

GOVERNMENT OF MAHARASHTRA



WORKING PLAN

FOR THE

RESERVED FORESTS OF THANA DISTRICT

THANA CIRCLE, MAHARASHTRA STATE

FOR THE YEARS

1969-70 TO 1988-89

VOLUME I—TEXT

(PARTS I AND II)

BY

N. J. JOSHI, B.Sc. (Hons.), A. I. F. C., I. F. S.

Deputy Conservator of Forests

TABLE OF CONTENTS

	SUBJECT		PARAGRAPH		PAGE
Foreword					vii
Introduction					ix
List of common forest plants, occurring in Thana Forests					xi
Glossary of local terms used in the plan					xvii
Abbreviations used					xviii

PART I.—SUMMARY OF FACTS ON WHICH PROPOSALS ARE BASED

Chapter I.—The Tract dealt with

Section	1.—Name and situation	.. .. .	1, 2	1
Section	2.—Configuration of the ground	.. .. .	3, 4	1
Section	3.—Geology, Rock and Soil	.. .. .	5 to 13	1
Section	4.—Climate	.. .. .	14 to 17	2
Section	5.—Water-supply	.. .. .	18	3
Section	6.—Distribution and area	.. .. .	19, 20	3
Section	7.—State of boundaries	.. .. .	21	4
Section	8.—Legal position	.. .. .	22	4
Section	9.—Rights and concessions	.. .. .	23	4

Chapter II.—The Forests

Section	1.—Composition and condition of the crop	.. .. .	24 to 40	5
Section	2.—Injuries to which the crop is liable	.. .. .	41 to 51	9

Chapter III.—Utilisation of the Produce

Section	1.—Agricultural customs and wants of the population	.. .. .	52 to 55	13
Section	2.—The markets and marketable products	.. .. .	56 to 58	13
Section	3.—Lines of export	.. .. .	59 to 62	14
Section	4.—Methods of exploitation and their costs	.. .. .	63 to 67	15

Chapter IV.—Staff and Labour Supply

Section	1.—Staff	.. .. .	68	17
Section	2.—Labour supply	.. .. .	69, 70	18

Chapter V.—Past Systems of Management

Section	1.—General history of the forests	.. .. .	71 to 77	19
Section	2.—Past systems of management and their results	.. .. .	78 to 100	20
Section	3.—Special works of improvement undertaken	.. .. .	101 to 109	25
Section	4.—Past yield	.. .. .	110	27
Section	5.—Past revenue and expenditure	.. .. .	111	28

Chapter VI.—Statistics of growth and yield

Section	1.—Growth	.. .. .	112 to 120	29
Section	2.—Stocking	.. .. .	121 to 129	31
Section	3.—Yield	.. .. .	130 to 132	33

SUBJECT	PARAGRAPH	PAGE
Chapter VII.—Estimate of Capital Value of Forests		
Section 1.—Capital value of the forests	133	35
Section 2.—Financial results of teak plantations	134 to 140	35
Chapter VIII.—Wild Life		
Section 1.—General history of wild life	141 to 143	38
Section 2.—Legal position	144	38
Section 3.—Rights and concessions in respect of the wild animals and wild birds.	145	38
Section 4.—Injuries to the wild life	146	38
Section 5.—Measures adopted for protecting wild life	147	38
Section 6.—Statistics of wild life captured, hunted or otherwise dead.	148	38
Section 7.—Special works of improvement undertaken	149	39
Section 8.—Revenue	150	39
PART II.—FUTURE MANAGEMENT DISCUSSED AND PRESCRIBED		
Chapter I.—Basis of Proposals		
Section 1.—National Forest Policy	151 to 153	40
Section 2.—Factors influencing the general objects of management	154, 155	41
Section 3.—Method of treatment to be adopted	156, 157	42
Section 4.—Working circles, their areas, distribution and reasons for their constitution.	158, 159	43
Section 5.—Blocks and compartments	160, 161	44
Section 6.—Analysis and valuation of the crop	162 to 164	44
Section 7.—Period of the plan	165	45
Chapter II.—Working Plan for the Protection Working Circle		
Section 1.—General constitution	166	46
Section 2.—General character of the vegetation	167	46
Section 3.—Blocks, compartments and felling series	168	46
Section 4.—Special objects of management	169	46
Section 5.—Analysis and valuation of the crop	170	46
Section 6.—Method of treatment	171	46
Chapter III.—Working Plan for the Selection-cum-Improvement Working Circle		
Section 1.—General constitution	172	47
Section 2.—General character of the vegetation	173	47
Section 3.—Blocks, compartments and felling series	174	47
Section 4.—Special objects of management	175	47
Section 5.—Analysis and valuation of the crop	176 to 179	47
Section 6.—Silvicultural system	180	48
Section 7.—Choice of species	181	48
Section 8.—Rotation	182	49
Section 9.—Exploitable size	183	49
Section 10.—Felling cycle and sequence of fellings.. .. .	184	49

SUBJECT	PARAGRAPH	PAGE
Chapter III.—Working Plan for the Selection-cum-Improvement Working Circle—contd.		
Section 11.—Regulation of the yield	185 to 196	49
Section 12.—Demarcation of coupes and marking technique ..	197	52
Section 13.—Method of executing the fellings	198 to 201	52
Section 14.—Subsidiary cultural operations	202 to 204	53
Section 15.—Other regulations	205, 206	54
Chapter IV.—Working Plan for the Lakes Catchment Area Working Circle		
Section 1.—General constitution	207	55
Section 2.—General character of the vegetation	208	55
Section 3.—Blocks, compartments and felling series	209	55
Section 4.—Special objects of management	210	55
Section 5.—Analysis and valuation of the crop	211, 212	55
Section 6.—Silvicultural system	213	56
Section 7.—Choice of species	214	56
Section 8.—Rotation	215	56
Section 9.—Size of mature trees	216	56
Section 10.—Felling cycle and sequence of fellings	217	56
Section 11.—Regulation of the yield	218	56
Section 12.—Demarcation of coupes and marking technique ..	219	57
Section 13.—Method of executing the fellings	220, 221	57
Section 14.—Subsidiary cultural operations	222	58
Section 15.—Other regulations	223	58
Chapter V.—Working Plan for the Conversion Working Circle		
Section 1.—General constitution	224	59
Section 2.—General character of the vegetation	225	59
Section 3.—Blocks, compartments and felling series	226	59
Section 4.—Special objects of management	227	59
Section 5.—Analysis and valuation of the crop	228, 229	59
Section 6.—Silvicultural system	230	60
Section 7.—Choice of species	231	60
Section 8.—Rotation and conversion period	232 to 242	60
Section 9.—Division of the area into periodic blocks	243 to 246	63
Section 10.—Regulation of the yield	247	63
Section 11.—Demarcation of coupes and marking technique ..	248	63
Section 12.—Method of executing the fellings	249 to 257	63
Section 13.—Plantation technique	258	65
Section 14.—Subsidiary cultural operations	259 to 263	65
Section 15.—Other regulations	264, 265	66
Chapter VI.—Working Plan for the Industrial Woods Plantation Working Circle		
Section 1.—General constitution	266	67
Section 2.—General character of the vegetation	267	67
Section 3.—Blocks, compartments and felling series	268	67
Section 4.—Special objects of management	269	67

SUBJECT	PARAGRAPH	PAGE
Chapter VI.—Working Plan for the Industrial Woods Plantation Working Circle—<i>contd.</i>		
Section 5.—Analysis and valuation of the crop	270	67
Section 6.—Method of treatment	271	67
Section 7.—Choice of species	272	67
Section 8.—Rotation	273	67
Section 9.—Regulation of the yield	274	67
Section 10.—Sequence of fellings	275	67
Section 11.—Demarcation of coupes and marking technique ..	276	68
Section 12.—Method of executing the fellings	277	68
Section 13.—Plantation technique	278 to 284	68
Section 14.—Subsidiary cultural operations	285 to 288	69
Section 15.—Other regulations	289, 290	69
Chapter VII.—Working Plan for the Pulpwood Plantation Working Circle		
Section 1.—General constitution	291	70
Section 2.—General character of the vegetation	292	70
Section 3.—Blocks, compartments and felling series	293, 294	70
Section 4.—Special objects of management	295	70
Section 5.—Analysis and valuation of the crop	296, 297	70
Section 6.—Method of treatment	298	70
Section 7.—Choice of species	299	70
Section 8.—Rotation	300	71
Section 9.—Regulation of the yield	301	71
Section 10.—Sequence of fellings	302	71
Section 11.—Demarcation of coupes and marking technique ..	303	71
Section 12.—Method of executing the fellings	304	71
Section 13.—Plantation technique	305, 306	71
Section 14.—Subsidiary cultural operations	307	71
Section 15.—Other regulations	308, 309	71
Chapter VIII.—Working Plan for the Miscellaneous Plantation Working Circle		
Section 1.—General constitution	310	72
Section 2.—General character of the vegetation	311	72
Section 3.—Blocks, compartments and felling series	312	72
Section 4.—Special objects of management	313	72
Section 5.—Analysis and valuation of the crop	314, 315	72
Section 6.—Method of treatment	316	72
Section 7.—Choice of species	317	72
Section 8.—Rotation	318	72
Section 9.—Regulation of the yield	319	73
Section 10.—Sequence of fellings	320	73
Section 11.—Demarcation of coupes and marking technique ..	321	73
Section 12.—Method of executing the fellings	322	73
Section 13.—Plantation technique	323	73
Section 14.—Subsidiary cultural operations	324, 325	73
Section 15.—Other regulations	326, 327	73

**Chapter IX.—Working Plan for the Fodder Reserves
Working Circle**

SUBJECT	PARAGRAPH	PAGE
Section 1.—General constitution	328	74
Section 2.—General character of the vegetation	329	74
Section 3.—Blocks, compartments and felling series	330	74
Section 4.—Special objects of management	331	74
Section 5.—Analysis and valuation of the crop	332	74
Section 6.—Method of treatment	333	74
Section 7.—Choice of species	334	75
Section 8.—Method of executing the works	335 to 339	75

**Chapter X.—Working Plan for the Casuarina
Working Circle**

Section 1.—General constitution	340	76
Section 2.—General character of the vegetation	341	76
Section 3.—Blocks, compartments and felling series	342	76
Section 4.—Special objects of management	343	76
Section 5.—Analysis and valuation of the crop	344	76
Section 6.—Method of treatment	345	76
Section 7.—Choice of species	346	76
Section 8.—Rotation	347	77
Section 9.—Regulation of the yield	348	77
Section 10.—Sequence of fellings	349	77
Section 11.—Demarcation of coupes and marking technique	350, 351	77
Section 12.—Method of executing the fellings	352	77
Section 13.—Plantation technique	353	77
Section 14.—Subsidiary cultural operations	354 to 356	77
Section 15.—Other regulations	357	77

Chapter XI.—Working Plan for the Babul Working Circle

Section 1.—General constitution	358, 359	78
Section 2.—General character of the vegetation	360	78
Section 3.—Blocks, Compartments and felling series	361	78
Section 4.—Special objects of management	362	78
Section 5.—Analysis and valuation of the crop	363	78
Section 6.—Method of treatment	364	79
Section 7.—Choice of species	365	79
Section 8.—Rotation	366	79
Section 9.—Regulation of the yield	367	79
Section 10.—Sequence of fellings	368	79
Section 11.—Demarcation of coupes and marking technique	369, 370	79
Section 12.—Method of executing the fellings	371	79
Section 13.—Artificial regeneration and operations	372 to 376	79
Section 14.—Other regulations	377 to 379	80

**Chapter XI-A.—Working Plan for Miscellaneous
Working Circle**

General constitution	379-A	81
------------------------------	-------	----

SUBJECT	PARAGRAPH	PAGE
Chapter XII.—Working Plan for the Minor Forest Produce (overlapping) Working Circle		
Section 1.—General constitution of the working circle	380	82
Section 2.—Minor forest products of the area	381	82
Section 3.—Special objects of management	382	82
Section 4.—Method of treatment	383 to 391	82
Chapter XIII.—Working Plan for the Bamboo (Overlapping) Working Circle		
Section 1.—General constitution	392	84
Section 2.—General character of the vegetation	393	84
Section 3.—Blocks, compartments and felling series	394	84
Section 4.—Special objects of management	395	84
Section 5.—Method of treatment	396	84
Section 6.—Felling cycle	397	84
Section 7.—Method of executing the fellings	398 to 400	84
Section 8.—Subsidiary cultural operations	401, 402	86
Chapter XIV.—Miscellaneous Regulations		
Section 1.—Exploitation and disposal of forest produce	403 to 409	87
Section 2.—Irregular exploitation	410	88
Section 3.—Roads	411	88
Section 4.—Buildings	412, 413	89
Section 5.—Maintenance of boundaries	414 to 416	89
Section 6.—Firewood and charcoal depots	417	90
Section 7.—Preservation plots	418	90
Section 8.—Experimental plots	419	90
Section 9.—Game management	420, 421	91
Section 10.—Survey and maintenance of maps	422 to 424	91
Chapter XV.—Fire Protection	425 to 430	92
Chapter XVI.—Establishment and Labour		
Section 1.—Staff	431 to 434	94
Section 2.—Labour	435	96
Chapter XVII.—Control and Records		
Section 1.—Control forms	436, 437	97
Section 2.—Compartment histories	438	97
Section 3.—Plantation and nursery registers	439	97
Chapter XVIII.—Financial Forecast and Cost of the Plan		
Section 1.—Financial forecast	440	98
Section 2.—Cost of the plan	441	98
Chapter XIX.—Summary of Prescriptions .. .. .	..	99

FOREWORD

This is the third revised Working Plan for Thana forests. It has been prepared by Shri N. J. Joshi, I.F.S., Divisional Forest Officer, Working Plans, Thana, for the period 1969-70 to 1988-89.

During last 20 years, *i.e.*, since preparation of the Plan and Scheme which are replaced by this Working Plan, changes of far reaching importance specially in the economic fields have taken place and the demand for the Forest produce both from the people and the industry has increased to a great extent. With the increase in demand, the price of the forest produce has also increased. These factors called for critical examination of the forests for their intensive management. Therefore, during the preparation of this Working Plan all forests have been divided into compartments and stock mapped showing type, quality, density, age and reproduction of valuable species. Further, 10 per cent enumerations of all tree growth have been carried out over the whole area dealt with under this plan, except the Jawhar Reserves.

This Working Plan aims at intensive management consistent with the modern trends. Its prescriptions are oriented to promote forest-based industries. It envisages annual conversion of 2,399 hectares into teak forests, 125 hectares into industrial-wood forests and 600 hectares into Pulpwood forests, by clearfelling and planting.

Due to the changes brought about in management, it is expected that the forests would improve to a great extent by large scale plantations of teak and industrially valuable species.

Poona :
The 26th June 1971.

J. G. THOSRE,
Conservator of Forests,
Working Plans Circle, M. S., Poona.

INTRODUCTION

The first regular working plan to be introduced in the Thana forests was the working plan for the forests of Bhiwandi taluka sanctioned in 1894. Separate working plans for the forests of different ranges followed. All these different plans were revised and amalgamated in the working plan for the Thana forests sanctioned in 1922. This plan was revised in 1935 and again in 1951. The present plan is the third revised plan for the Thana forests. It replaces the following plans and schemes :—

- (i) Revised working plan for the Thana forests by Shri S. P. Jadhav.
- (ii) Working Scheme for the forests of Jawhar by Shri S. H. Korlhalli.
- (iii) Working Schemes for Khativali and Atgaon Inam Forests by the D. F. O., East Thana.

The working plans division Thana was opened for revising the various plans in force in the Thana forests. The undersigned took over as Divisional Forest Officer, Working Plans, Thana, on 29th December 1962. The field work in respect of this plan was begun in April 1963 and was completed in June 1965. For the first time, the Thana forests were divided into blocks and compartments and were stock-mapped, during the present revision. The present plan would have been ready much earlier, but for the non-availability of blank copies of the toposheets from the Survey of India, Dehra-Dun. Pending reprinting of the maps, tracings of the required maps had to be made and ammonia prints prepared from them.

The enumerations were carried out under the " Forest Resources Survey Scheme " from November 1962 to December 1966. This was the first time that the whole of the Thana forests were covered by partial enumerations carried out on a lay-out given on statistical lines.

Undersigned expresses his deep sense of gratitude for the valuable guidance given by Shri V. D. Mehendale, I.F.S., Conservator of Forests, Working Plans Circle, during the course of the preparation of the present plan. He is also grateful to Shri J. G. Thosre, I.F.S. the present Conservator of Forests, Working Plans Circle, Poona, for the valuable instructions given by him in drafting the plan. Thanks are due to the Divisional Forest Officers, Dahanu, Thana and Shahapur and their staff for the help and co-operation given by them in the collection of field and statistical data.

The following subordinates were associated with the field work consisting of stock-mapping and stem-analysis of teak trees and with compilation of statistical data.

1. A. P. Bhatkhande	..	R. F. O.
2. S. M. Ringangaonkar	..	Do.
3. V. K. Chavare	..	Do.
4. R. M. Yadav	..	Do.
5. S. G. Varadkar	..	Do.

The following subordinates were also associated in the compilation of data required for various appendices :—

1. S. S. Kankrej	..	R. F. O.
2. P. V. Oturkar	..	Do.
3. D. D. Nanaware	..	Do.

The mapping work was done by the following Surveyors :—

1. G. D. Patil
2. R. L. Bhavanani
3. J. S. Mutalik
4. P. G. Hebalkar

The following were associated with the enumeration work :—

- | | | |
|-------------------------|----|----------|
| 1. R. M. Parande | .. | A. C. F. |
| 2. M. S. Parasnis | .. | Do. |
| 3. S. N. Bhonsale | .. | Do. |
| 4. K. N. Thakekar | .. | Do. |
| 5. S. D. Lele | .. | R. F. O. |
| 6. M. N. Mohikar | .. | Do. |
| 7. G. S. Joshi | .. | Do. |
| 8. S. S. Kankrej | .. | Do. |
| 9. S. G. Varadkar | .. | Do. |
| 10. S. M. Ringangaonkar | .. | Do. |
| 11. M. P. Sapkal | .. | Do. |
| 12. H. S. Mahadar | .. | Do. |

and a number of Foresters and Surveyors.

The undersigned desires to keep on record his appreciation of the hard work done by all of them. A special mention is made of the excellent work done by R. M. Yadav, R. F. O. in compiling the results of stem-analysis of teak trees.

N. J. JOSHI,

*Divisional Forest Officer,
Working Plans, Thana.*

DAHANU :
The 4th December 1967.

LIST OF COMMON PLANTS OCCURRING IN THANA FORESTS

Serial No.	Local name	Botanical (Latin) name	Natural order
(1)	(2)	(3)	(4)
Trees			
1	Ain	<i>Terminalia tomentosa</i>	Combretaceae.
2	Alu	<i>Vangueria spinosa</i>	Rubiaceae.
3	Al or Ashi	<i>Morinda tinctoria</i>	Rubiaceae.
4	Amba	<i>Mangifera indica</i>	Anacardiaceae.
5	Ambeda	<i>Spondias mangifera</i> (Syn. <i>spondias pinna-ta</i>).	Anacardiaceae.
6	Amati (Wauding)	<i>Embelia robusta</i>	Euphorbiaceae.
7	Anjani	<i>Memecylon edule</i>	Melastomaceae.
8	Apta	<i>Bauhinia racemosa</i>	Leguminosae.
9	Asana	<i>Bridelia retusa</i>	Euphorbiaceae.
10	Arjunsadada	<i>Terminalia arjuna</i>	Combretaceae.
11	Athroon (Kakar-Bhekal)	<i>Flacourtia ramontchi</i> (Syn. <i>Flacourtia indica</i>).	Bixaceae.
12	Avli	<i>Phyllanthus emblica</i> (Syn. <i>Emblia officinalis</i>).	Euphorbiaceae.
13	Babul	<i>Acacia arabica</i>	Leguminosae.
14	Bel	<i>Aegle marmelos</i>	Rutaceae.
15	Bakula	<i>Mimusops elengi</i>	Sapotaceae.
16	Bava (Bhava)	<i>Cassia fistula</i>	Leguminosae.
17	Behada	<i>Terminalia belerica</i>	Combretaceae.
18	Bhendi	<i>Thespesia populnea</i>	Malvaceae.
19	Bhoma	<i>Glochidion lanceolarium</i>	Euphorbiaceae.
20	Bhokar (Shelute)	<i>Cordia myxa</i>	Boraginaceae.
21	Bhor Jambhul	<i>Ammania baccifera</i>	Lythraceae.
22	Bhuthesh (Lawsat)	<i>Mussaenda frondosa</i>	Rubiaceae.
23	Bhitia (Alan or Bhutaksha)	<i>Elaeodendron glaucum</i>	Celastraceae.
24	Biba	<i>Semecarpus anacardium</i>	Anacardiaceae.
25	Bibla	<i>Pterocarpus marsupium</i>	Leguminosae.
26	Bondara	<i>Lagerstroemia parviflora</i>	Lythraceae.
27	Bor	<i>Zizyphus jujuba</i> (Syn. <i>Zizyphus mauritiana</i>).	Rhamnaceae.
28	Chambuli	<i>Bauhinia vahlii</i>	Leguminosae.
29	Chanda, chandava	<i>Macaranga roxburghii</i>	Euphorbiaceae.
30	Char, Charoli	<i>Buchnania latifolia</i>	Anacardiaceae.
31	Chera	<i>Erinocarpus nimmoanus</i>	Tiliaceae.
32	Chinch	<i>Tamarindus indica</i>	Leguminosae.
33	Dandoshi	<i>Dalbergia lanceolaria</i>	Leguminosae.
34	Daiwas (Dahivel)	<i>Cordia macleodii</i>	Boraginaceae.
35	Datir	<i>Ficus heterophylla</i>	Urticaceae.
36	Dhaman	<i>Greua tiliaefolia</i>	Tiliaceae.
37	Dhava	<i>Anogeissus latifolia</i>	Combretaceae.

Serial No.	Local name	Botanical (Latin) name	Natural order
(1)	(2)	(3)	(4)
Trees—cont.			
38	Dikemali	<i>Gardenia lucida</i>	Rubiaceae.
39	Gela	<i>Randia dumatorum</i>	Rubiaceae.
40	Ghatbor	<i>Zizyphus xylopyra</i>	Rhamnaceae.
41	Gol	<i>Trema orientalis</i>	Urticaceae.
42	Hed	<i>Adina cordifolia</i>	Rubiaceae.
43	Hirda	<i>Terminalia chebula</i>	Combretaceae.
44	Humb	<i>Saccopetalum tomentosum</i> (Syn. <i>Milusa tomentosa</i>).	Anonaceae.
45	Jamba	<i>Xylia xylocarpa</i>	Leguminosae.
46	Jambul	<i>Eugenia jambolana</i> (Syn. <i>Syzygium cumini</i>)	Myrtaceae.
47	Kalamb	<i>Stephegyne parvifolia</i> (Syn. <i>Mitragyna parvifolia</i>).	Rubiaceae.
48	Kadoai	<i>Hymenodictyon excelsum</i>	Rubiaceae.
49	Kahad	<i>Garuga pinnata</i>	Burseraceae.
50	Kandol	<i>Sterculia urens</i>	Sterculiaceae.
51	Karambel	<i>Dillenia pentagyna</i>	Dilleniaceae.
52	Karlilimb (Kadilimb)	<i>Murraya koenigii</i>	Rutaceae.
53	Karanj	<i>Pongamia glabra</i> (Syn. <i>pongamia pinnata</i>)	Leguminosae.
54	Karavati	<i>Ficus asperrima</i>	Urticaceae.
55	Kaju	<i>Anacardium occidentale</i>	Anacardiaceae.
56	Katekumbal	<i>Sideroxylon tomentosum</i>	Sapotaceae.
57	Kavath	<i>Feronia elephantum</i>	Rutaceae.
58	Khair	<i>Accia catechu</i>	Leguminosae.
59	Kharsing	<i>Stereospermum xylocarpum</i>	Bignoniaceae.
60	Khavas	<i>Sterculia colorata</i>	Sterculiaceae.
61	Kinhai	<i>Albizia procera</i>	Leguminosae.
62	Kirmira	<i>Casearia tomentosa</i> (Syn. <i>Glycosmis pentaphylla</i>).	Rutaceae.
63	Kokam (Ratambi)	<i>Garcinia indica</i>	Guttiferae.
64	Kuda	<i>Holarrhena antidysenterica</i>	Apocynaceae.
65	Kuda (Kalu)	<i>Wrightia tomentosa</i>	Apocynaceae.
66	Kudi	<i>Wrightia tomentosa</i>	Apocynaceae.
67	Kumbhi	<i>Careya arborea</i>	Myrtaceae.
68	Kusumb (Koshimb)	<i>Schleichera trijuga</i> (Syn. <i>Schleichera oleosa</i>).	Sapindaceae.
69	Koral or Ambli	<i>Bauhinia malabarica</i>	..
70	Kura	<i>Ixora parviflora</i> (Syn. <i>Ixora arborea</i>)	Rubiaceae.
71	Kukeri	<i>Sterculia guttata</i>	Sterculiaceae.
72	Lokhandi	<i>Ixora nigricans</i>	Rubiaceae.
73	Maraudi	<i>Acanthus ilicifolius</i>	Acanthaceae.
74	Medhshing	<i>Dolichandrone falcata</i>	Bignoniaceae.
75	Moha or Mowhra	<i>Bassia latifolia</i> (Syn. <i>Madhuka latifolia</i>)	Sapotaceae.

Serial No.	Local name	Botanical (Latin) name	Natural order
(1)	(2)	(3)	(4)
Trees—cont.			
76	Mokha	<i>Schrebera swietenoides</i>	Oleaceae.
77	Nana	<i>Lagerstroemia microcarpa</i>	Lythraceae.
78	Nandruk	<i>Ficus retusa</i>	Urticaceae.
79	Nimbara	<i>Melia dubia</i>	Meliaceae.
80	Nixar (Samudraphal)	<i>Barringtonia acutangula</i>	Myrtaceae.
81	Padal	<i>Stereospermum helonioides</i> (Syn. <i>Stereospermum passionatum</i>).	Bignoniaceae.
82	Pair	<i>Ficus arnottiana</i>	Urticaceae.
83	Palas	<i>Butea frondosa</i> (Syn. <i>Butea monosperma</i>)	Leguminosae.
84	Nagkuda pandarakuda	<i>Tabernaemontana heyneana</i>	Apocynaceae.
85	Pandhra khair (Kanti)	<i>Acacia ferruginea</i> (Syn. <i>Murraya paniculata</i>).	Leguminosae.
86	Pandhari	<i>Murraya exotica</i>	Rutaceae.
87	Pangara	<i>Erythrina indica</i> (Syn. <i>Erythrina variegata</i>)	Leguminosae.
88	Par Dambhul	<i>Olea dioica</i>	Oleaceae.
89	Pendharun	<i>Gardenia turgida</i>	Rubiaceae.
90	Petari	<i>Trewia nudiflora</i>	Euphorbiaceae.
91	Phasi	<i>Dalbergia paniculata</i>	Leguminosae.
92	Pharadi	<i>Albizzia chinensis</i>	Leguminosae.
93	Phungali	<i>Excoecaria agallocha</i>	Euphorbiaceae.
94	Pimpal	<i>Ficus religiosa</i>	Urticaceae.
95	Pipar	<i>Ficus tsiela</i>	Urticaceae.
96	Ranlimbu	<i>Atlantia racemosa</i>	Rutaceae.
97	Raktarohida	<i>Maba nigrescens</i>	Ebenaceae.
98	Ranjan (Rayan khirni)	<i>Mimusops hexandra</i>	Sapotaceae.
99	Ritha	<i>Sapindus emarginata</i>	Sapindaceae.
100	Sag (Teak)	<i>Tectona grandis</i>	Verbenaceae.
101	Satvin	<i>Alstonia scholaris</i>	Apocynaceae.
102	Sawar	<i>Bombax malabarica</i> (Syn. <i>Salmalia malabarica</i>).	Malvaceae.
103	Shemat	<i>Odina wodier</i> (Syn. <i>Lannea grandis</i>)	Anacardiaceae.
104	Shenkhair	<i>Acacia suma</i> (Syn. <i>Lannea coromandellica</i>)	..
105	Shendri or Kamala	<i>Mallotus philippinensis</i>	Euphorbiaceae.
106	Shindi	<i>Phoenix sylvestris</i>	Palmae.
107	Shiras	<i>Albizzia lebbek</i>	Leguminosae.
108	Shiras (Kala)	<i>Alibissia odoratissima</i>	Leguminosae.
109	Shivan	<i>Gmelina arborea</i>	Verbenaceae.
110	Shisham	<i>Dalbergia latifolia</i>	Leguminosae.
111	Suru	<i>Casuarina equisetifolia</i>	Casuarineae.
112	Tembhurni	<i>Diospyros melanoxylon</i>	Ebenaceae.
113	Tiwas	<i>Ougeinia dalbergioides</i> (Syn. <i>Ougeinia cojeinensis</i>).	Leguminosae.

Serial No.	Local name	Botanical (Latin) name	Natural order
(1)	(2)	(3)	(4)
Trees—cont.			
114	Tetu	<i>Oroxylum indicum</i>	Bignoniaceae.
115	Tiwar	<i>Avicennia alba</i>	Verbenaceae.
116	Toddy palm	<i>Borassus flabellifer</i>	Palmae.
117	Umbar	<i>Ficus glomerata</i>	Urticaceae.
118	Undi	<i>Calophyllum inophyllum</i>	Guttiferae.
119	Vad	<i>Ficus bengalensis</i>	Urticaceae.
120	Warang	<i>Kydia calycina</i>	Malvaceae.
121	Waras	<i>Heterophragma roxburghii</i> (Syn. <i>Heterophragma quadriculata</i>).	Bignoniaceae.
122	Wawali or Papara	<i>Holoptelea integrifolia</i>	Urticaceae.
Shrubs			
1	Adulsa	<i>Adhatoda vasica</i>	Acanthaceae.
2	Dhaiti	<i>Woodfordia floribunda</i> (Syn. <i>Woodfordia fruticosa</i>).	Lythraceae.
3	Ghaneri	<i>Lantana camara</i>	Verbenaceae.
4	Ghayapat	<i>Agave americana</i>	Cactaceae.
5	Gultora	<i>Lantana alba</i>	Verbenaceae.
6	Kanfuti	<i>Moghania strobilifera</i>	Leguminosae.
7	Karoi	<i>Strobilanthus callosus</i>	Acanthaceae.
8	Kaladhotra	<i>Datura fastuosa</i>	Solanaceae.
9	Karawandi	<i>Carissa carandas</i>	Apocynaceae.
10	Kalsunda or Pivli koranti	<i>Barleria prionitis</i>	Acanthaceae.
11	Kevani (Muradsheng)	<i>Helicteres isora</i>	Sterculiaceae.
12	Khulkhula	<i>Crotolaria retusa</i>	Leguminosae.
13	Mogli or Ranerand	<i>Jatropha curcas</i>	Euphorbiaceae.
14	Nirgudi	<i>Vitex negundo</i>	Verbenaceae.
15	Nivdung (Prickly pear)	<i>Opuntia dillenii</i>	Cactaceae.
16	Phangala (phangali)	<i>Pogostemon purpuria</i>	Labiatae.
17	Rantur	<i>Moghania species</i>	Leguminosae.
18	Rmetha	<i>Lasiosiphon eriocephalus</i>	Thymelaceae.
19	Ranbhendi	<i>Thespesia lampas</i>	Malvaceae.
20	Rantulashi	<i>Ocimum gratissimum</i>	Labiatae.
21	Rui	<i>Calotropis gigantea</i>	Asclepiadaceae.
22	Shikekai	<i>Acacia concinna</i>	Leguminosae.
23	Suran	<i>Amorphophallus campanulatus</i>	Araceae.
24	Thor	<i>Euphorbia ligularia</i>	Euphorbiaceae.
25	Toran	<i>Zizyphus rugosa</i>	Rhamnaceae.
26	Ukshi	<i>Calycotris floribunda</i>	Combretaceae.

Serial No.	Local name	Botanical (Latin) name	Natural order
(1)	(2)	(3)	(4)
Herbs			
1	Anant Mul (Upalaxari or Indian Sarsaparila).	<i>Hemidermus indicus</i>	Asclepiadaceae.
2	Bhinguli	<i>Indigofera enneaphylla</i>	Leguminosae.
3	Burada	<i>Blumea lacera</i>	Compositae.
4	Chikara	<i>Desmodium pulchellum</i>	Leguminosae.
5	Dindi	<i>Leea macrophylla</i>	Ampelideae.
6	Kajra (Kuchla)	<i>Strychnos nux-vomica</i>	Loganiaceae.
7	Litchi	<i>Urena lobata</i>	Malvaceae.
8	Papadi	<i>Pavetta tomentosa</i>	Rubiaceae.
9	Rankel	<i>Musa superba</i>	Scitamineae.
10	Ranhalad or Sholi	<i>Curcuma aromatica</i>	Scitamineae.
11	Rankanda	<i>Scilla indica</i>	Liliaceae.
12	Sarp mukha	<i>Tephrosia purpurea</i>	Leguminosae.
13	Sonki	<i>Senecio grahami</i>	Compositae.
14	Tarota or Takala	<i>Cassia tora</i>	Leguminosae.
15	Vikhara Talimkhana	<i>Asteracantha longifolia</i>	Acanthaceae.
Climbers			
1	Alsi	<i>Dalbergia volubilis</i>	Leguminosae.
2	Bhuikohala	<i>Ipomea digitata</i>	Convolvaceae.
3	Chilhari	<i>Caesalpinia sepiaria</i>	Leguminosae.
4	Gunj	<i>Abrus precatorius</i>	Leguminosae.
5	Gulvel (Amarvel)	<i>Tinospora cordifolia</i>	Menispermaceae.
6	Kanguni	<i>Celastrus paniculata</i>	Celastraceae.
7	Kantharyel	<i>Capparis sepiaria</i>	Capparideae.
8	Kuhili	<i>Mucuna pruriens</i> (Syn. <i>Mucuna pruriata</i>).	Leguminosae.
9	Kusari	<i>Jasminum arborescens</i>	Oleaceae.
10	Madvel Modvel Bokadvel	} <i>Combretum ovalifolium</i>	Combretaceae.
11	Mastod	<i>Capparis spinosa</i> (<i>Zizyphus oenoplia</i>)	Capparideae.
12	Moravel or Ranjai	<i>Clematis triloba</i>	Ranunculaceae.
13	Nandanvel	<i>Vitis repanda</i>	Ampelideae.
14	Palasvel	<i>Butea superba</i>	Leguminosae.
15	Phulsun	<i>Spatholobus roxburghii</i>	Leguminosae.
16	Sakalvel	<i>Ventilago madraspatana</i>	Rhamnaceae.
17	Ukshi	<i>Calycopteris floribunda</i>	Combretaceae.
18	Valhiwala	<i>Millettia racemosa</i>	Leguminosae.
19	Watvel	<i>Cocculus macrocarpus</i>	Menispermaceae.
20	Wagati	<i>Wagatea spicata</i>	Leguminosae.
21	Wag, Gowindi	<i>Capparis horrida</i> (Syn. <i>Capparis Zeylanica</i>). (Syn. <i>Capparis roxburghii</i>).	Capparideae.

