representation of the remaining species are very negligible.

#### Category II - Roadside Plantations

As per the estimation, there are 6.03 lakh trees in all this category. It is mainly represented by *Acacia nilotica* 3.75 lakh, *Eucalyptus* spp. 1.69 lakh, *Prosopis juliflora* 0.35 lakh, and *Dalbergia sissoo* 0.15 lakh. The representation of the remaining species is very low and hence not presented here.

#### Category III - Village Woodlots

In this category the total number of trees, as per the estimation, is 1.50 lakh and is comprised mainly by *Zizyphus* spp. 0.34 lakh, *Acacia nilotica* 0.27 lakh, and *Ficus* spp. 0.16 lakh. The remaining species have a poor representation.

#### Category IV - Block Plantations

In this category the total number of trees have been estimated to be 8.31 lakh. It is mainly represented by *Acacia nilotica* 3.31 lakh, *Populus* spp. 2.49 lakh, *Eucalyptus* spp. 1.57 lakh, *Mangifera indica* 0.53 lakh, and *Prosopis juliflora* 0.14 lakh. The remaining species are not being mentioned due their low representation.

#### Category V - Ponds

As per the estimate all the species have a very poor representation in this category.

#### Category VI - Railway Lines

The total number of trees in this category, as per the estimation, are 0.59 lakh. The predominant species are *Eucalyptus* spp. 0.35 lakh and *Acacia nilotica* 0.23 lakh. Other species are negligible in number.

#### Category VII - Canals

As per the estimate this category has 7.01 lakh trees in all. It is represented mainly by *Acacia nilotica* 4.98 lakh, *Eucalyptus* spp. 1.37 lakh, *Prosopis juliflora* 0.44 lakh and *Dalbergia sissoo* 0.13 lakh.

#### Analysis of Volume (Stock)

In the entire rural area of Karnal district total volume of all species and dia-classes combined, as per the estimation, comes to be 7.86 lakh cubic meters and the distribution thereof is discussed below:

1. An assessment of dia-classwise and specieswise distribution (all categories combined) of volume is given in table no. 4. It shows that the total estimated volume of trees of all species belonging to the dia-class 20-30 cms. is 2.51 lakh cubic meters (31.97%) which incidently is the highest of all the dia-classes. It is followed by 10-20 cms. dia-class having volume of 2.23 lakh cubic meters (28.36%), 30-40 cms. dia-class 1.76 lakh cubic meters (22.33%) and 40 cms. and above dia-class having volume of 0.79 lakh cubic meters (17.34%).

It also shows that the total volume per hectare contributed by trees of all species of all dia-classes combined is 2.126 cum. The volume per hectare for different dia-classes (in decreasing order) are as below:

20-30 cms. dia-class (0.680 cum.), 10-20 cms. dia-class (0.603 cum.), 30-40 cms. dia-class (0.475 cum.) and 40 cms. and above dia-class (0.369 cum.).

It may also be seen from the table No. 4 that the total volume contributed by each species, for combined dia-classes, and the percentage thereof (in decreasing order) are as below:

*Eucalyptus* spp. 2.48 lakh cubic meters (31.61%), *Acacia nilotica* 2.24 lakh cubic meters (28.53%), *Dalbergia sissoo* 0.56 lakh cubic meters (7.13%), *Populus* spp. 0.495 lakh cubic meters (6.30%), *Mangifera indica* 0.494 lakh cubic meters (6.28%), *Morus* spp. 0.33 lakh cubic meters (4.14%), *Azadirachta indica* 0.25 lakh cubic meters (3.23%), *Ficus* spp. 0.23 lakh cubic meters (2.91%), *Syzygium cumini* 0.15 lakh cubic meters (1.91%).

2. The distribution of total estimated volume, categorywise and dia-classwise (all spp. combined), is given in table no. 6. It shows that the total volume of all the categories in the dia- class 20-30 cms. is 2.51 lakh cubic meters (31.97%) which is the highest of all the dia-classes. It is followed by 10-20 cm. dia- class having a total volume of 2.23 lakh cubic meters (28.36%), 30-40 cm. dia-class having 1.76 lakh cubic meters (22.33%) and 40 cms. and above dia-clas having 1.36 lakh cubic meters (17.34%).

