

## **DST Project: “Assessment of floral biodiversity” in Dabka and Khulgarh Watersheds located in Kumaon region**

The department of Science and Technology, Govt of India has assigned a project to FSI on “Assessment of floral biodiversity” in Dabka and Khulgarh Watersheds located in Kumaon region. The main objective of the project are

- Estimation of present forest cover and change in forest cover at an interval of 5 years since 1988
- Estimation of number of stems and growing stock of trees in forest and trees outside forest areas
- Estimation of productivity of NTFP and Generation of floral diversity index of tree species
- Development of spatial/temporal database of tree resources for the study area.

To achieve the above objectives, different methodologies were used.

For Estimation of Present Forest Cover and Change in Forest Cover in different years, the study area lying on toposheet no. 53O/7 and 53O/10 were geo-referenced in polyconic projection. Imageries (Land sat 1988,1994,LISS and PAN 1998,2002) were geo-referenced on the basis of geo-referenced toposheets from the boundary of watershed. Analyses of multidated satellite images were used to prepare the classified thematic maps by various digital image-processing techniques. To maintain consistency, the visual interpretation was carried out at 1:50,000 scales.

To estimate present forest cover, the merge data (LISS III and PAN) of year 2002 was classified into five classes viz. Very dense forest (>70%), Moderately dense forest (40-70%), Open forest (10-40%), Cropland, and Non-forest area (includes scrub, barren land, water bodies and settlements) followed by calculations of area of each class.

To estimate forest cover change, the satellite data of 1988, 1994, 1998 and 2002 was classified into five classes viz. Very dense forest (>70%), Moderately dense forest (40-70%), Open forest (10-40%), Cropland, and Non-forest area (includes scrub, barren land, water bodies and settlements). Calculations of area of each class for four–five different years were carried out. On the basis of area, analyses in the form of change matrix were done for four–five years interval (1988-1994,1994-1998,1998-2002).

For Estimation of Stems and Growing Stock in Forest and Tree Outside Forest (TOF) of Dabka watershed, one sq.km grid was marked on Toposheet of SOI of both the watersheds. A plot of 0.1 ha.in forest area at the center of grid and for the Trees outside forest (TOF) plot of 0.1 ha for block plantation and 0.5 ha for scattered stratum were laid out. The enumeration of all trees having

diameter 10cm. and above were enumerated, species and diameter class wise, with enumeration starting from North direction and proceeding in clockwise direction. After completion of fieldwork, the field forms were checked for inconsistencies and coding mistakes. The data were entered in PC and the species wise distribution of trees in each diameter class were generated. For calculation of growing stock, local volume equations have been used and estimation of growing stock were carried out, in both Forest and Tree resources outside forest for both watersheds.

For the Productivity Estimation of NTFP's in both the watersheds all the trees, shrubs and herbs were listed with their dominance and economic value. From this three tree species, four shrub species and four herb species of economic importance were selected from Dabka watershed. Similarly in Khulgad watershed four tree species two shrub species and four herb species of economic importance were selected. For collection of plants / plant parts methodology was developed to collect the data so that estimation of productivity could be carried out. Eight to twelve specimens of each species have been collected from respective watersheds. Fresh weights of each specimen were noted down in the field while dry weights were recorded after proper drying of specimens. For Biodiversity Index (Herbs, Shrubs and Trees) phytosociological analysis of all plant species was done by quadrat method (Misra 1964). In each quadrat the tree layer was sampled by taking height of the tree with the Haga altimeter at 1.37mt (at breast height). Crown covers of trees were measured by taking the length and width of the crown. For Herbs and Shrubs, total numbers of individuals were counted and collar diameter of each individual was recorded. The data on vegetation were quantitatively analyzed for Frequency, Density and Abundance (Curtis and McIntosh, 1950). Two diversity indices – Shannon-Wiener index ( $H'$ ) & Simpson's diversity index ( $Cd$ ) were applied to find out the species richness, diversity and homogeneity of species in the two watersheds.