Serial No.	Local name	Botanical (Latin) name	Natural order
(1)	(2)	(3)	(4)
Bamboos			
1	Bundi or Char	<i>Oxytenanthera monostigma</i>	Gramineae.
2	Marvel	<i>Dendrocalamus strictus</i>	Gramineae.
3	Padhai or Katas	<i>Bambusa arundi nacea</i>	Gramineae.
Grasses			
1	Ber	<i>Ischaemum rugosus</i>	Gramineae.
2	Bhale Kusal	<i>Andropogon triticus</i>	Gramineae.
3	Bhongrut (Phulera, Phil)	<i>Anthistiria ciliata</i> (Syn. <i>Themeda quadrivalvis</i>)	Gramineae.
4	Bhuri	<i>Aristida paniculata</i>	Gramineae.
5	Boru	<i>Andropogon halepensis</i> (Syn. <i>Sorghum helepense</i>)	Gramineae.
6	Chirka	<i>Eragrostis tremula</i>	Gramineae.
7	Dongari gavot	<i>Andropogon monticola</i>	Gramineae.
8	Ghanya, Marvel	<i>Andropogon pertusus</i>	Gramineae.
9	Gondval	<i>Andropogon pumilis</i>	Gramineae.
10	Harali (Duroa)	<i>Cynodon dactylon</i>	Gramineae.
11	Kunda	<i>Ischaemum pilosum</i>	Gramineae.
12	Kother	<i>Woodrowia diandra</i>	Gramineae.
13	Kusali	<i>Andropogon contortus</i> (Syn. <i>Heteropogon contortus</i>)	Gramineae.
14	Lavhala	<i>Rottboellia perforata</i>	Gramineae.
15	Marvel	<i>Andropogon annulatus</i> (Syn. <i>Dichanthium annulatum</i>)	Gramineae.
16	Pavnya	<i>Ischaemum sulcatum</i>	Gramineae.
17	Phool	<i>Themeda triandra</i>	Gramineae.
18	Rosha	<i>Andropogon schoenanthus</i>	Gramineae.
19	Sheda	<i>Ischaemum laxum</i>	Gramineae.

GLOSSARY OF LOCAL TERMS

Serial No.	Local Term	Meaning
(1)	(2)	(3)
1	<i>Adiwasi</i>	Aboriginals, the original and primitive natives of the territory.
2	<i>Dalhi Cultivation</i>	Plots given out for cultivation to encourage human habitation in lonely part of the forests for the supply of labour.
3	<i>Datan</i>	A brush for cleaning the teeth made out of tender shoots of trees.
4	<i>Gairan</i>	Protected forests (of <i>Ex-Jawhar State</i>) set apart for grazing and for exercise of sanctioned privileges.
5	<i>Injaili species</i>	Junglewood or species other than teak.
6	<i>Geru</i>	A coloured earthy powder used for marking.
7	<i>Jamabandi</i>	Revenue settlement.
8	<i>Kacha (roads)</i>	Temporary (roads).
9	<i>Kharabas</i>	Very steep unworkable areas.
10	<i>Kolpat</i>	Deadwood.
11	<i>Kuran</i>	Pasturage reserved for grass cutting and grazing.
12	<i>Malki lands</i>	Lands belonging to private individuals.
13	<i>Mazdoor</i>	Labourers.
14	<i>Nala</i>	Stream.
15	<i>Rab</i>	A patch of ground which is given a good burn and used for regeneration purposes.
16	<i>Shikari</i>	A hunter.
17	<i>Tahal</i>	Leafy branches of trees.
18	<i>Tahasil, Taluka</i>	Administrative unit of a District.
19	<i>Vanamahotsawa</i>	Festival of tree planting.
20	<i>Vanmakta</i>	Collection of forest produce on payment of fees.
21	Quality I	Over 90' Height of mature dominant trees.
	Quality II	Over 70'—90' Height of mature dominant trees.
	Quality III	Over 50'—70' Height of mature dominant trees.
	Quality IVa	Over 40'—50' Height of mature dominant trees.
	Quality IVb	Upto 40' Height of mature dominant trees.

ABBREVIATIONS USED

A. C. F.	..	..	Assistant Conservator of Forests.
B. F. M.	..	..	Bombay Forest Manual.
B. G.	..	..	Broad Gauge.
b. h.	..	..	Breast height.
C. A. I.	..	..	Current annual increment.
C. B. O.	..	..	Cutting back operations.
Cf.	..	..	Compare.
D. F. O.	..	..	Divisional Forest Officer.
Dn., Divn.	..	..	Division.
F. L. C. Societies	..	..	Forest Labourers' Co-operative Societies.
I. F. A.	..	..	Indian Forest Act.
M. A. I.	..	..	Mean annual increment.
M. F. P.	..	..	Minor Forest Produce.
No.	..	..	Number.
P. B.	..	..	Periodic Block.
Perm.	..	..	Permanent.
R. F. O.	..	..	Range Forest Officer.
Sec.	..	..	Section.
Temp.	..	..	Temporary.

PART I.—SUMMARY OF FACTS ON WHICH PROPOSALS ARE BASED

CHAPTER I.—THE TRACT DEALT WITH

Section 1.—Name and Situation

The plan will be known as the "Working Plan for the Reserved Forests of Thana District". It deals with all the reserved forests of 2892·28380 sq. km. in Thana District and that of 10·08881 sq. km. in Poona district; at present distributed in three Forest Divisions *viz.*, (i) Dahanu, (ii) Thana and (iii) Shahapur.

2. The area covered by the plan lies between longitudes 70°-42' and 73°-50' East and between latitudes 19°-1' and 20°-14' North. It is bounded on the North by Surat district of Gujarat State, on the East by Nasik, Ahmednagar and Poona districts, on the South by Kolaba district and Greater Bombay and on the West by the Arabian sea.

Section 2.—Configuration of the Ground

3. The tract is hilly and at places precipitous. The hills are the outer ranges of the Western Ghats (the Sahyadries) which run along the eastern boundary through the Nane Ghat on the border of Poona district. Some of the well known peaks situated in this tract, their altitudes and the names of ranges in which they are situated are as under :—

Name of the Peak (1)	Elevation above M. S. L. (2)	Name of Range (3)
(i) Harischandragad	1425·5 m (4679')	Tokawada.
(ii) Ajoba Hill	1381·6 m (4535')	Washala.
(iii) Bhatgad	1099·1 m (3607')	Vihigaon.
(iv) Sidgad	886·3 m (2923')	Murbad.
(v) Mahuli Fort	818·4 m (2686')	Shahapur.
(vi) Malangad (Haji-Malang)	790·0 m (2595')	Badlapur.
(vii) Gambhargad	686·4 m (2252')	Udhava.
(viii) Tungar	663·3 m (2176')	Mandavi.

4. The main drainage is from the east to west through Ulhas and Vaitarna rivers which flow towards the west into the Arabian sea. Their chief tributaries are Kalu, Bhatsa, Surya, Deherja, Pinjal and Tansa rivers. There are many creeks, some of them extending in land up to 25 km. (15 miles). The main creeks are the Dahanu creek, the Vasai (Bassein) creek, the Vaitarna creek and the Thana creek.

Section 3.—Geology, rock and soil

5. The geological information about Thana district is rather scanty as a thorough geological survey of the area has not yet been made by the Geological Survey of India. The main geological formation in the district are :—

- (i) Sub-Recent-Recent Soil.
- (ii) Pleistocene-Recent Laterite.
- (iii) Upper Cretaceous-Eocene Deccan trap.

The upper-cretaceous-eocene and the pleistocene-recent formations are rocks and the sub-recent-recent formation is a resultant soil layer obtained on disintegration of rocks.

A.—Rocks

6. *Upper cretaceous eocene*.—The Deccan trap covers almost the entire district and consists of the usual horizontal layers of basaltic lava. The rocks are generally grey to green in colour. The non-vesicular forms are hard, tough, compact and medium to fine grained, breaking with a conchoidal fracture. The vesicles are filled with various minerals such as quartz, amethyst, calcite, agate, zeolite and jasper.

7. *Pleistocene-Recent*.—Laterite is a compact and vesicular rock essentially composed of hydrated oxides of aluminium and iron with small amounts of oxides of manganese and titanium. Generally it is reddish brown in colour. Laterite is found at many places particularly on the crest of hills where it forms cappings over the Deccan-trap. It is found in Mokhada Mahal, e.g., near the rest house at Suryamal. It is not very common in forest areas.

B.—Soils

8. *Sub-Recent-Recent*.—The typical soil derived from the Deccan-trap is the "regur" or "black cotton soil." The black soil contains high alumina and carbonates of calcium and magnesium with variable amount of potash, low nitrogen and phosphorus. The soil is generally porous and swells considerably on addition of water and dries up with cracks on losing moisture. The "black cotton soil" is usually found in the flat areas, which have almost pure crop of *ain*.

9. In the hilly areas the soil is loamy and varies greatly in colour, depth and texture. On the upper slopes it is generally lighter in colour, shallow and murrumy in texture. On the lower slopes and in the valleys it is darkish brown, fairly deep, rich in humus. The difference in the soil on the lower and upper slopes is reflected in the quality and composition of the crop found on these slopes. On the upper slopes the crop is of poorer quality and consists of more xerophytic and inferior species like *Kandol*, *Pangara*, *Kakad Shemat*, *Tivas*, etc.

10. Red soil is found in Badlapur, Jawhar, Tokawada and Vihizon ranges.

11. Deep soils are found in the coastal area and along banks of rivers. The soil in the *Casuarina* Plantations on the coast is almost pure sand while the soil in the *babul* forest along the Vaitarna river (in Dahisar range) is deep alluvium. The results of the analysis of 8 samples of soils collected from different localities are given in Appendix No. I. The results of soil analysis show that the soils vary in texture from sandy loams to clays. Also the soils are acidic (Ph. is less than 7).

12. Deposits of bauxite are found on the Tungar hills. The ore is stated to be of fairly good quality. The Al_2O_3 content varies from 30.85% to 58.66%.

13. Hotsprings are found in the bed as well as on the banks of the Thansa river at Ganeshpuri and Vajreshwari (Mandavi range).

Section 4.—Climate

14. The climate of Thana district is generally hot and humid. The maximum and minimum temperatures vary between $45^{\circ}C$ and $12^{\circ}C$. The diurnal range of variation in temperature does not normally exceed $17^{\circ}C$. The figures of monthly mean maximum and mean-minimum temperatures at Dahanu, Thana and Shahapur are given in Appendix No. II. From these figures it is seen that the difference in the mean maximum and mean-minimum temperatures is the least at coastal places like Dahanu ($32.2^{\circ}C$ and $16.8^{\circ}C$), while it is highest in places away from the coast like Shahapur ($44.5^{\circ}C$ and $12.2^{\circ}C$). The climate is pleasant during the winter, i.e., from November to February when the humidity is low. Summer lasts from March to June. During this season the climate is very warm particularly in the eastern region which is away from the sea. In the coastal region the climate during the summer is warm and humid. The effect of this difference in the climate is evident in the better growth of teak in Dahanu and Thana divisions than in Shahapur division.

15. The rains are brought by the South-West Monsoon, which breaks by the 2nd week of June. Regular rainy season starts from the 3rd week of June and lasts till middle of October. Occasional showers due to low pressure systems in East Arabian Sea are obtained in November or December. Heaviest rainfall occurs during July and August. Average annual rainfall in this area is 3075.48 mm. (121.1 inches). Statements showing the monthly rainfall data recorded at all the tahasil headquarters in Thana district from 1953 to 1962 and the monthly average for the 10 years are given in Appendix No. III. From these statements it is evident that the rainfall at places away from sea like Shahapur (3322.62 mm.) Jawhar (3432.69 mm.) and Vada (3501.9 mm.) is more than that at coastal places like Dahanu (2696.85 mm.) and Bassein (2540.01 mm.). This is because of the proximity of former places to the hills.

16. Prevailing winds are from the West and are generally of moderate velocity. Sometimes the area is hit by cyclones particularly in the months of October and November. The cyclones of 1903, 1940 and 1948 caused heavy damage to the forests by uprooting mature trees of teak (*Tectona grandis*) which is more susceptible to wind damage on account of its shallow root system.

17. Dew is very heavy in the months following the monsoons and persists in some places till the end of February. Frost is unknown in this area.

Section 5.—Water-supply

18. The various rivers which flow through this area provide water to the villages situated nearby. However many of the rivers particularly the small ones dry up during the hot season especially in April and May. The same thing happens perhaps earlier in case of springs, nallas and ponds on which a large number of villages depend for their supply of water. The District Local Board and later on the Zilla Parishad have constructed a number of wells to supply water to villages. But a large proportion of these wells too dry up in the hot season. Thus in spite of the heavy rainfall received during the monsoons, large tract of the district suffers from acute shortage of water during the hot season. This shortage is particularly felt in the eastern portion, i.e., in Shahapur, Murbad, Kalyan, Mokhada and Jawhar tahasils. In these tahasils the water is often infested with guinea worms during the summer. The position of water supply in the coastal region, i.e., in Dahanu, Talasari, Palghar, Bassein, Thana and Vada tahasils is much better. Here the depth of the water table varies from 3 to 6 metres as against 6 to 12 metres or even more in the eastern region. A statement containing the record of water level in important wells is given in Appendix No. IV.

Section 6 —Distribution and Area

19. The registers of reserved forests (Form No. I) have been brought up to date, i.e., up to 31st March 1962. The entries are verified with Notifications and correction wherever necessary have been carried out. As per planimetry the area is 2902.37261 square km. or 290237.261 hectares (1120.62 sq. m.). Out of this, an area of 2892.28380 square km. or 289228.380 hectares (1116.73 square miles) is distributed in 988 villages of Thana district and the remaining area of 10.08881 square km. or 1008.881 hectares (3.89 square miles) is distributed in 2 villages of Poona district.

The area of reserved forests works out to 31.80 per cent of the total land area of Thana district. The reserved forests are distributed into three divisions as under :—

Division	Area in Sq. km. (In sq. miles)	
	(1)	(2) (3)
Dahanu	1115.59102	(430.73)
Shahapur	914.13406	(352.95)
Thana	872.64843	(336.94)
Total	2902.37261	(1120.62)

A statement of area by sheets and ranges is given in Appendix No. V.

20. The forests do not generally occur in large compact blocks but are mostly distributed in numerous scattered small blocks surrounded by the protected forests, private cultivations (maliki lands) or revenue waste lands. The biggest block is 437.51310 square km. in extent while the smallest is only 0.0182 square km.

Section 7.—State of Boundaries

21. The boundaries of the reserved forests are demarcated by cairns of loose stones erected at suitable intervals. The cairns are second class boundary marks as specified in "A" 123 of B. F. M., Vol. II. Boundary lines are also cleared up to a width of 6 metres (20 feet). The boundary lines are cleared every year. The pillars are also well maintained but they are not numbered. The length of the reserved forest boundary in the three forest divisions is as under:—

Division	Length of boundary in Km.		
	Natural	Artificial	Total
(1)	(2)	(3)	(4)
Dahanu	98.975 (61 M-3½ F)	2141.835 (1330 M-7 F)	2240.811 (1392 M-2½ F)
Thana	62.764 (39 M)	1615.580 (1003 M-7 F)	1678.345 (1042 M-7 F)
Shahapur	212.433 (132 M)	1507.754 (936 M-7 F)	1720.188 (1068 M-7 F)
Total ..	374.172 (232 M-3½ F)	5265.169 (3271 M-5 F)	5639.344 (3504 M-½ F)

Note.—The figures in the brackets are in miles and furlongs.

Section 8.—Legal position

22. Most of the forests covered by this plan were notified as reserved forests under Section 20 of the Indian Forest Act under various Notifications published from 1884 to 1898. The first Notification was published as early as 1884 under which the forests of Salsette taluka were declared as reserved forests. The number and dates of notifications under which the forests of the various talukas were declared as reserved forests are given in Appendix No. VI. A list of Notifications under which areas were disforested under section 27 of the Indian Forest Act is given in Appendix No. VII.

Section 9.—Rights and concessions

23. The forests are not burdened with rights except the right of way and water. The special privileges sanctioned for the Thana district are reproduced in Appendix No. VIII. They specify the minor forest products like grass, dead leaves, bamboos, *karvi*, thorns, etc., which the villagers can collect and the shrubs which they can cut for wood-ash manure.

CHAPTER II.—THE FORESTS

Section 1.—Composition and Condition of the Crop

A.—Ecological types

24. The forests of Thana district can be grouped under the following types as per the "Revised Classification of Indian Forest Types" by Champion and Seth :—

- (i) 3B/C1—Moist teak bearing forests.
- (ii) 3B/C2—Southern moist mixed deciduous forests.
- (iii) 4B/TS1—Mangrove scrub.
- (iv) 8A/C2—Western sub-tropical hill forests.

25. *The moist teak bearing forests.*—More than 90 per cent of the forests of Thana District belong to this type. Within this main type considerable local variations in the composition and quality of the crop are observed. These variations are mainly due to the edaphic factors, however, other factors like topography, biotic influences and past treatment are also responsible for such variations. The revised classification of forest types of India by Champion and Seth has recognised three sub-types, viz. "very moist teak forest", "moist teak forest" and "slightly moist teak forest", this further classification of the type which is mainly based on the total annual rainfall cannot be applied to the Thana forests which have a more or less uniform rainfall of about 2500 mm. and over, all over the forest areas. However the following six main associations can be distinguished in this main type viz :—

- (i) The *teak-ain-kuda-karvand* association.
- (ii) The *teak-khair-kuda-takla* association.
- (iii) The *teak-dhavada-kuda-takla* association.
- (iv) The *ain-khair-koshimb-karvand* association.
- (v) The *kakad-shemat-kuda-takla* association.
- (vi) The *ain-bonda* association.

26. *The teak-ain-kuda-karvand* association.—This association is found all over the tract on sites having deep, well drained alluvial or loamy soil. The forests are mostly of quality III (height of mature trees from 50 to 70 feet) with occasional patches of quality II (height 70 to 90 feet) and quality I (height over 90 feet). Patches of forest of quality I are found only in Dabheri round of Jawhar range. The density of the crop of forests of this association varies from 0.5 to 0.7. The floristics are as under :

I. *Top canopy trees.*—Teak (*Tectona grandis*) (a), *Ain* (*Terminalia tomentosa*) (Va), *Khair* (*Acacia catechu*) (f), *Hed* (*Adina cordifolia*) (o), *Kalamb* (*Mitragyna parvifolia*) (o), *Bibla* (*Pterocarpus marsupium*) (o) etc.

II-*Second storey trees.*—The second storey is well defined and consists of *Kuda* (*Holarrhena antidysenterica*) (f), *Karambel* (*Dillenia pentagyna*) (f), *Kumbhi* (*Careya arborea*) (f), *Palas* (*Buteamonosperma*) (o), *Tembhurni* (*Diospyres melanoxylon*) (o), etc.

II (a) *Bamboos.*—They are : *Katas Bamboo* (*Bambusa arundinacea*) (f), and *Manvel bamboo* (*Dendrocalamus strictus*) (f). The latter species is generally found on upper slopes where drier conditions than those on lower slopes prevail. Clumps of both the species of bamboos died after gregarious flowering during 1959 to 1960 and now young growth is present.

III. *Shrubs.*—The main species of shrubs are : *Karvand* (*Carissa carandas*), (Va), *Ukshi* (*Calycopteris floribunda*) (Va), *Murudsheng* (*Helicteres isora*) (f) and *Rantur* (*Moghania species*) (o).

IV (a) *Herbs*—The main herbs are :

Ranbhendi (*Thespesia lampas*) (o), *Burada* (*Blumea lacera*) (la), *Karvi* (*Carvia callosa*) (la), Particularly on higher slopes and *Litchi* (*Urena lobata*) (o).

IV (b) *Grasses.*—The main species of grasses are :

Koher (*Arundinella Setosa*), *Kusli* (*Andropogon contortus*), *Bhuri* (*Aristida paniculata*) *Phulera* (*Anthistiria ciliata*), *Marvel* (*Andropogon annulatus*), *Ber* (*Ischaemum rugosus*) etc.

V-Climbers.—The main species of climbers are :

Ukshi (*Calycopteris floribunda*) (f), *Modwel* (*Combretum ovalifolium*) (f), *Pallaswel* (*Butea superba*) (o), *Kuhili* (*Mucuna Pruriata*) (o), *Chilhar* (*Caesalpinia sepiaria*) (o), *Kusari* (*Jasminum arborescens*) (o), etc.

Note.—(Va)—Very abundant, (a)=abundant, (f)=frequent, (c)=common, (o)=occasional, (r) rare, (la)=locally abundant.

27. The *teak-khair-kuda-karvand* association.—This association is found near Ganja in Dahisar range. The area is flat to undulating and the soil is deep sandy loam. Teak and *Khair* form more than 75 per cent of the crop. *Ain* is very sparse. Other species in the overwood and the underwood are the same as in the *teak-ain-kuda-karvand* association mentioned above but their proportion is low. Undergrowth is very sparse and mainly consists of *karvand* and *Ukshi*. Bamboos are absent while growth of grass is poor. Profuse natural regeneration of *khair* is present.

28. The *teak-dhavada-kuda-takla* association.—This association occurs on the upper slopes of hills which are exposed to severe winds and soil erosion and on flat tops of hills having shallow rocky soil. This is also found in areas subjected to frequent fires and heavy damage by hacking and grazing due to proximity to villages etc. The quality of forests is generally IVa with occasional patches of quality III. Where the soil is very poor, the quality deteriorates to IVb. Density of the crop varies from 0.4 to 0.6. The floristics are as under :—

I—*Teak* (*Tectona grandis*) (a), *Dhavada* (*Anogeissus latifolia*) (f), *kakad* (*Garuga pinnata*) (f), *Shemat* (*lannea coromandellica*) (f), *Sawar* (*Salmalia malabarica*) (o), etc.

II—*Kuda* (*Holarrhena antidysenterica*) (f), *Kudi* (*Wrightia tomentosa*) (f), *Chera* (*Erinocarpus nimmoanus*) (o).

II (a)—*Manvel* (*Dendrocalamus strictus*) (o), this has mostly died after flowering, *Bundi* (*Oxytenanthera monostigma*) (o).

III—*Karvand* (*Carissa carandas*) (f), *Ukshi* (*Calycopteris floribunda*) (f).

IV (a)—*Takla* (*Cassia tora*) (o), *Karvi* (*Carvia callosa*) (la).

IV (b)—*Kusali* (*Andropogon contortus*), *Kother* (*Arundinella setosa*), *Phulera* (*Anthistiria ciliata*), *Kunda* (*Ischaemum pilosum*).

V—*Kuhili* (*Mucuna pruriata*) (o), *Mastodi* (*Capparis spinosa*) (o).

29. The *ain-khair koshimb-karvand* association.—This association occurs on deep alluvial soil found along banks of rivers or nallas and on the lower slopes of the hills. *Ain* and *khair* are the characteristic species. The quality of the forests is mostly III with occasional patches of quality II (found in Sawa range near Saivan). Density of the crop varies from 0.5 to 0.7. The floristics are as under :—

I—*Ain* (*Terminalia tomentosa*) (Va), *Khair* (*Acacia catechu*) (a), *Hed* (*Adina cordifolia*) (f), *Kalamb* (*Mitragyna parvifolia*) (f), *Koshimb* (*Schleichera oleosa*) (f), *Teak* (*Tectona grandis*) (o), *Shisham* (*Dalbergia latifolia*) (o), *Bibla* (*Pterocarpus marsupium*) (o), *Nana* (*Lagerstroemia microcarpa*) (o), *Shiras* (*Albizzia lebbek*) (o), *Kinhai* (*Albizzia procera*) (o), *kala Shiras* (*Albizzia odoratissima*) (o), *Mango* (*Mangifera indica*) (o), *Jambhul* (*Syzygium cumini*) (o), *Asana* (*Bridelia retusa*) (o), *Arjun sadada* (*Terminalia arjuna*) (o), *Pharadi* (*Albizzia chinensis*) (f), *Waras* (*Heterophragma quadriculata*) (o), *Chamoli* (*Bauhinia foveolata*) (o), etc.

II—*Karambel* (*Dillenia pentagyna*) (f), *Kumbhi* (*Careya arborea*) (f), *Palas* (*Butea monosperma*) (o), *Tembhurni* (*Diospyros melanoxylon*) (o), *Tiwas* (*Ougenia dalbergioides*) (o), *Awaii* (*Embllica officinalis*) (o), *Bhokar* (*Cordia myxa*) (o), *Humbl* (*Miliusa tomentosa*) (o), *Karani* (*Pongamia pinnata*) (o), *Bava* (*Cassia fistula*) (o), *Lokhandi* (*Ixora nigricans*) (r), *Shendri* (*Mallotus philippinensis*) (r) etc.

II (a)—*Katas bamboo* (*Bambusa arundinacea*) (f), and *Manvel bamboo* (*Dendrocalamus strictus*) (o). The later species is generally found on the upper slopes. Both the bamboos have died after gregarious flowering.

III—*Karvand* (*Carissa carandas*) (Va), *Ukshi* (*Calycopteris floribunda*) (Va), *Murudsheng* (*Helicteres isora*) (f), *Rantur* (*Moghania strobilifera*) (o), *Adulsa* (*Adhatoda vasica*) (r), *Ghaneri* (*Lantana camara*) (r), *Dhaity* (*Woodfordia fruticosa*) (o).

IV(a)—*Ranbhendi* (*Thespesia lampas*) (f), *Karvi* (*Carvia callasa*) (la), *Rankel* (*Musa superbo*) (o), *Litchi* (*Urena lobata*) (o), *Indigifera* sp. (o), and a number of species of *Labiatae*, *Malvaceae*, *Compositae* and *Solanaceae* families.

IV(b)—*Kother* (*Arundinella setosa*), *Kusali* (*Andropogon contortus*), *Phulera* (*Anthistiria ciliata*) etc. The grasses are not abundant.

V—*Ukshi* (*Calycopteris floribunda*) (f), *Modwel* (*Combretum ovalifolium*) (f), *Palaswel* (*Butea superba*) (o), *Chilhar* (*Caesalpinia sepiaria*) (o), *Gunj* (*Abrus precatorius*) (o), *Kuhili* (*Mucna pruriata*) (o), *Kusari* (*Jasminum arborescens*) (o), *Waghathi* (*Wagatea spicata*) (r), *Nandanvel* (*Vitis repanda*) (o), *Mastod* (*Capparis spinosa*) (o), *Kanguni* (*Celastrus paniculata*) (r), *Alsi* (*Dalbergia volubilis*) (r), *Chambuli* (*Bauhinia vahlii*) (o), etc.

30. The *kakad-shemat-kuda-takla* association.—This association occurs on poorer sites *i. e.*, upper slopes of hills or locally on patches with exposed rocks. The site quality is generally IV-a with occasional patches of low III quality. Where the soil is very poor, the quality deteriorates to IV-b. Density of the crop varies from 0.4 to 0.6. The floristics are as under :—

I—*Kakad* (*Garuga pinnata*) (f), *Shemat* (*Lannea coromandellica*) (f), *Teak* (*Tectora grandis*) (o), *Sawar* (*Salmalia malabarica*) (o), *Dhavada* (*Anogeissus latifolia*) (f), *Panagra* (*Erythrina variegata*) (o), *Bhndara* (*Lagerstroemia parviflora*) (o), *Kandol* (*Sterculia urens*) (o), *Kadwai* (*Hymenodictyon excelsum*) (o), *Kukeri* (*Sterculia guttata*) (r), *Khavas* (*Fermiana cclarata*) (r).

II—*Kuda* (*Holarrhena antidysenterica*) (f), *Kudi* (*Wrightia tomentosa*) (o), *Chera* (*Erinocarpus nimmoanus*) (o), *Bor* (*Zizyphus mauritiana*) (r), *Kirmira* (*Casearia tomentosa*) (o), *Petari* (*Trewia nudiflora*) (la), etc.

II(a)—*Manvel* (*Dendrocalamus strictus*) (o), it has died after flowering, *Bundi* (*Oxytenanthera monostigma*) (o).

III—*Karvand* (*Carissa carandas*) (f), *Ukshi* (*Calycopteris floribunda*) (f), *Dhaity* (*Woodfordia fruticosa*) (o), *Ghaneri* (*Lantana camara*) (r), *Thor* (*Euphorbia ligularia*) (r), etc.

IV(a)—*Takla* (*Cassia tora*) (o), *Burada* (*Blumea lacere*) (la), *Karvi* (*Carvia callosa*) (la), *Litchi* (*Urena lobata*) (o), etc.

IV(b)—*Kusali* (*Andropogon contortus*), *Kother* (*Arundinella setosa*), *Phulera* (*Anthistiria ciliata*), *Phool* (*Themeda triandra*).

V. Climbers are rare.

31. The *ain-bonda* association.—This association is mostly found in Tokawada and Washala ranges on the foothills of the Western Ghats. The soil is shallow and poor in humus content. Site quality is IVa and IVb. Average density is 0.5. *Ain* and *bonda* are most common species and constitute more than 75 percent of the crop. *Teak* is practically absent. Other associates in the overwood are the same as in the *kakad-shemat-kuda-takla* association but their proportion is less. Underwood is not very well defined and mainly consists of *kuda* and *kudi*. Undergrowth is sparse, while climbers are rare. Bamboos are absent.

32. The southern moist *Mixed deciduous forests*.—This type occurs in parts of Gokhivara range. (Nagla forest near Bassein creek and on the middle slopes of Tungar hill). The soil is deep and rich in humus. Site quality is III. Density varies from 0.5 to 0.7. *Ain* is conspicuous by its absence. *Teak* is occasionally found but its proportion is low (5 to 10 percent). Proportion of evergreen species like ficus species, *moha*, *mango*, and *tad* palm (*Borassus flabellifer*) in the overwood and *shendri*, *lokhandi*, in the underwood is more. The floristics structure otherwise greatly resembles that of the *ain-khair-koshimb-karvand* association except for the absence of *ain*. There is profuse regeneration of *manvel* and *katas* bamboos both of which have died after flowering. Climbers are numerous. Growth of grass is sparse.

33. The *mangrove scrub forests*.—This type is found in the reserved forests in small patches along the Bassein creek in Gokhivara range (near Nagla). It is more commonly found in the revenue waste lands along the creeks in Bassein and Salsette *Tahsils*. It is more or less dense forest of very low average height. The crop consists of almost exclusively of *tiwar* (*Avicennia alba*) and *maraudi* (*Acanthus ilicifolius*). The area is submerged by salt water at every tide. The soil is muddy.

34. *The western sub-tropical hill forests.*—This type is found on the higher slopes of the Western Ghats in Vashala and Tokawada ranges and also on the Tungar hills in Gokhiwara and Mandvi ranges. It occurs as a narrow strip between 500 to 1100 metres altitude. Locally the rainfall is higher than the average rainfall of the district. Temperature too is lower due to high altitude. The area is exposed to strong winds with the result that the height growth of the trees is poor except in the valleys. The soil is moderately deep to shallow with fair amount of humus. Site quality is mostly IVa, with occasional patches of quality III. Density is between 0.5 to 0.7. Being situated in the remote places, the forest is economically not very important. It is a semi evergreen type of forest with many evergreen species in the overwood and with underwood and undergrowth almost exclusively of evergreen species. The floristics are as under:—

I—Mango (*Mangifera indica*) (f), Karanj (*Pongamia pinnata*) (o), Kokam (*Garcinia indica*) (ra), Jambul (*Syzygium cumini*) (o), Undi (*Calophyllum inophyllum*) (f), Katekumbal (*Sideroxylon tomentosum*) (f), Shisham (*Dalbergia latifolia*) (o), Waras (*Heterophragma quadriculata*) (f), Asana (*Bridelia retusa*) (f), Hirda (*Terminalia chebula*) (f), Bheda (*Terminalia belerica*) (o), Wavala (*Holoptelea integrifolia*) (o), Bhoma (*Glochidion lanceolarium*) (o), Payar (*Ficus arnottiana*) (o), Bher Jambhul (*Ammannia baccifera*) (o), Par Jambhul (*Olea dioica*) (o), Chandada (*Macaranga peltata*) (o).

II—Lokhandi (*Ixora nigricans*) (f), Pandari (*Murraya paniculata*) (f), anjani (*Memecylon edule*) (a), Kadilimb (*Murraya koenigii*) (f), Koshimb (*Schleichera oleosa*) (f), Karavati (*Ficus hispida*) (o), Shendari (*Mallotus philippinensis*) (o), Dativ. (*Ficus heterophylla*) (o), Ranlimbu (*Atlantia racemosa*) (o).

IIa—Bomboos are absent.

III—Rametha (*Lasiosiphon eriocephalus*) (o), Thor (*Euphorbia ligularia*) (o), Khulkhula (*Crotolaria retusa*) (o), Dhaity (*Woodfordia fruticosa*) (o), Phangali (*Pogostemon purpuricaulis*) (o),

IVa—Sonki (*Senecio grahzi*) (o), Rankel (*Musa superba*) (o), Karvi (*Carvia callosa*) (Va), Dindi Leea (*macrophylla*) (o), Papadi (*Pavetta tomentosa*) (o). Climbers, orchids ferns and other herbs are numerous.

B—Local types

35. Four local types have been distinguished for the purpose of description of the crop and its management. They are (i) teak forest, (ii) mixed forest, (iii) *babul* forest and (iv) *casuarina* forest. *Babul* and *casuarina* forests are artificial forests consisting of plantations of these species. As regards other forests, those having more than 20 per-cent proportion of teak in the overwood are classed as “teak forests”, while those with less than 20 percent teak are classed as “mixed forest”. The teak and mixed forests can be further sub-divided in two sub-types each *viz.*, better quality and poorer quality teak forests and mixed forests.

36. *Teak forests.*—This type includes the most valuable forests of the district. The forests are valuable because of the occurrence of teak. The proportion of teak varies. On deep, rich and well-drained soils the proportion of teak is not more than about 30 per-cent. But in such localities the growth of teak is good. On poorer sites with shallow soils and particularly in areas which are subject to frequent fires and severe damage due to hacking etc. the proportion of teak is more than 50 per-cent but here the growth of the trees is not so good. Almost pure teak forests are confined to the teak plantations. On better sites the associates of teak are valuable timber species like *ain*, *khair*, *hed*, *Kalamb bibla* etc., while on poorer sites the associates are drier species like *dhavada*, *kakad*, *shemat*, etc. The three common associations found in the teak forests are “teak-*ain-kuda-karvand*” association, “teak-*khair-kuda-karvand*” association and “teak-*dhavada-kuda-takla*” association. The first two associations form the “better quality” sub-type, while the third forms the “poorer quality” sub-type. The floristics structure of the teak forest resembles the sub-types “moist teak forest” and “slightly moist teak forest” of the type “the moist teak forests” of Champion and Seth’s classification (*vide* para. 25).

