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GOVERNMENT OF INDIA

Preinvestment Survey of Forest Resources

25, Subhash Road

DEHRA DUN

Resources Survey of North Eastern and Eastern Part of Kalimpong Forest Division of West Bengal

1976

Contents

RJEZ-7

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RESOURCES SURVEY OF NORTH EASTERN AND EASTERN PARTS OF KALIMPONG FOREST DIVISION OF WEST BENGAL.

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P R E F A C E.

With the creation of the West Bengal Forest Corporation, certain forest divisions have been handed over by the West Bengal Forest Directorate to the Corporation. Kalimpong Forest Division which has a large area of reserve forests in its North-Eastern and Eastern region has been taken over by the West Bengal Forest Corporation recently. The Corporation is very keen to exploit these rich resources of untapped forests and wanted that a re-survey of the forest resources on a proper statistical design be carried out in which allowable error is fixed before hand so that they can go ahead with the preparation of some industrial plans. This region was already surveyed by the West Bengal Forest Directorate in the year 1966-67 and the report of the same was published in its Bulletin No. 15. The earlier survey was, however, not conducted on statistical design.

2. The main stress by the Corporation in this region was to find out the plywood reaources and I am glad to say that as a result of this survey it has been established that there are enough resources to sustain a large sized commercial plywood mill on the basis of the availability of resources in the region. This is, however, subject to the development of infra-structure because at the moment the means of communication etc; are rather poor.

3. In the preparation of this work Dr. A.K. Banerjee, Zonal Coordinator, Preinvestment Survey of Forest Resources, Eastern Zone and his staff ~~has~~ have put in hard work and have kept to schedule of time.

ROMESH CHANDRA
Chief Coordinator

DEHRA DUN
Dated: 2.2.1976.

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CHAPTER I

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CHAPTER - I.

1.1. Introduction.

Kalimpong forest division of West Bengal has a large compact area of reserved forest in its north-eastern and eastern parts, which were not exploited due to lack of infrastructure. The area lies between 27°-3' to 27°-8' N. latitudes and 88°-40' to 88°-52' E. longitudes. The area is bounded on the north by Sikkim and Bhutan, on the east by Jaldakha river, on the south by Eastnar and other forest blocks and in the west by an artificial boundary as shown in Figure-1.

The West Bengal Forest Directorate completed the resources survey of this region in the year 1966-67 and compiled a report which was published by the West Bengal Forest Directorate as Bulletin No. 15.

The forest division was recently taken over by West Bengal Forest Corporation and plans are afoot to exploit the hitherto untapped areas. Hence the West Bengal Forest Directorate wanted a re-survey of this region based on a statistical design so that the allowable error of the survey is fixed beforehand. The present work was as such, undertaken on a priority basis in April 1975 and completed by the end of May, 1975.

The forest of this area generally belong to the middle hill forests (Champion & Seth's East Himalayan sub-tropical wet hill Forests-8B/CI), the upper hill forests (Champion and Seth's Northern Montane Oak forests-11B/CI) and also to the East Himalayan Sub-alpine forests 14/C2. The species are many but Castanopsis species, Schima sp., Phoebe species in the middle hill forests, and Oaks, laurels, birches in the upper hill forests, are common. Among the conifers, Tsuga dumosa & Taxus baccata are found in small quantities. Rhododendron along with small sized bamboos occupy the highest elevational reaches.

1.2. Objectives:

The objectives of the survey are enumerated below:-

1) Determination of standing total timber volume, plywood volume and small wood volume at an allowable error of + 10% at 95% probability level. The species considered suitable by the West Bengal Forest Corporation for plywood manufacture (local names in bracket) are:-

Sl. No.	Name of species (Local Names)
1.	Acer campbellii (Kapasi)
2.	Alnus nepalensis (Utis)
3.	Beilschmiedia species (Tarsing)
4.	Exbucklandia populnea (Pipli)
5.	Castanopsis tribuloides & C. hystrix (Katus)

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Sl.No.	Name of species (Local Names)
6.	Cinnamonum species (Sissi)
7.	Blapocarpus lanceaefolius (Bhadrasi)
8.	Machilus edulis (Lapche kawla)
9.	Machilus garnicana (Chiple kawla)
10.	Machilus odoratissima (Lati kawla)
11.	Micholia cathcartii (Tite champ)
12.	Michelia doltsopa (Mithe champ)
13.	Nyssa javanica (Lekh chilauni)
14.	Prunus nepalensis (Arupate)
15.	Quercus lamellosa (Buk)
16.	Quercus lineata (Phalant)
17.	Phoebe species (Angare)
18.	Toona species (Toon)
19.	Betula species (Bujpati)
20.	Micholia lanuginosa (Phunsre)
21.	Engelhardtia spicata (Mawa)
22.	Sloanea dasycarpa (Gobre)
23.	Lithocarpus pachyphylla (Sungre)
24.	Taxus baccata
25.	Magnolia campbellii (Ghoge champ)
26.	Tsuga dumosa (Tengra salla)
27.	Terminalia myriocarpa (Pani saj)
28.	Lithocarpus elegans (R. Kawla)
29.	Acrocarpus fraxinifolius (Mandane)
30.	Ailanthus integrifoliaVar calycina (Gokul)
31.	Schima wallichii (Chilauni)
32.	Betula species (Saur)

The remaining species are considered as 'others' and will be referred as such. Bamboos have not been enumerated.

The specifications for different categories of wood are:-

(a) Plywood: wood having a minimum length of 2.5 m. and having dimensions upto 30 cm. d.u.b. at the thin end of species listed above.

(b) Total timber: Timber in all categories of species including plywood species and having a minimum diameter of 20 cm. d.o.b. in the thin end and minimum length of 2.5 m.

(c) Residual timber: Total timber- plywood.

(d) Small wood: Wood having 20 cm. d.o.b. at thick end to 5 cm. at thin end.

(e) Total wood: Total timber + small wood.

2) Cull Study.

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1.3. Area Statement:

The forests in the area are all reserved and are under the complete control of the Forest Department of the Govt. of West Bengal. The ranges in the project area are divided into a number of forest blocks. The net forest areas in the blocks are given below. It may be noted that the net areas have been arrived at by substracting areas which are not under high forests from the gross areas indicated in the latest Working Plan. The net areas exclude plantations, roads, rest houses, and forest villages.

Table - 1

Area Statement.