For preparation of spatial database, the data collected for trees, herbs & shrubs with diameter/collar diameter and their respective species name having Latitude and Longitude of their location will be shown in the spatial map along with attribute data.



Sample Plots on SOI Toposheet



Recording of DBH during Inventory



Open Forest in Dabka

## Technical Analysis of Results

## PRESENT FOREST COVER

The present forest cover of both the watershed shows that in Dabka watershed 53 % area is Forested, 16% is Non Forested and remaining 31 % is under Cropland (agricultural). However, in Khulgad watershed only 35 % area is forested, 25% is Non-Forested and 39% is under Cropland (agricultural).

**Table 28 : Present Forest Cover of both watersheds**

CLASSES	Dabka Watershed		Khulgad Watershed	
	Area (In ha.)	% Of Geog Area	Area (In ha.)	% Of Geog Area
Forest cover				
Very dense forest	622	9.01	207	6.26
Mod. dense forest	880	12.74	392	11.85
Open forest	2200	31.86	552	16.69
Total forest	3702	53.61	1151	34.79
Non-Forest	1106	16.02	858	25.94
Cropland	2098	30.38	1299	39.27
Total Geog Area	6906		3308	

\*Non-Forested area includes Scrub, Barren land, Grassland, and Settlement.

## FOREST COVER CHANGE

The forest cover change map generated at an interval of 5 years for both watersheds was used to prepare change matrices depicting the net change in forest cover. The technical analysis of these matrices is presented below with their respective change matrices.

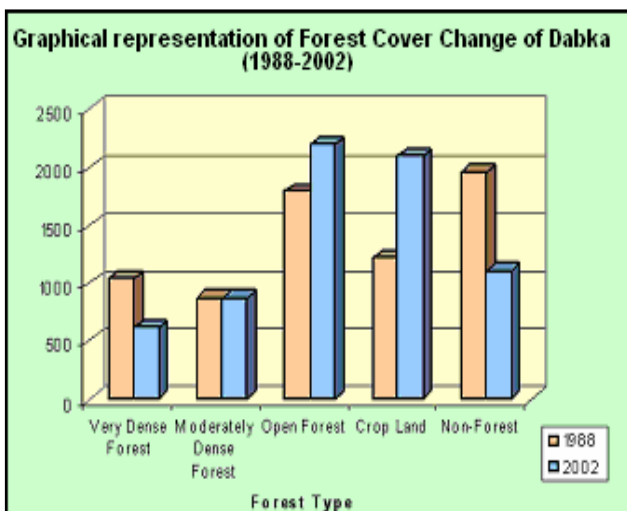


Fig 38 : Forest cover change in Dabka (1988-2002) Khulgad(1988-2002)

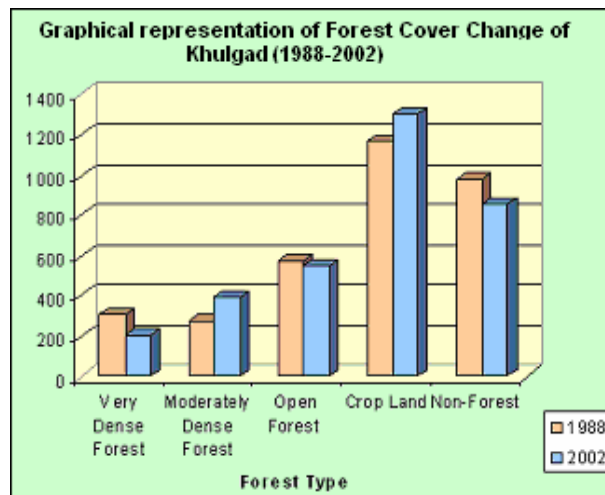


Fig 39 : Forest cover change in

## Estimation of Stem and Growing Stock in Forest and TOF

### DABKA

	Dabka	
	TOF	Forest
Estimated Stems	422180	930384
Stems/Ha	144	251
Growing Stock (Volume in cum)	180831	472131
Volume/Ha (in cum)	62	127