37. *Mixed forests.*—This type is characterised by either the total absence or the low proportion of teak (less than 20 per cent) in the crop. It usually occurs in areas which have not been exposed to the adverse effects of biotic factors like fires, overgrazing, hacking etc. Such areas are generally remote being situated away from the habitation. Locally

this type also occurs in the more moist areas like nalla banks and shaded valleys. This type is more common in Tokawada and Washala ranges. Three kinds of associations are commonly found in this sub-type. They are: "*ain-Khair-kosimb-karvand*" association, "*kakad-shemat-kuda-takla*" association and "*ain-bonda*" association. The first association forms the "better quality" sub-type, while the later two associations constitute the "poorer quality" sub-type. The mixed forests often resemble the sub-type "very moist teak forest" of the type "the moist teak bearing forests" of Champion and Seth's classification (vide para. 25). The types "southern moist mixed deciduous forest" (vide para. 32) and the "western sub-tropical hill forest" (vide para. 34) have also been considered as "mixed forests" (better quality), because they contain very little teak.

38. *Casuarina* forests.—This forest consists of the plantations of *Casuarina equisetifolia* (*Suru*) along the sea-coast in Palghar, Dahanu and Bordi ranges of Dahanu division. These are pure *Casuarina* plantations. There is no underwood or undergrowth. In the younger plantations there is some ground cover consisting of herbs and grasses. But in older plantations even this is absent and the ground is covered with only the fallen needles of the *Casuarina* trees. From 1962-63. *Eucalyptus hybrid* is being planted in alternate lines along with *Casuarina*, as an experimental measure.

39. *Babul* forest.—This type occurs in a narrow strip along the Vaitarna river in Dashisar range. *Babul* was raised artificially by sowing. The area is flat and has deep loamy soil. Most of the *babul* trees were uprooted by storms. Almost a pure crop of *babul* is found in the regenerated areas. In the rest of the areas the crop is open, consisting of scattered trees of *petari*, *shenkhair* (*Acacia suma*) and *tad*-palm. Undergrowth consists of *karvand*, *ukshi* etc. Climbers are many. Thick growth of grasses exists.

General ecological observations

40. It is a common observation in the Thana forests that the proportion of teak and other drier species like *dhavada* increases with increase in the effect of biotic factors like fires, grazing, hacking, etc. Thus the forests near habitations usually have a high proportion of teak while remote places usually have a mixed forest with a low proportion of teak. In damp valleys and on shaded slopes the proportion of evergreen species like *mango*, *jaman shendri* etc. increases, while teak is practically absent. Thus the mixed forest appears to be the "climatic climax" of this area (corresponding to the very moist teak forest of southern moist mixed deciduous forest of Champion and Seth's revised classification of the forest types of India); while the teak forest is a "preclimax" and a semi evergreen type of forest would be the "post-climax". In many places, particularly where xerophytic conditions are aggravated due to biotic factors like fires, overgrazing and hacking, the teak forest appears to be of secondary origin as a result of retrogression, from the climatic climax. The abundance of *karvand* in the teak forests as an undergrowth though it is xerophytic species shows that the teak forest is either the pre-climax or is the result of retrogression.

Section 2.—Injuries to which the Crop is Liable

41. The most important agency causing serious damage to the forest is man and his cattle. The damage caused by other biotic agencies like wild animals, insects, weeds, climbers, parasites etc. is not serious. Amongst other agencies, serious damage is caused by soil erosion and cyclones. Frost is unknown, while damage by drought is negligible.

42. Man damages the forests in three ways viz., by (i) setting fires, (ii) illicit cutting of trees for timber, hacking of trees for firewood and lopping trees for "*tahal*" and (iii) removing leaf litter for *rab*-burning.

43. Fires are sometimes accidental, but more often they are intentional caused by *Shikaries* for driving game to convenient spot or by graziers for getting quicker growth of grass. Fires cause extensive damage to the reproduction by killing the young seedlings, while the scorching heat produces hollowness in saplings and poles. Fires also indirectly accelerate soil erosion by destroying the soil cover as well as humus. As a

result of this, there is less moisture-absorption and more run-off. Fire damage is more severe in Thana and Shahapur divisions particularly in Thana, Padgha, Shahapur and Dhasai ranges. Fire damage is comparatively less in Dahanu division. A statement showing the annual forest area burnt by fires in the three Thana divisions is given below :—

Year	Dahanu Division	Thana Division	Shahapur Division
(1)	(2)	(3)	(4)
(Area in hectares)			
1953-54	3,015.74	4,688.01	6,766.04
1954-55	1,957.48	1,749.88	6,676.21
1955-56	2,946.95	2,670.54	5,025.44
1956-57	1,408.71	1,034.38	3,202.31
1957-58	2,738.49	3,217.32	5,665.66
1958-59	1,152.56	1,412.36	2,861.34
1959-60	800.88	546.33	2,293.37
1960-61	1,989.99	555.24	1,417.83
1961-62	1,262.23	774.98	1,927.13
1962-63	1,354.10	1,787.92	2,220.93
1963-64	758.79	1,617.53	2,146.54
1964-65	576.67	764.75	1,998.33
1965-66	1,076.17	906.72	1,118.51
Total	20,738.76	20,625.98	43,319.54
Average area burnt annually	1,595.29	1,586.61	3,332.27

44. Damage by illicit cutting of trees for timber and firewood is common all over the forests. Illicit cutting of particularly teak and *khair* trees is heavier where means of communications for the quick removal of the illicit material are easily available e. g., areas along highways, roads, railway lines and creeks. In remote places like Udhawa, Dahisar and Tokawada ranges, this damage is not so serious. In Dahanu and parts of Shahapur division the local "adivasis" have developed a pernicious practice of disposing off illicitly cut timber. They build new houses out of this timber and after 3-4 years these houses are sold to persons who do the business of purchasing such old houses and selling the material at Ghoti in Nasik district which has gained reputation as an important market for old timber. After selling a house, the "adivasi" cuts more trees and builds another new house which will again be sold in 3-4 years as an old house. A statement showing the quantity and value of illicit material removed from the forests of the three divisions for ten years is given below. The statement gives recorded figures from offence cases. The actual quantity of material removed illicitly from the forests must be more.

Statement showing the quantity and value of illicit material illegally removed from the forests

Year	Dahanu Division		Thana Division		Shahapur Division	
	Material in cu. m.	Value in Rs.	Material in cu. m.	Value in Rs.	Material in cu. m.	Value in Rs.
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1953-54 ..	378.240	61,264.80	1,385.645	1,75,200.00	660.357	56,234.50
1954-55 ..	569.860	40,250.00	1,432.790	18,921.00	459.541	42,328.75
1955-56 ..	627.565	46,489.20	1,615.768	19,551.00	489.244	48,328.50
1956-57 ..	819.947	86,872.20	1,385.645	1,75,398.00	655.071	45,432.25
1957-58 ..	1,167.496	1,23,695.40	1,243.073	1,52,543.00	516.257	55,120.25
1958-59 ..	863.581	91,405.20	1,373.666	1,75,390.00	578.439	62,233.50
1959-60 ..	837.035	88,693.08	1,715.950	2,13,220.00	554.233	58,332.75
1960-61 ..	1,026.994	1,08,808.20	1,807.976	2,10,060.00	610.097	96,643.75
1961-62 ..	803.636	85,143.60	1,838.701	2,16,300.00	447.507	44,769.50
1962-63 ..	700.425	74,209.20	2,197.322	2,58,500.00	816.804	40,206.50
Total ..	6,994.779	8,26,920.88	15,996.536	14,13,283.00	5,757.550	5,49,630.25
Average quantity Removed annually	699.477	81,692.08	1,599.653	1,41,328.30	575.755	54,963.02
	(24,701.047 cft.)		(56,491.21 cft.)		(20,331.46 cft.)	

45. Hacking and cutting trees for firewood cause severe damage, as here all trees irrespective of the species suffer. This damage is very pronounced in the vicinity of towns where the demand for firewood is heavy. This damage near towns like Palghar, Shahapur, Virar, Ambernath etc. has assumed alarming proportions. It has not only upset the normal working on account of the coupes remaining unsold for want of exploitable material but in some cases, the areas have been completely denuded e. g. areas near Virar, Thana and Ambernath. Here the top soil is being washed away except where it is covered by grass and the only way of reclothing the areas is afforestation. Damage by lopping is not extensive, but is confined to the areas adjoining cultivation.

46. In the Thana district burning the field (*rab*-burning) before planting paddy is a very common agricultural practice. For this purpose, the forest villages (see note below) are allowed to remove fallen dead leaves from the forests. The demand for the leaf litter for *rab* burning is so great that most of the accessible forest areas are literally swept clean by the villagers for collecting the litter. In many places the villagers are permitted to remove this litter in carts. In Palghar range even nonforest villagers are allowed to collect and remove the dead leaves in carts on payment of a nominal permit fee. In this area, collection of dead leaves from forests for selling to cultivators of nonforest villages has become a business. The virtual cleaning of the forest year after year, has disrupted the nitrogen cycle; for there is hardly any humus formed and thus the soil gets impoverished day by day. This rather indirect and slow but continuous damage to the fertility of forest soil becomes obvious when the areas come up for regeneration.

Note :—The definitions of the terms “forest village” and “forest villager” are given in the Forest Privilege Code vide Article No. 131 (a) and (b) of the Bombay Forest Manual, Volume III and are reproduced below :—

(a) A “forest village” means a village in which there are reserved or protected forests constituted under the Indian Forest Act.

(b) A “forest villager” or an “inhabitant of a forest village” means a person who is permanently resident in a forest village, or who is the actual cultivator of land situated in such a village.

47. As every where else in India, in Thana district too the large number of uneconomic cattle population in the villages is subjecting the forest to heavy pressure of grazing. Only remote areas are free from this pressure. The adverse effects of over grazing are indirect. Trampling and browsing not only destroy the young seedlings but the consequent hardening of the soil hinders the germination of seeds. Overgrazing also increases soil erosion. The grazing is free and there is absolutely no control over the number of cattle that could graze in a given area.

48. Amongst wild animals, deer damage *khair* plantations by browsing and porcupines and rodents damage *sawar* plantations by stripping off the bark and also by uprooting the seedlings. An interesting observation that took place in 1959-60, the rat population increased considerably with consequent extensive damage to teak seedlings in the nurseries and to teak and *khair* seedlings in the plantations. Amongst insects, the teak defoliator (*Hyblea puera*), the teak skeletoniser (*Hapalia machaeralis*) and the root borer of *babul* (*Coelosterna scabarata*) cause some damage. Damage by climbers in young plantations is seen in the moister areas. The climbers break the leading shoots and this leads to forking. Climbers also cause crookedness of the bole. Damage by climbers is not only confined to plantations but is also seen in the coppice growth.

49. The natural process of soil erosion by which the top soil is gradually washed away by the run-off is not harmful nor is it avoidable. This process is so slow that it is more or less in equilibrium with the opposite process of soil formations as a result of the disintegration of the rocks. Moreover, the top soil from the upper slopes is not lost altogether but is deposited on the lower slopes and in the valleys where the deep rich soil supports luxuriant tree growth. It is the accelerated soil erosion which is harmful as it results in the top soil being completely washed away from the forest areas, which thus gets impoverished. Accelerated soil erosion is invariably due to the activities of man. Clearfelling the tree growth exposes the soil to the impact of the falling rain-drops, thereby accelerating the run-off. Though grass and other weeds cover up the exposed areas within a month of the onset of monsoons, the initial loss of the top soil is considerable. This loss is greater, the steeper the slope. Therefore, beyond a certain gradient, clearfelling is definitely harmful. The adverse effects of clearfelling steeper slopes are evident all over the Thana forests where the clearfelling system was practised for over 35 years.

On very steep slopes landslides also occur sometimes. Another way in which serious soil erosion is caused by man is the neglected extraction paths prepared for extraction of the material from the forests under exploitation. No doubt, the paths have to be prepared by clearing the tree growth. But generally no steps are taken to cover up the paths with cross bunds after the working season is over in spite of a provision to that effect in the sale conditions and consequently these paths act as big nallas through which tens and tens of the rich top soil is washed down into the stream and is thus permanently lost to the forest. Such neglected extraction paths result in a network of gullies. Old extraction paths which have been turned into nallas are met everywhere in the exploited forests. The total loss of top soil and consequently the fall in the fertility of the forest in the whole of the Thana forest on account of the neglected extraction paths is staggering.

50. Damage due to cyclones is at times very severe. Instances of severe cyclone damage have been recorded only thrice so far viz., in 1903, 1940 and 1948. The effects of the cyclone of 1940 were the severest in Dahanu division, less severe in Thana division and least in Shahapur division. The forests were just recovering from the devastating effects of the 1940 cyclone, when the cyclone of 1948 occurred causing again severest damage in Dahanu division and comparatively less in the other two divisions. An idea of the immense damage caused by the 1948 cyclone can be had from the results of enumerations of cyclone damaged trees carried out between 1948 to 1951 in an area of 208576 hectares (515404 acres) (figures reproduced from para 32 of Jadhav's Working Plan) given in Appendix No. IX.

51. Teak being a shallow rooted species was affected most particularly in the higher girth classes. More than 50 per cent of the trees of teak and other timber species in the higher girth classes (higher than 90 cm.) were affected. As a consequence, the crop is now glaringly deficient in the higher girth classes. This has affected the yield. It has been calculated that the quantity of timber extracted from the trees uprooted in the 1948 cyclone amounted to 12 years' annual yield from the whole of the Thana forests.

CHAPTER III.—UTILIZATION OF THE PRODUCE

Section 1.—Agricultural Customs and Wants of the Population

52. The population of Thana district exhibits great contrast. The population at and around industrially developed places like Thana, Kalyan, Bhiwandi, Ulhasnagar, Ambernath etc. consists mainly of industrial workers. They depend on the forests for their requirement of firewood which is available in headloads brought by the villagers from the adjoining forest areas. The forests in the vicinity of these towns have greatly suffered from the constant hacking of trees for firewood and for timber which is readily purchased by the Saw Mills.

53. The population of the coastal tract extending from Bassein to Gholwad consist of fishermen who require bark of *ain* for colouring their nets, and of horticulturists who grow products like bananas, betel leaves, *chikku*, flowers, vegetables etc. and require for use in their gardens bamboos and small sized timber. The coastal population also depend on the forests for firewood supply.

54. In the rest of the district the population is mainly of *adivasis* like "Warlies", "Thakurs", "Kolies", and "Katharies". These people practice a primitive type of agriculture. Paddy, *nagali*, *varai* are the main crops. Paddy requires good water supply and hence can be grown only in low lying areas. *Nagali* and *varai* are not very exacting and hence are the main crops in the hilly tracts, *viz.*, Jawhar, Mokhada, parts of Shahapur (Washala and Vihigaon ranges) *tahsils*. A common practice followed by all the agriculturists in Thana district is "rab" burying. "Rab" is a nursery for raising paddy seedlings and requires good burn before the seed is sown. For burning the *rabs*, the agriculturists collect the fallen and dead leaves from the forests. They also cut "tahal" from certain trees in "gairans" and "maliki" lands. The adverse effect of the removal of leaf litter on the fertility of the forest soil by depriving it of its supply of Nitrogen has already been mentioned in para 46. The surrounding population graze their cattle in the forests. Grazing is free and unrestricted except in the closed areas. The people also depend on the forests for firewood, for small timber for huts, cowsheds and for fencing material. Of late, the land-hunger has increased considerably amongst the *adivasis* as a result of increase in population and consequently instances of encroachments on the forest lands for cultivation are increasing.

55. The following statement of the average quantity and value of the material removed annually from 1953-54 to 1965-66 by rights and privilege holders from the forests of the three divisions gives an idea of the great utility of these forests to the local population.

Division (1)	Timber		Firewood	
	Cubic metres (2)	Value in Rs. (3)	Metric tonnes (4)	Value in Rs. (5)
Dahanu	37.14	5,977.00	194.500	69,294.00
Thana	52.52	2,854.00	275.880	63,387.00
Shahapur	79.78	6,249.00	87.416	12,129.00
Total	169.44	15,080.00	547.796	1,44,810.00

Section 2.—The Markets and Marketable Products

56. All sizes of timber and every stick of firewood from the Thana forests find a market. The most important market is Bombay. In fact proximity to Bombay has made these forests the most valuable in the State inasmuch as they yield the maximum revenue per unit area. Most of the firewood and charcoal are exported to Bombay. Timber in large quantities is also exported to Saurashtra, particularly from the Sawata depot in Dahanu division. Kalyan and Thana also consume large quantities of round teak timber for feeding the saw mills. Timber, firewood and charcoal from the eastern part of Shahapur division (*e.g.*, Vihigaon range) are exported to Nasik as well.

The traditional centres for sale of timber are Sawata and Manor in Dahanu division and Shivansai in Thana division. With the formation of forest labourers' co-operative societies a number of new sale depots have been established *e.g.*, Talasari and Charoti (for Charcoal and firewood) in Dahanu division; Bhiwandi, Bassein, Kalyan and Padagha in Thana division and Khardi Shenwa, Kasara and Asangaon in Shahapur division. Sawata is still the largest sale depot for timber in the whole of the district. Both, contractors and forest labourers co-operative societies bring the material to Sawata depot

where purchasers from as far as Saurashtra gather annually for the sales. About 20,000 cu.m. of timber is annually sold from this depot. Nearly half of this quantity is teak timber. Teak timber meeting railway specifications is supplied to the railways at agreed rates from the material from coupes worked departmentally or through the agency of forest labourers' co-operative societies.

57. The principal major forest products that are sold are timber of teak, *ain*, *bibla*, *khair*, *dhawada*, *hed*, *kalamb*, *sawar* etc. and firewood and charcoal. *Khair* wood is in demand for *kath* manufacture as well as for preparing axles and hubs of carts. *Hed* and *kalamb* timber is in demand for bobbins, shuttles and footscales. *Sawar*, *kadwai*, *kakad* and *shemat* are in demand for packing cases, plywood and matchwood industries. Most of the local demand is confined to small sized timber and firewood. However, only a small portion of these products is consumed locally and most of the products are sold for export to outside markets. The Integrated Unit at Dahanu Road which has started working in 1965-66, requires about 14 cu.m. timber (mostly non-teak) per working day.

58. The various minor forest products are bamboos, grass, *apta* and *tembhurni* leaves, *bel* leaves, *tad* palm leaves, *chilhar* and *ain* bark, *kadipatta*, *babul* branches, *mohawa* flowers and seeds, *hirda* fruits, plantain (*rankel*) leaves, *kusri* flowers, *tak* fruits, *karvi*, *vavding*, honey, gum (*Karaya*) etc. The annual revenue realised in the three divisions during the period from 1953-54 to 1965-66 from the sale of various minor forest products is given in Appendix No. X. The average annual revenue from the sale of various minor forest products is Rs. 1,44,447-00, Rs. 43,369-00 and Rs. 34,546-00 in Dahanu, Thana and Shahapur divisions respectively. The rates sanctioned for the sale of minor forest produce on permits in the three Thana divisions are given in Appendix No. XI.

Section 3.—Lines of Export

59. The district is served by three railway lines, three national highways and a number of major district roads. The three railway lines are the Bombay-Baroda B. G. line of the Western railway running along the coastal tract through Bassein, Palghar and Dahanu Road, the Bombay-Bhusaval B. G. line of the Central railway running through Thana, Kalyan, Asangaon, Khardi and Kasara and the Bombay-Poona B. G. line of the Central railway running through Kalyan, Ambernath, Badlapur and Wangani stations. A new B. G. line of Central railway from Diva to Panvel has been constructed in 1965.

60. The three national highways are the Bombay-Ahmedabad national highway No. 8 running through Manor, Charoti and Talasari; the Bombay-Agra national highway No. 3 running through Bhiwandi, Padgha, Shahapur, Khardi and Kasara and the Bombay-Poona national highway No. 4 running through Thana and Sheel. The state highways are the Dahanu-Jawhar road (length 60.8 km.), the Mahim-Palghar-Manor-Vada road (72.2 km.), the Vada-Bhiwandi-Kalyan road (53.12 km.), The Vada-Parali-Khodala road (48 km.) and the Kalayan-Murbad-Tokawada road (56 km.). The major district roads are the Mokhada-Vihigaon road (44.25 km.), the Shahapur-Dhasai-Shenva-Dholkamb road (31.77 km.), the Ambadi-Ganeshpuri-Bassein road (41 km.), the Pali-Jawhar road *via* Vikramgad (36.20 km.) etc. In addition there are a number of other district roads and village approach roads built under the 5 year plan schemes. The Bombay-Ahmedabad national highway is being straightened and will now pass from Ghodbunder to Shirsad and after passing through Dahisar range it will join the old road near Manor. With this section which will be ready by 1968, all the forests of Dahisar range will become easily accessible. The important forest roads in use are Karha to Akra (6 km.) in Dahanu division, Aghai to Mouj (8 km.) in Shahapur division and Potgaon to Badlapur (15 km.) in Thana division.

61. In addition to roads and railways there are the creeks and the sea which are also used for transport of forest produce. The timber from Sawata depot is transported through the Dahanu creek to the Arabian sea and later on to the various parts in Saurashtra. The Vaitarna creek helps transport of timber from the Manor depot. The Bassein creek is also used for the transport of forest produce. Thus the lines of export available for the transport of forest produce are numerous.

62. A large number of new roads have been planned by the *Zilla Parishad*. The Ozar-Saiwan forest road is already under construction. With these roads, this area will have a very well developed net-work of lines of communications. As on 31st March 1962, the total length of all types of roads, *i. e.*, national highways, state highways, major district roads, other district roads and village roads in Thana district was 1740.5 km. (1087.47 miles).

Section 4.—Methods of exploitation and their costs

63. The two main agencies of exploitation are the contractors and the forest labourers' co-operative societies. Departmental exploitation is done only to a limited extent. During 1965-66 the number of coupes worked by the three agencies were as under :—

(1)	Dahanu Division (2)	Thana Division (3)	Shahapur Division (4)	Total (5)
Forest labourers' Co-operatives	85	26	13	124
Contractors	83	110	158	351
Departmental	16	5	3	24

The coupes which are not allotted to the forest labourers' co-operative societies or which are not earmarked for departmental working are sold every year by tender in the month of July or August. For the first time in the State, the co-operative movement was introduced amongst the forest labourers in Dahanu division during 1948-49 with the registration of two societies. The number of societies existing in 1965-66 was 62, out of which 37 were in Dahanu division, 18 in Thana division and 7 in Shahapur division. The movement has now been well established in the Dahanu division and has spread to the other two divisions also. The number of societies and the number of coupes allotted to them from 1959-60 onwards are given in Appendix No. XII.

During 1965-66, 75 per cent of the main felling coupes were allotted to societies in Dahanu division. In Thana division this percentage worked out to 36 while in Shahapur division it was only 15.

64. Felling and conversion of trees are done by axe. Logging is mostly done by saw. Conversion is now being done to a limited extent by saw. Billetting of wood for firewood or for manufacture of charcoal is done partly by axe and partly by saw. Transport of the material from the coupes to the depots is done by bullock carts or by trucks.

65. The minimum wage rates, *i. e.*, daily wage rates and piece work rates for various forest operations are sanctioned by Government and these are binding on contractors, forest labourers' Co-operative Societies and also the Department. The rates are revised every year in consultation with the forest labourers' co-operative societies which are represented in the Wage Board constituted for each Circle. The rates recommended by the Board are sanctioned by Government. The minimum wage rates sanctioned for 1965-66 are given in Appendix No. XIII.

66. *Past and current prices.*—As in the case of all other commodities, the prices of forest produce are steadily rising. The following figures of revenue per acre realised in the three divisions during the last 25 years will indicate the phenomenal rise in prices that has taken place.

Year (1)	Average price per acre in Rupees		
	Dahanu Division (2)	Thana Division (3)	Shahapur Division (4)
1938-39	108.00	94.00	65.00
1947-48	452.00	404.00	339.00
1953-54	381.00	336.00	147.00
1954-55	541.00	404.00	153.00
1955-56	605.00	675.00	200.00
1956-57	1,599.00	799.00	290.00
1957-58	1,344.00	599.00	266.00
1958-59	929.00	780.00	207.00
1959-60	991.00	809.00	270.00
1960-61	1,060.00	727.00	334.00
1961-62	1,079.00	954.00	354.00

The above figures show that Dahanu Division has the highest revenue per acre, next comes Thana Division and the last is Shahapur Division.

67. The following statement gives figures of market rates for various sizes of timber obtained at Sawata depot in 1949-50 and in 1966-67.

<i>Species</i>	<i>Class of timber</i>	<i>Rate per ton given in Jadhav's plan (for 1949-50)</i>	<i>Current market rates per ton (1966-67)</i>
(1)	(2)	(3)	(4)
			Rs.
<i>Teak</i>	Log	Rs. 250 to 300	1,051-50
<i>Teak</i>	Beam	Rs. 200 to 250	1,004-40
<i>Teak</i>	Pole I	Rs. 110 to 150	768-50
<i>Teak</i>	Pole II	Rs. 80 to 100	633-00
<i>Teak</i>	Pole III	Rs. 60 to 75	444-00
<i>Ain</i>	Log	Rs. 60 to 100	965-00
<i>Shisam</i>	Log	Rs. 100 to 150	1,124-50
<i>Khair</i>	Log	Rs. 80 to 150	1,575-00
<i>Bibla</i>	Log	Rs. 75 to 100	450-00
<i>Hed</i>	Log	Rs. 100 to 150	500-00
<i>Kindi</i>	Log	Rs. 70 to 90	251-00
<i>Kalam</i>	Log	Rs. 100 to 150	225-00
<i>Tinoas</i>	Log	Rs. 125 to 150	1,325-00

(1 ton=50 c.ft.=1.42 cu. m.)

CHAPTER IV.—STAFF AND LABOUR SUPPLY

Section 1.—Staff

68. The following statement shows the sanctioned staff in each of the three divisions, as on 1st July 1965 :—

Class of Service	Name of post	Number of posts									Grand Total (5+8+11)
		In Dahanu Division			In Thana Division			In Shahapur Division			
		Perm.	Temp.	Total	Perm.	Temp.	Total	Perm.	Temp.	Total	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
I	D. F. O.	1	..	1	1	..	1	1	..	1	3
II	Sub-D. F. Os.	1	2	3	1	1	2	1	..	1	6
	Instructor	..	1	1	..	..	..	..	..	..	1
III	R. F. Os.	9	7	16	10	9	19	8	1	9	44
	Foresters	64	9	73	51	15	66	48	2	50	189
	Guards	176	112	288	151	78	229	125	13	138	655
	Head Clerk	1	..	1	1	..	1	1	..	1	3
	Sr. Acctts.	1	1	2	1	1	2	1	..	1	5
	Jr. Acctts.	2	3	5	2	2	4	4	..	4	13
	Clerks	20	9	29	14	12	26	18	5	23	78
	Surveyors	1	1	2	2	1	3	2	1	3	8
	Armed Constables	..	1	1	1	3	4	..	1	1	6
	Drivers	..	2	2	..	3	3	..	2	2	7
IV	Peons	5	4	9	5	1	6	4	1	5	20
	Watchmen	..	4	4	1	3	4	..	1	1	9
	Grand Total	281	156	437	241	129	370	213	27	240	1,047

A statement showing the sanctioned staff in Forest School Division, Shahapur and the Integrated Unit Division, Dahanu Road, as on 1st July 1965 is given below :—

Class of Service	Name of post	Forest School Division, Shahapur			Integrated Unit Division, Dahanu Road			Grand total (5+8)
		Perm.	Temp.	Total	Perm.	Temp.	Total	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
I	D. F. O.	..	..	..	..	1	1	1
II	Instructor	..	1	1	..	..	..	1
III	Asstt. Instructor	..	1	1	..	..	..	1
	Foresters	..	..	..	..	3	3	3
	Guards	..	..	..	..	3	3	3
	Head Clerk	..	..	..	..	1	1	1
	Jr. Acctt.	..	..	..	..	1	1	1
	Clerks	..	1	1	..	2	2	3
	Store Keeper	..	..	..	..	1	1	1
	Kiln Operator	..	..	..	..	1	1	1
IV	Sawyer	..	..	..	..	1	1	1
	Saw Doctor	..	..	..	..	1	1	1
	Fitter	..	..	..	..	1	1	1
	Sweepers	..	2	2	..	1	1	3
	Mess servants	..	4	4	..	..	..	4
	Khalashis	..	..	..	..	4	4	4
	Peons	..	2	2	..	4	4	6
	Watchmen	..	1	1	..	3	3	4
	Grand total	..	12	12	..	28	28	43

Section 2.—Labour Supply

69. The chief sources of labour for forest works are *Thakurs, Katkaries, Kunbis, Kolies* and *Warlies*. *Warlies* are expert wood cutters but are lazy by nature. *Katkaries* are hardworking and have specialized in the preparation of charcoal. A statement of labourers employed by various agencies on forest works in each of the three divisions, during 1965-66 is given below:—

Name of Division	Name of Agency					
	Forest Department		Contractors		F. L. C. Societies	
	No. of labourers	Wages paid	No. of labourers	Wages paid	No. of labourers	Wages paid
(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Rs.		Rs.		Rs.
Dahanu ..	1,32,860	2,65,720-00	6,69,775	13,39,550-00	4,39,095	8,78,190-00
Thana ..	40,005	80,010-00	1,88,291	3,76,582-00	13,216	26,432-00
Shahapur ..	12,730	25,460-00	69,871	1,39,742-00	7,119	14,238-00
Total ..	1,85,595	3,71,190-00	9,27,937	18,55,874-00	4,59,430	9,18,860-00

Thus the various forestry operations, involved in working of reserved forests during 1965-66 through all the three agencies of Thana district, provided an employment to the tune of 1572962 labour days which costed Rs. 31,45,924 on account of daily wages.

70. Generally the supply of labour for cutting and carting is satisfactory except in areas near the industrially developed places like Bhiwandi, Kalyan, Ambernath etc. Shortage of labour is felt during the planting season as it coincides with the sowing of agricultural crops. Strenuous efforts have to be made to procure labour for planting and weeding. Taking into consideration the normal availability of labour the annual plantation potentiality for Dahanu division works out to about 1,700 hectares, that for Thana division works out to about 500 hectares and that for Shahpur division works out to about 200 hectares. Thus the annual plantation potentiality for the three Thana divisions works out to about 2400 hectares.

The number of inforest settlements is small and the villagers are more interested in agriculture than in forest works. The details of the in-forest settlements are as under:—

Range	Name of in-forest settlement	Area (in hectares)	Population (in numbers)	Area leased for cultivation (in hectares)
(1)	(2)	(3)	(4)	(5)
Dahanu Division				
Sawa	Akra	196-87	702	254-49
	Palsin	54-95	128	57-12
	Aira	217-92	589	248-08
Dahisar	Jaishet	57-31	176	1-86
Jawhar	Thakurpada, Bahiriponda	2,247-95	121	18-66
	Dahul	298-16	300	39-04
Thana Division				
Mandavi	Nandan	1,666-94	256	51-39
	Ambarbhui	499-83	232	40-26
Shahapur Division				
Vaitarna	Akhada	546-08	224	160-90
	Vadvali		189	51-01
	Ujjaini		253	79-01
	Ghayapatpada		63	47-40
	Khorda		25	19-10
	Pachghar		187	100-08
	Satronda		47	51-88
Tilmal	89	44-56		
East Wada	Virhe	167-03	117	104-95
	Bhokarpada		62	36-46
	Sakarshet		33	24-29
Vihigaon	Amla	39-25	45	43-80

CHAPTER V.—PAST SYSTEMS OF MANAGEMENT

Section 1.—General History of the Forests

(A) Forest covered by the current Thana Working Plan by Jadhav.

71. *Maratha Period.*—Prior to 1808, the Maratha regime exercised sovereign authority over the public forests. Certain portions of the forests were set apart for meeting the requirements of Government while cutting was permitted from the rest of the area. Local population was free to obtain all the produce they needed for domestic and agricultural purposes from the forests.

72. *Early British Period.*—The necessity of conserving the forests was not recognised till about 1840. During this period the exploitation of tree growth was very unsystematic. Customs duty was levied on the value of the wood cut and removed from the forests. The rates of duty varied from *taluka* to *taluka*. Demarcation of the village reserves was carried out from 1840 onwards. In 1845 Forest Department was organised for the first time and the system of management consisted in reserving teak and nine other species. The main sources of revenue were the thinnings in the teak reserves and collections under the fee system (*Vanamakta*) introduced in 1852. The whole of the Thana District formed only one division and the staff for protection of forests as well as for supervision over the fellings was inadequate. Consequently illicit fellings occurred on a large scale. The fee system was abolished in 1862 and the system of departmental fellings was introduced. The departmental fellings put some check on the wholesale destruction of the forests but under this system only the best teak trees were cut and excessive fellings were made in the easily accessible forests. Unrestricted and unregulated lopping of *injaili* trees for *tahal* also caused much destruction of forest. The “*Kolpat*” contract system by which right of collection of dead-wood in the forests was disposed of annually also caused great damage.

73. *The First Working Plan (1887 to 1917).*—In 1882, one forest division was split up into two divisions which were further split up into three divisions in 1897. The system of dividing the forests of each range into blocks and annual coupes was introduced in 1887-88 and regular fellings under the “coppice-with-standards” system were started from that year, though the first regular working plan (for the forests of Bhivandi) incorporating the system was sanctioned in 1894. Working plans for the forests of other ranges followed e.g., working plan for the forests of Bassein, Mahim and Vada ranges drawn up by Millett in 1895, Khardi and Murbad ranges by Fisher drawn up in 1902 etc. By 1905, all the forests were brought under regular working plans. All these plans except the plan for Talasari forests drawn up in 1905, prescribed the “coppice-with-standards” system with a rotation of 40 years for the coppice.

74. The various working plans drawn up between 1894 and 1905 for the forests of different ranges were brought together in 1922 under the “Thana Forests Working Plan” prepared by Aitchison and Hamilton. This plan prescribed the “Clearfelling system” with a rotation of 80 years. The clearfelling was actually started from 1917-18 only, as the “coppice-with-standards” system was considered economically unsound and as the standards tended to suppress the coppice growth. The 1922 plan was revised in 1935 by Starte who prescribed the continuation of the clearfelling system with a rotation of 80 years. Starte’s plan was revised by Jadhav in 1951 and it is still in force and is now under revision.

(B) Jawhar Forests

75. As regards the ex-Jawhar state forests, the practice of shifting cultivation on steep slopes resulted in serious soil erosion and consequent destruction of the forests. This practice was stopped in 1885 when *Jamabandi* was introduced. From the year 1889-90 a system of selling forests by villages was introduced and this continued till 1917-18 when Dr. Gustasp’s plan was put in force. This plan prescribed improvement fellings on a felling cycle of 30 years. As this system was not likely to give much revenue, the State did not agree to the improvement fellings system which was then changed to “coppice-with standards” system already in vogue in the adjoining Thana forests. In 1925 Dr. Gustasp’s plan was revised by J. Dutt, Divisional Forest Officer, Working Plans, Northern Circle (in Bombay Province) who prescribed the clearfelling system which was then already in force in the adjoining Thana forests. J. Dutt’s plan was brought in force in 1927-28. Dutt had fixed the rotation at 60 years.

76. In 1948-49 with the merger of Jawhar State in erstwhile Bombay State, the Jawhar forests were put under the charge of Divisional Forest Officer, North Thana. When Shri Jadhav took up the revision of Starte's plan for the Thana forests, the question of bringing these forests under the Thana working plan was considered. However, as the settlement of the Jawhar forests was not done, it was decided to work them under a separate plan till the forests were settled. In 1951, Shri Korlhali prepared the "Working Scheme for the forests of Jawhar" which was a revision of Dutt's plan. Korlhali's scheme came in force in 1953-54 and is now under revision. As the settlement of Jawhar forests was completed in 1959, the Jawhar forests are now incorporated in the present plan.