It also shows that category-I (all dia-classes combined) has the highest volume of 4.06 lakh cubic meters (51.68%) followed by category-VII having 1.27 lakh cubic meters (16.21%), category-II having 1.14 lakh cubic meters, category-IV having 0.90 lakh cubic meters (11.46%), category-III having 0.38 lakh cubic meters (4.81%) and category-VI which has only 0.10 lakh cubic meters (1.30%). Category-V has the lowest volume which is negligible.

3. The distribution of total volume (estimated), specieswise and categorywise (all dia-classes combined), is given in table No. 5. It can be inferred that the categorywise total volume, when all species are combined, are as below (in order of decreasing volume):

Category-I 4.06 lakh cubic meters (51.68%), category-VII 1.27 lakh cubic meters (16.21%), category-II 1.14 lakh cubic meters (14.52%), category-IV 0.90 lakh cubic meters (11.46%), category-III 0.38 lakh cubic meters (4.81%) and category-VI 0.10 lakh cubic meters (1.30%). Category-V has a very negligible volume.

It can also be seen that the distribution of specieswise total volume, when all categories are combined, are as under (in order of decreasing volume):

*Eucalyptus* spp. 2.48 lakh cubic meters (31.61%), *Acacia nilotica* 2.24 lakh cubic meters (28.53%), *Dalbergia sissoo* 0.56 lakh cubic meters (7.13%), *Populus* spp. 0.495 lakh cubic meters (6.30%), *Mangifera indica* 0.494 lakh cubic meters (6.28%), *Morus* spp. 0.33 lakh cubic meters (4.14%), *Azadirachta indica* 0.25 lakh cubic meters (3.23%), *Ficus* spp. 0.23 lakh cubic meters (2.91%), *Syzygium cuminii* 0.15 lakh cubic meters (1.91%), *Prosopis juliflora* 0.14 lakh cubic meters (1.74%) and *Melia azedarach* 0.11 lakh cubic meters (1.44%). The contribution of other species are very poor.



Table No. 1

**Total Number of stems specieswise and dia-classwise  
(All categories combined)**

Rural area of KARNAL DISTT. : 3697.61 Sq. km

S.No.	Name of Species	10-20	20-30	30-40	40 +	Total	%age
1.	<i>Acacia catechu</i>	0	0	0	0	0	0.00
2.	<i>Acacia nilotica</i>	1043900	455728	121655	252391	1646522	35.43
3.	<i>Acacia</i> spp.	4202	624	170	28	5024	0.11
4.	<i>Acacia tortilis</i>	0	0	0	0	0	0.00
5.	<i>Albizia</i> spp.	5137	2384	851	483	8855	0.19
6.	<i>Azadirachta indica</i>	60927	24359	12606	9880	107772	2.32
7.	<i>Dalbergia sissoo</i>	126225	61411	32053	19136	238825	5.14
8.	<i>Eucalyptus</i> spp.	880454	282828	36169	6416	1205867	25.95
9.	<i>Ficus</i> spp.	23706	11527	6217	14450	55900	1.20
10.	<i>Mangifera indica</i>	113307	55077	22314	19590	210288	4.53
11.	<i>Melia azedarach</i>	99084	21122	2952	682	123840	2.67
12.	<i>Morus</i> spp.	172985	52494	14451	5793	245723	5.29
13.	<i>Populus</i> spp.	277804	77989	3577	170	359540	7.74
14.	<i>Prosopis cineraria</i>	57	28	57	57	199	0.00
15.	<i>Prosopis juliflora</i>	131107	20214	3605	795	155721	3.35
16.	<i>Psidium guyava</i>	0	0	0	0	0	0.00
17.	<i>Salvadora</i> spp.	256	341	426	539	1562	0.03
18.	<i>Syzygium cumini</i>	61097	19988	7239	3946	92270	1.99
19.	<i>Tamarix articulata</i>	880	284	28	56	1248	0.03
20.	<i>Zizyphus</i> spp.	30264	8147	1420	567	40398	0.87
21.	Misc. spp.	92695	28364	16751	9483	147293	3.17
<b>Total</b>		<b>3124087</b>	<b>1122909</b>	<b>282541</b>	<b>117310</b>	<b>4646847</b>	<b>100</b>
<b>% age</b>		<b>67.23</b>	<b>24.16</b>	<b>6.08</b>	<b>2.52</b>	<b>100</b>	

**Table No.2**

**Total number of stems categorywise and dia-classwise  
(All species combined)**

Rural area of KARNAL DISTRICT : 3697.61 Sq.Km.