Sl.No.	Block	Gross area	Non-high forests Hectares	Net area hectares.
1.	Renock	952.22	-	952.22
2.	Rashet	720.33	9.69	710.64
3.	Pankasari	1359.79	108.17	1251.62
4.	Rechila	2534.81	-	2534.81
5.	Thesum	979.75	-	979.75
6.	Ruka	1789.47	-	1789.47
7.	Chichu	491.90	-	491.90
8.	Paren	1466.15	67.04	1399.11
9.	Mo.	2033.19	84.50	1948.69
		12327.61	269.40	12058.21

1.4. Climate:

The climate is mild temperate changing to sub-tropical towards the southern part of the project area. The rainfall is approximately 3500 mm.- 4000 mm. per year. The maximum rain falls between the months of May and September. The humidity continues to remain high throughout the year. The mean minimum temperature varies between 6°- 15° C. It goes below 0° C. between November and February in Rechila Block when some snowfall is also experienced.

1.5. Topography and drainage:

The project area is mountaneous throughout. The elevation ranges from 457 m. -3159 m. The region is the catchment of Neora river, Murti river and Jaldhaka river. Actually the first two originate in the Rechila- Thesum and Mo blocks respectively.

Being a part of the outer Himalayas, the slope of the forested areas vary considerably. Out of 93 plots chosen at random as per design

12058.21
269.40
12327.61

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indicated later, the distribution of slopes was found to be as follows:-

Table - 2.
Percentage distribution of slopes.

Slope	Percentage distribution.
$< 5^{\circ}$	0
$1-5^{\circ}$	2.15
$6-10^{\circ}$	2.15
$11-20^{\circ}$	15.07
$21-30^{\circ}$	37.63
$31-40^{\circ}$	26.88
$41-45^{\circ}$	16.12

The above table will show that the largest concentration of slopes is between 21° to 40°.

1.6. Rocks:

The best part of the project area has Darjeeling gneiss and Daling series as the base rock-formations, which consist of various types of granite in different degrees of metamorphism and occassionally green slates, quartzites and hornblende schists. These rocks are often weathered.

1.7. Soils:

The soils are either clayey or sandy loam. They are generally brown forest or grey-brown Podzolic soils. The mixture of stones are quite common. The following table shows the percentage of soil profiles (93 examined) of various steniness in the top surface.

Table- 3.
Percentage distribution of different categories of steniness in soils.

Percentage by volume of stones		Percentage of soils examined.
< 5	..	0
1-5	..	21.52
6-25	..	58.06
26-50	..	19.35
51-75	..	0
76-100	..	1.07

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The depth of humus in the soil profiles (93 examined) is variable and the distribution of various depths as percentages have been indicated in Table -4.

Table-4.

Distribution of soil humus depths.

Depth of humus		Percentage of No. of profiles examined.
0-4 cm.	..	49.46
5-8 cm.	..	38.72
9-12 cm.	..	5.37
13-16 cm.	..	6.45
16 + cm.	..	0

The depth of soil also varies. Among the sites examined (93 in number), the soil depth measured (i.e. at which regular rock formations appear) has been classified in table -5.

Table- 5.

Depth of Soil

Depth of soil		Percentage of examined profiles.
None	..	1.07
Insignificant - 1m	..	49.48
1 m.- 2 m.	..	37.63
2 m. +	..	11.82

It will be seen from the above table that a very large section of the area has shallow soil depth of which is below one meter.

1.8. Roads:

There is hardly any motorable road in the area. There are number of foot tracks along northern part of the project area. In the recent past the West Bengal Forest Directorate have started constructing some roads from Labha connecting Pankasari block and which is likely to be extended to Rechila block. There are number of other proposals of road construction in the area as follows:-

(a) Mo.- Rechila chak road via Thosum: 50 km.

(b) Paren- Tangta road via Chichu and Ruka: 30 km.

(c) Pashiting - Rashet link road: 10 km.

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However, if any large exploitations are taken up in the upper hills before the roads are constructed, the wood has to be sent out through Labha, a small hamlet on the west of the project area.

1.9. Maps:

The following Survey of India sheets of 1903-1904 were used for the present work.

Index No.		Scale.
292 SE/3	..	4" = 1 mile.
292 SE/284 & 293 NE/2	(combined)	4" = 1 mile.
292 SW/2	..	4" = 1 mile.
292 SE/1	..	4" = 1 mile.
292 NE/3	..	4" = 1 mile.
292 NW/4	..	4" = 1 mile.

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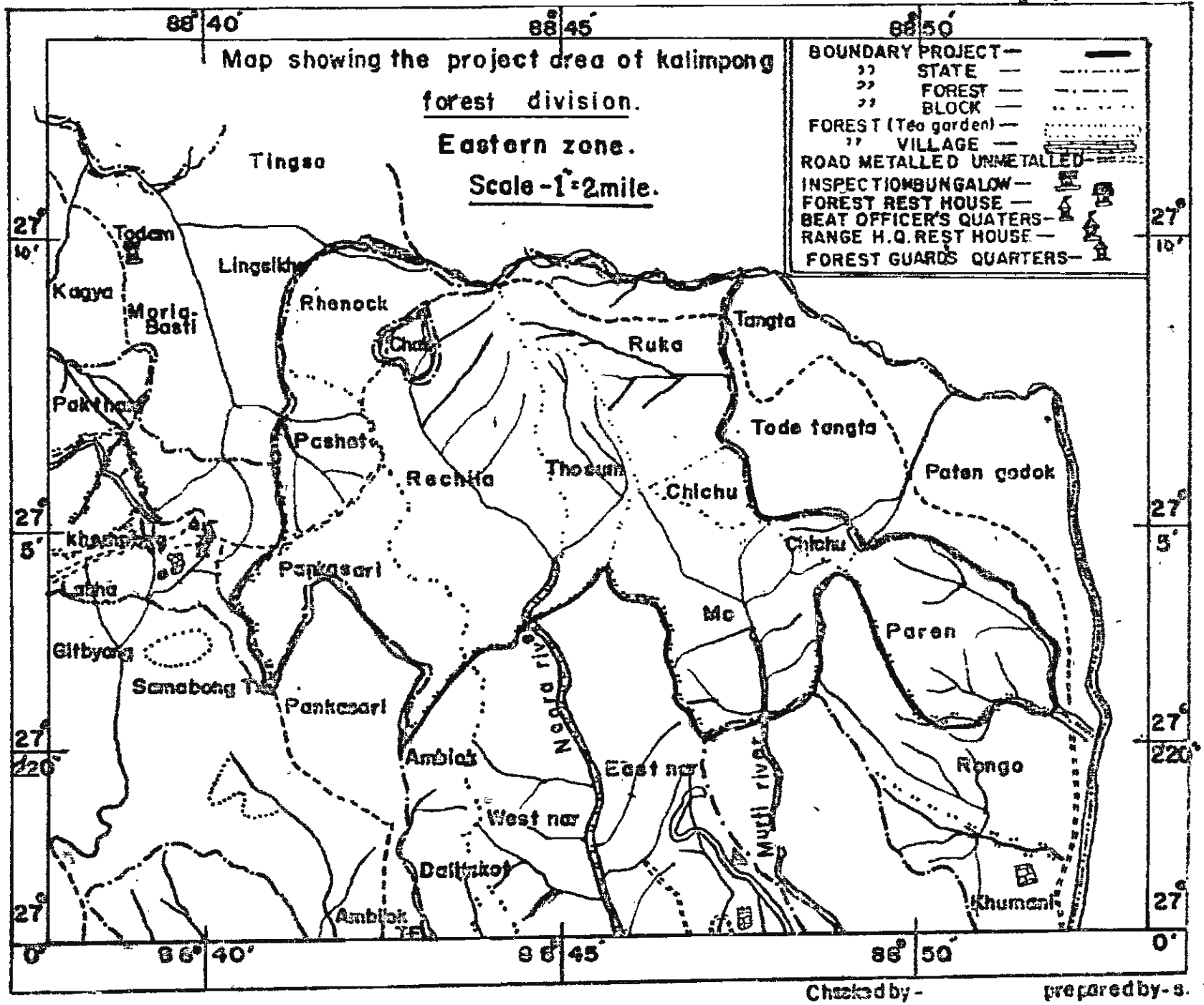
Fig-1