(C) *Atgaon and Khativali Inam forests*

77. (i) The Atgaon forests were taken over by Government for management in 1904. There was no regular management of these forests till 1930. In 1930 Shri Patkar, Divisional Forest Officer, East Thana drew up a felling scheme for working these forests under the clearfelling system with a rotation of 40 years and this scheme is still in force.

(ii) The Khativali forests were handed over to the Forest Department for management in 1886. They continued to be worked under the coppice system with a rotation of 30 years as per a scheme drawn by the then D. F. O., South Thana. By 1900, 19 coupes were worked and thereafter there was no area left to be worked, as much of the area included in the scheme was excluded at the time of forest settlement. In 1911, the D. F. O., South Thana prepared a revised scheme according to which the worked area was divided into 40 coupes and each year one coupe was to be worked under thinning combined with improvement-cum-selection fellings. In 1918, the system was changed to clearfelling and one rotation was completed by 1951-52. Since 1951-52 the areas are being worked in the 2nd rotation. In 1951-52 the prescriptions were modified and the areas on steep slopes were left unworked for being worked under selection fellings.

Section 2.—Past Systems of Management and their Results

(A) *Thana Forests*

I—The First Working Plan

78. The working plan for the forests of Bhiwandi taluka drawn up in 1894 was the first working plan to be introduced in the Thana forests. The working plan for the forests of Bassein, Mahim and Vada talukas was drawn up in 1895 and the working plan for the forests of Dahanu, Umbargaon, Shahapur, Khardi and Murbad ranges was drawn up in 1902. By 1905 all the forests of the district were covered by working plans. All these plans except the plan for the Talasari forests, prescribed the "coppice-with standards" system with a rotation of 40 years. In some places the method was described as coppice-standards partaking of the nature of severe improvement fellings.

79. The number of standards was generally fixed at 30 per acre but for the Tansa forests it was 35 to 40 and for the Mokhada forests it was 45. In 1909, instructions were issued to aim at a reservation of 40 or even 50 trees per acre and all stems under 12" circumference were to be reserved in addition.

80. As a preliminary method of treatment, this system was probably the best that could have been devised and on the whole it worked well inasmuch as the large number of overmature, badly shaped and unsound trees which the forests contained, were profitably exploited and replaced by vigorous young growth. But in several other respects, the system proved unsuitable. In the first place, it was economically unsound as the standards reserved were often of species which had no value as timber, while some of the standards were overmature and crooked and did not put on any increment. It was therefore not sound, economically, to retain such trees. Moreover the large number of standards which were retained as per the instructions issued in 1909 adversely affected regeneration and also retarded the growth of the coppice.

81. For the Talasari forests, the method of treatment laid down was the selection system. The exploitable age was fixed at 120 years corresponding to a diameter of 18". This exploitable diameter was too high and very few sound teak trees were to be found above this diameter, with the result that no contractors came forward to undertake the fellings. Moreover there was no justification for having a separate system for the Talasari forests.

II—The Aitchison and Hamilton's Plan of 1922

82. The Aitchison and Hamilton's plan known as the "Thana Forest Working Plan" revised all the previous separate plans for the various forests and prescribed the "clearfelling system". Though the plan was published in 1922, the clearfelling system was actually introduced from 1917-18 only. The rotation was fixed at 80 years. The regeneration was mainly to be natural by coppice and seed and was to be supplemented by artificial regeneration where necessary. The Thana forests are capable of producing big sized timber and hence the replacement of the coppice-with-standards system, by a high forest system was distinctly an improvement. But the reliance on natural regeneration did not improve the stocking, as coppice of inferior species suppressed the coppice of superior species like teak, while natural seedlings had no chance against the rampant growth of weeds and grasses that followed clearfelling. Artificial regeneration was confined to only dibbling seeds on charcoal kiln sites.

83. The plan prescribed removal of the old standards under improvement fellings along with thinnings, in the areas worked under the previous plans. This resulted in the removal of inferior species and unsound teak trees which were hampering the growth of teak coppice and had a beneficial effect on the growth of teak coppice.

III—Starte's Plan of 1935

84. No major changes were proposed in Starte's plan which was a revision of the 1922 plan of Aitchison and Hamilton. The system of working prescribed was the same viz. the clearfelling system. The felling series and the coupes also remain practically the same. The rotation was also kept the same as prescribed by the 1922 plan viz. 80 years. The only new change proposed was the introduction of the system of *rab* plantations of teak (by planting of stumps) and of *khair*, *shivan*, *tiwas* and *ain* (by dibbling seed). In order to ensure the success of regeneration, intensive tending operations were prescribed. The stump planting on rabbed sites prescribed by the 1935 plan gave very good results and some excellent plantations of teak and *khair* are seen in the coupes worked under this plan viz. C. Nos. 17 to 35 of the Main Working Circle, particularly on the lower slopes in better quality areas. The burning of the *rabs* kept down the weeds and thus helped the growth of the seedlings and stumps. The 1935 plan also prescribed that artificial regeneration should be carried out to the extent of at least 12½ per cent of the total area of the exploited coupe. However the *rab* plantations were scattered throughout the coupe and were thus lost in the vigorous coppice growth which came up after clearfelling. Though the clearfelling system followed by artificial regeneration gave good results on better quality areas, its application to all areas irrespective of the topography and the quality of locality, was not correct as it resulted in soil erosion on steep slopes, while on poor quality areas, artificial regeneration was not a success. Even where the site was suitable for raising plantations, artificial regeneration was done in not more than 12½ per cent of the area and the major part of the clearfelled area was regenerated by coppice of inferior species which largely suppressed the coppice of superior species like teak.

IV—Jadhav's Plan

85. The Starte's plan was revised by Shri S. P. Jadhav and the revised plan was brought in force from 1951-52. The following working circles were formed.

Ordinary Working Circles :—

- (i) The Main (Timber) Working Circle,
- (ii) The Pole Working Circle,
- (iii) The Lakes Catchment Working Circle,
- (iv) The Casuarina Working Circle,
- (v) The Inexploitable Working Circle,
- (vi) The Kuran Working Circle,
- (vii) The Babul Working Circle,

Overlapping Working Circles :—

- (viii) The Matchwood (overlapping) Working Circle,
- (ix) The Bamboo (overlapping) Working Circle,
- (x) The Minor Forest Produce (overlapping) Working Circle,

The results of the prescriptions of Jadhav's plan for each working circle are given below :

I. The Main (Timber) Working Circle

86. The major portion of the forests was included under the Main Working Circle, as was also the case in the two previous plans. In fact the felling series and coupes under the 1922 plan remained largely unchanged in Starte's plan as well as in Jadhav's plan. The major change in the prescriptions made in Jadhav's plan was that the clearfelling system was replaced by a system designated as "clearfelling-cum-selection-cum-improvement fellings." The main defect in the prescriptions of the two previous plans was that the clearfelling system was applied to all the forests of the Working Circle irrespective of the topography or site quality. This was sought to be remedied to some extent by prescribing clearfellings for non-steep areas while the steep areas would be worked under the "selection-cum-improvement fellings." The proportion of the artificially regenerated area was sought to be increased by prescribing regeneration of at least 33 per cent of the clearfelled area artificially.

87. The discontinuation of the clearfelling of forest in the steep areas was indeed a step in the right direction. However combination of the clearfelling system with a rotation of 80 years with the selection-cum-improvement felling system which for obvious reasons has to be worked under as short a felling cycle as possible, in the same working Circle was incorrect. It had some practical advantages in view of the peculiar topography of the forest which are generally difficult for dividing into separate compact blocks of steep and non-steep areas. Even if these areas were not separated and allotted to separate working circles for the above difficulty, the terms steep and non-steep should have been defined and some indication should have been given as to which areas should be considered as steep and which as non-steep. Unfortunately this was not done. It was left to the local staff to decide the areas to be worked under the two systems in the annual coupe due for exploitation. The result was that if the local staff was not inclined to take up large scale plantations it could report that the area is not fit for clearfelling. Thus instances can be seen of coupes which are not on steep slopes and which could have supported excellent plantations of teak have been worked wholly under the selection-cum-improvement fellings. Similarly, instances of coupes with poor site quality clearfelled and consequently resulted in blanks are also seen. The prescription that at least $\frac{1}{3}$ rd of the clearfelled area should be artificially regenerated was not strictly followed and thus major part of the area worked is full of coppice growth of inferior species. There was no control on the number of trees over the exploitable size that could be removed in the areas worked under the selection-cum-improvement fellings with the result that the crop which had already become deficient in the upper girth classes on account of the cyclones of 1940 and 1948, was further depleted and the future yield was thus not safeguarded. The areas were not stockmapped and differentiated into quality classes based on the height of mature trees. Instead whole felling series were allotted to quality classes based on the average yield per acre obtained from them. This was not only a deviation from the standard practice of assessing the site quality but also the classification adopted had no practical value as it overlooked the frequent local variations in site quality which is a characteristic feature of the Thana forests.

In brief the results of past working are :—

- (i) Some steep areas were clearfelled resulting in erosion.
- (ii) Some areas fit for clearfelling and planting were not clearfelled, but worked under selection-cum-improvement fellings.
- (iii) All clearfelled areas were not planted and as such the crop now is either of coppice origin or the areas are blank and understocked.
- (iv) Areas worked under selection-cum-improvement fellings were over-exploited.

II. The Pole Working Circle

88. This working circle comprised of forests of Thana and Palghar ranges which are subjected to heavy illicit cutting due to their proximity to expanding towns where a ready market for the produce exists. The treatment prescribed for these areas was the same as that for the main working circle except that the rotation was fixed at 40 years instead of 80 years in order to produce poles and firewood. Jadhav's plan changed the clearfelling system applicable to this area under the previous two plans to "clearfelling-cum-selection-cum-improvement system." Rotation was maintained at 40 years. Starte's

plan had suggested that the present rotation of 40 years should not be changed as the existing crop was poor and that at the end of the first rotation, the areas should be amalgamated with the main working circle. Actually some of the felling series of this working circle, in Palghar range were transferred to the main working circle, in Jadhav's plan. The results of past treatment are similar to those observed in the main working circle. In fact it is not apparent why these areas should be worked under a short rotation when the locality factors here are the same as those in the forests of main working circle and when these forests are potentially of the same quality.

III. The lakes catchment area Working Circle

89. The forests of this working circle are situated in the catchment areas of Tansa and Vaitarna lakes from where water is supplied to Bombay. These forests were formerly included in the main working circle, and were worked under the clearfelling system. But it was found that clearfelling the areas tended to silt up the lakes. The clearfelling system was, therefore, discontinued in the catchment area of Tansa lake in 1939. In Jadhav's plan a separate lakes catchment area working circle, was constituted. The system prescribed was strict improvement felling with a felling cycle of 20 years. All dead, decaying, unsound and overmature trees were to be removed. Different girth limits over which, the trees were to be considered overmature were prescribed for various species. This conservative working coupled with the low incidence of grazing prevailing in the areas has resulted into some improvement in the condition of the crop. The prescriptions appear to be correct but in certain respects they were liable to be misunderstood. As such in practice, in some cases they have not been properly implemented and this resulted, in heavy fellings.

IV. The Casuarina Working Circle

90. The areas comprised of scattered narrow strips along the sea-coast in Bordi Dahanu and Palghar ranges of Dahanu Division. An area of about 191.5 hectares (471 acres) of this working circle was transferred to Gujarat on the bifurcation of the *ex*-Bombay State in 1960, an area of about 55.86 hectares (138 acres) only remained in this working circle. *Casuarina* plantations were first raised in 1889-90. From 1913 to 1921 the areas were annually planted. No further plantations, were raised as it was thought that they were unprofitable. This was however not correct and hence Starte's working plan contained separate *Casuarina* working circle and from 1935, a regular system of clearfelling with artificial regeneration was followed. The rotation was fixed at 20 years. In Jadhav's plan the rotation was reduced to 15 years. The *Casuarina* plantations are a great success silviculturally as well as financially. It is unfortunate that no more areas are available for raising these plantations. Since 1962, *Eucalyptus hybrid* has been planted along with *casuarina* in alternate lines, as an experimental measure. In the first year, the growth of *Eucalyptus* was better than that of *casuarina*, but in the second year *casuarina* has done better than *ucalyptus*. If *Eucalyptus* succeeds in this area, it may be more profitable to have pure *Eucalyptus* plantations instead of raising *casuarina*, as *Eucalyptus* can be regenerated by coppice at least for 4 rotations. However with its deep rooted system and strong demand for Nitrogen, it is doubtful how far *Eucalyptus* will succeed in the coastal sands which have salty water in the sub-soil, and are poor in Nitrogen content.

V. The Inexploitable Working Circle

91. This working circle included the so-called "*Kharabas*" i. e. areas which are situated on very steep slopes and from where extraction of the material is difficult and which if exploited would cause land-slips and soil erosion. The *Kharabas* were mapped in the various working plans prepared before 1905. Since then, their boundaries have remained unchanged. The basis on which these areas were selected is not known. In many cases it has been found that areas with moderately steep slopes have also been included in *Kharabas*. Prior to 1901, when these areas were first demarcated, the means of transport were not much developed and the demand for the produce was not very great. Now the position is greatly altered. The Thana forests which are situated near Bombay, which is the hub of the industries of our Nation, require the most intensive management. Many of the so-called "*kharaba*" can be worked under the selection system without any danger of soil erosion. Though the working plan prescribed that the territorial D. F. Os. may in consultation with the D. F. O. working plans formulate schemes for the working of such of the *kharabas* as contain valuable material, only one such scheme has been formulated consequent to the present drive to produce more due to the existing National emergency, for working the *kharaba* in Thana division. As per this scheme, some of the *kharabs* areas in Gokhivara, Mandavi and Murbad ranges were worked under the selection system during 1963-64, 1964-65 and 1965-66.

VI. The Kuran Working Circle

92. This working circle comprised of an area of 424.1 hectares (1048 acres) scattered in 7 villages in Bordi and Palghar ranges. The areas are flat and low-lying and do not contain any tree growth but contain only grass. All the areas have either been leased or handed over to the Milk Commissioner, Bombay for development as grazing land and fodder reserves. The working plan prescribed managing the areas as *kurans* in case they are returned to the Forest Department. However the areas continue to be out of the control of the Forest Department and hence there was no working in this area by this department.

VII. The Babul Working Circle

93. This working circle comprised of an area of about 70.82 hectares (175 acres) situated along the bank of Vaitarna river in Dahisar range. The area was afforested in 1905 but was not included in any working plan till Jadhav's plan was prepared. The area was regenerated by raising *babul* plantations in 1923-24 and 1924-25. Jadhav's plan prescribed clearfelling with artificial regeneration by sowing *babul* seed. The rotation was fixed at 30 years. The *babul* plantations raised in the exploited coupes are quite successful, but as most of the *babul* trees from unworked coupes have disappeared due to storms or by illicit cutting the coupes are remaining unsold and hence remain to be regenerated.

VIII. The Matchwood (Overlapping) Working Circle

94. This was an overlapping working circle and included areas of main, pole and lakes catchment area working circles. The main object of management was to provide matchwood from *Sawar* (*Salmelia malbarica*) to the match industry. All *Sawar* trees above 91.44 cm. (36" girth) at b. h. were prescribed to be exploited from the annual coupes under working in the three working circles. It was prescribed to plant *Sawar* in patches or on rabs in areas which are not clearfelled. It was also prescribed to raise concentrated plantations of *sawar* and other matchwood species in areas not less than 4.05 hectares (10 acres) in extent in exploited coupes which are situated within 32.2 km. (20 miles) of railway stations or within easy lead to the match factory or centre of consumption. The plantations were to be protected from wild animals or rodents by fencing. Where this was not possible, 25 per cent of the rabbed area was to be compulsorily planted with *sawar* and other matchwoods viz., *maharukh* (*Ailanthus excelsa*), *papara* (*Holoptelea integrifolia*), *kadvai* (*Hymenodictyon excelsum*), *waring* (*Kydia calycina*), *shemat* (*Lannea coromandellica*), *ambada* (*Spondias mangifera*), *petari* (*Trewia nudiflora*) and *kokad* (*Garuga pinnata*). In practice attempts were made to raise only *sawar* plantations particularly under the second five year plan scheme of raising matchwood plantations. But these plantations were not successful mostly due to damage by rodents. No attempts seem to have been made to protect these plantations by suitably fencing the areas.

IX. The Bamboo (Overlapping) Working Circle

95. The working circle overlapped all the reserved forests containing bamboos. The area was divided into 17 bamboo felling series and each felling series was further divided into three compartments A, B and C corresponding to the number of years in the felling cycle viz., 3. The bamboo species occurring in Thana Forests are *manvel* (*Dendrocalamus strictus*), *katas* (*Bambusa arundinacea*) and *bundi* (*Oxytenanthera monostigma*). Most of the bamboos, particularly *manvel* and *katas* died due to gregarious flowering which took place in 1959-60 and since then there has been no regular exploitation of bamboos except in parts of Shahapur division. The dead bamboos have been removed on permits. Profuse regeneration of bamboos is seen in some areas but except on the higher slopes, where there is no damage by cattle, the regeneration has failed to develop into clumps.

X. The Minor Forest Produce (Overlapping) Working Circle

96. This working circle overlapped the whole area included in Jadhav's plan. The minor forest produce available in these forests are (i) *apta* (*Bauhinia recemosa*) and *tembhurni* (*Diospyros melanoxylon*) leaves, (ii) *bel* (*Aegle marmelos*) leaves, (iii) *myrobalans* (*Terminalia chebula*), (iv) *chilhar* (*Caesalpinia Sepiaria*) bark, (v) *vavding* (*Embelia robusta*), (vi) *tad* (*Borassus flabellifer*) fruits, (vii) *mohwa* (*Bassia latifolia*)

flower and seeds, (viii) *kusari* (*Jasminum arborescens*) flowers and (ix) *plantain* (*Musa superba*) leaves. The working plan prescribed farming out the produce annually by auction sale. It also prescribed preservation and propagation of the trees yielding the above forest produce. The plan also prescribed planting of agave along the demarcation line as agave yields fibre which is used for rope making. Agave was planted at some places under the second five year plan scheme of agave plantations. But these scattered plantations can hardly give sufficient raw material for the rope making industry. No plantations of any other trees yielding minor forest products were raised.

V.—*Scheme for Exploitation of Khair trees from the Thana Forest by Wagle*

97. This scheme was drawn up in 1962 to ensure a sustained supply of *khair* trees to the Swastik Kath Factory at Dahanu Road. It covered the unexploited areas (i. e., coupes 51 to 80) of the main working circle of Jadhav's plan and the unexploited areas (coupes 26 to 40) of Thana woodlands of the only working circle of Saldanha's working plan. The forests of Shahapur division were excluded from this scheme as the growth of *khair* trees in this division was not well concentrated. The areas included in this scheme were formed into a *khair* overlapping working circle. Exploitable size for *khair* was 91.44 cm (36") and the felling cycle was of 20 years. There were 3 felling series formed. Yield was prescribed by number of trees. The yield calculation was based on the enumerations carried out in 1946-47. This data was however not reliable, as the enumeration was not done even in 1 per cent of the area. Moreover the scheme itself has been in operation for the last 2 years only and it is too early to say how far the estimate of the yield is correct. It has been the experience that because of the quite large annual areas to be worked, it is difficult to keep control over the fellings. Moreover the *Kath* factory is not operating and the *khair* trees are sold by tender. A separate *khair* overlapping working circle is therefore, not justified under these circumstances.

(B) *The Working Scheme for the Forests of Jawhar by Korlhalli*

98. All the forests were allotted to only one working circle *viz.*, the main (Timber) working circle. The method of treatment prescribed was exactly the same as was prescribed for the main working circle of Jadhav's plan *viz.*, clearfelling with-artificial regeneration over at least 1/3rd of the clearfelled area, for non-steep areas; and the selection *cum*-improvement fellings for the steep areas. The rotation too was the same as fixed for the Thana forests *viz.*, 80 years. The steep and non-steep areas were not specified nor defined. The results of this treatment were similar to those observed in the main working circle of Thana forests and the remarks passed on the working of the main working circle of Jadhav's plan for the Thana forests apply *mutatis mutandis* to this scheme.

99. An overlapping working circle *viz.*, the minor forest produce working circle was constituted in order to develop the resources of the important M. F. P. of the area which are (i) *apta* and *tembhurni* leaves, (ii) *chilhar* bark, (iii) myrobalans and *cassia fistula* fruits, (iv) *moha*, *karanj* and *shendri* (*Mallotus phillippinensis*) fruits and (v) gums. All the products were prescribed to be farmed out annually by auction sale. Rules were prescribed for the proper extraction of *karaya* gum obtained from *kandol* (*Sterculia urens*). As bamboo (both *padhai* and *manzel*) occurred scattered no separate bamboo working circle was constituted. It was prescribed to sell bamboo on permits. Planting of trees yielding the various M. F. P. and of bamboos was prescribed, but no such plantations were actually raised.

(C) *Working Scheme for the Khativali and Atgaon Inam Forests by the D. F. O., Shahapur*

100. These forests are being worked in the same way as the forests of the main working circle of Jadhav's plan and as such the results of the treatment are also the same. No separate remarks, are therefore, necessary.

Section 3.—*Special Works of Improvement Undertaken*

(A) *Fire Protection*

101. All exploited coupes and all rab plantations in the area of the Main and Pole Working Circles were fire-traced for a period of 5 years from the year of regeneration as prescribed by the plan. Fire protection to other areas was not prescribed. Fire

tracing along the roads and cart-tracks passing through forests was also done at some places. The expenditure incurred on fire conservancy during last 10 years from 1953-54 to 1962-63 in the three divisions is given below. The average annual expenditure on fire conservancy is far from adequate.

Expenditure incurred in :—

Year	Dahanu Division	Thana Division	Shahapur Division
(1)	(2)	(3)	(4)
	Rs. p.	Rs. p.	Rs. p.
1953-54	6,121 12	1,730 75	3,971 25
1954-55	8,064 00	3,614 50	8,200 56
1955-56	9,963 75	4,418 87	8,150 62
1956-57	9,676 75	5,413 75	8,701 31
1957-58	8,524 87	4,627 47	7,894 75
1958-59	2,621 87	5,427 67	7,450 63
1959-60	8,322 49	4,991 00	6,726 82
1960-61	7,866 68	4,642 86	7,065 61
1961-62	6,728 11	3,183 63	7,233 49
1962-63	5,100 75	3,360 00	6,998 15
Total	72,990 39	41,410 50	72,393 17
Average Annual expenditure	7,299 03	4,141 05	7,239 31

(B) Plantations

102. A statement showing the figures of the areas worked under the clearfelling system and those worked under the selection-*cum*-improvement system in the main working circle in the three divisions from 1953-54 to 1965-66 is given in Appendix No. XIV. A statement giving the area artificially regenerated in the three divisions from 1951-52, the year of introduction of Jadhav's plan to 1965-66 is given in Appendix No. XV. From the statement it is evident that plantations over an area of 7,234.509 hectares (17,855 acres) were raised during the above period. The plan had prescribed that artificial regeneration to the minimum extent of 33 per cent of the clearfelled area should be carried out. As against this 40.8 per cent of the clearfelled area was planted. However, the plan had estimated that about 2/3rd, *i. e.*, 66 per cent of the exploited area will be worked under the clearfelling system but actually only 37.44 per cent of the area was clearfelled and the rest was worked under the selection-*cum*-improvement fellings system.

103. Special plantations of agave, teak, *khair*, matchwood species, etc., were undertaken under the 5 year plan schemes. A statement giving the details of these plantations carried out from 1955-56 to 1965-66 is given in Appendix No. XVI. The total plantations carried out during the above period in the three divisions are as under :—

Agave plantations	516.65 Km.
Matchwood plantations	589.44 hectares.
<i>Kaju</i> plantations	1,012.23 "
<i>Khair</i> plantations	290.83 "
Teak plantations	1,904.56 "
Bamboo plantations	782.65 "
<i>Eucalyptus</i> plantations	987.06 "
Oil seed species plantations	22.25 "

Except for teak and agave plantations, other plantations are not very successful.

(C) Thinnings

104. Thinnings have generally been carried out as prescribed under the plan. Third thinning was not prescribed in C. No. 1 to 9 of many of the felling series in Dahanu Division as the second thinning was in arrears in those areas. Fourth thinning was not due till 1977-78 for the coupes worked under the clearfelling system from 1917-18, i.e., from coupe No. 1 onwards.

(D) Roads and Buildings

105. A statement giving the list of existing forest roads and buildings in the three divisions is given in Appendix No. XVII.

106. The various buildings constructed since 1951-52 are given in Appendix No. XVIII. No forest roads were constructed since then except the Ozar-Saiwan road which remained incomplete.

(E) Lac cultivation

107. During the second five year plan period Lac Cultivation was undertaken in Shahapur Division from 1958-59 to 1960-61. An area of 250 acres situated in C. No. 2 to 14 of M. F. S. C. I. and C. Nos. 32, 34, 52 and 53 of M. F. S. C. II. was selected for the purpose. The host trees were of *Butea monosperma* (palas). 5,000 trees were infested with lac brood in 1958-59 and 5,000 in 1960-61. It was however observed that the Lac insects did not acclimatise to the hot and humid climate and heavy rainfall of the area with the result that the insects died. The scheme was therefore discontinued in 1960-61. The total expenditure incurred on this scheme was Rs. 9,590-52.

(F) Integrated unit at Dahanu

108. Under the third five year plan scheme of "Development and supply of substitutes for teak" an integrated unit consisting of a saw mill, a wood seasoning kiln and a preservative plant has been installed at Dahanu Road. The construction of the buildings and the installation of the machinery was started in 1962-63 and was completed in 1964-65. The total expenditure incurred by the end of 1964-65 was Rs. 15,85,725 which included Rs. 1,20,069 which was the cost of acquisition of the land. The unit was placed in charge of a Special Divisional Forest Officer in February 1964. The saw mill unit started functioning from April 1965. The cost of sawing was estimated at Rs. 82 per cu. m. of sawn timber. The other two units viz., the seasoning kiln and the preservative plant have also started functioning. The object of the scheme is to popularise the use of secondary timbers so as to reduce the demand on teak which is in short supply. By the seasoning and preservative treatment, the secondary timbers can be made as durable as teak. The annual intake capacity of the saw mill unit is about 3,000 tons (4,248 cu. m.) of secondary timber in round and that of the seasoning kiln and the preservative plant is about 1,500 tons (2,124 cu. m.) of sawn timber each. The annual requirement of secondary timber of the Integrated unit is expected to be met from the annual coupes worked departmentally or through the forest labourers Co-operative Societies.

(G) Forest Guards' Training School at Shahapur

109. Under the third five year plan a training school for forest guards was started at Shahapur. The school building, hostels for students and quarters for the staff were built in 1963-64 and the school started functioning from August 1963 with a batch of 60 trainees. The strength was increased to 120 trainees after additional hostels were ready.

Section 4.—Past Yield

110. Statements showing the yield of teak and injaili timber and firewood and the average yield per acre obtained in the three divisions from the final fellings and from 1st, 2nd and 3rd thinnings carried out during the period from 1953-54 to 1965-66 are given in Appendix No. XIX. From the figures of yield from final fellings it is seen that the yield

per acre is much more in Dahanu Division than in Thana and Shahapur Divisions. It is also seen that the yield of timber is more than the yield of fuel in Dahanu Division, while it is more or less the same as the yield of fuel in Shahapur Division. The average annual yield of timber and fuel from 1953-54 to 1965-66 in the three divisions was as under :—

Division (1)	Timber		Fuel	
	(2)		(3)	
	(in tons)		(in tons)	
Dahanu	3.17	8.63		
Thana	2.58	10.57		
Shahapur	2.06	1.07		

Section 5.—Past Revenue and Expenditure

111. Statement showing the annual revenue from timber, fuel, M.F.P. and other sources and expenditure on conservancy and works and establishment, as also expenditure on plan schemes for the three divisions for 1953-54 to 1965-66 are given in Appendix No. XX. The total revenue and expenditure for the years 1953-54 and 1965-66 were as under :—

Division (1)	Revenue		Expenditure	
	1953-54 (2)	1965-66 (3)	1953-54 (4)	1965-66 (5)
	Rs.	Rs.	Rs.	Rs.
Dahanu	30,53,379.00	60,05,875.90	7,57,171.00	20,80,809.50
Thana	26,31,084.00	32,55,485.00	6,95,308.00	20,31,580.00
Shahapur	18,50,351.00	32,48,889.00	4,94,817.00	13,33,242.00

CHAPTER VI.—STATISTICS OF GROWTH AND YIELD

Section 1.—Growth

112. The rate of growth of teak trees in the Thana forest was first studied by felling sample trees in "good" quality and "medium" quality areas at the time of preparation of the Aitchison and Hamilton's plan of 1922. The growth data then obtained was as under :—

Girth in inches

Age in years— 45, 50, 60, 65, 70, 75, 80, 90, 100.
 Good quality Teak— 37.2, 42.4, 46.4, 48.2, 49.2, 49.2, 50.6, 51.9, 53.4.
 Medium quality Teak—27.4, 32.5, 37.2, 40.5, 40.9, 44.0, 44.7, 46.1 47.5.

113. At the time of preparation of Start's plan of 1935, the results of stem analysis of 480 teak trees of quality III and 220 teak trees of quality II carried out in 1930-31 were considered. The average rate of a growth of each quality was found to be as under :—

Girth in inches

Age in years— 10, 20, 30, 40, 50, 60, 70, 80, 90.
 IInd quality teak— 10.06, 13.01, 23.06, 28.75, 32.08, 35.28, 37.92, 41.31, 44.64.
 IIIrd quality teak—8.02, 13.02, 17.04, 22.09, 27.03, 31.02, 33.97, 37.05, 38.04.

114. No stem analysis of teak trees was done at the time of preparation of Jadhav's plan which is now under revision.

115. In the past, these forests were not stockmapped and classified as per standard quality classification. The terms "medium" and "good" quality or quality II and III used in the previous plans were vague and did not correspond to any specific quality classification based on top height. It was, therefore, felt advisable to carry out stem analysis of teak trees from quality III and IV-a areas which account for more than 90 per cent of the total forest area. Accordingly stem analysis of 156 trees from quality III forests and 30 trees from quality IV-a forest was carried out.

116. The mean diameter at 50 years which was taken as the reference age and the standard deviation of the mean were calculated. Data from trees which had diameters at 50 years, falling outside the range of mean ± 2 S. D. was rejected. Accordingly data from 5 trees of quality III was rejected. The standard error of the mean of the remaining 151 trees was calculated. It came to 0.42 cm. which works out to 1.5 per cent of the mean. This corresponds to a margin of error of + 3 per cent at 95 per cent confidence level. For quality IV-a data, 30 years was taken as the reference age. The standard error of the mean came to 1.3 cm. which works out to 9 per cent of the mean. This corresponds to a margin of error of + 18 per cent at 95 per cent confidence level.

117. The results of stem analysis of teak trees for quality III and IV-a areas are as under :—

Result of stem analysis of teak trees from quality III forests

Age in years	Diameter at b. h. in cm.		Height in metres	volume in cubic metres	C. A. I.	M. A. I.
	u. b.	o. b.				
(1)	(2)	(3)	(4)	(5)	(6)	(7)
10	6.90	7.70	5.00	0.015	0.0045	0.0010
20	11.60	13.00	8.70	0.055	0.0079	0.0029
30	16.30	17.50	11.70	0.135	0.0091	0.0045
40	19.90	21.40	13.80	0.220	0.0097	0.0056
50	23.00	24.50	15.40	0.325	0.0098	0.0065
60	25.40	27.00	16.70	0.420	0.0096	0.0070
70	27.70	29.50	17.80	0.510	0.0090	0.0073
75	29.05	30.50	18.30	0.552	0.0086	0.0074
80	29.80	31.50	18.70	0.598	0.0081	0.0075
85	30.73	32.50	19.10	0.634	0.0075	0.0075
90	31.60	33.20	19.40	0.670	0.0088	0.0075
100	33.00	34.80	19.80	0.734	0.0049	0.0074
110	33.60	36.00	20.00	0.738	0.0026	0.0071

Result of stem analysis of teak trees from quality IV-a forests

Age in years	Diameter at b. h. in cm.		Height in metres	Volume in cubic metres	C. A. I.	M. A. I.
	u. b.	o. b.				
(1)	(2)	(3)	(4)	(5)	(6)	(7)
10	5.50	6.00	4.00	0.0070	0.00130	0.00070
20	10.00	11.00	6.40	0.025	0.00240	0.00129
30	13.30	14.60	8.45	0.052	0.00320	0.00176
40	16.00	17.40	10.24	0.084	0.00390	0.00216
50	18.20	19.80	11.80	0.126	0.00440	0.00255
60	20.80	22.20	13.00	0.170	0.00475	0.00289
70	22.80	24.40	13.90	0.220	0.00490	0.00315
75	23.70	25.40	14.20	0.240	0.00489	0.00326
80	24.75	26.40	14.42	0.265	0.00479	0.00337
85	25.60	27.40	14.65	0.285	0.00464	0.00345
90	26.60	28.40	14.80	0.310	0.00445	0.00351
100	28.70	30.50	15.00	0.362	0.00406	0.00370
110	30.70	32.60	15.20	0.428	0.00355	0.00395

The curves derived from the above data are reproduced in Appendix No. XXI.

118. The rate of growth of Teak plantations in quality III locality was obtained by taking actual measurements in plantations of various ages. The oldest plantations was 32 years old. The measurements were taken in the plantations in coupe Nos. 16 to 47 of F. S. No. XXII of the main working circle of Jadhav's plan (situated in Kasa range). The girths and heights were plotted against age and smooth curves were drawn. The final reading obtained from these curves are as under :—

Age in years	Girth (Diameter at b. h. cm.)		Height in metres
(1)	(2)	(3)	(3)
5	17.50	(5.57)	3.42
10	26.00	(8.27)	6.19
15	33.00	(10.50)	8.50
20	38.25	(12.17)	10.21
25	43.00	(13.68)	11.70
30	46.25	(14.74)	23.01

On referring to the top height by site quality and age curve given in the yield tables it is seen that the fractional site quality of plantation Teak is 1.5 of IV. It is thus of a little higher quality than Teak in a mixed uneven-aged forests of local quality III as can be seen from the result of stem analysis of quality III Teak which corresponds to a fractional quality of 1.08 of IV. This shows that regular tending operations like thinnings carried out in the plantations result into better growth of the trees.