S.No.	Category	10-20	20-30	30-40	40+	Total	%age
1	I	1562682	528380	141156	68933	2301151	49.52
2.	II	370414	168414	46333	17859	603020	12.98
3.	III	76600	39265	19616	14621	150102	3.23
4.	IV	688360	125713	13856	3122	831051	17.88
5.	V	1419	426	57	28	1930	0.04
6.	VI	40172	17631	880	198	58881	1.27
7.	VII	384440	243080	60643	12549	700712	15.08
	<b>Total</b>	<b>3124087</b>	<b>1122909</b>	<b>282541</b>	<b>117310</b>	<b>4646847</b>	<b>100.00</b>
	<b>%age</b>	<b>67.23</b>	<b>24.16</b>	<b>6.08</b>	<b>2.52</b>	<b>100</b>	
	<b>Stems/ha.</b>	<b>8.45</b>	<b>3.04</b>	<b>0.76</b>	<b>0.32</b>	<b>12.57</b>	

**Table No.3**  
**Total number of stems specieswise and categorywise**  
**(All dia-classes combined)**

Rural area of KARNAL DISTRICT : 3697.61 Sq. Km.

S.No.	Name of Species	C a t e g o r i e s							Total	%age
		I	II	III	IV	V	VI	VII		
1.	<i>Acacia catechu</i>	0	0	0	0	0	0	0	0	0.00
2.	<i>Acacia nilotica</i>	390628	374815	26602	331235	1647	23308	498287	1646522	35.43
3.	<i>Acacia</i> spp.	2924	28	993	0	0	0	1079	5024	0.11
4.	<i>Acacia tortilis</i>	0	0	0	0	0	0	0	0	0.00
5.	<i>Albizia</i> spp.	6643	709	1050	227	0	28	198	8855	0.19
6.	<i>Azadirachta indica</i>	101099	1221	1136	2612	0	0	1704	107772	2.32
7.	<i>Dalbergia sissoo</i>	203618	14991	3095	4004	0	28	13089	238825	5.14
8.	<i>Eucalyptus</i> spp.	707242	168953	0	157284	28	35063	137297	1205867	25.95
9.	<i>Ficus</i> spp.	37731	1051	15643	795	0	28	652	55900	1.20
10.	<i>Mangifera indica</i>	157142	198	0	52721	0	0	227	210288	4.53
11.	<i>Melia azedarach</i>	118446	539	2953	1788	0	0	114	123840	2.67
12.	<i>Morus</i> spp.	233116	994	6786	3350	0	0	1477	245723	5.29
13.	<i>Populus</i> spp	110014	341	57	248986	0	0	142	359540	7.74
14.	<i>Prosopis cineraria</i>	0	57	142	0	0	0	0	199	0.00
15.	<i>Prosopis juliflora</i>	58229	34523	5423	13627	170	113	43636	155721	3.35
16.	<i>Psidium guyava</i>	0	0	0	0	0	0	0	0	0.00
17.	<i>Salvadora</i> spp.	0	0	1562	0	0	0	0	1562	0.03
18.	<i>Syzygium cumini</i>	87387	483	1107	3151	0	0	142	92270	1.99
19.	<i>Tamarix articulata</i>	738	85	425	0	0	0	0	1248	0.03
20.	<i>Zizyphus</i> spp.	2413	255	34409	2839	0	0	482	40398	0.87
21.	Misc.spp.	83781	3777	48719	8432	85	313	2186	147293	3.17
<b>Total</b>		<b>2301151</b>	<b>603020</b>	<b>150102</b>	<b>831051</b>	<b>1930</b>	<b>58881</b>	<b>700712</b>	<b>4646847</b>	<b>100</b>
<b>%age</b>		<b>49.52</b>	<b>12.98</b>	<b>3.23</b>	<b>17.88</b>	<b>0.04</b>	<b>1.27</b>	<b>15.08</b>	<b>100</b>	

Table No.4

Distribution of total volume (in cum.) - specieswise and dia-classwise

(All categories combined)

Rural area of KARNAL DISTRICT : 3697.61 Sq. Km.