Checked by - prepared by - S. N.

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Fig-2

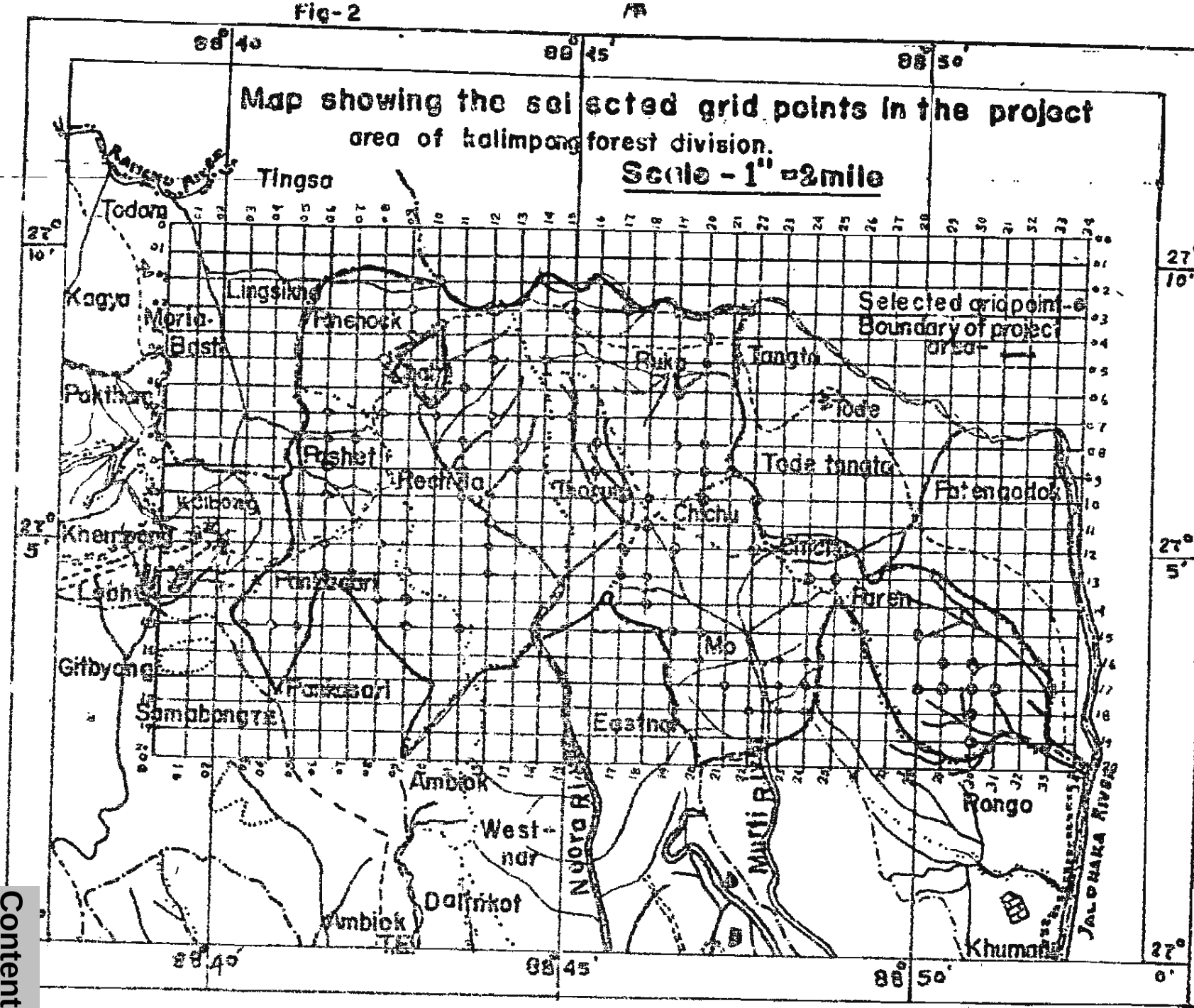
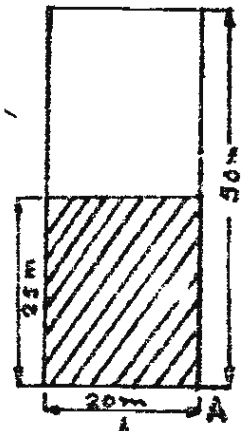


Fig- 2A

Orientation of plot in the grid centre 'A'

Not to scale



This part is used for sample tree form (No-2)

Checked by-

Prepared by-a. roy.

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CHAPTER -II.

2.1. Design:

The data that was collected by the West Bengal Forest Directorate during their resources survey formed the basis of the sampling design in the present case. Considering the population infinite and block as stratum, the basal area per plot in each block was calculated. The size of the sample for 10% allowable error worked out to 93 points. They were allocated to different blocks by the method of optimum allocation. The plot sites were selected from random number tables by assigning numbers to grid crossings drawn over the map at 15 secs. intervals. The list is in table 6.

Table -6.

Allocation of plots to different blocks.

Block	No. of plots allocated.	No. of plots actually enumerated.
Benock	6	4
Rashot	5	5
Pankasari	10	13
Rechila	18	18
Ruka	13	14
Thosum	8	6
Chichu	5	5
Mo.	14	17
Baren	10	11
	89	93

Figure 2 shows the distribution of the plots actually enumerated.

The size of each plot was 0.1 hectare as per orientation shown in Figure 2 (A).

The total area thus surveyed is 9.3 hectares distributed over 93 plots which works out to 0.077 of the net area of the forests.

2.2. Laying out of the plots and collection of data:

The field parties reached the selected plots with the help of maps, compartment and block boundaries. On reaching the point they laid out the plot as per design indicated in Figure 2 (A) and made necessary observations and took measurements to fill-up the forms 1,2 and 3 which are appended. The explanation of these forms are incorporated in the manual appearing as appendices 1,2, & 3.