119. The data regarding the growth of *casuarina* was similarly collected by taking actual measurements in plantations of various ages. The girths and heights were plotted against age and smooth curves were drawn. The readings from these curves are as under :—

Age in years	Girth in cm.	Height in metres
(1)	(2)	(3)
5	38.80	13.80
10	67.00	24.80
15	80.00	26.00

120. As regards the rate of growth of *sawar*, stumps analysis of six trees was done at the time of preparing Jadhav's plan and the data obtained is as under :—

Age in years	Diameter at b. h. in cm.
(1)	(2)
10	7.36
20	13.46
30	21.08
40	27.18
50	33.27
60	37.59

Section 2.—Stocking

121. At the time of the preparation of the working plan under revision, the enumerations as originally contemplated could not be completed for want of staff (*vide* para 91 of Jadhav's plan). Actually enumerations were carried out in 12 felling series instead of in 135 felling series as originally decided. The data therefore is not of much use. At the time of preparation of the present plan 10 per cent enumerations were carried out in the Thana forests (except Jawahar forests) under the scheme of "Survey of Forest Resources" sanctioned under the third five year plan. The whole work was carried out between November 1962 to November 1966. The number of the enumeration parties (each party consisting of 2 foresters and 1 surveyor) varied from time to time. Initially there were 5 parties in charge of one Range Forest Officer. Later on 3 more parties were added and a Sub-Divisional Forest Officer, was put in charge of the work assisted by a Range Forest Officer. During 1964-65 season, the strength of the parties was increased to 12 and 3 Range Forest Officers were posted to assist the Sub-Divisional Forest Officer. During 1965-66 the strength was reduced to 9 parties in charge of 2 Range Forest Officers who worked under the supervision of the Sub-Divisional Forest Officer. The sampling design was given by the Forest Statistician M. S., Poona, who also analysed the data. Topographical units which were defined by natural features were selected for sampling. In the case of the ex-Jawahar state forest however this method of sampling was not adopted as the Jawahar maps were not accurate. Here, only 5 per cent enumeration by strip sampling was carried out. During the enumerations all the species were enumerated in 15 cm. girth classes. Separate data was collected for each felling series. From this data, range-wise results for different working circles have been compiled in four statements *viz.*, (i) Girthwise estimates of total number of trees specieswise in respect of 24 important species and rest of the species together. (ii) Girthwise stock per hectare separately for *ain*, *bonda*, *kakad*, *shiras*, *sawar*, *teak*, *tivas*, *beheda*, *hed*, *kalam*, *khair*, *shisham* and rest of the species together. (iii) Species-wise percentage distribution in various girth classes for a different species as per (ii). (iv) Girthwise percentage distribution for different species as per

(ii). This data which is available with the Forest Statistician, is too bulky to be reproduced and hence an abstract of the above statements separately for total area under each working circle is given in Appendix No. XXII. The total area enumerated in the forests of various working circles as per Jadhav's plan was as under :—

Working Circle	Total area in hectares	Area enumerated in hectares	Percentage
(1)	(2)	(3)	(4)
Main Working Circle	212,436	19,065	8.97
Lakes Catchment Area Working Circle	17,399	1,745	10.03
Jawhar Forests	18,571	765	4.12
Pole Working Circle	2,178	116	5.33

122. From the results of enumeration it is seen that the percentage of valuable species in the crop in the forests of the main working circle is as under :—

Teak (18.32 per cent), *ain* (16.75 per cent), *kakad* (4.04 per cent), *bondara* (2.35 per cent), *hed* (2.09 per cent), *shisham* (1.78 per cent), *khair* (1.73 per cent), *kalam* (1.64 per cent), *Sawar* (1.05 per cent), *behada* (0.78 per cent), *bibla* (0.76 per cent), *tiwas* (0.26 per cent).

The total number of the trees of all species per hectare for different working circles is as under :—

Main Working Circle	410.20
Jawhar Forests	388.38
Pole Working Circle	320.04
Lakes Catchment Working Circle	446.88

123. The forests of the main working circle had received three different treatments Area of coupe Nos. 1 to 34 (Group 'A') was clearfelled during the previous plans and contained even-aged forests with a few teak plantations. Area of coupe Nos. 35 to 47 was worked under the dual system of clearfelling-cum-selection-cum-improvement felling under Jadhav's plan while area of coupe Nos. 48 to 80 was worked under coppice with standards system before 1917. Enumeration data from these three types of areas was grouped separately *viz.*, Group 'A' (C. Nos. 1 to 34), Group 'B' (C. Nos. 35 to 47) and Group 'C' (C. Nos. 48 to 80) and the estimate of the growing stock was calculated separately for each group.

124. Even if the crop in coupe Nos. 1 to 34 is even-aged, it is not a pure crop but consists of a large number of species mixed together. It is therefore very difficult to assess the extent to which the present stocking in this group is deficient or otherwise as compared to a fully stocked area because the available stand tables are for pure even-aged crop *e. g.*, the yield and stand tables for teak. For want of any other criteria the present stocking of all species including teak can be compared with the figures from these stand tables, for the corresponding quality (*i. e.*, IV) by comparing the number of trees diameter curve derived from the enumeration data with a similar curve drawn from the stand table data. The two curves drawn are reproduced in Appendix No. XXIII. From these curves it will be seen that the present stocking is far too inadequate as compared to a fully stocked even-aged crop. The extent to which the present stocking is deficient can be found out by comparing the average basal area per acre given in the yield tables. The crop diameter of the crop in this group can be worked out as under :—

Total basal area = $b_1 n_1 + b_2 n_2 + b_3 n_3 + \dots$ Where n_1, n_2, n_3 , etc. are the number of trees in various girth classes.

And b_1, b_2, b_3 , etc. are the basal areas of average trees in each girth class.

The total basal area of the group divided by the total area gives the average basal area per acre. This works out to 32.16 sq. ft./acre. The crop diameter therefore is 5.7 inches. The basal area/acre for this diameter as per the yield table is 37 sq. ft./acre. Therefore the density of the crop is $\frac{32.16}{37}$, i. e. 0.8.

125. In order to bring out the extent to which teak will have to be introduced in these areas to convert them into fully stocked teak forests, similar comparison of the stocking of teak trees only with yield table figures can be made. The two number of trees/diameter curves are reproduced in Appendix No. XXIV. The density of teak works out to 0.18.

126. As regards the areas comprising of coupe Nos. 35 to 47 it is not possible to derive any conclusion from the enumeration data, as the area contains both even-aged patches worked under the clearfelling system and uneven-aged patches worked under the selection-cum-improvement system during Jadhav's plan.

127. As regards the area comprising of coupe Nos. 48 to 80, the crop is uneven-aged. It is the general observation that this crop is deficient in the number of trees in the higher girth classes on account of the over exploitation in the past and also particularly in respect of teak on account of the cyclones in which the bigger teak trees were uprooted in large numbers. It is however difficult to express in quantitative terms the extent to which the crop is short of full stocking as well as the extent to which the actual proportion of tree in various girth classes differs from the correct proportion. This difficulty arises because there are no stand tables prepared for uneven-aged forests. The yield and stand tables for teak are for even-aged pure crop of plantation teak and hence cannot obviously be used for comparing the distribution of trees in various girth classes. A criterion for comparison is however, available in the law of de-Liocourt which provides a satisfactory and convenient yardstick of the balanced character of the uneven-aged crop of the temperate region. It has been shown that this law holds good in the case of the balanced uneven-aged moist deciduous forest of South Chanda Division. According to this law, the number of trees in successive diameter classes represents a geometric series in the case of a balanced crop and hence if the logarithms of the number of trees in various diameter classes are plotted against the mid-diameters of the classes, the resulting points give a straight line in the case of a balanced crop (*vide* paper by G. S. Mathauda, Assistant Silviculturist, F. R. I., Deharadun, published on page 258 of the proceedings of the Ninth Silvicultural Conference Part II). This test can be applied for studying the abnormalities in the distribution of trees in various size classes. The curve of log of trees / girth for the present crop is reproduced in Appendix No. XXV. From the curve, it is seen that the crop is deficient in 15-30 cm. girth classes.

128. The above test shows only the abnormalities in the distribution of the trees in various girth classes. It does not give any idea about the extent to which the crop is short of full stocking because an understocked crop may also have the correct proportion between the trees in various girth classes. As regards stocking, a comparison of the total growing stock with the stocking in a well stocked uneven-aged crop of similar locality would indicate the extent to which the crop is understocked. The number of trees per acre of 30 cm. girth and above in the compartment with maximum density in the Dangs Forest was found to be 198. The average number of trees per acre in the Thana forests of 30 cm. girth and above is 112. Thus the density of this crop is only 0.56. This gives an idea of the extent to which the stocking requires to be built up.

129. Considering the distribution of only teak trees, it is seen from the log of number of trees/girth curve given in Appendix No. XXVI, that there is a great deficiency in the 31-45 cm. girth classes.

Section 3.—Yield

130. The figures given in Appendix No. XIX give an idea of the total yield per acre obtained in the three divisions as well as the proportion of timber and fuel in the total yield. From these figures it is seen that the yield per acre is much more in Dahanu Division than in Thana and Shahapur Divisions. The proportion of timber in the total yield is more than that of fuel in Dahanu Division while in Thana Division the proportion of timber and fuel are nearly the same. In Shahapur Division, the proportion of fuel is more than that of timber. The obvious reason for the different proportions in the three divisions is that the forests of Dahanu Division have a greater proportion of timber yielding species than the other two divisions.

131. *Local commercial volume tables.*—Local commercial volume tables for teak from III quality localities in Dahanu, Thana and Shahapur Divisions were prepared from the outturn data available from the felling registers maintained by the forest labourers' Co-operative societies which had worked coupes in the three divisions. Actual outturn of timber was noted against the girth classes to which the tree belonged. For each girth class, the number of readings required for 95 per cent precision was calculated and sufficient readings exceeding this number were recorded. The actual girth at breast height of each tree was recorded and the corresponding basal area was calculated. The girth corresponding to the mean basal area was taken as the average girth of the girth class. The average girths of all girth classes were plotted against their average volumes and smooth curves were drawn. The volume corresponding to the mean girths of the classes were read from these curves and the following volume tables were prepared. The curves from which the tables were prepared are given in Appendix No. XXVII.

Local commercial volume tables for teak from quality III

LOCALITY

Girth class in cm.	Volume in cubic metres		
	Dahanu Division	Thana Division	Shahapur Division
(1)	(2)	(3)	(4)
15-30	0.010	0.010	0.007
30-45	0.025	0.024	0.022
45-60	0.055	0.060	0.049
60-75	0.095	0.100	0.093
75-90	0.155	0.160	0.146
90-105	0.240	0.230	0.214
105-120	0.330	0.320	0.289
120-135	0.440	0.470	0.406
135-150	0.570	0.700	0.540
Locality from which the data was obtained.	Compartment Nos. 62, 214, 232, 235, 275 and 281 in Kasa range.	Compartment Nos. 580, 512, 825, 830, 977 and 979 in West Vada and Badlapur ranges.	Compartment Nos. 674 and 691 in Dhasai range.
Total number of measurements on which the calculations are based.	3121	452	661

132. Data regarding the outturn of *avn*, *dhavada*, *khair*, *kalam*, *kakad*, and *haldu* was collected at the time of preparation of Jadhav's plan (*vide* para 96 of the plan) by felling trees of these species and recording the measurements. This data given in Appendix No. XX of Jadhav's plan is reproduced in Appendix No. XXVIII.

CHAPTER VII.—ESTIMATE OF CAPITAL VALUE OF FORESTS

Section 1.—Capital Value of the Forests

133. Capital value which is also known as the expectation value is the net value based upon future income. It is the discounted value of future income minus future expenses. The Thana forests are being managed under a regular working plan on the principle of obtaining maximum sustained yield in perpetuity. It therefore produces a regular annual income (*i. e.* annual receipts less annual expenditure) which in theory at least, will be obtained in perpetuity. The capital value of the forests can therefore be calculated by the formula.

$$\text{Capital value} = \frac{r}{O. Op.}$$

Where 'r' is the net annual income and 'p' is the rate of interest. The net average annual income for 10 years from 1953-54 to 1962-63 for the three Thana divisions is Rs. 80,97,373. The total forest area of the three division is 290,237.261 hectares. The annual income per hectare therefore works out to Rs. 27.90. At 4 per cent rate of interest, the capital value of the forest by the above formula works out to :—

$$\frac{27.90}{0.04} = \text{Rs. } 697.50 \text{ per hectare.}$$

Thus the capital value of the forest of the three divisions works out as under :—

Division	Area in hectares	Capital value in Rs.
Dahanu	111,559.012	7,78,12,420
Shahapur	91,413.406	6,37,47,317
Thana	87,264.843	6,08,67,226
Total for the whole of Thana forests	290,237.261	20,24,26,963

Section 2.—Financial Results of Teak Plantations

134. It is of considerable interest to find out the financial results of teak plantations which are being raised on a large scale in the Thana forests. Profit of forestry (P) is calculated by the formula :—

$$P = Se - Sc. \quad \text{Where } Se = \text{expectation value of the soil.} \\ \text{and } Sc = \text{cost value of the soil.}$$

Since in the case of Government Forests, the cost value of the soil is Nil.

$$P = Se.$$

135. The soil expectation value of teak plantations can be calculated by Faustmann's formula *viz.*

$$Se = \frac{Yr + \sum T a \times 1.0p^{\frac{r-a}{r}} - C \times 1.0p^{\frac{r}{r}}}{1.0p - 1} - \frac{e}{O.0p}$$

Where Yr = Value of final yield at rotation age

r = rotation age

$\sum T a$ = sum of values of yields from thinnings

C = cost of formation

p = rate of interest

e = annual recurring expenses

136. The rotation $r=80$ years. The thinnings are to be carried out at 10th, 25th, 40th and 60th years. Most of the plantable area in the Thana forests is of local quality III which corresponds to the All India quality IV as per the "Yield and Stand Tables for Plantation Teak" (Indian Forest Records) (New Series) (Silviculture vol. 9 No. 4 published in 1964). The estimate of the final yield from thinnings can therefore be taken from the yield tables. For the purpose of the calculations 80 per cent of the yield given in the table is considered as salable. The current market rates (exclusive of the cost of felling, extraction and transport) for the stem timber and stem small wood obtainable at the various ages are as under :—

Yield at	Stem timber	Stem small wood
(1)	(2)	(3)
80 years	Rs. 14 Cft.	Rs. 3 Cft.
60 years	Rs. 9 Cft.	Rs. 3 Cft.
40 years	Rs. 7 Cft.	Rs. 2 Cft.
25 years .. .. .	..	Rs. 1 Cft.
10 years .. .. .	..	Rs. 0.5 Cft.

137. The cost of formation per acre works out to Rs. 250 as per the following current sanctioned rates :—

Particulars	Amount
(1)	(2)
	Rs.
Nursery cost	24
Preparation of rabs	80
Burning of rabs	5
Alignment, staking and planting	24
Three weedings in the 1st year	48
Two weedings in the 2nd year	22
One weeding in the 3rd year	12
Replacement of casualties	5
Fire tracing for 5 years	30
Total	250

(For simplification of the calculations of the expectation value, the weeding charges and fire tracing charges are considered as initial expenditure incurred in the first year. This will not make much difference in the value obtained.)

138. The annual recurring expenditure on staff etc. is negligible for one acre and hence need not be taken for calculation.

The rate of interest 'p' is taken as 4 per cent.

The soil expectation value thus works out to

$$S_e = \frac{9907 + (480 \times 1.04^{20} + 288 \times 1.04^{40} + 216 \times 1.04^{55} + 42 \times 1.04^{70} - 250 \times 1.04^{80})}{1.04^{80} - 1}$$

$$= \frac{9907 + (1051 + 1332 + 1857 + 655) - 5750}{22}$$

= Rs. 414 per acre.

or Rs. 1035 per hectare.

139. The total value of the final yield and the intermediate yield (capitalized to 80 years age) is Rs. 14,852. Thus an initial investment of Rs. 250 per acre gives net return of Rs. 14,852 after 80 years. This corresponds to a rate of compound interest of 5.2 per cent. The teak plantations in the Thana forests will thus yield a forest per cent of 5.2 per cent on the investment, on a rotation of 80 years. This exceeds the general rate of interest *viz.* 4 per cent by 1.2 per cent. Therefore the real or "entrepreneur's" profit of the plantations will be 1.2 per cent. Thus the teak plantations in the Thana forests are economically profitable.

140. The capital value of the Thana forests is Rs. 697.50 per hectare (*vide* para 133) while that of a teak plantation is Rs. 1,035 per hectare as calculated above. Thus the conversion of the present mixed miscellaneous type of forest into a teak forest will increase the value of the forest by Rs. 337.50 per hectare.

CHAPTER VIII.—WILD LIFE

Section 1.—General History of Wild Life

141. Before independence, the Thana forests were rich in the number and varieties of wild game occurring in them. The following extract from the Thana district Gazetteer (Vol. XIII, Part I, 1882 Edition) is of interest in this respect :—

“About a century ago (1874), the Salesette hills were infested with tigers who came freely down to the plains. In the five years ending 1879, 99 tigers and 55 panthers and leopards were slain.”

142. Leopards are now extinct while the number of tigers and panthers has been considerably reduced and they are now mainly confined to the remote hills. The main reason for the rapid dwindling of wild animals, specially since 1947, is the extensive poaching done by the local people as well as the so-called shikaries from Bombay to whom these forests are the nearest. The liberal issue of gun licences for crop protection has enabled the local villagers to indulge in poaching of small game like deer while the increasing use of Jeeps and searchlights has helped the triggerhappy “sportsmen” from Bombay to butcher even the big game like tigers and panthers.

143. For a list of wild animals and birds found in the Thana forests, please refer to Appendix No. XXIX. Some of the important animals and birds present in these forests are tigers, panthers, *sambar*, spotted deer, Jungle fowls, partridges, pigeons etc.

Section 2.—Legal Position

144. The Bombay Wild Animals and Wild Birds Protection Act of 1951 is applicable to this area and according to this Act hunting of any wild animals or wild birds (except those declared as vermin) without a licence is prohibited, whether in forests or non-forests areas or on private land. Before this Act came into force in 1953, the shooting of wild animals and birds in the reserved and protected forests was regulated under Rules 8 to 39 of the Bombay Forest Rules, 1942 framed under Section 26 (i), Section 32(j) and Section 76 (d) of the I. F. A., 1927. Though these rules have not been repealed, they have become obsolete as their provisions are covered by the Act of 1951. Such of the rules as are contrary to the provisions of the Act are not now valid.

Section 3.—Rights and Concessions in respect of the Wild Animals and Wild Birds.

145. There are no rights given to anybody in respect of hunting. Hunting and spreading snares are allowed in open areas of reserved forests to inhabitants of forest villages and hill tribes in Dahanu taluka (*vide* special privileges sanctioned for Thana district given in Appendix No. VII).

Section 4.—Injuries to the Wild Life

146. The chief injury to wild life is caused by man through poaching, which is very extensive.

Section 5.—Measures adopted for Protecting Wild Life

147. The Bombay Wild Animals and Wild Birds Protection Act, 1951, which is applicable to the whole tract irrespective of whether it is a forest land or not, does afford, to some extent, protection to the wild life by restricting its wanton destruction by poaching. However for want of sufficient and suitably equipped staff, it has become difficult to make the Act fully effective. Shooting of deer has been completely prohibited under the provisions of this Act.

Section 6.—Statistics of Wild Life Captured, Hunted or otherwise Dead.

148. For details of wild animals shot during 1953-54 to 1965-66 refer to Appendix No. XXX. From the statement it will be seen that 2 tigers, 8 panthers and 1 *sambar* have been shot.

Section 7.—Special Works of Improvement undertaken

149. A wild life sanctuary is proposed to be constituted in the catchment area of Tansa lake (in Shahapur division). The total area of the sanctuary will be 12,109.419 hectares. An area of 9,498.782 hectares which forms the surrounding of the proposed game sanctuary has been formed into a game preservation block. At present shooting and hunting is prohibited in the area of the proposed sanctuary.

Section 8.—Revenue

150. The average annual revenue realised during the 10 years from 1953-54 to 1962-63, as fees for the issue of game licences is Rs. 1,000.

PART II.—FUTURE MANAGEMENT DISCUSSED AND PRESCRIBED

CHAPTER I.—BASIS OF PROPOSALS

Section 1.—National Forest Policy

151. The National Forest Policy of 1894 has been reoriented in 1952 consequent to the revolutionary changes that have taken place during the intervening period in the physical, economic and political fields of this country. The new Forest Policy is formulated comprehensively to meet the manifold needs. In particular, it focusses attention on the functions, the different forests are to fulfil and lays stress on their classification on functional basis which should indicate the lines on which their management should be prescribed.

Functional classification of the Forests.

152. The forests dealt with under this plan have been classified as follows as per the functional classification adopted by the Ex-M. P. Government *vide* their Resolution No. 3952-2624-XI, dated 10th December 1952:—

(i) *Protection Forests* :—These include all the forests situated on steep slopes (*i.e.* above 25°) and forests situated in the catchment of Vaitarna, Tansa and the proposed Bhatsai Lakes. The total area under this category is 100,452·855 hectares, forming 34·61 per cent of the total forest area.

(ii) *Tree Forests* :—These are the forests situated on moderate slopes (*i. e.* less than 25°) and which are suitable for growing large sized timber of teak and other economically important species. *Casuarina* and *babul* forests also fall in this category. The area under this category is 175,920·791 hectares, forming 60·61 per cent of the total forest area.

(iii) *Minor Forests* :—This class includes the forests which are situated near the towns and along the coastal tract and which have suffered in the past due to illicit cutting and hacking and are now capable of producing only small timber and fire-wood. The area under this category is 5,340·690 hectares, forming 1·84 per cent of the total forest area.

(iv) *Remaining Forests* :—These are the areas included in the *Kuran* Working Circle of Jadhav's plan and the denuded and almost blank areas situated along the coastal tract in Dahanu and Thana Divisions and similar areas situated near Thana. It also includes the area of 820·655 hectares given for '*Dalhi*' cultivation and an area of 69·969 hectares under preservation plots. In addition it also includes an area of 4,848·320 hectares to be assigned to School Forest. The total area under this category is thus 8,522·925 hectares forming 2·94 per cent of the total forest area.

153. A statement showing distribution of compartments to various ranges of Thana Divisions is given in Appendix No. XXXI-A. A statement giving the area by functional classes of ranges and compartments is given in Appendix No. XXXI-B.

The total area and percentage of each class of forests is as under :—

Class	Area in hectares	Percentage
(1)	(2)	(3)
Protection	100,452·855	34·61
Tree	175,920·791	60·61
Minor	5,340·690	1·84
Remaining	8,522·925	2·94
Total ..	290,237·261	100·00

Section 2.—Factors Influencing the General Objects of Management

154. The various factors influencing the general objects of management are as follows :—

(i) The Thana forests are situated very near to Bombay and other industrially expanding centres like Thana, Kalyan, Bhiwandi and Dahanu where many industries like saw mills, hardboard factories etc. using forest produce are located. There is, therefore, a great demand for every type of forest produce that can be obtained from these forests.

(ii) On account of the favourable climatic and edaphic conditions, the forests are capable of growing big sized timber of teak and other valuable species like *khair* for which too, a great demand exists.

(iii) In the absence of any natural regeneration of teak worth the name, the only way of increasing the proportion of teak, which is the most valuable species that can be grown in these forests, is to raise it artificially.

(iv) On account of the heavy rainfall occurring in the locality, clearfelling the steep slopes results into severe soil erosion and consequent deterioration of the site quality.

(v) Some of the forests are situated in the catchment areas of the Vaitarana, Tansa, Vihar and the proposed Bhatsai Lakes which supply water to Bombay City. The forests conserve the water which ultimately reaches the lakes. They also prevent the silting up of the lakes.

(vi) Forests, situated near towns like Thana, Kalyan and along the coastal belt where a great demand for firewood exists, have suffered much in the past on account of damage by illicit cutting and hacking for firewood. Some of these areas are completely denuded and have very little soil left, with the result that the areas are fit only for growing grass; while in the case of the rest of the area, though the site quality has deteriorated to such an extent that the area has become unfit for growing teak and other valuable species, it is still suitable for raising firewood species.

(vii) Under the perspective plan of the Maharashtra Forest Department, large scale plantations of *Eucalyptus* species and other industrial woods like *sawar*, *haldu*, *kalamb* etc. are proposed to be raised so as to supply pulpwood for paper manufacture and industrial woods for other forests based industries. Areas suitable for raising these plantations are available near the industrial centres and along the major roads leading to these centres.

(viii) The demand for forest produce is increasing at a very rapid rate and hence exploitation of suitable areas which were so far considered as inaccessible, will have to be resorted to for increasing the yield. Such areas are situated on steep slopes and hence they will have to be worked under the selection system so as to minimise the danger of soil erosion.

General Objects of Management.

155. Considering the above factors, the general objects of management of the Thana forests will be :—

(i) To protect and conserve the vegetal cover on steep slopes and high ranges and in the catchment areas of lakes so as to prevent soil erosion and to conserve water-supply to lakes.

(ii) To preserve the physical features and to conserve micro-climatic and micro-edaphic conditions of the site.

(iii) Consistent with the first two objects, to aim at creation of a normal forest and all that it implies.

(iv) To raise large concentrated plantations of teak and other economically valuable industrial woods.

(v) To raise plantations of pulpwood species like *Eucalyptus* and bamboos and other industrial woods like *hed*, *kalamb*, *sawar* etc. on suitable sites so as to supply raw material for paper manufacture and other forest based industries like manufacture of *kath*, matches, packing cases etc.

(vi) To meet the local demand for forest produce to the extent possible.

(vii) Consistent with the above, to derive maximum and as far as possible, sustained annual yield.

Section 3.—Method of Treatment to be adopted

156. The treatment for the various classes of forests is proposed after taking into consideration the principles enunciated in the National Forest Policy and the objects of management. The treatment to be adopted for the various classes of forests is as under :—

(i) *Protection Forests* :—Here the main object of management is to preserve the vegetal cover so as to prevent soil erosion and to conserve water-supply. Revenue is of secondary importance. At the same time, removal of trees reaching exploitable size beyond which their retention is not financially profitable, will have to be ensured. It is, therefore, proposed to work such of these forests as are accessible, under the "Selection-cum-improvement" fellings system.

(ii) *Tree Forests* :—The main object of management of these forests is to grow large sized timber of teak which is the most valuable timber species. As the proportion of teak is very scanty, the object of management can be achieved only by raising plantations of teak. Sufficient area will be planted with *Eucalyptus* and bamboos so as to sustain a 200 tonnes capacity pulpwood factory. Some areas will also be earmarked for raising plantations of industrial woods like *khair*, *hed*, *kalamb*, *sawar* etc. *Casuarina* and *babul* will be planted in suitable areas.

(iii) *Minor Forests* :—Here the object of management is to meet local demands in respect of small timber, firewood and grazing. The treatment proposed is therefore clearfelling with artificial reproduction of species like *eucalyptus hybrid*, *acacia auriculiformis* etc.

(iv) *Remaining Forests* :—The area under this category which formed the Kuran Working Circle of Jadhav's plan has either been leased to various bodies for long periods or has been handed over to the Milk Commissioner, Bombay for indefinite period. The area is, therefore, not under the control of the Forest Department at present nor is likely to come under its control during the period of the plan. No treatment has, therefore, been proposed for this area as the question does not arise for the present. The details of the area are as under :—

Name of village	Survey number	Area in hectares	Remarks
(1)	(2)	(3)	(4)
Umroli	138	92-92	} Handed over to the Milk Commissioner, Bombay, for use in connection with the Milk Cattle Colonisation Plan.
Bandate	35	1-45	
Kamara	80	77-71	} Leased to Adarsha Dugdhalaya, Bombay, as per G. R., F. D., No. 3246/28 of 23-5-1944, at an annual rent of Rs. 2.
Mahim	808	13-44	
Kelva	435	90-77	
Kelva	369	55-59	} Leased to Shri M. S. Killedar and Bros. for 35 years from 1-8-1938 on annual rent of Rs. 2 per acre for first 20 years and Rs. 3 per acre for the remaining 15 years.
Mahim	932	28-85	
Bordi (Man forest)	515	66-03	Except for 2-02 hectares reserved for Agricultural Department for grass breeding station, the remaining area has been leased to the Village Panchayat, Bordi on an annual rent of Re. 0-50 per acre as per G.R., F. D., No. 4540/39, dated 7th October 1943.
Total		423-86	

157. The denuded and almost blank areas situated along the coastal tract in Dahanu and Thana Divisions and similar areas near Thana are fit only for growing grass and hence will be developed as fodder reserves so as to supply fodder to the Government Milk Colonies at Aarey in Bombay and at Dabchari near Talasari. From the Dalhi lands only teak, *tivas* (*Ougeinia dalbergioides*) and *shisham* (*Dalbergia latifolia*) trees will be removed, while injaili trees will be retained for *tahal* cutting by the plot-holders. Preservation plots will be strictly protected from fire and grazing to carry out ecological studies. No treatment is proposed for the areas to be assigned to school forests, as a separate working plan is to be prepared for these areas.

Section 4.—Working Circles, Their Areas, Distribution and Reasons for their Constitution

158. The following working circles have been constituted :—

(i) *Protection Working Circle* :—This includes all the unworkable areas, *i.e.*, areas which are too steep and inaccessible to work. On account of the steepness, any sort of exploitation will immediately enhance the danger of landslides and severe soil erosion. These forests will not, therefore, be subjected to any exploitation. An area of 16,212·054 hectares of protection forests from the inexploitable working circle of Jadhav's plan has been included in this working circle. The total area in this working circle is thus 16,212·054 hectares.

(ii) *The Selection-cum-Improvement Working Circle* :—This includes all the accessible areas which are too steep for clearfelling and hence are required to be worked under the Selection-cum-Improvement fellings. All workable areas with a slope of more than 25° are allotted to this working circle with the exception of the areas situated in catchment of lakes for which a separate working circle has been formed. An area of 9,378·230 hectares from the inexploitable working circle of Jadhav's plan was found to be accessible and not very steep and hence has been included in this working circle. Similarly areas which are in small patches, *i.e.* less than 40 hectares (less than 100 acres) in extent, though otherwise suitable for allotment to this working circle have been allotted to the working circle to which the adjoining areas have been allotted for convenience of management. The total area included in the Selection-cum-Improvement working circle is 48,628·003 hectares.

(iii) *The Lakes catchment area Working Circle* :—This includes all the workable area situated in the catchment of Vaitarna, Thansa, Vihar and the proposed Bhatsai lake. It was considered necessary to constitute this area into a separate working circle and not include in the selection-cum-improvement working circle, because in the catchment areas more emphasis will have to be given on soil and water conservation measures for which specific prescriptions will have to be given. Similarly fire protection and grazing control will have to be rigid in this area. In felling, preference will have to be given to retention of miscellaneous evergreen, semi-evergreen or less deciduous species which give a better soil cover than that of teak which remains deciduous for a long time in the dry season and causes drip during the rainy season. In fact the object of management of these forests will be achieved by aiming at creation of an irregular forest of mixed species. However, teak being an economically important species, it will be favoured particularly in areas which are not situated very near the lakes. The total area included in this working circle is 35,612·798 hectares.

(iv) *The Conversion Working Circle* :—This includes all better quality areas (with site quality III and above) situated on moderate slopes. Most of these areas are suitable for raising large sized timber of teak and other valuable species and hence the object of management will be to convert the forests into more valuable forests by clearfelling the area and planting it with teak and other valuable timber species. The area included in the conversion working circle is 159,926·276 hectares.

(v) *The Industrial Woods Plantation Working Circle* :—The demand for various industrial woods such as *khair*, *sawar*, *hed*, *kalam*, etc. is increasing. These species will have to be raised and worked on a rotation of 40 years which is much shorter than that for teak. Therefore, some of the areas which are suitable for allotment to conversion working circle, particularly that situated along the main lines of communications leading to industrial centres, have been constituted into a separate working circle for raising plantations of industrial woods. The area included in this working circle is 5,014·838 hectares.

(vi) *The Pulpwood Plantation Working Circle* :—National prosperity depends to a large extent on quick industrial development. Forest management too must, therefore, be industrially oriented. One of the important forest based industry is paper manufacture for which the raw material in the form of short fibred pulpwood can be obtained from *Eucalyptus* and the long fibred pulpwood from bamboos. Suitable areas containing mostly mixed crop and situated not far from Kalyan which is proposed as the site for location of a 200 tonne capacity pulpwood factory, have been constituted into the pulpwood plantation working circle for raising plantations of *Eucalyptus hybrid* and bamboos. The area included in this working circle is 10,834·289 hectares.

(vii) *The Miscellaneous Plantation Working Circle* :—This includes the areas which have suffered considerably in the past by illicit cutting and hacking. The site quality has deteriorated and the areas are no more fit for growing superior timber species. Plantations of firewood species like *Albizia species*, *Acacia auriculiformis*, *Eucalyptus* etc. which are not exacting in regard to soil conditions will therefore be raised in these areas. The area included in this working circle is 5,340,690 hectares.

(viii) *The Fodder Reserves Working Circle* :—This includes the denuded areas in Dahanu and Thana Divisions which are fit only for growing grass. The areas are situated near Vangaon, Boisar, Virar and Thana where the pressure on the forests for firewood is so tremendous that it will be extremely difficult to protect any plantations in the area. Grass can come up very well in the area included in this working circle which is 2,783,981 hectares.

(ix) *The Casuarina Working Circle* :—This includes all the *casuarina* plantations raised along the sea coast in Palghar, Dahanu and Bordi ranges. The area of these plantations is 72,343 hectares.

(x) *The Babul Working Circle* :—This includes all the *babul* forests situated along the Vaitarna river in Dahisar range. The total area included in this working circle is 73,045 hectares.

(xi) *The Miscellaneous Working Circle* :—This includes an area of 4,848,320 hectares to be managed as 'School Forests' for imparting practical training to Forest Guards Trainees of Forest Guards' Training School at Shahapur, and area of 69,969 hectares covered by three preservation plots and an area of 820,655 hectares under 'Dalhi' cultivation scattered in all the three Thana Divisions. The area of this working circle thus totals to 5,738,944 hectares.

(xii) *The Minor Forest Produce (Overlapping) Working Circle* :—This includes all the areas covered by this plan.

(xiii) *The Bamboo (Overlapping) Working Circle* :—This includes all the bamboo bearing areas. The bamboo flowered all over the Thana forests in the year 1959-60. Its regeneration has not yet established all over. However clump formation may take place during the period of this plan and exploitation of bamboos will then be possible. To regulate the exploitation of the matured bamboos, this working circle has been constituted.

159. A rangewise statement of allotment of area to the different working circles is given in Appendix No. XXXII.

Section 5.—Blocks and Compartments

160. The area was not divided into blocks and compartments in the past. The whole area covered by this plan has now been divided into 34 blocks which have been further divided into 1,170 serially numbered compartments. As far as possible, compact areas have been designated as separate blocks. However there are numerous scattered patches which had to be grouped together to form suitable blocks. A statement giving the names of the blocks, names of the ranges in which they occur, the number of compartments included in them and their areas, is given in Appendix No. XXXIII.

161. The compartment boundaries have been carefully selected as the compartments will be permanent units. The boundaries generally follow natural features like ridges and nallas. Average size of compartment is 2.4 sq. km. The compartments have been serially numbered beginning from Bordi range in Dahanu Division and ending in Tokawada range in Thana Division. A statement showing the qualitywise distribution of area by compartments is given in Appendix No. XXXIV-A. Sub-compartments have been formed where it was found necessary to allot parts of a compartment to different working circles or to different periodic blocks in the conversion working circle. A statement showing the distribution of area of compartments into various working circles is given in Appendix No. XXXIV-B.