S.No.	Name of Species	10-20	20-30	30-40	40+	Total	%age	Vol./ha.
1.	<i>Acacia catechu</i>	0	0	0	0	0	0.00	0.000
2.	<i>Acacia nilotica</i>	62633	63802	69343	28521	224299	28.53	0.607
3.	<i>Acacia</i> spp.	253	88	97	32	470	0.06	0.001
4.	<i>Acacia tortilis</i>	0	0	0	0	0	0.00	0.000
5.	<i>Albizia</i> spp.	309	334	485	545	1673	0.21	0.005
6.	<i>Azadirachta indica</i>	3656	3411	7186	11163	25416	3.23	0.069
7.	<i>Dalbergia sissoo</i>	7573	8598	18270	21624	56065	7.13	0.152
8.	<i>Eucalyptus</i> spp.	85580	117375	34505	10996	248456	31.61	0.672
9.	<i>Ficus</i> spp.	1423	1615	3543	16329	22910	2.91	0.062
10.	<i>Mangifera indica</i>	6798	7711	12718	22136	49363	6.28	0.133
11.	<i>Melia azedarach</i>	5944	2958	1682	770	11354	1.44	0.031
12.	<i>Morus</i> spp.	10379	7350	8236	6547	32512	4.14	0.088
13.	<i>Populus</i> spp.	19446	27218	2619	213	49496	6.30	0.134
14.	<i>Prosopis cineraria</i>	3	4	32	64	103	0.01	0.000
15.	<i>Prosopis juliflora</i>	7866	2831	2054	898	13649	1.74	0.037
16.	<i>Psidium guyava</i>	0	0	0	0	0	0.00	0.000
17.	<i>Salvadora</i> spp.	15	48	243	609	915	0.12	0.002
18.	<i>Syzygium Cumini</i>	3667	2798	4125	4458	15048	1.91	0.041
19.	<i>Tamarix articulata</i>	53	40	16	64	173	0.02	0.000
20.	<i>Zizyphus</i> spp.	1816	1141	809	641	4407	0.56	0.012
21.	Misc. spp.	5563	3970	9547	10717	29797	3.79	0.081
<b>Total</b>		<b>222977</b>	<b>251292</b>	<b>175510</b>	<b>136327</b>	<b>786106</b>	<b>100</b>	<b>2.126</b>
<b>%age</b>		<b>28.36</b>	<b>31.97</b>	<b>22.33</b>	<b>17.34</b>	<b>100</b>		
<b>Vol./ha.</b>		<b>0.603</b>	<b>0.680</b>	<b>0.475</b>	<b>0.369</b>	<b>2.126</b>		

Table No.5

**Distribution of total volume (in cum.) - specieswise and categorywise  
(All dia-classes combined)**

Rural area of KARNAL DISTRICT : 3697.61 Sq. Km.

S.No.	Name of Species	C a t e g o r i e s							Total	%age
		I	II	III	IV	V	VI	VII		
1.	<i>Acacia catechu</i>	0	0	0	0	0	0	0	0	0.00
2.	<i>Acacia nilotica</i>	54258	53438	4165	29536	185	1886	80831	224299	28.53
3.	<i>Acacia</i> spp.	198	2	107	0	0	0	163	470	0.06
4.	<i>Acacia tortilis</i>	0	0	0	0	0	0	0	0	0.00
5.	<i>Albizia</i> spp.	1292	202	145	18	0	2	14	1673	0.21
6.	<i>Azadirachta indica</i>	23218	753	313	874	0	0	258	25416	3.23
7.	<i>Dalbergia sissoo</i>	43188	8695	1213	548	0	32	2388	56064	7.13
8.	<i>Eucalyptus</i> spp.	140063	44673	0	17412	12	8070	38227	248457	31.61
9.	<i>Ficus</i> spp.	13959	206	8130	335	0	32	247	22909	2.91
10.	<i>Mangifera indica</i>	42396	148	0	6757	0	0	63	49364	6.28
11.	<i>Melia azedarach</i>	10746	39	379	124	0	0	67	11355	1.44
12.	<i>Morus</i> spp.	30505	233	896	400	0	0	477	32511	4.14
13.	<i>Populus</i> spp.	17900	24	4	31558	0	0	10	49496	6.30
14.	<i>Prosopis cineraria</i>	0	3	100	0	0	0	0	103	0.01
15.	<i>Prosopis juliflora</i>	4368	4364	388	929	10	21	3569	13649	1.74
16.	<i>Psidium guyava</i>	0	0	0	0	0	0	0	0	0.00
17.	<i>Salvadora</i> spp.	0	0	915	0	0	0	0	915	0.12
18.	<i>Syzygium cumini</i>	14084	149	387	360	0	0	69	15049	1.91
19.	<i>Tamarix articulata</i>	97	5	70	0	0	0	0	172	0.02
20.	<i>Zizyphus</i> spp.	240	18	3807	277	0	0	66	4408	0.56
21.	<i>Misc.</i> spp.	9785	1167	16778	929	10	179	948	29796	3.79
<b>Total</b>		<b>406297</b>	<b>114119</b>	<b>37797</b>	<b>90057</b>	<b>217</b>	<b>10222</b>	<b>127397</b>	<b>786106</b>	<b>100</b>
<b>%age</b>		<b>51.68</b>	<b>14.52</b>	<b>4.81</b>	<b>11.46</b>	<b>0.03</b>	<b>1.30</b>	<b>16.21</b>	<b>100</b>	