In forest area of Dabka watershed, the no. of stems in different dia classes shows that the species *Quercus incana* (3.37 lakh stems) is the most dominant species followed by *Rhododendron arboreum* and *Quercus semicarpifolia* with 1.84 lakh stems each. It also reveals that 65.10% of stems are lying in diameter class 10-30. The species *Quercus incana* is also most dominant species in **TOF Area** having 0.73 lakh stems followed by *Pinus roxburghii* and *Shorea robusta* having 0.34 lakh and 0.24 lakh stems. As far as volume in different diameter classes of Dabka Watreshed in **Forest Area** is concerned, *Rhododendron arboreum* is having the maximum volume 89.063 thousand cum followed by *Quercus incana* (88.360 thousand cum) and *Lyonia ovalifolia* (56.713 thousand cum). In TOF area *Quercus incana* is having the maximum volume 22.2 thousand cum followed by *Engelhardtia colebrookiana* (21 thousand cum). The most dominant species is *Quercus incana* in Forest as well as TOF area. The total Growing Stock of Forest Area and TOF Area are 472.131 thousand cum and 180.831 thousand cum respectively

### KHULGAD

The tree species *Pinus roxburghii* is the dominating species in Forest and Tree Outside Forest (TOF) with 3.32 lakh stems (84 %) in Forest area and 2.91 lakh stems (64 %) in TOF Area of Khulgad watershed. The other species found in forest area are *Quercus incana* and *Lyonia ovalifolia* having 0.21 and 0.17 lakh

stems respectively while in TOF area the other major species are *Pinus wallichiana* and *Pyrus pashia* having 0.47 and 0.44 lakh stems respectively.

As far as volume in different diameter classes of Khulgad Watreshed in **Forest**

	Khulgad	
	TOF	Forest
<b>Estimated Stems</b>	458700	394847
<b>Stems/Ha</b>	223	343
<b>Growing Stock (Volume in cum)</b>	121378	103949
<b>Volume/Ha (in cum)</b>	59	90

**Area** is concerned, *Pinus roxburghii* is having the maximum volume 94.901 thousand cum followed by *Quercus incana* (4.724 thousand cum). In TOF area *Pinus roxburghii* is having the maximum volume 82.782 thousand cum followed by *Pinus wallichiana* (11.3 thousand cum). The most dominant species is *Pinus roxburghii* in both Forest and TOF area. The total

Growing Stock of Forest Area and TOF Area are 103.949 thousand cum and 121.378 thousand cum respectively.

## BIODIVERSITY INDEX

From the first and second round survey of herbs, shrubs and trees a Phytosociology study was carried out. In this study diversity index, Occurrence, Frequency, density, abundance, Basal area and Importance value Index (IVI) have been calculated. A total of 90 species of herbs, 27 species of shrubs and 30 species of trees were reported from the quadrat study in Dabka watershed. In herbaceous layer IVI indicates that *Hedychium spicatum* is the most dominant herb species with IVI 21.26, while *Eupatorium adinophorum* is the co-dominant herb species with IVI 17.90. The study of shrub species shows that *Berberis aristata* having IVI 59.78 with 198 individuals is the most dominant species while *Rubus ellipticus* with 138 individual is the co-dominant shrub species with having IVI 42.69. Out of 30 tree species in quadrat study, *Quercus incana* with IVI 105.48 has maximum numbers of individuals i.e. 311 and *Rhododendron arboreum* with IVI 55.94 is the second dominant tree species with 188 individuals. *Quercus semicarpifolia* and *Pinus roxburghii* are the other co-dominant tree species in Dabka watershed. Similar work for Khulgad watershed has also been carried out.