Section 6.—Analysis and Valuation of the Crop

162. The Thana forests were not stockmapped at all in the past. At the time of preparation of this plan, all the compartments were stockmapped. Local quality classification based on the height of mature trees, was adopted for showing the site qualities. Two types of forests (apart from the *babul* and the *casuarina* forests) were recognised

for stockmapping *viz.* mixed forests and teak forests. Forests with more than 20 per cent teak in the overwood were classed as teak forests and the rest as mixed forests. Density and age of the crop and occurrence of important species and their regeneration have been shown on the stockmaps.

163. The stockmapping work was carried out from April 1963 to June 1965. The standard conventional signs and symbols used for stockmapping are given in Appendix No. XXXV. At the time of stockmapping the compartments, detailed compartment descriptions (compartment history form No. 1) have also been written up.

164. Details of enumerations carried out have already been given in Chapter VI of Part I (*vide* paras 121 to 129).

Section 7.—Period of the Plan

165. The period of the plan is fixed at 20 years from 1st July 1969 to 1st July 1989 after which it may be revised. If necessary it may be revised earlier. This period corresponds to the period of the blocks formed under the conversion working circle. It also corresponds with the period of the felling cycle prescribed for the lake catchment area working circle and the selection-*cum*-improvement working circle. It is also equal to half the rotation fixed for the industrial woods plantation working circle. No exploitation will ever be advisable in the areas included in the protection working circle. The steep areas included in the selection-*cum*-improvement working circle and the catchment areas will not stand any treatment, other than the one prescribed. The technique of artificial regeneration of teak, *khair* etc. has proved to be successful and hence no difficulties are anticipated as regards the conversion working circle except labour difficulty which it may be possible to overcome. It is, therefore, not expected that any fundamental changes will be required at the end of the period of this plan. Allotment of the areas to the various P. Bs. may only have to be reviewed at the end of the period. It is only in respect of the miscellaneous plantation working circle, the pulpwood plantation working circle and the industrial woods plantation working circle that the prescriptions may have to be revised. Large scale plantations of *Eucalyptus* have been undertaken only recently and there is no data about its rate of growth. Similarly the technique of raising large scale plantations of industrial woods like *hed* and *kalamb* has not been practised so far, nor any reliable data regarding their rates of growth is available. The rotations for these two working circles have therefore been fixed tentatively and will have to be reviewed after more growth data becomes available. This can be conveniently done at the time of the next revision of the plan.

CHAPTER II. WORKING PLAN FOR THE PROTECTION WORKING CIRCLE

Section 1.—General Constitution

166. This working circle comprises of the “*kharabas*” i.e. unworkable areas which are not fit for exploitation on account of the very steep nature of the terrain and their inaccessibility. The total area allotted to this working circle is 16212.054 hectares. An area of 2590.284 hectares was considered as “*kharaba*” and included in the inexploitable working circle in Jadhav’s plans. However, out of this, an area of 9378.230 hectares was found to be workable on actual inspection and hence only the remaining area is now considered as “*kharaba*” and included in this working circle.

Section 2.—General Character of the Vegetation

167. On account of the steepness of the area, there is considerable soil erosion and the soil is therefore shallow. Consequently the site quality is poor; usually IVb to IVa. Occasional patches of III quality are seen on gentler slopes or in valleys. The forest belongs to the local type “mixed forest” with teak either totally absent or occurring in small numbers. On high altitudes e.g. on the main ridge of the Western Ghats in Tokawada and Washala ranges and on the Tungar hill in Mandavi and Gokhiwara ranges, the forest is semi-evergreen in nature and belongs to the “Western sub-tropical hill forest” of Champion and Seth’s classification. In the rest of the area, the forest belongs to the type “The moist teak bearing forests” with the “*kakad shemat-kudatakla*” and the “*ain-kuda*” association occurring most commonly. The density of the crop is 0.4 to 0.5. The important trees occurring in the forests are teak, *shisham*, *ain dhavada*, *semal* etc. but their proportion in the crop is low. Natural regeneration of important species is scanty. *Karvi* forms a gregarious undergrowth. Thick growth of grasses comes up in open patches. Bamboos have flowered and died but their regeneration is plenty wherever it occurs.

Section 3.—Blocks, Compartments and Felling Series

168. The number of compartments allotted to this working circle are given in Appendix No. XXXVI. No felling series have been formed since no working is prescribed for these forests.

Section 4.—Special Objects of Management

169. The special object of management of the forests allotted to this working circle is—

“To preserve and improve the existing vegetal cover so as to prevent soil erosion and to maintain and improve the microclimatic and microedaphic conditions of the site”.

Section 5.—Analysis and Valuation of the Crop

170. As the areas were not to be exploited nor brought under any silvicultural system, it was not considered worthwhile to distinguish the various quality classes and the types of forests nor to show the other details like density and age of the crop. In the stockmaps, therefore, the areas allotted to this working circle have simply been shown as “unworkable”. No enumerations too, were carried out in this area, as they were not considered necessary.

Section 6.—Method of Treatment

171. On account of the steepness of the terrain, any sort of exploitation will immediately enhance the danger of landslides and severe soil erosion. These forests will not therefore be worked and hence no silvicultural system has been prescribed.

CHAPTER III. WORKING PLAN FOR THE SELECTION-CUM-IMPROVEMENT WORKING CIRCLE

Section 1.—General Constitution

172. This Working Circle includes all workable areas which are too steep to be fit for clearfelling and hence are required to be worked under the selection-cum-improvement system. All workable areas with a slope of more than 25° have been allotted to this working circle. Most of the area in Tokawada range and parts of Murbad, Washala Vihigaon, Vaitarna and Jawhar ranges are steep and hence have been allotted to this working circle. In the other ranges, only large compact blocks of such areas have been allotted to this working circle. From the point of view of the convenience of management, smaller patches of such areas which are less than about 40 hectares in extent have been allotted to the working circle to which the adjoining area belongs. The total area allotted to this working circle is 48,628.003 hectares.

Section 2.—General Character of the Vegetation

173. The forest mostly belongs to the type "moist teak bearing forest" which has been described in Chapter II of Part I (vide paras 25 to 31). Both the local types viz., teak forests and mixed forests occur. Mixed forest is more common in Murbad, Tokawada and Washala ranges, while the teak type is more common in other areas. The common associations are the "teak-dhawada-kuda-takla" association, the "kakad-shemat-kuda-takla" association and the "ain-bonda" association. The site quality is mostly IVa with patches of III quality occurring locally on more gentle slopes and in valleys. On flat tops of hills and in places where the underlying rock is exposed, the quality deteriorates to IVb. The density of the crop varies from 0.4 to 0.6. Important species occurring in the crop are teak, *shisham*, *khair*, *ain*, *dhawada*, *hed*, *kalamb*, *bibla*, etc. Regeneration of these species is scanty. Profuse regeneration of bamboos (*Manvel* and *Bundi*) occur in patches. From 1917 to 1952 part of the area was worked under the clearfelling system. Adverse effects of soil erosion are to be seen clearly in these clearfelled areas. The rest of the area was worked either under the coppice-with-standards system prior to 1917 or under the selection-cum-improvement system, since 1952, during Jadhav's plan. The standards were removed in thinnings and under the selection-cum-improvement system all mature trees were removed. Bigger trees particularly of teak, were uprooted in large numbers during the two severe cyclones of 1940 and 1948. The net result of all these factors has been that the crop is conspicuously deficient in the higher girth classes. On account of heavy grazing and the repeated fires, natural regeneration particularly, of valuable species, is also sparse.

Section 3.—Blocks, Compartments and Felling Series

174. The number of compartments allotted to this working circle are given in Appendix No. XXXVII. The area of this working circle has been divided into 38 felling series. The division of the area into felling series and coupes is given in Appendix No. XXXVIII.

Section 4.—Special Objects of Management

175. The special objects of management of the forests allotted to this working circle are:

- (i) To maintain and improve the soil cover so as to prevent accelerated soil erosion on steep hill slopes and thus to preserve and improve the site quality.
- (ii) To obtain big sized timber of teak and other valuable species.
- (iii) To increase the proportion of valuable species by proper treatment and by planting.

Section 5.—Analysis and Valuation of the Crop

176. The entire area of this working circle has been stockmapped on 8" = 1 mile toposheets (in the case of ex-Jawahar State forests the stockmapping is done on 4" = 1 mile sheets) and the results of stockmapping are given in Appendix No. XXXIV. Most of the area is of IVa quality. Both teak and mixed types occur. The Crop is mostly middle-aged. Density of the crop varies between 0.4 to 0.5.

177. As mentioned in Chapter IV of Part I (*vide* para 121) partial enumerations were carried out under the Survey of Forest Resources Scheme. The results of enumerations are given in Appendix No. XXII. The data for the group containing coupe Nos. 48 to 80 of the main working circle which contains an uneven-aged crop will represent more accurately the composition of the crop in this working circle. Separate data for the area included in this working circle is not available.

178. The results of enumerations show that the stocking per hectare of trees above 15 cm. girth is 56.79. Teak forms 14.04 per cent of the crop. The other valuable species in the order of preponderance are *ain*, *kakad*, *bondara*, *hed*, *shisham*, *khair*, *sawar*, *beheda*, *bibla* and *tivas*.

179. The distribution of teak per hectare is as under:—

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Girth/Class in cm.	16—30	30—45	45—60	60—75	75—90	90—105	105—120	Above 120	Total	
No. of trees	..	15.61	10.17	10.58	6.63	5.53	4.01	2.82	5.03	60.58

From these figures it is seen that the stocking of teak per hectare is very inadequate. The number of trees/heactare above 105 cm. in girth is only 7.85. The number of trees/hectare in the next lower class (91 cm. to 105 cm. in girth) which forms the future crop is only 4.01.

Section 6.—Silvicultural System

180. Up to 1952, *i. e.*, till the introduction of Jadhav's plan, the steep areas which now constitute this working circle were clearfelled. This resulted into severe soil erosion with the consequent deterioration of the condition of the new coppice regeneration. The composition of the crop also deteriorated as the coppice of inferior species suppressed the coppice regeneration of superior species. During Jadhav's plan, the selection-*cum*-improvement system was prescribed for the steep areas which was a very correct step. However, the steep areas to be worked under the selection-*cum*-improvement system were neither segregated and allotted to a separate working circle nor were they demarcated on the maps. This often resulted into the clearfelling of areas which should not have been clearfelled. Now the steep areas have been separated and allotted to this working circle. In view of the steepness of the terrain and the high rainfall prevalent in the area, severe soil erosion is bound to result if clearfelling is resorted to on a large scale and hence any system involving clearfelling of large area is not suitable for this area. The only suitable system is therefore the selection system. However owing to the over-exploitation in the past and the uprooting of big sized trees in the cyclones, the crop is deficient in the higher girth classes and hence is far from resembling a true selection forest. Moreover the proportion of inferior species is much more than that of valuable species. In view of this abnormal character of the crop, the true selection system cannot be applied to this area for the present. Therefore the "selection-*cum*-improvement" is prescribed. Under selection felling, trees over the selection size will be felled, only if their retention is not necessary on silvicultural grounds, *i. e.*, when required for seed and for soil protection. Under improvement felling all dead, dying and unsound trees will be felled. Thinnings will be carried out in congested area in favour of teak and superior injaili species like *ain*, *khair*, *shisham*, *hed*, *kalam*, *bibla* etc. As natural regeneration of valuable species does not come up well on account of over-grazing and repeated fires, the proportion of the valuable species in the crop should be increased by planting these species in patches not less than one hectare in extent over at least 5 per cent of the area under exploitation. If suitable gaps fit for planting are not available, clearfelling to the minimum possible extent may be done to create the required patches of one hectare.

Section 7.—Choice of Species

181. Teak which is the most valuable timber species will be the main species to be favoured. Other superior injaili species like *ain*, *shisham*, *hed*, *kalam*, *bibla*, *khair* etc. will also be favoured. In the patches, the main species to be planted will be teak, however, *khair*, *tivas*, *shisham*, *bamboo* etc., depending on the suitability of the soil, may be tried.

Section 8.—Rotation

182. From the results of stem analysis of teak trees from IVa quality areas given in Chapter VI of Part I (*vide* para 117) and the curves reproduced in Appendix No. XXI, it is seen that the M. A. I. and C. A. I. curves intersect nearabout 100 years. The rotation is therefore tentatively fixed at 100 years. Since the areas are to be worked under the selection-*cum*-improvement system, the rotation has only a theoretical significance and it is therefore not considered necessary to fix the correct rotation.

Section 9.—Exploitable Size

183. Though teak reaches a size of 90 cm. in girth at b. h. in about 100 years, in quality IVa areas, it is observed that some sound teak trees of 105 cm. girth at b. h. and over do occur in such areas. Similarly because of the over-exploitation in the past there is a great deficiency of trees above this size as well as in the next lower class and hence it is necessary to build up the stock of mature trees for ensuring future yield. The exploitable size for teak is therefore fixed at 105 cm. girth at b. h. other timber yielding species like *shisham*, *bibla*, *hed*, *kalam*, *khair*, *sawar* etc. are marketable only in big sizes of at least 90 cm. in girth at b. h. and hence the exploitable size for these species is fixed at 90 cm. girth at b. h.

Section 10.—Felling Cycle and Sequence of Fellings

184. Under the selection-*cum*-improvement system, the felling cycle should be as short as possible. At the same time, too short a felling cycle makes the annual exploitation area too big to control the fellings. Considering all factors, a felling cycle of 20 years which is a sub-multiple of the tentative rotation age *viz.*, 100 years, is therefore prescribed. In each felling series, 20 annual coupes have been formed. The sequence of felling is given in Appendix No. XXXIX.

Section 11.—Regulation of the Yield

185. In the past the yield was regulated by area only. This resulted into over-exploitation and consequent depletion of the stock, thus adversely affecting future yields. One of the most important aspects of scientific forest management is to ensure the maximum sustained yield of the trees of the exploitable size in successive felling cycles. Yield regulation merely by area results into over-exploitation. Yield regulation based on the estimate of the growing stock (Von Mantle's formula and its modifications) is not possible as the stocking is not normal. Moreover yield regulation by volume requires great skill and hence will be difficult to follow in practice. It is, therefore, proposed to regulate the yield by area-*cum*-number of trees of same exploitable size in the case of teak, as teak is the most important and valuable species. It is considered sufficient to regulate the yield of other species by area only.

186. There are two recognised methods of regulating the yield of trees of the exploitable class in terms of the number of trees to be removed annually *viz.*, the Brandis' method and the Smythies' method. Brandis' method prescribes removal of trees equal to the average annual recruitment of trees to the exploitable class for the total period required for the trees of the lowest girth class to reach the exploitable class. The actual recruitment from each class however, depends on the number of trees occurring in the class and hence when the distribution of trees in the various girth classes is abnormal, the actual yield varies considerably, from the yield by the Brandis' method, in successive felling cycles. Smythies' method prescribes removal of trees of exploitable size that are recruited during a felling cycle, and expresses the number of trees to be removed as a percentage of the number of exploitable trees available for marking in the coupe. Prescribing the yield in terms of percentage not only safeguards future yield, as all the available trees are not removed, but it also becomes easy to follow in practice, particularly if the prescribed percentages are in some convenient round figures *e.g.*, 20 per cent = 1 in 5 trees to be marked, 50 per cent = 1 in 2 trees to be marked etc. Smythies' formula however takes into consideration the recruitment of trees to exploitable size in the first felling cycle only and hence cannot ensure equalisation of yield in the successive felling cycles especially when the distribution of trees in various girth classes is not normal.

187. It is therefore proposed to calculate the actual recruitment to the exploitable size in all the felling cycles in a rotation and to so fix the number of trees to be removed in the first cycle as to ensure sustained or progressively increasing yield in successive felling cycles. The number so fixed will be expressed as a percentage of the trees available for marking in the annual coupe.

188. The yield has been calculated on the basis of the figures of average teak trees per hectare in various girth classes in coupe Nos. 48 to 80 of the main working circle of Jadhav's plan. From the enumeration data for this area, the teak trees per hectare occurring in various girth classes are as under :—

		Girth class				No. of trees
(1)		(2)				(3)
V	.. ..	Up to 30 cm.	.. ..	.. ..	.. ..	15.81
IV	.. ..	31 to 60 cm.	.. ..	.. ..	.. ..	20.75
III	.. ..	61 to 90 cm.	.. ..	.. ..	.. ..	12.16
II	.. ..	91 to 105 cm.	.. ..	.. ..	.. ..	4.01
I	.. ..	Above 106 cm.	.. ..	.. ..	.. ..	7.85
Total					.. ..	60.58

189. The survival percentage, *i.e.*, the proportion of trees above exploitable size to trees in each girth class expressed as percentage has been calculated on the number of trees that should have been therein each girth class if the stock was evenly balanced. These figures have been obtained from the curve drawn as per the Law of de Liocourt (*vide* Appendix No. XXVI). The survival percentage and the number of trees of each girth class reaching the exploitable size are as under :—

		Girth class		Survival percentage	No. of trees reaching exploitable class
(1)		(2)		(3)	(4)
Per cent					
V	.. ..	Upto 30 cm.	.. ..	18	2.82
IV	.. ..	31 to 60 cm.	.. ..	14	2.90
III	.. ..	61 to 90 cm.	.. ..	22	2.67
II	.. ..	91 to 105 cm.	.. ..	76	3.04
Total recruitment to existing trees above 105 cm.				.. ..	11.43
Existing trees above 105 cm.				.. ..	7.85
Grand total of exploitable trees				.. ..	19.28

190. From the results of stem analysis of teak trees from IVa quality area, the number of years required for a tree to pass through each girth class and the average annual recruitment from each class, during these periods are as under :—

		Girth class	No. of trees	Period required year	Average annual recruitment
(1)		(2)	(3)	(4)	
II	3.04	22	0.14
III	2.67	47	0.057
IV	2.90	34	0.085
V	2.82	17	0.166

191. The number of trees recruited during each felling cycle of 20 years is as under :—

Felling cycle		Total recruitment during the cycle	Average annual recruitment during the cycle
(1)	(2)	(3)	(4)
1st	$0.14 \times 20 =$	2.8	0.14
2nd	$\left. \begin{array}{l} 0.14 \times 2 \\ 0.057 \times 18 \end{array} \right\} =$	1.3	0.065
3rd	$0.051 \times 20 =$	1.14	0.057
4th	$\left. \begin{array}{l} 0.057 \times 9 \\ 0.085 \times 11 \end{array} \right\} =$	1.54	0.077
5th	$0.085 \times 20 =$	1.70	0.085
6th	$\left. \begin{array}{l} 0.085 \times 3 \\ 0.166 \times 17 \end{array} \right\} =$	3.08	0.154

192. Now all the recruitment is not realizable, because in the first year coupe, recruitment of only one year is available, in the second year coupe, recruitment of 2 years only is available and so on till in the 20th year coupe all the 20 years recruitment in the coupe will be available. The total realizable recruitment in a felling cycle can be calculated by Sagreiyas' formula (*vide* paper on "Brandis' method of yield regulation" by Shri K. P. Sagreiya, published on page 362 of the proceedings of the IX the Silvicultural Conference, Part II). *viz.*

$$Rr = \frac{1}{2} [(F \cdot R^a - P (R^a - R_x))]$$

Where F = the felling cycle.

R^a = average annual recruitment during the felling cycle.

P = period during which the initial rate of recruitment operates.

and R_x = the initial rate of recruitment.

193. The recruitment realizable during the five felling cycles is therefore as under :—

$$\text{1st Felling Cycle} = \frac{1}{2} [20 \times 0.14 - 0] = 1.4$$

$$\text{2nd Felling Cycle} = \frac{1}{2} [20 \times 0.065 - 2(0.065 - 0.14)] = 0.72$$

$$\text{3rd Felling Cycle} = \frac{1}{2} [20 \times 0.057 - (0)] = 0.57$$

$$\text{4th Felling Cycle} = \frac{1}{2} [20 \times 0.077 - 9(0.077 - 0.007)] = 0.68$$

$$\text{5th Felling Cycle} = \frac{1}{2} [20 \times 0.085 - (0)] = 0.85$$

$$\text{6th Felling Cycle} = \frac{1}{2} [20 \times 0.154 - 3(0.154 - 0.085)] = 1.43$$

194. The accumulating recruitment in one cycle is realizable in the next cycle along with latter's realizable recruitment. Thus the total number of trees realizable in the felling cycles are :—

Felling cycle	Total recruitment	Realizable recruitment	Accumulating recruitment of previous felling cycle	Net realizable recruitment
(1)	(2)	(3)	(4)	(5)
1st	2.80	1.40	..	1.40
2nd	1.30	0.72	1.04	2.12
3rd	1.14	0.57	0.58	1.15
4th	1.54	0.68	0.57	1.25
5th	1.70	0.85	0.86	1.71
6th	3.08	1.43	0.85	2.28
Total	11.56			9.91

195. Thus out of the total recruitment of 11.56 trees which would take place in 120 years, only 9.91 trees are available for removal. The balance of trees will remain as stock in hand at the end of the 6th felling cycle. Now the stock in hand of 7.85 trees of exploitable size already existing at the beginning of the first felling cycle can be exploited in such a way that there is equal yield during all felling cycles. Thus the maximum sustained number of trees that can be exploited in each felling cycle is 9.91 (net realizable recruitment) + 7.85 (stock in hand) = 17.76

$$\frac{17.76}{6} = 2.96.$$

196. For the sake of convenience of working, the yield in the first cycle can be expressed as a percentage (P) of the available trees.

$$P = \frac{2.96 \times 100}{1.40 + 7.85} = 32 \text{ per cent}$$

For simplification, the yield is prescribed as 33½ per cent (or 1 in 3) of the available trees of the exploitable size in the annual coupe.

Section 12.—Demarcation of coupes and marking technique

197. Rules for demarcation of coupes, sub-coupes and unworkable areas and the marking technique are prescribed in paras 403 to 407.

Section 13.—Method of executing the fellings

198. Before commencing marking, a stockmap and a treatment map of the area will be prepared by a gazetted officer or by the Range Forest Officer. The method of preparation of treatment map and the marking rules are given below.

199. *Preparation of treatment map*: After the coupe is demarcated, the whole area will be thoroughly inspected by a responsible officer not below the rank of a Range Forest Officer, who will prepare the stockmap by using standard conventional signs and a treatment map showing the (a) unworkable and (b) the plantable areas.

200. (a) *Unworkable areas would include the following* :—

- (i) Precipitous and very steep slopes.
- (ii) Understocked areas with density below 0.4 including half a chain wide strip surrounding such areas.
- (iii) Eroded areas and areas liable to serious erosion.
- (iv) One chain wide strip along either side of main water courses, well defined nalas and public roads.

The unworkable areas will be demarcated as per instructions laid down in para 406.

(b) *Plantable areas*: Patches of one hectare or more in extent, suitable for raising artificial regeneration of teak and other valuable species will also be shown on the treatment map. The total area of such patches should be at least 5 per cent of the area of the coupe. Sites with better quality (III) and gentler slopes should be preferred. Existing plantable gaps should be considered first. In any case the selected sites should be such that their clearing will not result into soil erosion. The plantable areas will be demarcated by giving three tar bands on selected trees on the periphery.

201. *Marking Rules*.—The following rules are laid down for the guidance of the marking officer :

- (A) *All over the coupe except the plantable areas* .—(i) All climbers should be cut at the time of marking.
- (ii) Bamboos interfering or likely to interfere with the growth of promising young teak and other timber species should be cut back at the time of marking.
- (iii) All sound fruit trees like mango, phanas, chinch, moha, tembrun, tad, kavath, char, rayan, and kaju should be reserved.

(iv) All sound trees of economic and medicinal value such as *bibla*, *koshimb*, *hirda*, *ritha*, *kudi*, *kala-kuda*, *kamla*, *behada*, *raktarohida*, *bel* and *arjunsadada* should be reserved.

(B) *In the unworkable areas.*—(i) All dead trees will be marked for felling.

(ii) In the one chain wide strips on either side of nallas and roads; in addition to the dead trees, half dead, overmature and very unsound trees may be marked for felling if their removal is not likely to result in erosion.

(C) In the plantable areas all trees will be marked for felling.

(D) *In the rest of the areas.*—(i) All dead, dying, overmature, unsound, diseased and malformed or otherwise defective trees of teak and other timber species should be marked for felling irrespective of their girths.

NOTE : A tree will be considered as : (i) dying when it has more than 1/3rd of its crown dead ; (ii) unsound when its bole emits a hollow sound when struck with the back of an axe or when it has not got any marketable timber; (iii) malformed when it is defective or abnormal either in crown, or bole and includes conditions like stagheadedness, gnarls, twists or constrictions by climbers beyond recouplement or crookedness etc ; (iv) otherwise defective means conditions other than the above such as heavily burnt by fire at its base and likely to fall down within a couple of years, with general cavities dug in its stem for taking out honey or has many ant-holes or fungus, rots or other diseased portions.

(ii) One out of every 3 teak trees of and over 105 cm. in girth at b. h. will be marked for felling. The trees to be retained will be sound and vigorous.

(iii) Timber species other than teak, *i. e.* *shisham*, *tivas*, *bibla*, *hed*, *ain*, *shivan*, *dhavada*, *nana*, *sawar*, *kalam*, etc. of and over 90 cm. in girth at b. h. will be marked for felling.

(iv) trees of inferior species, *i. e.*, other than teak and other timber species mentioned in rule (iii) will be marked for felling only if they are interfering or are likely to interfere with well grown and healthy trees of teak and other timber species.

(v) All live stools of illicitly felled trees should be marked for felling.

(vi) Wherever the crop is congested, thinning marking will be done in favour of valuable species like teak, *khair*, *ain*, *bibla*, *hed*, *shisham*, *nana*, *kalam*, *tivas*, *sawar*, *dhavada* etc. in the order in which they are stated here.

IMPORTANT NOTE : No *khair* trees will be marked for removal as the exploitation of *khair* trees is to be regulated in accordance to "Scheme for the exploitation of *Khair*."

Section 14.—Subsidiary cultural operations

202. *Cutting back operations.*—These operations will be done departmentally in the next year of working. The following works will be carried out :

(i) All standing trees marked for felling but left unfelled will be felled.

(ii) All reserved trees badly damaged during the course of exploitation will be felled.

(iii) All damaged coppice growth will be cut back. All malformed advance growth of teak will be cut back and inferior growth likely to interfere with the coppice shoots of teak and other superior species will be cut.

(iv) All bamboos interfering with resultant coppice growth of teak and other superior species will be felled.

(v) All stools will be cleared of felling debris.

(vi) In areas liable to erosion, gullies and small nallas will be plugged with debris or stones lying hereby so as to check soil erosion and widening and deepening of the nallas and gullies. Water tables will be put on all extraction paths and *kacha* roads.

(vii) All climbers will be cut over the whole area of the coupe.

203. *Cleanings*.—Cleanings will be carried out in sixth year from the year of felling in the planted area. It will consist of the following works :

- (i) All climbers will be cut over the whole area of the coupe.
- (ii) Damaged and malformed saplings and coppice shoots will be cut back.
- (iii) Number of coppice shoots will be reduced to two or three per stool. Shoots to be retained should be vigorous, well grown and evenly spaced.
- (iv) Fast growing inferior species like *gol* and *chara*, and bamboos will be cut and removed if interfering or likely to interfere with the reproduction of teak and other valuable species.
- (v) In patches containing advance growth of teak and established regeneration of other valuable species, a spacing between two saplings should roughly be $\frac{1}{3}$ rd of the average height.

204. *Thinnings*.—One thinning in the 11th year from the year of planting will be carried out in the patches regenerated artificially. The thinning should be of 'C' grade which roughly corresponds to a spacing equal to $\frac{1}{3}$ rd the average height of the poles. Preference should be given to vigorous and well grown poles.

The sequence of the subsidiary cultural operations is given in Appendix No. XL.

Section 15.—Other regulations

205. *Fire protection*.—The exploited coupe should be fire traced for five years from the year of felling.

206. *Closure to grazing*.—The exploited coupe will remain closed to grazing for a period of five years from the year of felling.

CHAPTER IV.—WORKING PLAN FOR THE LAKES CATCHMENT AREA WORKING CIRCLE

Section 1.—General Constitution

207. This working circle includes all the workable area situated in the catchment of the Vaitarna, Tansa and Vihar lakes and the proposed Bhatsai lake. The area in the catchment of the Vaitarna and Tansa lakes constituted the lakes catchment area working circle of Jadhav's plan. The scheme for construction of a dam on the river Bhatsai will be under execution soon and hence the area in the catchment of this dam, mostly situated in Washala and Dhasai ranges of Shahapur division, has been included in this working circle. Area situated in the catchment of the Vihar lake has also been included in this working circle. The total area allotted to this working circle is 35,612.798 hectares.

Section 2.—General Character of the Vegetation

208. The forest belongs to the type "moist teak bearing forest" described in Chapter II of Part I (*vide* paras 25 to 31). Both the local types viz., teak and mixed forests occur. All the associations constituting this type except the *ain, bonda* association, are found in the area. The site quality on the lower gentler slopes is III while it deteriorates to IV-a and sometimes to IV-b on the higher steep slopes. The density of the crop varies from 0.5 to 0.6. Important species occurring in the crop are teak, *shisham, khair, ain, hed, kalam, bibla*, etc. Regeneration of bamboos occurs in patches. The area in the catchment of Tansa lake was worked under the selection-*cum*-improvement system since 1939 and that in the catchment of Vaitarna lake was brought under this system since 1952. The crop however still does not fully resemble a true selection forest on account of the deficiency of trees in the higher girth classes due to over-exploitation and lack of adequate natural regeneration due to fires. The crop is therefore mostly middle-aged. The reserved forest area so far as it falls in the catchment of the Vihar lake and that in the catchment area of the proposed Bhatsai dam, formed part of the main working circle, in the previous plans and was worked under the coppice-with-standards system prior to 1917. Part of the area was clearfelled from 1917 to 1952 and part of the area was worked under the clearfelling-*cum*-selection-*cum*-improvement system under Jadhav's plan. The crop here is therefore not uniform.

Section 3.—Blocks, Compartments and Felling Series

209. The number of compartments allotted to this working circle are given in Appendix No. XLI. The area of this working circle has been divided into 24 felling series. A statement showing the division of the area into felling series and coupes is given in Appendix No. XLII.

Section 4.—Special Objects of Management

210. The special objects of management of the forest included in this working circle are:

- (i) to maintain the vegetal cover on the soil to prevent soil erosion,
- (ii) to prevent silting up of the lakes by taking suitable soil conservation measures and to conserve moisture in the soil so as to ensure adequate supply of water to the lakes,
- (iii) to improve the forest in density and value,
- (iv) consistent with the above to derive maximum and sustained annual yield.

Section 5.—Analysis and Valuation of the Crop

211. The entire area included in this working plan has been stockmapped on 8"—1 mile toposheets and the results of stockmapping are given in Appendix No. XXXIV. Both teak and mixed forest types occur. Density of the crop varies between 0.5 to 0.6.

212. As mentioned in Chapter VI of Part I (*vide* para 121) partial enumerations were carried out in the area, under the forest resources survey scheme. The results of numerations are given in Appendix No. XXII. Separate enumeration data for the

areas included in the lakes catchment area working circle of Jadhav's plan, is available. From this data it is seen that the number of trees of 15 cm. girth at b.h. and over per hectare is 446.88. Teak forms 15.95 per cent of the crop. The other valuable species in the order of their preponderance are:—

ain (20.01 per cent), *bondara* (4.39 per cent), *kakad* (3.28 per cent), *shisham* (2.30 per cent), *hed* (1.95 per cent), *sawar* (1.46 per cent), *khair* (1.41 per cent), *kalam* (1.03 per cent), *dhavada* (0.96 per cent), *bibla* (0.66 per cent).

Section 6.—Silvicultural System

213. In view of the special object of management viz., to ensure strict soil and moisture conservation in the area, the system of working should be such that there is minimum opening of the canopy and consequent exposure of the soil. Improvement fellings which involve removal of the dead, dying and unsound trees would be the ideal treatment for this area. However, the crop contains valuable timber species like teak, *khair*, *ain*, etc. and the area is capable of producing big sized timber of these species. It will be wrong to allow these trees to become overmature and unsound and thus to waste this valuable national wealth. Mature trees of these species must therefore be removed if silviculturally available i.e., if not required for seed or for protection of the soil. Therefore improvement fellings are prescribed for this area. Existing blanks will be planted up with suitable species if the area is suitable for planting. In thinnings, etc., valuable species which also give better soil cover will be favoured.

Section 7.—Choice of Species

214. In order to achieve fully, the object of management, viz., to provide an effective soil cover so as to ensure soil and moisture conservation, preference will have to be given to species which are evergreen or are deciduous for a very short time. Teak sheds its leaves during summer and causes drip from its leaves during the monsoons and hence it is not ideal as a soil cover. However, it is economically very valuable and the economic considerations, though are to be subordinated to the need of soil protection, cannot altogether be overlooked. Teak will therefore be encouraged in areas which are not situated very near to the lakes or on precipitous slopes. In areas situated near the lakes species like *karanj*, *neem*, *moha*, *bibla*, *bamboos*, *tivas*, *shisham*, etc., will be favoured both in planting the blanks and thinnings.

Section 8.—Rotation

215. Under the improvement fellings, rotation has no bearing on the working and hence the rotation has not been fixed.

Section 9.—Size of Mature Trees

216. In the working of these forests, revenue is of secondary importance; the primary object being to afford fullest soil cover. At the same time, the mature trees of timber species are however, not to be allowed to become unsound and overmature thus wasting the valuable national wealth in the form of timber. Teak also puts on price increment if allowed to reach large sizes. The size of mature teak trees can therefore be fixed as the girth up to which teak remains sound. The area contains both quality III and IV-a crops. In quality III areas sound teak trees up to 120 cm. in girth at b.h. are found and hence teak trees of 120 cm. girth at b.h. and over in quality III areas and of 105 cm. girth at b.h. and over in quality IV-a areas will be considered as mature. As regards the other timber trees like *shisham*, *bibla*, *hed*, *kalam*, *sawar*, etc., trees of 105 cm. in girth at b.h. and over will be considered as mature.

Section 10.—Felling Cycle and Sequence of Fellings

217. The felling cycle of 20 years prescribed for the lakes catchment area working circle of Jadhav's plan is retained as it is found convenient. The sequence of fellings is given in Appendix No. XLIII.

Section 11.—Regulation of the Yield

218. Yield will be regulated by area.

Section 12.—Demarcation of coupes and Marking Technique

219. The prescriptions in this respect will be the same as given in paras 403 to 407.

Section 13.—Method of executing the Fellings

220. Before commencing marking a stockmap and a treatment map of the area will be prepared by a Gazetted Officer or by the Range Forest Officer. In the treatment map the unworkable areas will be shown as prescribed in para 212. The existing blanks suitable for planting will be shown in the treatment maps. Patches as small as 1/10th of a hectare can be shown on the map. The plantable areas will be demarcated by giving three tar bands on selected trees on the periphery.

221. *Marking Rules.*—The following rules are laid down for guidance of the marking officer—

(A) *All over the coupe.*—(i) All climbers should be cut at the time of marking.