**Table No. 6**

**Distribution of total volume (in cum.) - categorywise and dia-classwise  
(All species combined)**

Rural area of KARNAL DISTRICT 3697.61 Sq. Km.

S.No.	Category	10-20	20-30	30-40	40 +	Total	%age
1.	I	113963	125122	88371	78841	406297	51.68
2.	II	26476	34925	29819	22899	114119	14.52
3.	III	4597	5499	11180	16521	37797	4.81
4.	IV	48919	29494	8097	3547	90057	11.46
5.	V	85	68	32	32	217	0.03
6.	VI	3207	6060	730	225	10222	1.30
7.	VII	25730	50124	37281	14262	127397	16.21
	<b>Total</b>	<b>222977</b>	<b>251292</b>	<b>175510</b>	<b>136327</b>	<b>786106</b>	<b>100</b>
	<b>%age</b>	<b>28.36</b>	<b>31.97</b>	<b>22.33</b>	<b>17.34</b>	<b>100</b>	

**Appendix -I**  
**List of the villages selected for Pilot Survey in Haryana State.**

S.No.	Name of the village	Area(Ha.)
1.	Golapur	123.00
2.	Dhaurala	511.11
3.	Mohammedpur	1731.00
4.	Bhatoo	583.00
5.	Dobhi	2896.00
6.	Khandakheri	2324.00
7.	Baidwala	1416.38
8.	Kuranganwali	1479.00
9.	Siwara	1126.00
10.	B. Busna	248.00
11.	Lalheri	267.09
12.	B. Tauru	184.94
13.	Haliaki	480.00
14.	Nathusari	1741.00
15.	Bondkalan	2353.00
16.	Gorakhpur	4370.00
17.	Baghana	1479.51
18.	K. Lakasingh	140.00
19.	Shohdapur	316.05
20.	Nandgaon	825.14
21.	Gurauthi	1720.00
22.	Kharkhara	979.00
23.	Mammon Majra	199.51
24.	Sulhera	572.00
25.	Bhandari	677.00
26.	Saundhad	2753.00
27.	Dachaur	2728.00
28.	Dighal	2211.00
29.	Kahnaur	2762.00
30.	Shampura	1017.00
31.	Phadani	208.00
	<b>Total</b>	<b>40420.73</b>

**Appendix - II**  
**Districtwise number of the villages selected**  
**for Inventory Survey in Haryana State**

<b>S.No.</b>	<b>Name of the District</b>	<b>Total No.of villages in the District</b>	<b>No. of villages Selected for survey</b>
1.	Ambala	1306	39
2.	Bhiwani	428	23
3.	Faridabad	505	11
4.	Gurgaon	721	14
5.	Hisar	510	33
6.	Jind	354	16
7.	Kurukshetra	743	20
8.	Karnal	634	18
9.	Mohindergarh	743	16
10.	Rohtak	458	19
11.	Sirsa	323	21
12.	Sonipat	348	11
	<b>Total</b>	<b>7073</b>	<b>241</b>



Appendix - III

List of species found in Sample villages in Karnal District.