10% test check was conducted by the supervisory officers. The field data were then checked for consistency in the office before the data were sent for card punching and computer processing.

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CHAPTER - 3

3.1. Inventory:

3.1.1. Diameter class distribution per hectare:

The diameter class distribution per hectare of stems utilitywise in each individual block is tabulated in tables 7(a-j). The percentage error of stemsper hectare (for the entire area) is 4.9.

3.1.2. Estimated stems (Gross)

The diameter class-wise estimated number of stems in each block as worked out by multiplying per hectare data with net area, is given in tables 8(a-j).

It is obvious from the table that the average number of stems per hectare over the entire area is 275, out of which approximately 200 per hectare is within the diameter range 10 cm.-39 cm. Further the distribution of plywood and others is approximately equal.

3.2. Culls:

The culls have been considered in two categories. The first category to be referred to as ' standing culls' are those standing trees which are obviously hollow, rotten or fungus affected or insect attacked and cannot be used for purposes other than firewood. The number of estimated stems per hectare figures given in tables '9' and '8' include those cull trees and are therefore, gross figures.

The percentage of culls in each diameter class for the two utility classes have been calculated from observations made in form- 4 and has been presented in table 9.

It will be noticed from the table that the total ' standing cull' percentage over the entire area is 5.85%. It is, however, much more in the case of plywood, and shows upward trend with increase of diameter class in both utility categories.

The second category of cull to be referred to as 'hidden cull' include those which are not obvious, and are found as infected parts or hollows or insect attacks, cracks etc; when a tree is felled. This part of the cull will be considered when the volume equations are discussed.

3.3. Gross volume:

The composition of forest in this project area is more or less similar to that of Singalila and Tonglu project area of Darjeeling division dealt with in another report recently. The following volume equations that were made out after felling a large number of trees in that area are applicable here as well. While the methodology has been discussed in that report (P.I.F.R., Eastern Zone Report No. 1), for convenience, the actual equations are reproduced here. It may be mentioned here that the 'hidden culls' were considered and substracted from the basic felling data before the volume equations were fitted in.

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Table - 7(a-j)

Diameter class distribution of stems / hectares(Cross)

Table- 7(a)

Block- Renock

Utility class	Diameter class (cm.) 10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100	Total
Plywood	45	15	18	10	8	10	3	5	-	3	117
Others	63	13	15	10	5	-	3	-	-	-	109
TOTAL:	108	28	33	20	13	10	6	5	-	3	226

Table- 7(b)

BLOCK- Rashet.

	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100	Total
Plywood	12	18	40	22	10	4	-	-	-	-	106
Others	86	14	6	-	-	-	-	-	-	-	106
TOTAL:	98	32	46	22	10	4	-	-	-	-	212

Table - 7(c)

BLOCK- Pankasari.

	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100	Total
Plywood	35	22	24	28	26	8	6	5	2	2	158
Others	102	53	27	5	5	-	-	-	-	-	192
TOTAL:	137	75	51	33	31	8	6	5	2	2	350

Table- 7(d)

BLOCK- Rechila

	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100	Total
Plywood.	29	28	27	23	16	12	5	3	3	3	149
Others	74	32	12	5	3	-	1	-	-	-	127
TOTAL:	103	60	39	28	19	12	6	3	3	3	276

Table- 7 (e)

BLOCK- Thosum.

	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100	Total
Plywood	28	28	20	10	17	17	17	5	-	10	152
Others	33	25	10	5	2	-	2	2	-	-	79
TOTAL:	61	53	30	15	19	17	19	7	-	10	231

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Table - 7 (f)

BLOCK- Buka

Utility class	Diameter class (cm.) 10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100	TOTAL
Plywood	23	12	16	9	15	6	3	8	1	6	99
Others	63	45	38	11	8	4	6	3			178
TOTAL:	86	57	54	20	23	10	9	11	1	6	277

Table - 7 (g)

BLOCK- Chichu. /

Plywood	4	16	14	16	8	10	2	-	4	-	74
Others	50	20	34	12	2	2	8				128
TOTAL:	54	36	48	28	10	12	10		4		202

Table- 7 (h)

BLOCK- PAREN.

Plywood.	11	7	5	4	8	5	7	3	2	2	54
Others	82	50	19	4	8	5	1				169
TOTAL:	93	57	24	8	16	10	8	3	2	2	223

Table - 7(i)

BLOCK- Mo. /

Plywood	60	47	34	26	19	12	3	2		1	204
Others	66	44	14	8	8	3	1	0			144
TOTAL:	126	91	48	34	27	15	4	2		1	348

Table -79(j)

BLOCK- For the entire area (i.e. total)

Plywood	31	24	23	18	16	9	5	4	2	3	135
Others	65	38	20	7	5	2	2	1			140
TOTAL:	96	62	43	25	21	11	7	5	2	3	275

REMARKS:- The standard error of stem per plot for the entire area comes out to be 1.41 and the percentage error is 4.9.

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Table - 8 (a-j)

Estimation of Stem (Gross) by utility and diameter class.

BLOCK- RENOCK

Utility class	Diameter class (cm.) 10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100	TOTAL.
Plywood.	42850	14283	16664	9522	7142	9522	2381	4761	-	2381	109506
Others	59514	11903	14283	9522	4761	-	2381	-	-	-	102364
TOTAL:	102364	26186	30947	19044	11903	9522	4762	4761	-	2381	211870

BLOCK- RASHET

Table - 8 (b)

Plywood	8530	12792	28420	15634	7106	2843	-	-	-	-	75325
Others	61115	9949	4263	-	-	-	-	-	-	-	75327
TOTAL:	69645	22741	32683	15634	7106	2843	-	-	-	-	150652

BLOCK- PANKASARI.

Table -8(c)

Plywood	44288	27921	29846	34660	32734	9628	7702	6739	2888	1925	198331
Others	128049	66432	33697	5777	6739	-	-	-	-	-	240694
TOTAL:	172337	94353	63543	40437	39473	9628	7702	6739	2888	1925	439025

BLOCK- RECHILA.

Table- 8 (d)

Plywood	74636	71819	67595	57737	39430	29573	12674	8449	8449	7041	377400
Others	187293	81677	29573	12674	7041	-	2816	-	-	-	321074
TOTAL:	261929	153496	97168	70411	46471	29573	15490	8449	8449	7041	698477

BLOCK- THOSUM.

Table -8(e)

Plywood	27759	27759	19595	9797	16329	16329	16329	4899	-	9797	148593
Others	32658	24493	9797	4899	1632	-	1632	1632	-	-	76743
TOTAL:	60417	52252	29392	14696	17961	16329	17961	6531	-	9797	225336

BLOCK- RUKA.