(ii) All sound fruit trees like *mango, phanas, chinch, moha, tembru, tad, kavath, char, rayan, kaju*, etc., should not be marked for felling.

(iii) All sound trees of following species of economic value and medicinal plants should be reserved, *bibla, koshimb, hirda, ritha, kudi, kala-kuda, kamala, karanj, bahava, raktarohida, bel* and *arjunsadada*.

(B) *In the unworkable areas.*—(i) All dead trees will be marked for felling.

(ii) In the one chain wide strips on either side of nallas and roads, in addition to the dead trees, half dead, overmature and very unsound trees may be marked for felling if their removal is not likely to result in erosion.

(C) *In the rest of the areas.*—(i) All dead, dying, overmature, unsound and malformed or otherwise defective trees of teak and other timber species should be marked for felling, irrespective of their girths, if silviculturally available and not required for soil protection or if their removal will not create gaps or extend the existing gaps.

NOTE.—A tree will be considered as—

(a) dying when it has more than 1/3rd of its crown dead,

(b) unsound when its bole emits a hollow sound when stroked with the back of an axe or when it has not got any marketable timber;

(c) malformed when it is defective or abnormal either in crown or bole and includes conditions like stag headedness, gnarls, twists or constrictions by climbers beyond recouplement or crookedness, etc.

(d) otherwise defective means conditions other than the above such as heavily burnt by fire at its base and likely to fall, within a couple of years, with general cavities dug in its stem for taking out honey or has many ant-holes or fungus rot or other diseased portions.

(ii) Teak trees of and over 120 cm. in girth at b.h. in III quality areas and of and over 105 cm. in girth at b.h. in IV-a quality areas will be marked for felling.

(iii) Timber species other than teak, *i.e., khair, shisham, tivas, bibla, hed, ain, shivan, dhavada, nana, sawar, kalam*, etc. of and over 105 cm. in girth at b.h. will be marked for felling.

(iv) Trees of inferior species *i.e.,* species other than teak and timber species mentioned in rule (iii) will be marked for felling only if they are interfering or are likely to interfere with shade giving trees like *karanj, bibla*, etc.

(v) All live stools of illicitly felled trees should be marked for felling.

(vi) Wherever the crop is congested, thinning marking will be done in favour of the shade giving trees.

NOTE.—No tree will be marked for felling under any of the above rules, if its removal is likely to cause soil erosion or create gaps or extend the existing gaps.

IMPORTANT NOTE—No *khair* and *semal* trees will be marked for removal as the exploitation of *Khair* and *semal* trees is to be regulated in accordance to “Scheme for the exploitation of *khair* and *semal*”.

Section 14.—Subsidiary Cultural Operations

222. The prescriptions contained in paras 202 to 204 will apply to this area *mutatis mutandis* with the following addition :—

In cleanings, [vide rule (iv) under cleanings in para (203)] inferior species like *gol* and *chera* will be cut and removed if they are interfering or are likely to interfere with shade giving trees also. The prescribed soil conservation measures [vide rule (vi) under c.b.o.s.] will be carried out under any circumstances, as otherwise the objects of management will be defeated.

The sequence of the subsidiary cultural operations is given in Appendix No. XLIV.

Section 15.—Other Regulations

223. The prescriptions regarding fire protection and closure to grazing contained in paras 205 and 206 will apply to this area also. These prescriptions must be strictly enforced in order to achieve the object of management to the fullest extent.

CHAPTER V. WORKING PLAN FOR THE CONVERSION WORKING CIRCLE

Section 1.—General Constitution

224. This working circle includes all workable areas which are situated on moderate slopes (*i.e.* less than 25°) and have a better site quality *viz.* III and above. The areas are suitable for clearfelling and planting with valuable trees like teak and other timber species. Most of the area of Dahanu and Thana divisions and parts of the Shahapur division are included in this working circle. Steeper areas and poor quality areas have been excluded from this working circle, only when they form sizable patches which could be separately worked. Smaller patches of such areas are frequently found intermingled with the better quality areas on moderate slopes and such patches had to be included for force in this working circle, on grounds of practicability. The total area allotted to this working circle is 1,59,926.276 hectares.

Section 2.—General Character of the Vegetation

225. The forest mostly belongs to the type "moist teak bearing forest" which has been described in Chapter II of part I (*vide* paras 25 to 31). Both the local types *viz.* teak forest and mixed forest occur. Mixed forest is common in parts of Dahisar range in Dahanu division, part of Gokhiwara, Mandvi and Badlapur ranges in Thana division and parts of Shahapur and Vaitarna ranges in Shahapur division. The common associations found are the "teak-*ain-kuda-karvand*" association, the "teak-*khair-kuda-karvand*" association and the "*ain-khair-koshimb-karvand*" association. The "Southern moist mixed deciduous" type occurs in part of Gokhiwara range (for detailed description of the type refer to para 32, part I). The site quality is mostly III. Patches of II quality are found in parts of Udhava, Sawa and Jawhar ranges. Patches of I quality are found in the Vavar block in Jawar range. IVa quality occurs on locally steep slopes and on the flat tops of hills. The density of the crop varies from 0.5 to 0.7. Important species occurring in the crop are teak, *shisham*, *khair*, *ain*, *dhavada*, *hed*, *kalam*, *bibla* etc. Regeneration of bamboos (both *Manvel* and *Katas*) is seen in patches. The area formed part of the main working circle under Jadhav's plan. Part of the area was clearfelled since 1917 and this clearfelled area contains an evenaged crop mostly of coppice origin. Before 1960, only a part of the clearfelled area was artificially regenerated by planting teak, the rest being left to be regenerated by coppice growth. The earlier teak plantations were in small rabbed patches and are now difficult to be located. Part of the area was worked under the selection-*cum*-improvement system under Jadhav's plan and the rest of the area was worked under the coppice with standards system prior to 1917. In this area, the crop is mostly middleaged, the mature trees having been removed in thinnings while some of them were uprooted during the cyclones. Natural regeneration of valuable species is very sparse. This is mainly due to the repeated fires and uncontrolled grazing.

Section 3.—Blocks, Compartments and Felling Series

226. The numbers of compartments allotted to this working circle are given in Appendix No. XLV. The area of the working circle has been divided into 84 felling series.

Section 4.—Special Objects of Management

227. The special objects of management of the forests included in this working circle are :

- (i) To convert the existing unevenaged crop, containing a large proportion of inferior species into an evenaged crop of valuable timber species like teak and *khair*.
- (ii) To aim at deriving the maximum possible sustained yield of large sized timber of teak etc.

Section 5.—Analysis and Valuation of the Crop

228. The entire area of this working circle has been stockmapped on 8"=1 mile toposheets except in the case of ex-Jawhar state forests which are stockmapped on 4" to 1 mile toposheets. The results of stockmapping are given in Appendix No. XXXIV. Most of the area is of quality III.

229. As already mentioned in Chapter VI of part I (*vide* para 121) partial enumerations have been carried out all over the area. Separate enumeration figures for the area included in this working circle are not available. However, the data for Udhava, Kasa, Sawa, Vikramgad, West Wada, East Wada and Murbad ranges, most of the area from which is included in this working circle, may be considered as indicating the state of the crop of this working circle. From this data it is seen that the stocking per hectare is 410.20 trees above 15 cm girth at b.h. Teak forms 18.32 per cent of the crop. The other valuable species in the order of their preponderance are :

ain (16.75 per cent), *hed* (2.09 per cent), *shisham* (1.78 per cent), *khair* (1.73 per cent), *kalam* (1.64 per cent), *saxr* (1.05 per cent), *bibla* (0.76 per cent), *tivas* (0.26 per cent).

Section 6.—Silvicultural System

230. The main object of management is to convert the existing crop into uniform, evenaged crop of valuable species. Natural regeneration of valuable species is very sparse and hence the object can only be achieved by resorting to planting of the desired species. The only silvicultural system suitable for this purpose is the "clearfelling system" and hence the same is prescribed. However as already stated (*vide* para 224) small patches of low quality (IV-a and below) which are unsuitable for planting valuable species and locally occurring small patches with steep slopes which are not fit for clearfelling are intermingled with the better quality moderately sloped areas which will be clear-felled and planted. It will not be practicable to segregate such small unsuitable patches and hence they have been included in this working circle. However, such areas will not be clear-felled and hence the correct nomenclature of the prescribed system will be "modified clearfelling system" with artificial regeneration.

Section 7.—Choice of Species

231. Teak which is the most valuable timber species will be the principle species to be planted. Separate working circle has been formed for raising plantations of other industrial woods and hence only teak will be planted in this working circle on all suitable sites. Since teak does not permit any under-growth to grow, soils under pure teak plantations are not well protected and hence are liable to sheet erosion. Suitable species like *tivas* and bamboos (*Manvel*) will therefore, be underplanted so as to form an understorey in teak plantations.

Section 8.—Rotation and Conversion Period

232. Teak being the principal species, the rotation has to be fixed in relation to the growth of teak trees. In fixing the rotation two aspects have to be chiefly considered *viz.* (i) the age at which the mean annual increment (M. A. I.) starts falling. This is the age at which the C. A. I. and the M. A. I. curves intersect and (ii) the age at which the tree is financially ripe *i.e.* the financial rotation.

233. *The rotation of maximum volume production.*—From the results of stem analysis of teak trees from III quality areas (*vide* para 117 of Chapter VI, part I and the curves reproduced in Appendix No. XXI) it is seen that the M. A. I. and C. A. I. intersect at 85 years. This is, therefore, the rotation of maximum volume production.

234. *The rate of interest in financial rotation.*—As regards the financial rotation *i.e.* the rotation which gives the maximum profit, the matter can be considered by various methods. Whatever the method adopted, the financial rotation depends on the rate of (compound) interest on which the calculations are made. Higher the rate of interest; shorter is the financial rotation. High rate of compound interest causes a very rapid increase of the principal which soon passes the bounds of possible attainment in practice. For long term investment like forestry, a lower rate of interest has, therefore, to be adopted (of "Forest Valuation" by Chapman). A rate of 4 per cent has been adopted for the calculation of the financial rotation.

235. *The method of soil expectation value.*—By this method, the financial rotation is the rotation which gives the maximum soil expectation value. Soil expectation values of teak plantations were calculated by Faustmann's formula (*vide* paras 135 to 138 of Chapter VII, part I), for various rotations with rate of interest as 4 per cent. The results are as under :—

Relation on Year	Soil expectation value/acre in Rs.
(1)	(2)
40 ..	290
50 ..	297
60 ..	339
70 ..	353
80 ..	414

From the above results it is seen that maximum soil expectation value is obtained for a rotation of 80 years.

236. *Method of price age gradient.*—It is known that teak puts on a price increment, *i.e.* it fetches large prices per unit volume of timber, for larger sizes. The size and corresponding age of single teak tree which fetches the highest revenue will indicate the financial rotation.

From the data of sale prices of teak obtained at Sawta depot in 1965, the following relation between the girth at b. h. and the average price per cubic metre is found to exist :

Girth at b. h. (in cm.)	Corresponding age (in years)	Average price per cu. m.
(1)	(2)	(3)
49.48	40	317.70
56.60	50	353.00
61.27	60	377.30
64.40	70	423.60
67.50	75	492.20
68.30	80	564.80
69.80	85	635.40
71.00	90	712.00

237. From this it is seen that the net price per tree varies directly with age and that the price per cu. m. continues to rise even up to 90 years. The value of a teak tree at various ages calculated at the above rates will be as under :

Age	Saleable volume in cu. m.	Value of trees in Rs.	Capitalized value
(1)	(2)	(3)	(4)
40 ..	0.175	55.56	394.48
50 ..	0.256	90.37	433.78
60 ..	0.321	121.11	392.39
70 ..	0.373	158.00	346.00
80 ..	0.451	254.72	376.98
90 ..	0.491	349.59	349.59

238. The value at various ages capitalized to 90 years at 4 per cent rate of interest, are given in last column. From the above it is seen that the maximum capitalized value is obtained at the age of 50 years. Now, this age which gives the maximum value, depends on the rate of interest adopted. At 3 per cent interest this age will be 60 years while at 2.5 per cent interest it will be 75 years.

239. *Method of financial yields.*—According to this method financial rotation is that rotation which gives the highest rate of interest on the money invested.

240. The rate of interest earned on the initial investment of Rs. 250.00 is calculated for various rotations as done in para 139 of Chapter VII of part I for 80 years rotation. The results are as under :

Rotation (in years)	Rate of interest earned (in Rs.)
(1)	(2)
40	5.6 per cent.
50	5.4 per cent.
60	5.4 per cent.
70	5.2 per cent.
80	5.2 per cent.

From the above it will be seen that a rotation of 40 years gives the highest return on the initial investment.

241. *Choice of rotation.*—As already stated earlier, the financial rotation depends on the rate of interest adopted for calculations and the market prices. Both these vary with time and hence too much reliance cannot be placed on the financial rotations. Moreover, the financial rotations as calculated in paras 238 and 240 will not serve the object of growing large sized timber, as they are too short for the purpose. The rotation of maximum volume production is 85 years. The financial rotation based on the soil expectation value is 80 years. Though the results of stem analysis given in para 117 show that an average teak tree reaches a size of 98 cm. girth at b. h. in 80 years in III quality areas, teak in better quality (top III quality) areas in Dahanu and Thana Divisions is found to reach a size of 120 cm. girth at b. h. With proper tending operations, teak raised in the plantations can be expected to reach this size in 80 years. Timber of this size is most in demand. The rotation is, therefore, fixed at 80 years, which is also the rotation adopted so far, for teak in the Thana forests.

242. *Conversion period.*—Though clearfelling was started in the Thana forests since 1917, *i. e.* for the last 50 years, unfortunately it cannot be considered that conversion to the uniform valuable forest has taken place to the extent corresponding to this period. This is because, up to 1935, only a negligible portion of the clearfelled portion was planted with valuable species, from 1935 to 1952 (*i. e.* under Starte's plan) the planting was not more than 12 per cent of the clearfelled area and that too in small patches; while from 1952 onwards, *i. e.* under Jadhav's plan the planted area was not more than 41 per cent of the clearfelled area. It is only since 1961-62, *i. e.* since the beginning of the third five-year plan that large-scale concentrated plantations were raised in the area clearfelled as per the working plan prescriptions, as also in those areas which were specially clearfelled for raising plantations under the five-year plan schemes. The total area under such plantation is only 7,142 hectares which is less than 5 per cent of the total area to be covered during the full conversion period of one rotation. Moreover, even if the rotation has been fixed as 80 years, the present trend in forestry to have short rotations does not preclude the possibility of the rotation for teak being reduced in future to 60 years or so. It is also necessary to convert the existing crop into a more valuable one as early as possible. The conversion period is, therefore, fixed at 60 years. The area allotted to this working circle is 1,59,926.276 hectares, out of which 90 per cent area, *i. e.* 1,43,933 hectares can be considered as plantable. This gives a rate of conversion of 239.9 hectares per year.

Section 9.—Division of the Area into Periodic Blocks

243. The area of this working circle has been divided into 3 periodic blocks, each of 20 years period. All the three periodic blocks are fully allotted. P. B. I contains the area to be regenerated in the first period. In order to minimise the sacrifice of young crop which is inevitable in conversion, compartments containing areas which have not been clearfelled so far have been allotted to P. B. I. Compartments containing areas which have been exploited 40 years back (*i. e.* coupe Nos. 1 to 27 worked under clearfelling system) have been allotted to P. B. II. Area worked during the last twenty years or so, *i. e.* coupe Nos. 28 to 51 forms P. B. III. All the compartments do not contain crop which is fit for allotment to the same P. B. Where sizable parts of the compartments are fit for allotment to different P. Bs., the compartments have been divided into sub-compartment. The allotment of compartments to felling series, periodic blocks and coupes is given in Appendix No. XLVI.

244. *Treatment of periodic block I.*—The P. B. I areas of each felling series have been divided into 20 annual coupes. The area of the annual coupe will be clearfelled excepting patches which are not suitable for clearfelling for various reasons and planted mainly with teak. Advance growth of teak in the form of *rab* plantations raised in the past, if occurring in the annual coupe, will be reserved. Tending operations like weedings, cleanings and thinnings will be carried out as prescribed. Sequence of fellings of coupes in this P. B. is given in Appendix No. XLVII.

245. *Treatment of periodic block II.*—The only treatment to be given to the areas allotted to this P. B. will be to carry out thinnings. While carrying out these thinnings no *khair* and *semal* tree should be removed as the exploitation of *khair* and *semal* trees is to be regulated in accordance to the scheme for the exploitation of *khair*. All climbers will be cut and green stools of illicit cutting will be cut back. The area has been divided into 20 annual coupes. Sequence of working in the coupes in this P. B. is given in Appendix No. XLVIII.

246. *Treatment of periodic block III.*—The work to be carried out in this P. B. will be silvicultural thinning and improvement fellings. There are very few big sized trees in the area and hence no selection fellings need be carried out. In carrying out these operations no *khair* and *semal* trees will be marked for fellings as their exploitation is to be regulated in accordance to the scheme for the exploitation of *khair* and *semal*. The sequence of working in the coupes of this P. B. is given in Appendix No. XLIX.

Section 10.—Regulation of the Yield

247. The yield is regulated by area.

Section 11.—Demarcation of Coupes and Marking Technique

248. Rules for demarcation of coupes, sub-coupes and unworkable areas and the marking technique are given in paras 403 to 407.

Section 12.—Method of Executing the Fellings

(A) Rules for Periodic Block I

249. A year before the coupe is due for felling, a stockmap and a treatment map of the area will be prepared as detailed below :—

250. (I) *Preparation of treatment map.*—After the coupe is demarcated the whole area will be thoroughly inspected by a responsible officer not below the rank of a Range Forest Officer, who will prepare a stockmap of the area using the standard conventional signs. Particular care should be taken to show the local variation in quality of the site, as areas below III quality will not be suitable for planting. A treatment map will also be prepared showing the following areas :—

(a) *Unworkable areas* :—These will comprise of—

(i) Precipitous and very steep slopes.

(ii) Areas liable to erosion.

(iii) One chain wide strips along either side of main water courses, well defined nallas and public roads.

(b) *Areas with natural regeneration.*—Patches of at least one hectare in extent containing natural regeneration of teak to the extent of 750 seedlings and saplings per hectare will be shown separately as these patches will not be planted up.

(c) *Patches of advance growth.*—All successful *rab* patches of *khair* and teak to form future crop will be shown.

(d) *Plantable areas.*—These will comprise of the areas suitable for planting with teak.

(e) *Unplantable but workable areas.*—These will comprise of—

(i) Poor quality areas, *i. e.* areas with site quality less than III. (Note-IV-a quality areas having deep soil may be considered plantable).

(ii) Steep areas (*i. e.* with slope of more than 25°) which are workable but not fit for clearfelling on account of the gradient.

251. (i) The unworkable areas mentioned in para 250 (a) above will be demarcated as prescribed in para 406.

(ii) Areas with natural regeneration mentioned in para 250 (b) above will be demarcated by giving three *geru* bands on selected trees on the periphery. The middle *geru* band should be at b. h. and the other two *geru* bands at a distance of 10 cm. above and below the central *geru* band. The trees will be numbered and a list of the trees will be prepared.

(iii) Patches of advance growth mentioned in para 250(c) above will be demarcated by giving four *geru* bands on selected trees on the periphery.

(iv) Plantable areas to be clearfelled, *i. e.* areas mentioned in para 250 (d) above will be demarcated by giving three tar bands on selected trees on the periphery. The middle band should be at b. h. and the other two tar bands at a distance of 10 cm. above and below the central band. The trees will be numbered and a list of the trees will be prepared.

(v) Unplantable but workable areas mentioned in para 250 (e) above are not necessary to be demarcated as these are the remnant areas and stand automatically demarcated with demarcation of various kinds of areas mentioned above.

252. (2) *Marking Rules.*—The following rules are laid down for the guidance of the marking officer :—

(i) All climbers should be cut at the time of marking.

(ii) In the unworkable areas which are precipitous or have very steep slopes only dead trees will be marked for felling.

(iii) In the one chain wide strips on either side of nallas and roads, in addition to the dead trees, half dead, overmature and very unsound trees may be marked for felling if their removal is not likely to result in erosion.

(iv) In the workable but unplantable areas the marking will be done as per the rules laid down in para 201 (A) and (B).

(v) In the plantable areas all trees are to be felled. All the trees of 30 cm. and above in girth at breast height should be given a clear impression of marking hammer mark at breast height and also at the base on a clear blaze of at least 10 cm. x 10 cm. In addition, they should also be given digit serial numbers both at base and breast height.

(vi) In areas containing natural regeneration of teak *vide* para 250 (b) above, all overwood will be marked for felling and the regeneration below it, *i. e.* all seedlings and saplings occurring below the overwood will be cut clearfelled but not planted as they will be naturally regenerated from coppice of seedlings or saplings.

(vii) Patches of advance growth *vide* para 250 (c) natural or raised artificially should be retained as future crop after carrying out suitable cultural operations.

(B) Rules for Periodic Block II

253. A year before the coupe is due for working, the coupe and sub-coupe boundaries will be demarcated as prescribed in paras 404 and 405. Marking technique will be the same as prescribed in para 407.

254. *Marking Rules.*—The following rules are laid down for the guidance of the marking officer :—

- (i) All climbers should be cut at the time of marking.
- (ii) Wherever, the crop is congested, thinning marking will be done in favour of teak and other superior timber species so as to have a spacing equal to 1/3rd the average height of the trees.

IMPORTANT NOTE.—No *khair* and *semal* trees will be marked for removal as the exploitation of *khair* and *semal* trees is to be regulated in accordance to "schemes for the exploitation of *khair* and *semal*."

(C) Rules for Periodic Block III

255. A year before the coupe is due for felling, the coupe and sub-coupe boundaries will be demarcated as prescribed in paras 404 and 405. Marking technique will be the same as prescribed in para 407.

256. *Marking Rules.*—The following marking rules are laid down for the guidance of the marking officer:—

- (i) All climbers should be cut at the time of marking.
- (ii) All dead, dying and malformed trees should be marked for felling.
- (iii) All live stools of illicitly felled trees should be marked for felling.
- (iv) Thinning marking should be done in congested crops, in favour of valuable species like teak; *khair*, *ain*, *bibla*, *hed*, *shisham*, *nana*, *kalam*, *tivas*, *sawar*, *dhavada* etc. in the order in which they are stated here. The intensity of thinning should be such as to have the resulting spacing roughly equal to 1/3rd the average height of the trees.

IMPORTANT NOTE.—No *khair* and *semal* trees will be marked for removal as the exploitation of *khair* and *semal* trees is to be regulated in accordance with "Schemes for the exploitation of *khair* and *semal*."

(D) Rules for the Areas Planted from 1959-60 onwards.

257. By the time this plan comes in operation with effect from 1st July 1969, first thinning will have been done in the areas planted during 1958-59 and cleanings in areas planted in 1964-65. Areas planted from 1959-60 onwards, as per the current plan will, therefore, have to be attended to for some time during the period of the revised plan too. Though most of these plantations have been put in P. B. III, some of them had to be put in P. B. II and P. B. I for reasons given in para 243. A list of the areas planted from 1959-60 to 1965-66 is given in Appendix No. L. Areas less than 4 hectares in extent have not been included in this list. The year of plantation, the year in which cleanings to be done and the year in which first thinning to be done are shown against each. Cleanings and thinnings should be carried out as per this programme. Cleanings will be carried out as prescribed in para 260 and thinnings as prescribed in para 262. Cleanings should be carried out in the 4th year and first thinning in the 7th year in the areas planted between 1966-67 and 1969-70 also.

Section 13.—Plantation Technique

258. Detailed technique about raising teak plantations including nursery technique and the tending operations to be carried out during first three years is given in Appendix No. LI. This should be strictly followed. Similarly, detailed technique of raising and tending *khair* plantation is given in Appendix No. LII and this too should be strictly followed.

Section 14.—Subsidiary Cultural Operations

259. *Cutting back operations.*—These will have to be carried out in the patches containing advance growth of teak in plantations and in the unplatable workable areas (*vide* para 250) in P. B. I and in all exploited coupes in other P. Bs. The operations will be carried out as laid down in para 202. The soil conservation measures prescribed therein [rule (vi)] will however have to be carried out all over the area of the coupe.

260. *Cleanings*.—Cleanings will be done in the fourth year in teak plantations and will consist of the following operations :—

- (i) All climbers will be cut.
- (ii) All malformed and badly damaged saplings will be cut back.
- (iii) Of the multiple leaders, only the most vigorously growing shoot will be retained and others will be cut down. Persistent branches will be cut 15 cm. away from the stems and without damaging the plants.
- (iv) Fast growing inferior species like *gol* and *chera* and bamboos will be cut and removed if interfering or likely to interfere with the growth of teak and other valuable species.

261. *Thinnings*.—Opinions differ about the type, intensity and frequency of thinnings that will be most suitable for a teak plantation. Unfortunately, very little experimental work on thinning research has been done in our State. However, from the work done in Madras and other States, it has been established that though heavier grades of thinning yield progressively higher diameter increments, the yield of useful basal area decreases as the intensity of thinning increases. The yield of total volume is highest for 'C' grade ordinary thinning. 'C' grade ordinary thinning has, therefore, been prescribed for the teak plantations in this working circle. As regards the frequency of thinning the ideal method is to thin frequently. However, on practical considerations, the following thinning regime which provides for more frequent thinnings in earlier ages is considered suitable. The first thinning will be done in the 7th year, the second in the 12th year, the 3rd in the 20th year and the 4th in the 40th years.

262. The first thinning to be carried out in the 7th year may be a more or less mechanical thinning if the growth so indicates. Plants in every alternate diagonal line should be removed. As a result, the original spacing of 2 metres \times 2 metres will increase to 2.8 \times 2.8 metres and the number of stems per hectare will reduce from 2,500 to 1275. First thinning is a very important silvicultural work and the thinning marking should be made by an officer not below the rank of a Range Forest Officer. The second thinning should not be done mechanically. The spacing to be kept will depend on the growth of the poles. Normally, the spacing should be equal to $1/3$ the average height of the poles. The prescribed thinning should not be postponed under any circumstances and should preferably be carried out departmentally.

263. A statement giving the sequence of the cleanings and thinnings to be carried out is given in Appendix No. LIII.

Section 15.—Other Regulations

264. *Fire protection*.—The worked coupes of periodic block I should be fire-traced for six years from the year of working.

The worked coupes of periodic block II and periodic block III should be fire-traced for three years from the year of working in the interest of forest conservancy.

265. *Closure of grazing*.—The worked coupes of periodic block I will remain closed to grazing for a period of six years from the year of working.

The worked coupes of periodic block II and periodic block III will remain closed to grazing for a period of three years from the year of working as a measure for periodic closure in the areas allotted to conversion working circle in the interest of forest conservancy.

CHAPTER VI.—WORKING PLAN FOR THE INDUSTRIAL WOODS PLANTATION WORKING CIRCLE

Section 1.—General Constitution

266. This working circle includes part of the area which would have been otherwise allotted to the conversion working circle, *i.e.*, better quality area situated on moderate slopes. Areas situated near the main lines of communications have been allotted to this working circle for planting with industrial woods like *khair*, *hed*, *kalam*, *sawar*, *maharukh* etc. Total area allotted to this working circle is 5,014·838 hectares.

Section 2.—General Character of the Vegetation

267. The description given in para 225 applies *mutatis mutandis* to this area.

Section 3.—Block, Compartments and Felling Series

268. The numbers of compartments allotted to this working circle are given in Appendix No. LIV. The area of this working circle has been divided into 4 felling series. The division of the area into felling series and coupes is given in Appendix No. LV. The felling series named Kuda has been specially earmarked for raising *khair* plantations.

Section 4.—Special objects of Management

269. The Special object of management of the forest of this working circle is to raise plantations of industrial wood species like *khair*, *hed*, *kalam*, *sawar*, *maharukh* etc. require for forest based industries like manufacture of *kath*, bobbin and shuttles, matches packing cases etc.

Section 5.—Analysis and Valuation of the Crop

270. The entire area of this working circle has been stockmapped on 8" = 1 mile toposheets. The results of stockmapping are given in Appendix No. XXXIV. Most of the area is of quality III.

Section 6.—Method of Treatment

271. The object of management can be achieved only by clear felling the existing crop and planting the desired species. The clearfelling system with artificial regeneration is, therefore, prescribed.

Section 7.—Choice of Species

272. The species to be planted will be industrial wood species like *hed*, *kalam*, matchwood species like *sawar* and *maharukh* and *khair* which is used for manufacture of *kath*. Plantations of *hed* and *kalam* should be initially raised on a small scale as trial.

Section 8.—Rotation

273. The industrial wood species to be planted are marketable only in big sizes of at least 90 cm. in girth at b.h. It is seen that this size is reached in about 40 years. A rotation of 40 years has, therefore, been tentatively fixed. It is neither feasible, in the absence of exact growth data nor necessary in view of the shorter period of the plan, to fix the correct rotation at this stage.

Section 9.—Regulation of the Yield

274. The area of each felling series has been divided into 40 equal annual coupes. The yield will be regulated by area only.

Section 10.—Sequence of Fellings

275. A statement showing the sequence of fellings is given in Appendix No. LVI.

Section 11.—Demarcation of coupes and Marking Technique

276. Rules for the demarcation of coupes, sub-coupes and unworkable areas and the marking technique are given in paras. 403 to 407.

Section 12.—Method of executing the Fellings

277. The rules prescribed for P. B. I in paras. 250 to 252 regarding preparation of treatment maps and marking will apply to this area as well, with the modification that in the treatment maps, plantable areas suitable for planting with various species need not be shown separately as the requirements of soil etc. of all the industrial wood species is the same and it would be desirable to have a mixed plantation of all species instead of pure plantations. In order to avoid sacrifice of young teak growth, patches containing advance growth of teak will be treated as prescribed in the above rules.

Section 13.—Plantation Technique

278. The area to be planted should be given a good burn by burying *rabs* (*vide* details given in Appendix No. LI). Plantation technique for *khair* is given in Appendix No. LII. The technique of planting other industrial wood species is as under :

279. *Hed and Kalam*.—Seeds should be collected from trees from April to June and dried in the sun covered under cloth. The dried seeds should be stored in dry tins in a cool dry place. The seeds retain vitality at least for a year. The seed is very minute and the seedlings in the first season are extremely slow in growth. Direct sowing therefore, is not successful.

280. For raising the seedlings the following procedure is prescribed :

Seed boxes should be filled within about 3 cm. from the top, with finely sifted earth with a large proportion of sand, the surface made smooth and watered. The seeds should be sown in about April or May on the wet surface and very lightly covered with fine earth or sand. The boxes should be kept under cover, and watering with a very fine spray should be done frequently but sparingly. Germination ordinarily takes place in about three to six weeks. As soon as the seedlings are large enough to handle, that is, in about two or three months, they should be pricked out in polythene bags. The seedlings will be ready for planting in the forest, in the following rains.

Planting should be done in pits 30 cm. × 30 cm. × 30 cm. dug at a spacing of 2 metres × 2 metres,

281. *Sawar*.—The ripe fruits should be collected in the month of April and May and the fruits dried in the sun in bags. The fruits open and the floss comes out. By beating the bag with a stick, the seed can be easily separated from the floss. Seed should be dried thoroughly and stored in dry tins in a cool dry place till it is required in next rains.

282. The best method of raising *sawar* is stump planting and is, therefore, prescribed. Two year old seedlings should be used for preparing the stumps. The technique of preparing nursery beds and stumps is the same as prescribed for teak (*vide* Appendix No. LI). Planting should be done in pits 30 cm. × 30 cm. × 30 cm spaced at 8 metres × 8 metres. As *sawar* is susceptible to extensive damage by rodents, it is not advisable to raise pure plantation of *sawar*.

283. *Maharukh*.—The fruits ripen in May-June. The seed should be sown in May or June in well drained seed beds in rills about 22 cm. apart, water being given regularly but sparingly, as the seedlings will not stand an excess of water. Germination takes place in 1 to 2 weeks. Regular weeding should be carried out during monsoons. The seedlings will be ready for transplanting in the next monsoons. Seedlings raised in polythene bags give better results than naked transplants. Stump planting also gives good results.

284. All the above four species require well drained and fairly deep soil. In shallow, murummy soils *khair* should be raised. In the Kuda felling series *khair* should be planted on all well drained sites,

Section 14.—Subsidiary Cultural Operations

285. *Weedings*.—3 weedings should be carried out in the first year, 2 in the second year and 1 in the third year. The details regarding the weedings will be as prescribed for teak (*vide* Appendix No. LI).

286. *Cleanings*.—This will be carried out as laid down in para. 260 of Chapter V, part II in the 6th year from the year of regeneration.

287. *Thinnings*.—The first thinning will be done in 11th year in which the healthy plants should be spaced at $\frac{1}{3}$ rd the average height of the plants to provide adequate growing space. The second thinning of 'C' grade intensity will be done in 20th year, where also as a rough guide the spacing should be equal to $\frac{1}{3}$ rd the average height of the plants. Only two thinnings should suffice in view of short rotation.

288. A statement giving the sequence of cleanings and thinnings to be carried out is given in Appendix No. LVII.

Section 15.—Other Regulations

289. *Fire protection*.—The planted area should be fire-traced for seven years from the year of planting.

290. *Closure of grazing*.—The planted area will remain closed to grazing for a period of seven years from the year of planting.

CHAPTER VII.—WORKING PLAN FOR THE PULPWOOD PLANTATION WORKING CIRCLE

Section 1.—General Constitution

291. This working circle includes the predominantly mixed forests in Badlapur, Murbad, Mandvi, Gokhiwara and Dhasai ranges. The areas are situated at convenient distance from Kalyan which is the site selected for the proposed pulpwood plant. The total area allotted to this working circle is 10834·289 hectares.

Section 2.—General character of the Vegetation

292. The forest belongs to the type "Moist Teak bearing forest" described in Chapter II of Part I (vide paras 25 to 31). Most of the area in Badlapur range belongs to the local type "mixed forest". This local type also predominates in the areas of Murbad, Mandvi, Gokhiwara and Dhasai ranges. But these ranges also contain teak type of IV-a quality. The mixed forest is mostly of III quality. Areas near Virar, Hajimalang (near Kalyan) and near Badlapur have suffered due to hacking for firewood. Density of the crop varies from 0·4 to 0·7. The area formed part of the main working circle of Jadhav's plan.

Section 3.—Blocks, Compartments and Felling Series

293. A pulpwood factory with an intake of 200 tonnes per day will require 60,000 tonnes of pulpwood annually. 75 per cent of this annual requirement will be shortfibred pulpwood obtained from *Eucalyptus hybrid* and rest will be long fibred pulpwood from bamboos. *Eucalyptus* plantations can be expected to yield at least 75 tonnes per hectare after 15 years. To have sustained annual yield, plantations of *Eucalyptus* will have to be raised over 600 hectares annually, *i. e.* over 9000 hectares in 15 years. Bamboos will be under-planted in the second year in the *Eucalyptus* plantations at 6 metres × 6 metres. Bamboos can be expected to give sufficient quantity of long fibred pulpwood at rate of 5 tonnes per hectare on a 3 years felling cycle so as to get about 10000 hectares (10 percent more than the required extent) of plantable area.