S.No.	Botanical name	Common name
1.	2.	3.
1.	<i>Acacia nilotica</i>	Babul, Kikar, Bawar, Bawal
2.	<i>Acacia</i> spp.	
3.	<i>Aegle marmelos</i>	Bel, Belpara, Bil, Billii
4.	<i>Albizia lebbek</i>	Kala siris, Kalbage, Koko, Siris, Bhandar, Sarsaoda
5.	<i>Albizia procera</i>	Safed siris/siras, Karha, Karhar, Karhai
6.	<i>Albizia</i> spp.	Hiharu, Morai, Móg, Sundi, Kunis
7.	<i>Artocarpus heterophyllus-</i>	Plavu/Thannas, Phannas Kathal
8.	<i>Azadirachta indica</i>	Neem, Nimbo, Nibbaro, Vepa
9.	<i>Bauhinia</i> spp.	Kachnar, Papri, Jhingora
10.	<i>Bombax ceiba</i>	Semal, Savar, Semer, Shimola
11.	<i>Butea monosperma</i>	Palas, Dhak, Palasin, Kakhar
12.	<i>Casearia elliptica</i>	Chillamera, Dholá, Gilchi, Umbh
13.	<i>Cassia fistula</i>	Amaltas, Bahra, Bhawa, Sonari
14.	<i>Citrus</i> spp.	Nimbu, Lemon
15.	<i>Cordia</i> spp.	Lassora, Bairula, Borala
16.	<i>Cratogeomys unilocularis</i>	Barna, Barun, Gundi
17.	<i>Dalbergia sissoo</i>	Sissoo, Shisham, Tahli
18.	<i>Delonix regia</i>	Gulmohar, Golmohan, Krishnachura
19.	<i>Embllica officinalis</i>	Amla, Aonla, Amlaki, Nellimara
20.	<i>Erythrina suberosa</i>	Dhaul, Gararu, Mandar, Pangra
21.	<i>Eucalyptus</i> spp.	Nilgiri, Safeda
22.	<i>Ficus bengalensis</i>	Bargat, Bad, Fig *
23.	<i>Ficus recemosa</i>	Gular, Aithi, Atti, Rumdi,
24.	<i>Ficus religiosa</i>	Pipal, Pipli, Papada, Pripari
25.	<i>Ficus</i> spp.	Anjar, Akhar, Budita
26.	<i>Flacourtia indica</i>	Kakai, Kangu
27.	<i>Gardinia resinifera</i>	Damkuruda, Karinga, Papada
28.	<i>Grevillea robusta</i>	Silver oak
29.	<i>Hevea brasiliensis</i>	Rubber tree

S.No.	Botanical name	Common name
1.	2.	3.
30.	<i>Holoptelia integrifolia</i>	Abal, Chielbil, Kaneji
31.	<i>Jonesia asoca</i>	Ashoka
32.	<i>Madhuca latifolia</i>	Mohwa, Mohudo, Iappa
33.	<i>Mangifera indica</i>	Am, Amb, Ambo, Mavu, Moru
34.	<i>Melia azedarach</i>	Bijain, Baknia, Bctain, Bakain
35.	<i>Mitragyna parvifolia</i>	Phalldu, Mundi, Kaiz, Battaganum
36.	<i>Moringa</i> spp.	Sajna, Sohjna, Sanjna, Saijna
37.	<i>Morus</i> spp.	Tut, Kimu, Shahtoot
38.	<i>Phoenix sylvestris</i>	Khjur, Betha
39.	<i>Polyalthea</i> spp.	Chami kohori
40.	<i>Populus</i> spp.	Banpipal, Godhpipal, Pahari Pipal
41.	<i>Prosopis cineraria</i>	Jand, Jant
42.	<i>Prosopis juliflora</i>	Juliflora
43.	<i>Prunus</i> spp.	Aru, Aria, Gont, Khurmani
44.	<i>Psidium guyava</i>	Amrud
45.	<i>Salvadora</i> spp.	Jal, Jhal
46.	<i>Spondias pinnata</i>	Ambra, Amra, Amar, Amria
47.	<i>Stereospermum suaveolens</i>	Padal, Pader, Khadsing
48.	<i>Syzygium cuminii</i>	Jamun, Jamoon, Jamak
49.	<i>Syzygium</i> spp.	
50.	<i>Tamarindus indica</i>	Imli, Amlı, Ambli, Chinch
51.	<i>Tamarix articulata</i>	France, Farash
52.	<i>Tectona grandis</i>	Sagwan, Sagun, Teak, Thcku
53.	<i>Terminalia arjuna</i>	Arujun, Kahuwa, Sadadoe
54.	<i>Terminalia chebula</i>	Harar, Har, Harra, Karaka
55.	<i>Toona ciliata</i>	Tun, Toon, Mathagiri, Vedi
56.	<i>Zizyphus mauritiana</i>	Ber, Beri
57.	<i>Zizyphus</i> spp.	Ber, Beri.