Table- 8(f)

Plywood	40902	21729	29398	16616	26841	10225	5112	14060	2556	11504	178943
Others.	113759	80525	67744	2045	14060	7669	10225	5113	-	1278	320824
TOTAL:	154661	102254	97142	37067	40901	17894	15337	19173	2556	12782	499767

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BLOCK- CHICHU

Table- 8(g)

Utility class	Diameter class (cm) 10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100	TOTAL
Plywood	1968	7870	6887	7870	3935	4919	984	Rs -	1968	-	36401
Others	24595	9838	16725	5903	984	984	3935	-	-	-	62964
TOTAL:	26563	17708	23612	13773	4919	5903	4919	-	1968	-	99365

BLOCK- MO

Table- 8 (h)

Plywood	116921	91702	66484	51583	36681	24072	6878	3439	1146	2293	401199
Others	128383	85971	26364	16048	16048	5731	2293	1146	1146	1146	284276
TOTAL:	245304	177673	92848	67631	52729	29803	9171	4585	2292	3439	685475

BLOCK- PAREN

Table- 8 (i)

Plywood	15262	10175	7631	6359	11447	7631	10175	5087	2543	2543	78853
Others	114471	69955	26710	6359	11447	7631	1271	-	-	-	237844
TOTAL:	129733	80130	34341	12718	22894	15262	11446	5087	2543	2543	316697

BLOCK- ENTIRE KALIMPONG DIVISION.

Table- 8(i)

Plywood	375116	286050	272526	209778	181645	114742	62235	47434	19550	37484	1604560
Others	849837	440743	229106	81633	62712	22015	24553	7941	1146	2424	1722110
	1222953	726793	501632	291411	244357	136757	86788	55375	20696	39908	3326670

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TABLE 9.

Percentage of ' Standing Cull by utility anddiameter Class'

Utility Class	Diameter Class (Cm.)										TOTAL.
	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100	
Plywood	.81	6.06	4.17	7.05	16.49	7.14	14.81	15.00	28.58	31.58	8.20
Others	1.24	2.81	4.45	10.00	7.69	50.00	-	-	[illegible]	10[illegible]	3.71
% All	1.11	3.97	4.30	7.82	14.52	15.38	11.42	12.00	25.00	38.09	5.85

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Table- 10

Local volume equation(a) Plywood.

Species	Equation.
Sp-1 (Acer campbellii)	$V = -.0962 - .0145\ D + .0008\ D^2$
Sp-2 (Alnus nepalensis)	$V = .2248 - .0353D + .0013\ D^2$
sp-6 (Cinnamomus species)	$V = .3353 - .0437\ D + .0012\ D^2$
Sp-9 (Machilus gammieana)	$V = -.3417 + .0055D + .0006\ D^2$
Sp10 (Machilus odoratissima)	$V = -1.3359 + .0565\ D$
Sp-12(Michelia doltsopa)	$V = -2.1537 + .0745\ D$
Sp615 (Quercus lamellosa)	$V = -3.7287 + .1431\ D - .0005\ D^2$
Sp-16(Quercus lineata)	$V = .3129 - .036\ D + .0009\ D^2$
Sp-17 (Phoebe species)	$V = -.5193 + .0252\ D$
Rest of species.	$V = -3.1373 + .0926\ D + .00008\ D^2$

Table- 10 - Local volume equation(b) Total timber.

Species	Equation
Sp- 1 (Acer campbellii)	$V = -.3077 + .00078\ D^2$
Sp -2 (Alnus nepalensis)	$V = .7287 - .042628\ D + .00137\ D^2$
Sp-6 (Cinnamomum species)	$V = -.3219 + .00073\ D^2$
Sp- 9 (Machilus gammieana)	$V = -.0672 + .00063\ D^2$
Sp-10 (Machilus odoratissima)	$V = -3.511 + .0915\ D + 35.411\ (1/D)$
Sp-12 (Michelia doltsòpa)	$V = -3.4152 + .0902\ D + 32.479\ (1/D)$
Sp-15 (Quercus lamellosa)	$V = -9.246 + .1650\ D + 134.00\ (1/D)$
Sp-16 (Quercus lineata)	$V = 1.4402 + .00082\ D^2 - .3431\ (1/D)$
Sp-17 (Phoebe species)	$V = -.7931 + .0362\ D$
Rest of Species.	$V = -4.0496 + .1003\ D + 39.727\ (1/D)$

Table- 10- Local volume equation (c) small wood

Small wood	$V = -.0037 + .0312\sqrt{D}$

Using the above equations and the enumeration figures already produced, the gross plywood, gross timber volume, gross smallwood volume and gross total wood volume were calculated through a suitable computer programme. They are reproduced in tables 11-14.

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Table - 11.

Gross Plywood Volume.

Sl.No.	Block	Net area in hectare.	Volume per hectare	Estimated gross volume.
1.	Renock	952.22	93.887	89401
2.	Rashet	710.64	70.858	50355
3.	Pankasari	1251.62	184.505	230930
4.	Rechila	2534.81	155.833	395007
5.	Thosum	979.75	255.061	249896
6.	Ruka	1789.47	175.083	313306
7.	Chichu	491.90	105.978	52131
8.	Paren	1399.11	130.226	182200
9.	Mo.	1948.69	149.205	290754
TOTAL:		12058.21	153.75	1853980

Standard error % = 7.5.

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Table - 12.

Gross Timber Volume

Sl. No.	Block	Net area in hectare	Volume per hectare	Estimated gross volume (rounded)
1.	Renock	952.22	175.642	167250
2.	Rashet	710.64	82.938	58939
3.	Pankasari.	1251.62	250.556	313601
4.	Rechila	2534.81	202.039	512130
5.	Thoshum	979.75	340.600	333703
6.	Ruka	1789.47	291.536	521695
7.	Chichu	491.90	183.299	90165
8.	Paren	1309.11	179.340	250916
9.	Mo	1948.69	240.087	467855
	Total:	12058.21	225.26	2716254

Standard error % = 5.92.

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Table - 13

Small Wood Volume

Sl. No.	Block	Net area in hectare	Volume per hectare	Estimated gross volume (Rounded)
1.	Renock	952.22	34.683	33026
2.	Rashet	710.64	31.773	22579
3.	Pankasari	1251.62	54.462	68166
4.	Rechila	2534.81	44.046	111648
5.	Thosam	979.75	44.703	43798
6.	Ruka	1789.47	47.991	85878
7.	Chichu	491.90	34.931	17182
8.	Paren	1399.11	36.942	51683
9.	Mo	1948.69	57.047	111167
	TOTAL:	12058.21	45.20	545127

Standard error % = 4.32.