**Appendix - IV**

**List of the villages Surveyed in Karnal District.**

<b>S.No.</b>	<b>Name of the village .</b>	<b>Name of Tehsil</b>	<b>Area (Ha)</b>	<b>Map</b>	<b>Sheet No.</b>
1.	Dachaur	Assandh	2728	53	C/10
2.	Bhandari	Panipat	677	53	C/15
3.	Shohdapur	Panipat	316	53	C/15
4.	Kutail	Karnal	1763	53	G/2
5.	Rindal	Karnal	402	53	G/1
6.	Hartari	Panipat	517	53	C/15
7.	Kalsaura	Karnal	1370	53	G/1
8.	Bir Naraina	Karnal	275	53	C/13
9.	Garhi Bhalaur	Panipat	345	53	C/3
10.	Dhami Heri	Karnal	147	53	G/1
11.	Makhala	Karnal	206	53	G/1
12.	Nayan	Panipat	882	53	C/15
13.	Nargina	Karnal	960	53	C/13
14.	Naryana	Panipat	1134	53	C/15
15.	Anchala	Karnal	364	53	C/14
16.	Garhi Chhaju	Panipat	499	53	G/3
17.	Simla Molana	Panipat	215	53	C/15
18.	Gangar	Karnal	224	53	C/13

## Appendix – V

### Definitions of Categories

Code No.	Category	Definition
1.	Farm forestry	Trees along the farm bunds and in small patches upto 0.1 ha. in area.
2.	Roadside plantation.	Trees planted along the roadside.
3.	Village woodlot	Naturally growing trees on private/community land.
4.	Block Plantation.	Block plantation having an area of more than 0.1 ha. and not falling in any of the above categories.
5.	Ponds.	Trees planted in and around water ponds.
6.	Railway lines	Trees planted along the railway lines.
7.	Canals	Trees planted along the canals.
8.	Rest	Trees not falling in any of the above categories.

**APPENDIX-VI**  
**FIELD FORMS**

# DISTRICT TREE FORM

(ABSTRACT OF ENUMERATION IN SAMPLE VILLAGES)

JOB NO.	CARD DESIGN NO.	STATE	DISTRICT	NO OF VILLAGES IN THE DISTRICT	NO OF SAMPLE VILLAGES IN THE DISTRICT	TOTAL AREA OF THE VILLAGES IN THE DISTRICT. (Km <sup>2</sup> )	SAMPLE VILLAGE	GEOGRAPHICAL AREA OF THE SAMPLE VILLAGE (Hact)	CATEGORY OF THE SAMPLE VILLAGE
1-3	4-6	7-8	9-10	11-15	16-17	18-22	23-27	28-31	32

## Number of Trees in The Sample Village According to Category of the Plantation/ Trees

FARM FORESTRY	ROAD SIDE PLANTATION	VILLAGE WOODLOT	BLOCK PLANTATION	PONDS	RAILWAY LINES	CANALS	REST	TOTAL
33-36	37-40	41-44	45-48	49-52	53-56	57-60	61-64	65-70

DATE .....

Page No. ....

Sign of Crew Leader .....

Total No. of Pages .....

Name of Crew Leader .....

## VILLAGE DESCRIPTION FORM

1. State and code
2. Division and code
3. District and code.
4. Mapsheet and code
5. Name of the Village
6. Area of the Village
7. Crew Leader (Name)
8. Date of commencement of survey
9. Date of completion of survey
10. Conspicuous feature selected as the centre for starting the survey.
11. Description of this centre and approach to this point.
12. Number of angular quadrants into which the area of village has been divided (give size of quadrants in degrees).
13. Compassing done by
14. Tree enumeration done by

- 15. Height measurements taken by
- 16. B.T. and other measurements taken by
- 17. Quadrant-wise summary of enumeration

QUADRANT NO.

DATE OF SURVEY

TOTAL NO. OF TREES

Dated:

Signature of  
Crew Leader

Diagram etc. of village