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Table - 14

Total Wood Volume

Sl. No.	Block	Net area in hectare	Volume per hectare	Estimated gross volume.
1.	Renock	952.22	210.3249	200276
2.	Rashet	710.69	114.7109	81518
3.	Pankasari	1251.62	305.0179	381767
4.	Rechila	2534.81	246.0849	623779
5.	Thosum	979.75	385.3029	37750
6.	Ruka	1789.47	339.5269	607573
7.	Chichu	491.90	218.2300	107347
8.	Paren	1399.11	216.2819	302601
9.	Mo	1948.69	297.1339	579022
	TOTAL:	12058.21	270.46	3261384

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3.4. Net Volume:

The volume equations have taken care of the ' hidden culls' and therefore, gross volume estimates exclude that category of cull. It does not, however, exclude the ' standing culls' (see Section 3.3) and, therefore, the cull percentage volume has been deducted (Table 15) from the gross volume to arrive at the net volume which appears in Table-15.

Table -15

Net Volume

Utility Class	Gross Vol. (in '000 cu. m.)	Error of estimation.	Cull %	Net Vol. (in '000cu. m.)	Vol./ha. (cu.m.)	Net Vol/C hectare (cu.m.)
Plywood	1854	7.5%	5.85	1746	153.75	144.75
Total timber	2716	5.9%	5.85	2557	225.26	212.08
Residual- (Total timber timber-Plywood)	862	None claimed	5.85	-	-	-
Small wood	545	4.3%	5.85	513	45.20	42.56
Total:	3261	None claimed	5.85	3070	270.46	254.64

3.5. Conclusions:

The plywood resources in the project area is enough to sustain large sized commercial plywood mills. The size of the restocking the area to be exploited annually. However, infrastructure development is the key to the successful exploitation of these forests. will mill/built depend on the capability of the Department in

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A N N E X U R E -I
(For Form No. 1)

CODING INSTRUCTIONS FOR INVENTORY WORK IN KALIMPONG DIVISION (PART)W.B.

THE PLOT DESCRIPTION FORM (FORM- 1)

Column	Description	Code.
1-3	Job number	To be filled in by the office.
4-5	Card design	To be filled in by the office.
6-7	Crew Leader	Write your initials.
8	State(West Bengal)	7
9-10	Revenue District(Darjeeling)- 70	
11-13	Forest Division (Kalimpong)	701
14-16	Forest Range	To be filled in by the office.

BLOCK (COL: 17-18)

Block			Code.
Renock	..	..	01
Rashet	..	..	02
Pankasari	..	..	03
Rechila	..	..	04
Thosum	..	..	05
Ruka	..	..	06
Chichu	..	..	07
Paren	..	..	08
Mo	..	..	09

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ALTITUDE(COL: 19-20)

Altitude in the centre of the plot will be read by contour lines in meter. The last two digits will be truncated and remaining digits left will be coded in the form as two digit code number. If there is no contour line, keep the column blanks.

Example:- Supposing the centre of the plot is located at an elevation of 1245 m. The truncate 45 and record as 10.

SLOPE (COL: 21)

The slope of the plot is to be measured by Abneys level by standing at the base line and siting the lowest point of the other end of the plot and code as follows:-

SLOPE		CODE.
No slope.	..	0
1-5 degrees.	..	1
6-10 degrees	..	2
11-20 degrees	..	3
21-30 degrees	..	4
31-40 degrees	..	5
41-45 degrees	..	6
More than 45 degrees	..	7

POSITION OF SLOPE (COL: 22)

The position of the slope with reference to the hill slope on which it is located will be classified as follows:-

POSITION OF SLOPE		CODE.
No slope	..	0
Ridge top	..	1
Upper one third	..	2
Middle one third	..	3
Lower one third	..	4
Valley botton	..	5

ASPECT (COL: 23)

Aspect means the direction of the maximum slope. Therefore, we have to stand at the centre of the plot to the direction of the maximum slope and record it by a compass.

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Contents

ASPECT		CODE.
No aspect.	..	0
North	..	1
North-east	..	2
East	..	3
South-east	..	4
South	..	5
South-west	..	6
West	..	7
North-west	..	8

ACCESSIBILITY CLASSES(COL: 24)

The road or a bridal path means a path with minimum width of 2 meters and can be used either by vehicular transport or by mule. The distance between the road or the path from the nearest point of the plot has to be guessed and recorded as follows:-

ROAD.		CODE.
If within 1000 meters.	..	1
If 1001-3000 "	..	2
3001-5000 "	..	3

ROCK (COL: 25)

You will come across the following types of the rock in the area.

Quartzite, dolomite, phyllite, Chlorite Schist, Sandstones, Slaty shale, Silt stones and Epidiorites etc. The coding will be as follows:-

Rock.	Code.
Quartzite.	1
Slate, Phyllite, Chlorite schist.	2
Dolomite.	3
Epidiorites, Granite ..	4
Sandstone or siltstones.	5
Carbanaceous shale, coal.	6
Others	7
No rock.	8

We have to remember that in case there is no rock in the plot itself please look out for a regular rock formation in the neighbouring areas and then code it after identification. If you cannot identify it or even otherwise please collect a sample, put it in a polythene bag, mark

CONTD.....23

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the bag with a grid point index and block index and send it to the base camp for identification or for checking.

DEGREE OF WEATHERING (COL: 26)

Degree of weathering of the regular rock formation will be as below:-

DEGREE OF WEATHERING.		CODE.
Partly weathered.	..	1
Completely weathered.	..	2
Fresh rock	..	3
No rock	..	4

DEPTH OF WHICH ROCK FOUND (COL: 27)

DEPTH OF ROCK	CODE.
When the regular rock formation is found on the top surface.	1
When the regular rock formation etc; found at 0-1 m. depth.	2
More than 1 m. depth .	3
No rock.	4

(Remember that if there is soil it can never have code 1).

LITTER (COL: 28-29)

The undercomposed litter will have the following codes depending on their thickness.

THICKNESS			CODE.
0-2 cm.	..	..	11
2-4 "	..	..	12
4-6 "	..	..	13
6-8 "	..	..	14
8 + "	..	..	15

If there is partly decomposed but recognisable litter then the code will be as follows, depending on the thickness.

CONTD.....24

THICKNESS IN CM.			CODE.
0-2	..	..	21
2-3	..	..	22
4-6	..	..	23
6-8	..	..	24
8 +	..	..	25

In case there is undecomposed material lying on partly decomposed always take coding for that item which is of greater thickness.

HUMUS (COL: 30)

Depending on the thickness, the code will be as follows. The depth of humus will be measured by scraping the litter.

THICKNESS			CODE.
0-4 cm.	..	..	1
5-8 "	..	..	2
8-12 "	..	..	3
13-16"	..	..	4
16+	..	..	5

STONINESS (COL: 31)

The quantities of stones in the soil will be coded as follows:-

PERCENTAGE BY VOLUME			CODE.
No stone.	..	..	0
1-5%	..	..	1
6-25	..	..	2
26-50	..	..	3
51-75	..	..	4
76-100	..	..	5

COLOUR (COL: 32)

PREDOMINANT COLOUR			CODE.
Black	..	..	1
Brown.	..	..	2
Red	..	..	3
Yellow	..	..	4
Grey brown	..	..	5
No soil	..	..	6

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STRUCTURE (COL: 33)

The degree of development of the structure will be coded as given below:-

DEGREE OF STRUCTURE DEVELOPMENT	CODE.
Structure less ..	0
Weakly developed structure.	1
Poorly developed " ..	2
Well developed " ..	3

CONSISTENCE (COL: 34)

To evaluate consistence, select and attempt to crush in the hand a small soil mass that appears slightly moist and code as follows:-

Consistence	Description	Code.
Loose	Non-coherent soil material crushed.	0
Very friable	With very gentle presure and coherent when pressed together.	1
Friable	Soil material crushed, but with gentle to moderate pressure between thumb and forefinger, and coherent when pressed together.	2
Firm	Soil material crushed with moderate pressure between thumb and forefinger but resistence is distinctly noticeable.	3
Very firm.	Soil material crushed with strong pressure; partly crushable between thumb and forefinger.	4

STICKINESS (COL: 35)

Degree of adhesion to objects at field capacity(i.e. just saturated with moisture).

STICKINESS	CODE.
Non sticky. ..	0
Slightly sticky ..	1
Sticky ..	2
Very sticky ..	3

CONTD.....26

pH(COL: 36)

Collect soil sample from a horizon least 15 cm. below the humus layer in a polythene bag, mark with block and grid point code and send to camp for pH determination.

pH		CODE.
More than 8	..	1
8-7.1	..	2
7-6.1	..	3
6-5.1	..	4
5-4.1	..	5
4 and less	..	6

TEXTURE (COL: 37)

The codes for the texture need not be filled up in the field except when there is no soil when the code 6 will be written. If there is soil, collect 500 gm. sample at a depth of 15 cm. from the base of the litter or humus layer and put it in a polythene bag and mark it with block and grid number. This sample should be sent to base camp at the earliest.

TEXTURE		CODE.
Clay	..	1
Clayey loam.	..	2
Loam	..	3
Sandy loam	..	4
Sand	..	5
No soil	..	6

DEPTH OF SOIL (COL: 38)

The depth of the soil will be estimated by digging a 15 cm. deep pit and guessing the remaining depth. The guess will be based on all available informations e.g. exposed soil profile or luxurianco of ground vegetation.

ITEM	DESCRIPTION	CODE.
Very shallow	Less than 15 cm.	1
Shallow	15 to 30 cms.	2
Medium	31 to 90 cms.	3
Deep	90 cms and 180 cms.	4
Very deep	180 cm. and above.	5
No soil	Nil	6

CONTD....27

ROOTS (COL: 39)

The roots will be coded as follows. Quantity should be estimated at a depth of 30 cm.

QUANTITY OF ROOTS		CODE.
Abundant roots.	..	1
Medium	..	2
Few	..	3
Nil	..	4

VEGETATION (COL: 40)

Remember the following definition.

Forest means where the tree species stand on the soil. Shrubs means where scrubs are on the soil without any tree covering the shrubs. Grassland means where the grass is on the soil without any shrubs or tree covering the grass. Blank means where there is nothing or only harbs are on the soil. In this context the vegetation has to be noted and coded.

Plantation means those who have been man-made forest even if they are of very small height.

DESCRIPTION			CODE.
1-25 % forest balance scrub, grassland etc.			1
26-50%	-do-	-do-	2
51-75%	-do-	-do-	3
76-100%	-do-	-do-	4
Plantation.			5
No forest only blank			6
Orchards, Private gardens, pastures, large water areas, forest villages hutments, buildings Blanks etc.			7

FOREST TYPE(COL: 41-42)

Forest type has to be found out after the enumeration is completed by the office. The classification has to be based on the proportion of various indicator type species in the plot. This will be done in the office and you keep the columns blank.

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NO. OF STOREYS (COL: 43)

The codes for different storeys are as follows:-

The following items under this group will be recognised:-

There is no marked differentiation in the level of the canopy.	1
Two storeys with wall defined tiers which can be recognised in the forest.	2
Three storeyed forest. The variation among the tree species is so pronounced that distinct tiers are recognised in the plots.	3

CROWN DENSITY (COL: 44)

This will be measured on the degree of opening in the canopy. The folllewing classes will be recognised.

ITEM	CODE.
No opening ..	1
Upto 50% opening in the canopy.	2
More than 50% but less than 75% opening in the canopy.	3
More than 75% opening in the canopy.	4

REGENERATION (COL: 45)

This will be estimated occularly. For this the presence of seedlings, sapling and poles in the plot and in the surrounding areas will be taken into consideration.

REGENERATION	CODE.
When one established seedling, sapling or pole of the timber species is found on an average in every 6 sq. mt. of areas it will be called as profuse.	1
When above in 20 sq. mt. area on an average, it is adequate.	2
When above in more than 20 sq. mt. but less than 200 sq. mt., it is fair.	3
When less than 200 sq. mt. it is nil.	4

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GRAZING INCIDENCE (COL: 46)

Depending on the intensity of grazing the area is subjected to following classes will be as mentioned below:-

Item	DESCRIPTION	CODE.
Heavily grazed.	-	1
Moderately grazed.	-	2
Grazing absent.	-	3

FIRE INCIDENCE(COL: 47)

When the area is subjected to occassional and frequent fire. 1

When such a fire hazard is not common in the area. 2

PRESENT MANAGEMENT(COL: 48)

Depending on the silvicultural system practised in the forest, following groups are being made.

SELECTION. When the trees are felled with regard to certain exploitable diameter. 1

CLEARFELLING: When the trees standing on the forest are clearfelled for the purpose of raising plantation of certain selected species of trees. 2

THINNING: When crop is young to middle aged and required removal of some, for the healthy growth of the remaining crop. 3

ITEM	COL. NO.	DESCRIPTION
Grid No.	49-51	Fill up the columns as per code No. given in the block maps for the grids where the plots are being laid out.
Map sheet.	52	To be filled in by the office.
Inventory design.	53	To be filled in by the office.

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ANNEXURE- 2 (Form No. 2)

The enumeration form (Form 2) have to be filled up. Trees upto 10 cm. diameter have only to be measured. Lower diameter trees have to be neglected. Measurements has to be done in cm. (by rounding off) and no decimals should be used. The species code are as follows:-

ENUMERATIN FORM (FORM 2)

Sl. No.	Item	Col. No.	Description.
1.	Job No.	1-3	To be filled in by the office.
2.	Card design	4-5	To be filled in by the office.
3.	Report No.	6-7	To be filled in by the office.
4.	Species code	8-10	As per list of species given below:

Sl. No.	Name of species (Local names)	Code.
1.	Acer campbellii(Kapasi)	001
2.	Alnus nepalensis (Utis)	002
3.	Beilschmiedia species (Tarsing)	003
4.	Exbucklandia populnea (Pipli)	004
5.	Castanopsis tribuloides & C. hystrix(Katus)	005
6.	Cinnamomum species (Sissi)	006
7.	Elaeocarpus lanceaefolius (Bhadrasi)	007
8.	Machilus edulis (Lapche kawla)	008
9.	Machilus gammieana (Chiple kawla)	009
10.	Machilus odoratissima (Lati kawla)	010
11.	Michelia cathcartii(Tite champ)	011
12.	Michelia doltsopa (Mithe champ)	012
13.	Nyssa javanica (Lekh chilauni)	013
14.	Prunus nepalensis (Arupate)	014
15.	Quercus lamellosa (Buk)	015
16.	Quercus lineata (Phalant)	016
17.	Phoebe species (Angare)	017
18.	Toona species (Toon)	018
19.	Betula species (Bujpati)	019
20.	Michelia lanuginosa (Phumsre)	020
21.	Engelhardtia spicata (Mawa)	021
22.	Sloanea dasycarpa (Gobre)	022
23.	Lithocarpus pachyphylla (Sungre)	023
24.	Taxus baccata	024
25.	Magnolia campbellii(Ghoge champ)	025
26.	Tsuga dumosa (Tengra salla)	026
27.	Terminalia myriocarpa (Pani saj)	027
28.	Lithocarpus elegans (R. kawla)	029
29.	Acrocarpus fraxinifolius (Mandane)	030
30.	Ailanthus integrifolia ssp. Calycina (Gokul)	032
31.	Schima wallichii(Chilauni)	033
32.	Betula species (Saur)	034

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Contents

Sl.No.	Item	Col. No.	Description.
5	Diam.	11-13	To be recorded in cm.
6	Diam.	14-16	To be recorded in cm.
7	Species code	17-19	(Items 7 to 21 should be filled in accordingly)
8	Diam.	20-22	-
9	Diam.	23-25	-
10	Species code	26-28	-
11	Diam.	29-31	-
12	Diam.	32-34	-
13	Species code	35-37	-
14	Diam.	38-40	-
15.	Diam.	41-43	-
16.	Species code	44-46	-
17.	Diam.	47-49	-
18.	Diam.	50-52	-
19.	Species code	53-55	-
20.	Diam.	56-58	-
21.	Diam.	59-61	-
22.	No. of bamboo clumps in plot.	62	To be filled in by the crew leader.
23.	Total No. of trees.	63-65	-do- -do- -do-
24.	Block	66-67	-do- -do- -do- from list of block codes.
25.	Grid No.	68-70	-do- -do- -do-
26.	Map	71-72	To be filled in by the office.
27.	Inventory design.	73-74	-do- -do-

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A N N E X U R E- 3 (FOR FORM 3)

Choose 25 x 20 meter in the southern half of the plot each and every tree of which have to be examined and the sample tree form (Form 3) for all the grid points have to be filled up as indicated below:-

Column	Description	Code.
1-3	Job number	To be filled in by the office.
4-5	Card design	-do- -do- -do-
6-7	Block Number	As mentioned in the manual.
8-10	Grid number	As mentioned in the map.
11	Map sheet	To be filled in by the office.
Space provided before column 12-13	(write name of the species (Botanical names in brackets) in the space provided)	-
12-13	Serial number	Running Sl. No. in two digited codes like 01,02,03 and so on.
14-16	Species code	As mentioned in the manual
17-19	D.B.H.(O.B.)	Write the actual in Cm. Do not use any decimal.
20-22	D.B.H.(U.B)	Write the actual in Cm.
23-24	Total height in meters	Write the actual height in meters.
25	Top broken.	See if it is top broken then - 1 If not. -22
26	Hollowness-A tree is supposed to be hollow only when it may be seen as such from outside. If hollow .. - 1 When it is not. .. - 2	
27	Rotten- Whenever it can be seen from outside that a tree is substantially defective with fungus and other rot but still living. .. - 1 If not. .. - 2	
28	Any other defects	If any other defect is detected, write the nature of defect. You need not code it.
29-30	Number of trees	Count the total No. in the plot (25 x 20 meter) and write.
31-32	No. of bamboo clumps.	-

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Contents

FORM - 1

PLOT DESCRIPTION FORM

PREINVESTMENT SURVEY OF FOREST RESOURCES

EASTERN ZONE.

Job No	Card Design	Crew leader
1-3	4-5	6-7

Grid No.	Map	Inventory design
49-51	52	53

				PLOT DATA									SOIL DATA																			
State	Revenue District	Forest Division	Forest Range	Block	Altitude	Slope	Position of slope	Aspect	Accessibility class	Rock	Degree of weathering	Depth at which rock found	Litter	Humus	Stoniness	Colour	Structure	Consistence	Stickiness	PH	Texture	Depth	Roots	Vegetation	Forest type	No. of storey	Crown density	Regeneration	Grazing incidence	Fire incidance	Present management	
8	9-10	11-13	14-16	17-18	19-20	21	22	23	24	25	26	27	28-29	30	31	32	33	34	35	36	37	38	39	40	41-42	43	44	45	46	47	48	

Name of crew leader.....

Date.....

PLOT ENUMERATION FORM

FORM - 2.

PREINVESTMENT SURVEY OF FOREST RESOURCES, EASTERN ZONE.

Job No.	Card design	R. No.
1-3	4-5	6-7

No. of clumps plots.	Bamboo in the	Total No. of trees in the plot	Block	Grid No.	Map	Inventory Design
62		63-65	66-67	68-70	71-72	73-74

Species			Species			Species			Species			Species			Species		
Code	Diam	Cm.	Code	Diam	Cm.	Code	Diam.	Cm.	Code	Diam.	Cm.	Code	Diam.	Cm.	Code	Diam	Cm.
8-10	11-13	14-16	17-19	20-22	23-25	26-28	29-31	32-34	35-37	38-40	41-43	44-46	47-49	50-52	53-55	56-58	59-61

Date.....

Name of Crew Leader.....

Contents

SAMPLE TREE FORM.

FORM - 4.

PREINVESTMENT SURVEY OF FOREST RESOURCES, EASTERN ZONE.

Job No.	Card design	Block No.	Grid No.	Map sheet.		No. of trees	No. of bamboo clumps
1-3	4-5	6-7	8-10	11		29-30	31-32

Name of species	Sl.No.	Species Code	D.B.H. (O.B.) cm.	D.B.H. (U.B.) cm.	Total height in meters.	Defects			
						Top broken	Hollowness	Rotten	Any Other defects.
	12-13	14-16	17-19	20-22	23-24	25	26	27	28

Crew Leader.....

Date.....

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