294. The number of compartments allotted to this working circle are given in Appendix No. LVIII. The area of this working circle has been divided into 10-felling series. The division of the area into felling series and coupes is given in Appendix No. LIX.

Section 4.—Special objects of Management

295. The special object of management of the area of this working circle is to raise plantations of *Eucalyptus* and bamboos sufficient to sustain a pulpwood factory of 200 tonnes capacity and thus to encourage the industrial development of the locality.

Section 5.—Analysis and Valuation of the Crop

296. The area of this working circle has been stock-mapped on 8" = 1 mile toposheets. The results of stockmapping are given in Appendix No. XXXIV.

297. Enumeration figures for Badlapur range, most of the area of which is allotted to this working circle, show that stocking per hectare is 439·99 trees. Teak forms 39·22 per cent of the crop. The other valuable species in the order of their preponderance are *ain*, *shisham*, *sawar*, *khair*, *hed* etc. Separate enumeration data for the area of other ranges is not available.

Section 6.—Method of Treatment

298. The method of treatment prescribed is clear felling the existing growth, and regenerating the area artificially with the desired species.

Section 7.—Choice of Species

299. As already indicated, *Eucalyptus hybrid* will be the species to be planted for obtaining short-fibred pulpwood and bamboos (both *katas* and *Manvel*) for obtaining long fibred pulpwood.

Section 8.—Rotation

300. Though *Eucalyptus hybrid* is being worked on a short rotation of 10 years or even shorter rotation in other States, sufficient growth data regarding its rate of growth in this State is not available. Tentatively therefore, the rotation for *Eucalyptus* has been fixed at 15 years. Bamboos will be exploited on a felling cycle of 3 years. It is expected that mature bamboos will be available for exploitation in about 10 years.

Section 9.—Regulation of the Yield

301. The yield will be regulated by area.

Section 10.—Sequence of Fellings

302. A statement showing the sequence of fellings is given in Appendix No. LX.

Section 11.—Demarcation of Coupes and Marking Technique

303. The prescriptions laid down in paras. 403 to 407 will apply to this area.

Section 12.—Method of executing the Fellings

304. A treatment map will be prepared as prescribed in para. 250. Quality IVa areas will also be considered as plantable and will be shown as such in the treatment maps.

Section 13.—Plantation Technique

305. Detailed technique about raising *Eucalyptus* plantation including nursery technique and tending rules is given in Appendix No. LXI.

306. As regards bamboos, two year old seedlings raised in nursery beds or preferably in polythene bags should be underplanted in one year old *Eucalyptus* plantations in pits 30 cm. × 30 cm. × 30 cm. dug at a spacing of 6 metres × 6 metres. *Katas* bamboos should be planted in moist localities, *i. e.* those along the nallas or river banks. On hilly portion *Manvel* bamboos should be preferred.

Section 14.—Subsidiary Cultural Operations

307. As mentioned in the rules given in Appendix No. LXI, three weedings in the first year, two in the second year and one in the third year should be carried out. No cleanings and thinnings are necessary.

Section 15.—Other Regulations

308. *Fire protection.*—The worked coupe should be fire-traced for six years from the year of working.

309. *Closure to grazing.*—The worked coupe will remain closed to grazing for a period of 6 years from the year of working.

CHAPTER VIII.—WORKING PLAN FOR THE MISCELLANEOUS PLANTATION WORKING CIRCLE

Section 1.—General Constitution

310. This working circle includes some of the minor forests in Palghar, Thana, Bhiwandi and Padagha ranges referred to in para 152 of Chapter I, Part II. The areas are not suitable for growing timber species. The total area included in this working circle is 5340.690 hectares.

Section 2.—General character of the Vegetation

311. As regards the vegetation, the severe effects of maltreatment are very evident. An area of 1227.24 hectares has been shown as hacked forest and here practically no tree is left intact. The hacked forest consists of high stumps of the original tree growth with numerous pollarded shoot growing from each stump. Most of these areas are situated near towns e. g. Palghar, Thana etc. and have been subjected to continuous hacking and illicit cutting over a long period. The forest belongs to the type "Moist Teak bearing forest". Both the local types are present. Site quality is IVa to IVb. Where wholesale hacking has not taken place, the density varies from 0.4 to 0.5.

Section 3.—Blocks, Compartments and Felling Series

312. The compartments allotted to this working circle are shown in Appendix No. LXII. The area of this working circle has been divided into 8 felling series. The allotment of compartments to felling series and their division into coupes is shown in Appendix No. LXIII.

Section 4.—Special objects of Management

313. The special object of management of the area included in this working circle is :—

To raise plantations of fast growing species like *Eucalyptus*, *Albizzia*, *fulcata*, *Acacia auriculiformis*, *Dalbergia sissoo* etc. in the poor quality areas, so as to meet the local demand for firewood.

Section 5.—Analysis and Valuation of the Crop

314. The entire area of this working circle has been stockmapped on 8"=1 mile toposheets. The results of stockmapping are given in Appendix No. XXXIV.

315. As regards the enumerations, separate data for the area included in this working circle is not available.

Section 6.—Method of Treatment

316. The object of management can be achieved only by clearfelling the existing crop and planting the desired species. The clearfelling system with artificial regeneration is therefore prescribed.

Section 7.—Choice of Species

317. The species to be planted will be fast growing firewood species. Suitable species recommended are *Eucalyptus hybrid*, *Eucalyptus grandia*, *Albizzia fulcata*, *Pinus insularis*, *Acacia auriculiformis*, *Dalbergia sissoo*, *Albizzia lebbek*, etc.

Section 8.—Rotation

318. Data about the rate of growth of the prescribed species, in this locality is not available. However as the prescribed species are known to be fast growing, a rotation of 25 years should be sufficient for the maximum volume production. A rotation of 25 years has therefore been tentatively fixed.

Section 9.—Regulation of the Yield

319. The yield is regulated by area and for this purpose the area of each felling series has been divided into 25, as far as possible equal annual coupes.

Section 10.—Sequence of Fellings

320. A statement showing the sequence of fellings is given in Appendix No. LXIV.

Section 11.—Demarcation of Coupes and Marking Technique

321. The prescriptions laid down in paras 403 to 407 applies to this area.

Section 12.—Method of executing the Fellings

322. The prescriptions laid down in para. 277 of Chapter VI, Part II will apply to this area as well.

Section 13.—Plantation Technique

323. Detailed technique about raising *Eucalyptus* plantation including nursery technique and rules about tending is given in Appendix No. LXI. The other species too should be planted in the same manner. Use of chemical fertilisers is desirable in view of the short rotation and consequent necessity of early growth. A mixture of equal amount of Superphosphate with Ammonium sulphate should be given to the plants in September-October, of the first year, in doses of about 1 to 2 ounces per plant.

Section 14.—Subsidiary Cultural Operations

324. Rules about weedings are given in Appendix No. LXI.

325. *Cleanings and thinnings.*—No cleanings will be necessary. One thinning should be carried out in the 15th year as per the sequence given Appendix No. LXV.

Section 15.—Other Regulations

326. *Fire protection.*—The worked coupe will be fire-traced for six years from the year of working.

327. *Closure to grazing.*—The worked coupe will remain closed to grazing for a period of six years from the year of working.

CHAPTER IX.—WORKING PLAN FOR THE FODDER RESERVES WORKING CIRCLE

Section 1.—General Constitution

328. This working circle includes the denuded and blank areas in Dahanu and Thana divisions classed as miscellaneous forests (fodder reserves). The areas are situated near Vangaon, Boisar, Virar and Thana and have been nearly completely denuded due to hacking for firewood. The area is no more fit for growing trees. Moreover the pressure of population is so tremendous that it will be very difficult to protect any plantation in this area. The area is however suitable for growing grass, which is in great demand. The total area allotted to this working circle is 2783·981 hectares.

Section 2.—General character of the Vegetation

329. The original tree growth of the area must have belonged to the type "Moist Teak bearing forest" which is the most common type occurring in the Thana district. However, due to heavy illicit cutting and constant hacking for firewood, the original tree-growth has either completely disappeared e.g. in some of the areas situated near Virar and Thana or has been reduced to stools with a number of pollarded shoots. In the hilly areas, all the top soil is nearly washed away and the area has become unfit to grow any trees specially in the areas situated near Virar and Thana. In the areas situated near Vangaon, Boisar etc. the erosion is not severe mostly because, the area is more or less flat. In fact the soil is deep clay. Here too past efforts to raise tree plantations have failed due to bad drainage and difficulty of protection due to proximity to habitation.

Section 3.—Blocks, Compartments and Series

330. The number of compartments allotted to this working circle are given in Appendix No. LXVI. The area of this working circle has been divided into 5 series.

Section 4.—Special objects of Management

331. The special objects of management are :

- (i) To protect areas vulnerable to soil erosion by maintaining adequate soil cover.
- (ii) To produce good quality grass which can be used as fodder to be supplied to Government Milk Colony at Aarey near Bombay, the proposed colony at Dabchhari near Talasari and to scarcity affected areas in years of famine.

Section 5.—Analysis and Valuation of the Crop

332. The area of this working circle has been stockmapped on 8" = 1 mile toposheets. Blanks, hacked area and understocked areas have been shown separately. In the absence of proper tree growth it has not been possible to classify the area into different qualities. No enumerations also were carried out in this area in view of the absence of any tree growth.

Section 6.—Method of Treatment

333. The areas are to be developed as cutting kurans. They will therefore be closed to grazing permanently and for this purpose will be fenced with barbed wire. Bushy undergrowth and stumps of trees will hamper the growth of grass and hence will be removed. Soil and moisture conservation measures like gully plugging will be carried out to improve the site conditions. In the waterlogged areas, the water will have to be drained out. Mere closure will induce the growth of inferior grass too. In order to encourage growth of better quality fodder grass, seeds of suitable fodder grasses will be introduced in the area. The whole area will be strictly fire protected by fire tracing all around. It will not be possible to carry out all these works in the whole area in one year. Each series (*Kuran*) has therefore been divided into four annual units, so that the whole area will have been covered in four years. The division of the area into series and units is given in Appendix No. LXVII.

Section 7.—Choice of Species

334. Cultivation of fodder grasses is done on a large scale on private lands near Dahanu, Vangaon and Palghar. The grasses which are commonly grown therein will also be suitable for growing in this area. These grasses are :

- (i) *Ischeamum rugosum* (*ber*).
- (ii) *Themeda triandra* (*phool*).
- (iii) *Iseilema wightii* (*mushi*).
- (iv) *Andropogon annulatus* (*marval*).
- (v) *Ischaemum Laxum* (*Shedya*).

Section 8.—Method of executing the Works

335. The whole area of a series to be treated will be fenced with barbed wire. The annual area to be treated as per the programme given in Appendix No. LXVIII, will also be properly fire-traced after cutting and clearing a 3 metre wide line all around. The area will be inspected by an officer not below the rank of a Range Forest Officer who will prepare a map of the area showing area suitable for introducing fodder grasses. These areas will be plain or situated on moderate slopes and will have at least 15 cm. deep soil. Such area should be at least 4 hectares (above 10 acres) in extent in a compact block (it will not be possible to show smaller blocks on the 8" = 1 mile toposheets).

336. The area in which fodder grasses are to be introduced will be demarcated by erecting pillars at suitable intervals and by giving two *geru* rings on the trees standing on the periphery and if there are no trees, on the pillars themselves. In these areas, all the undergrowth will be cut and trees or stools will be uprooted. The debris will be burnt. If the area is plain, it will be ploughed, preferably with a tractor. After ploughing, farm-yard manure at 32 cart loads/hectare will be mixed with the soil. Seeds of fodder grasses will be broadcast at the onset of monsoons. About 50 kg. of seed is required for one hectare. The grasses can also be introduced by transplanting tussocks in lines about 0.5 metres apart. For this purpose, the seed will have to be sown in nurseries in March and watered. Ammonium sulphate dissolved in water to make 40 per cent solution should be given twice during the rainy season. About 110 kg. (of the manure) are required for one hectare. Weeding should be done wherever necessary and inferior grasses removed.

337. Harvesting will be done after the middle of October i.e., after seeding. Normally no operations will be required to be done in the 2nd and 3rd year. Broadcasting seed, on the onset of monsoons, administering ammonium sulphate during monsoons and removal of inferior grasses could be repeated. The first year operations will however have to be repeated in the fifth year as the normal life of grasses is 3 to 4 years and if no reseedings is done the inferior grasses fill-up the area.

338. In the whole unit, in all areas liable to erosion, gullies and small nallas will be plugged with debris or stones. Water tables will be put on all extraction paths and *kacha* roads.

339. *Storage*.—All the cut grass may be baled at site and the baled grass stored at specially built sheds at railheads like Dahanu, Vangaon, Boisar, Virar and Thana where a reserve of sufficient fodder can be built up for supplying fodder to scarcity affected area during years of famine.

CHAPTER X.—WORKING PLAN FOR THE CASUARINA WORKING CIRCLE

Section 1.—General Constitution

340. This working circle includes the *Casuarina* plantations in Bordi, Dahanu and Palghar ranges of Dahanu division. In the plan under revision, this working circle comprised of 247.36 hectares (609 A-25G). But during the bifurcation of *ex-Bombay State* in May 1960, part of Sanjan Range was transferred to Gujarat State, as a result, the area of this working circle has been reduced considerably. The area of this working circle is 72.343 hectares at present which includes an area of 15.481 hectares at Mahim in Palghar Range which was planted in 1955-56 to 1957-58.

Section 2.—General character of the Vegetation

341. The forests consist of plantations of *Casuarina quisetifolia*. There is no underwood or undergrowth. In the younger plantations, there is some ground cover consisting of herbs and grasses. But in older plantations even this is absent and the ground is covered only with the fallen needles of the *suru* trees. *Eucalyptus hybrid* has been interplanted in the *suru* plantation raised since 1962-63.

Section 3.—Blocks, Compartments and Felling Series

342. The area has been divided into 5 compartments. Out of these, compartment No. 1167 with an area of 1.820 hectares (4A 20G), at Dahanu proper is excluded as it lies in the vicinity of the office and residence of the Divisional Forest Officer, Dahanu who will decide its future from aesthetic point of view under the orders of the territorial Conservator. A statement showing compartments allotted to *Casuarina* Working Circle is given in Appendix No. LXIX-A. Only one felling series is formed. A statement showing division of area into annual coupes has been given in Appendix No. LXIX-B.

Section 4.—Special objects of Management

343. The special objects of management of this area are :

(i) To make the otherwise barren, unproductive, sandy area a productive area by planting *Casuarina* which is the only species which can thrive well in the area and fetch handsome revenue.

(ii) To minimise erosion and protect the inland cultivation from shifting sand, winds and storms.

(iii) To meet the local demand for firewood, to the extent possible.

Section 5.—Analysis and Valuation of the Crop

344. The whole area has been stockmapped. It consists of *Casuarina* plantations. No enumerations were however carried out. The initial spacing in the plantations is 3.64 metres \times 3.64 metres (12' \times 12') which is doubled after carrying out thinnings which are mechanical.

Section 6.—Method of Treatment

345. Since *Casuarina* is not a good coppicer nor it regenerates naturally, the method of treatment prescribed is clearfelling with artificial regeneration.

Section 7.—Choice of Species

346. So far, *Casuarina* has proved to be the only species which can be grown well in the coastal sands. As mentioned in para 90 (Part I, Chapter V), if the experimental plantations of *Eucalyptus hybrid* prove to be successful, it may eventually be substituted in place of *Casuarina*, as it being a good coppicer for 3 to 4 rotations, it will be economically more profitable than the *Casuarina* plantations. The oldest *Eucalyptus* plantation will be 10 years old in 1972-73, when its rate of growth *vis-a-vis* that of *Casuarina* can be compared and the switch over to *Eucalyptus* be then made if found profitable. This should be examined by the D. F. O., Dahanu and action taken as per Conservator of Forests, Thana Circle's orders.

Section 8.—Rotation

347. Under Jadhav's plan the rotation was fixed at 15 years. Since *Casuarina* wood is mainly used as firewood, it was considered advisable to reduce the rotation to 10 years if financially profitable. The net income per hectare from a *Casuarina* plantation at 15 years and 10 years is Rs. 8,325 and Rs. 3,965 respectively. The income at 10 years capitalized to 15 years at 4 per cent compound interest is Rs. 4,638 is far less than the net income at 15 years. Obviously it is not profitable to reduce the rotation to 10 years. The rotation is therefore kept unchanged, viz. 15 years.

Section 9.—Regulation of the Yield

348. The yield is regulated by area and for this purpose the area has been divided into 15 approximately equal annual coupes.

Section 10.—Sequence of Fellings

349. A statement showing the sequence of fellings is given in Appendix No. LXX.

Section 11.—Demarcation of Coupes and Marking Technique

350. The boundary of the annual coupe will be demarcated a year in advance by fixing stout wooden posts painted with red lead at the four corners and at suitable intervals in-between. Coupe number will be written on the posts on the side away from the area of the coupe.

351. The marking will be done by a tar band given at breast height and the serial number of the tree will be written above the tar band.

Section 12.—Method of executing the Fellings

352. The trees should be felled 0.3 to 0.5 metres below the ground level and all the stumps uprooted wherever possible. This will remove obstacles in the way of planting.

Section 13.—Plantation Technique

353. Detailed technique about raising *Casuarina* plantations including the nursery technique is given in Appendix No. LXXI.

Section 14.—Subsidiary Cultural Operations

354. *Weedings*.—There is very little growth of weeds in the area. No weedings will therefore be ordinarily necessary.

355. *Cleanings*.—Since the first thinning is prescribed in the 5th year, no cleaning is necessary.

356. *Thinnings*.—*Casuarina* is a strong light demander. It is also a very fast growing species. The first thinning will be mechanical in which every alternate diagonal line will be removed. The second thinning should be carried out in the 10th year and this too should be mechanical, wherein every alternate line will be removed. In carrying out the mechanical thinnings, allowance should be made for alteration i. e. for removal of damaged or malformed stems. In the first thinning 50 per cent of the original crop will be removed leaving the plants at a spacing of 3.9 m. x 3.9 m. In the second thinning, 50 per cent of the crop existing after the first thinning will be removed leaving 336 plants per hectare at a spacing of 5.50 m. x 5.50 m. The sequence of cultural operations is given in Appendix No. LXXII.

Section 15.—Other Regulations

357. Fire tracing is not necessary as there is little combustible material. The planted area should be closed to grazing for 5 years from the year of planting.

CHAPTER XI.—WORKING PLAN FOR THE BABUL WORKING CIRCLE

Section 1.—General Constitution

358. The area included in this working circle is situated along the left bank of the Vaitarna river in Dahisar range of Dahanu Division. The total area is 73.045 hectares which is distributed in four villages as under :

Serial No.	Name of village	Survey No.	Area in hectares
(1)	(2)	(3)	(4)
1	Nawale	192	1.050
2	Girale	100	7.772
3	Pargaon	192	34.840
4	Sonave	149	29.383
		Total	73.045

359. The area was constituted into reserved forest in 1905 and *babul* plantations were raised in it during 1923-24 to 1924-25. The planted area was however not brought under a regular working plan till it was included in the *babul* working circle of Jadhav's plan.

Section 2.—General character of the Vegetation

360. Most of the trees planted during 1923-24 and 1924-25 have disappeared due to uprooting in the cyclones of 1940 and 1948 and to some extent due to illicit cutting. Under Jadhav's plan coupe Nos. 1 to 11 and 14 were regenerated upto 1965-66. Coupe Nos. 1 to 3 and 6 to 11 and 14 have a good crop of young *babul* trees while in coupe Nos. 4 and 5, the growth is sparse. Coupe Nos. 12 and 13 which had remained in arrears and coupe No. 15 are being regenerated during 1966-67. The rest of the area i. e. coupe Nos. 16 to 30 contain a scrub type of forest of *karvadi* and *ukshi* with a few trees of *babul*, *petari shenbhair* and *tadpalm* scattered about. Bamboo (*Katas*) has died due to gregarious flowering and there is hardly any regeneration of bamboo to be seen. There is thick growth of grass. The area is flat and contains deep, reddish, alluvial soil. When the river is in flood, the area is inundated by water, often 3 to 4 metres deep. The flood water recedes in a day or two.

Section 3.—Compartments and Felling Series

361. The compartments allotted to this working circle are given in Appendix No. LXXIII-A. Only one felling series has been constituted in this working circle. The felling series is divided in 30 annual coupes. A statement showing the division of the area into coupes is given in Appendix No. LXXIII-B.

Section 4.—Special objects of Management

362. The special objects of management are :

- (i) To raise *babul* plantations in the area which is suitable for the purpose, so as to augment the supply of firewood ; and
- (ii) To raise the plantations of *ramkati babul* over at least 30 per cent of the plantation area to ensure supply of 'Datan' cutting for which a great demand exists at Bombay.

Section 5.—Analysis and Valuation of the crop

363. The area has been stockmapped. Results of stockmapping are given in Appendix No. XXXIV. It was not considered necessary to carry out any enumerations. The plantations have been raised at a spacing of 6' × 6' (2 metres × 2 metres).

Section 6.—Method of Treatment

364. Since *babul* is not a good coppicer nor its natural regeneration comes up well in the area, the only suitable method of treatment is clearfelling with artificial regeneration. This was the treatment prescribed under Jadhav's plan and the same should be continued.

Section 7.—Choice of Species

365. In view of the fact that the area is liable to be inundated by water during the monsoons, *babul* is the only species which can be planted as other species will not stand inundation.

Section 8.—Rotation

366. Under Jadhav's plan the rotation was fixed at 30 years. This is the rotation on which *babul* plantations are usually worked and hence the same is kept unchanged. *Babul* trees are expected to reach a size of 80 cm. in girth at b. h. and about 13.5 metres in height, in 30 years.

Section 9.—Regulation of the Yield

367. The yield is regulated by area. The present division of the area into 30 annual coupes is therefore continued.

Section 10.—Sequence of Fellings

368. A statement showing the sequence of fellings is given in Appendix No. LXXIV.

Section 11.—Demarcation of Coupes and Marking Technique

369. *Demarcation.*—The annual coupe should be demarcated a year in advance by erecting earthen mounds at suitable intervals on the periphery of the coupe and also by giving two tar bands and serial number on the boundary trees.

370. *Marking technique.*—All *babul* trees to be felled should be marked by giving a tar band at b. h. and chisel number and hammer mark at the base as well as at b. h. Trees to be reserved should be given a red band and serial number in red lead at b. h.

Section 12.—Method of executing the Fellings.

371. There are a number of *tad* palm trees in the area. These trees should be marked for reservation. The leaves of *tad* palm are used for thatching etc. Moreover, as its crown is light and high, the trees do not affect the *babul* plantations. After the felling operations are over, the uprooting of the stumps should be allowed. This will help in preparing the soil for sowing.

Section 13.—Artificial Regeneration and Cultural Operations

372. *Collection of seed.*—The existing *babul* trees are of both '*teli*' and '*vedi*' varieties. As '*teli*' variety is better one and as it grows well in high rainfall areas, it should be ensured that the seed is collected of the '*teli*' variety only. The pods of '*teli*' *babul* are moniliform and can therefore be easily identified. The seed of *ramkati babul* would be available in Poona district where it is fairly common. The best method of treating *babul* seed of all the varieties is to pass it through goats and sheep. Other method of treating the seed is to put in water which has reached boiling point and to keep it in the water overnight for cooling.

373. *Sowing.*—After the area is clearfelled and all the material has been extracted, it should be ploughed with double furrows in lines 2 to 3 metres apart. The treated seed should be dibbled in these lines on the onset of monsoons. If agri-silvi is possible, it should be adopted. In that case the distance between two lines should be 5 metres. The lease for agri-silvi should be for 5 years. Sowing and all tending operations up to the 5th year has to be done by the cultivator at his cost. Set of conditions on which the agri-silvi plots are leased in Poona division is given in Appendix No. LXXV. The same should be adopted.

374. *Weedings*.—Weedings should commence early after the first rains in July and continued at frequent intervals till the end of the monsoons. The lines should be weeded clear up to 1/2 metre on either side. The seedlings in the lines should be thinned at the time of the last weeding so that the distance between two seedlings is about 30 cm. Three or four weedings will be necessary in the first year. Along with the last weeding, mulching should be done. Two weedings in the second year and one weeding in the 3rd and 4th year should be sufficient.

375. *Cleanings*.—Cleanings operations should be carried out in the fifth year. The spacing between two plants in lines should be about 2 metres.

376. *Thinnings*.—Two thinnings are prescribed, the first in the 10th year and the second in the 20th year. The intensity of thinnings should be such that all the crowns of the trees to be retained are free and the trees are evenly spaced.

The sequence of subsidiary cultural operations to be carried out is given in Appendix No. LXXVI.

Section 14.—Other Regulations.

377. *Closure to grazing*.—The regenerated area should be closed to grazing for a period of 5 years from the year of sowing.

378. *Fire tracing*.—The planted area should be fire-traced for a period of 5 years from the year of sowing.

379. *Datan contracts*.—There is a great demand for 'Datan' cuttings. The *Datan* contracts should be given from plantations which are over 10 years in age and subject to the condition that leading shoots and the two adjacent branches are preserved intact.

CHAPTER XI-A.—WORKING PLAN FOR MISCELLANEOUS WORKING CIRCLE.

General Constitution

379-A. This working circle includes the remaining reserved forests not covered in any of the working circle. The area of this working circle totals to 5738·944 hectares. The following are the areas.

(i) *School Forests.*—An area of 4848·320 hectares of 22 compartments is to be managed as School Forests. A separate working plan will be prepared for this area for imparting practical training to the Forest Guard Trainees of the Forest Guards' Training School at Shahapur. These compartments have been shown in column 21 of Appendix No. XXXIV-A and also in column No. 15 of Appendix No. XXXIV-B.

(ii) *Dalhi cultivation.*—The *Dalhi* cultivation plots with an area of 820·655 hectares have been given out for cultivation with the object of encouraging human habitations in lonely part of the forests for the supply of labour for forest works in some ranges. These '*Dalhi*' plots are on the record of reserved forests but have been excluded from the coupes. '*Dalhi*' plots have been given out on annual leases which are renewed year after year. These plots are not subject to the right of succession. If any occupant dies or deserts his land, the same is given for cultivation to another deserving applicant.

The tree-growth of injaili species on '*Dalhi*' plots not included in the coupes, will be retained for *tahal* cutting by the plot holder and that of teak, *tiwas* (*ougeinia dalbergioides*) and *shisham* (*Dalbergia latifolia*) will be sold along with the adjoining coupes. When the areas are large, subsequent small inter-coupe adjustment will have to be made but not so as to effect the sequence of coupes in any way. The whole area being reserved forests and under the control of the Divisional Forest Officers, such adjustment can be sanctioned by the Conservator.

The extent of '*Dalhi*' lands by ranges appears in column 14 of Appendix No. XXXII and that by compartments appears in column 14 of Appendix No. XXXIV-B.

(iii) *Preservation Plots.*—An area of 69·969 hectares covered by three preservation plots will be dealt with as laid down in paragraph No. 418 of Chapter XIV of Part II.

CHAPTER XII.—WORKING PLAN FOR THE MINOR FOREST PRODUCE (OVERLAPPING) WORKING CIRCLE

Section 1.—General Constitution of the Working Circle

380. This is an overlapping working circle and covers the whole area dealt with under this plan.

Section 2.—Minor Forest Products of the Area

381. Apart from grass, bamboos, thorns, *babul datan*, etc., the various other minor forest products sold annually are :—

- (1) *Apta* and *Tembhurni* leaves.
- (2) *Bel* leaves.
- (3) *Kadi patta* leaves (*Murraya koenigii*).
- (4) Myrobalans.
- (5) *Chilhar* bark.
- (6) *Ain* bark.
- (7) *Wavding*.
- (8) *Tad* leaves and fruits.
- (9) *Mohwa* flowers and seeds.
- (10) *Kusri* flowers.
- (11) *Rankel* leaves.
- (12) Honey.
- (13) *Karaya* Gum.

Section 3.—Special objects of Management

382. The objects of management of this working circle are: (i) to ensure that the various minor forest products are collected in a proper manner and (ii) to take measures to increase or at least to maintain the yield of the various minor forest products.

Section 4.—Method of Treatment

383. The minor forest products should be sold annually either by auction or on permits as at present. Treatment proposed for increasing the yield of some of the important products is as under.

384. *Mohwa* flowers and fruits.—*Mohwa* trees yield important products out of its flowers and fruits. The corollae of the flowers yield alcohol on fermentation and distillation. They are also eaten by the poor in years of famine. The seeds yield an oil which is used in cooking, soap making etc., *Mohwa* seed should be sown at the beginning of the monsoon, on suitable sites in all the areas under regeneration to the extent possible, in the conversion, selection-cum-improvement and the lakes catchment area working circles.

385. *Karanj* (*Pongamia glabra*) seed.—*Karanj* oil is useful for soap making, burning and in medicine. It can be easily raised by direct sowing of seed. It prefers sites along rivers and nallas and should be raised to the extent possible in all suitable sites in the annual regeneration areas in the conversion, selection-cum-improvement and the lakes catchment area working circles.

386. *Tembhurni* (*Diospyros melanoxylon*) leaves.—The yield of leaves can be increased by pollarding the trees in the month of March and April. Plucking of the leaves should be restricted to the lower $\frac{3}{4}$ th length of a branch leaving the upper $\frac{1}{4}$ th portion intact.

387. Leaves of *Kadipatta* (*Murraya koenigii*).—The leaves have a good demand in Bombay where it is used for flavour in curry making. The shrubs come up well on the higher slopes of the main ridge of the western ghats and hence should be raised by sowing in suitable areas to the extent possible in the protection working circle. Sowing should be done in pits on the onset of monsoons.

388. *Hirida* (*Tehminalia chebula*).—The fruits are very valuable as myrobalans used for tanning and are also in demand for dye manufacture. The tree occurs on the higher slopes and should be raised by sowing on suitable sites to the extent possible, in the protection working circle. Sowing should be done in pits, at the onset of monsoons.

389. *Raulfia serpentina* plants (*Sarpagandha*).—The plant is very valuable for the manufacture of medicine used against high blood pressure. It has been successfully raised on an experimental basis, under teak plantations in Shahapur range. It should be under-planted in 2 to 3 years old teak plantations so as to form a compact block of about 200 hectares, if it is financially profitable to do so.

390. *Agave species*.—*Agave* is a good hedge plant and helps protection of areas from grazing, etc. It also yields a fibre which is used for rope making. *Agave* bulbils should therefore be planted along all external and compartment boundary lines and also in compact blocks to the extent possible at 1 × 1 metre in blanks where nothing else can be grown. *Agave* should be planted along the boundaries of all compartments in which the recurrent coupes have been worked.

391. In order to ensure continued supply of gum from *kandul* trees, the following rules for tapping the gum should be enforced :—

(i) Tapping should be confined to the main bole and branches of any size should not be touched.

(ii) The number of blazes to be made on each tree will be as under :—

Girth of the tree (1)	No. of blazes (2)
1 m to 1.30 m	2 blazes.
1.30 m to 1.60 m	3 blazes equally spaced.
1.60 m to 2.00 m	4 blazes equally spaced.
2.00 m and above.	1 blaze for every 45 cm of girth.

(iii) No fresh blaze will be made on the partially healed up surface of any old wounds.

(iv) The lowest row of blazes will be at a level of 1 metre above the ground level. The next row of blazes will be made at a height of 60 cm from the lower row i.e., 1.60 metres from the ground level. The vertical portion of the blaze of upper row will alternate with similar portion of the lower row and no two blazes of the two rows shall be directly one above the other.

(v) Each blaze will start as a parabola with a 2.50 cm wide base. The curved size of the parabola will be upward and in height not more than 7.50 cm. The depth of each blaze shall not exceed 0.6 cm in the wood.

(vi) Each blaze will be freshened fortnightly when collecting gum by scrapping out bark and wood only on the upper curved side of the blaze but under no circumstances any deepening of the existing blaze should be done.

(vii) At the end of the season, the height of each blaze should not be greater than 12.5 cm. The maximum permissible dimensions of each blaze at the end of the season will thus be width 10 cm, height 12.5 cm and depth 0.6 cm.

(viii) Each tree should be tapped continuously for a period of three years only. After that the tree should be given a rest for three years. In the second and third year of tapping, the first year blaze should be extended upwards by 12.5 cm each year, the width and depth of the blaze being the same as in the first year.

(ix) After three years' rest, new blazes will be made as above but in the unblazed spaces in between the blazed portions of the first cycle.

CHAPTER XIII.—WORKING PLAN FOR THE BAMBOO (OVERLAPPING) WORKING CIRCLE

Section 1.—General Constitution

392. This is an overlapping working circle and covers all the bamboo bearing areas. The total area covered by this working circle is 2,80,270.298 hectares.

Section 2.—General Character of the vegetation

393. The Bamboo species found in the Thana forests are :—

- (i) *Manvel (Dendrocalamus strictus)*.
- (ii) *Katas (Bambusa arundinacea)*.
- (iii) *Bundi (Oxytenanthera monostigma)*.

Most of the bamboos died after gregarious flowering which took place in 1959/60. Profuse regeneration has come up at many places but it has not developed into clumps except in remote hilly areas where damage by cattle is negligible, and in scattered patches on hill slopes where it is not very thick. Even where the regeneration has established, it may take some years till it reaches exploitable size, as the clumps so far noticed are very thin and few in numbers.

Section 3.—Blocks, Compartments and felling series

394. The compartments allotted to this working circle are given in Appendix No. LXXVII. The area of this working circle has been divided into 26 felling series and each felling series has been further divided into 3 coupes. The details of the felling series and coupes are given in Appendix No. LXXVIII.

Section 4.—Special objects of management

395. The special objects of management of the bamboo forests are :—

- (i) to ensure scientific exploitation of bamboos so as to get the maximum sustained yield.
- (ii) to provide for artificial regeneration of bamboos where natural regeneration is not adequate, so as to increase future yield.

Section 5.—Method of treatment

396. The method of treatment will be selection felling of mature culms in each clump.

Section 6.—Felling cycle

397. The exploitation of bamboos will be done on a felling cycle of 3 years and for this purpose each felling series has been divided into 3 coupes. A statement showing the sequence of working the coupes is given in Appendix No. LXXIX. However, actual exploitation of bamboos should be started only after ascertaining that bamboos have reached exploitable stage.

Section 7.—Method of Executing the Fellings

398. The bamboos from the annual coupes should be sold on permits or exploited through the agency of Forest Labourers' Co-operative Societies.

399. Compartments included in the coupe due for working should be demarcated a year in advance by erecting pillars at suitable intervals. This demarcation will exclude the coupes under contract to avoid the overlapping of contract. On the pillars, compartment number, coupe number and felling series number should be written. In order to enable the subordinate staff to control the fellings and to enforce the felling rules, the Divisional Forest Officer will order the opening of the compartments for cutting and removal of bamboos, successively during the year of working, only one or two compartments being opened at a time.

400. The following felling rules are prescribed :—

(i) Bamboo extraction will not be permitted during monsoons (i.e., from 15th June to 30th September) as this is the period of formation of new culms.

(ii) From every bamboo clump, the following kinds of bamboo culms must without exception be removed irrespective of whether the clump is mature and whether there are any other green (living) culms available for exploitation as per the following rules or not :—

(a) dead and dry culms (including decaying culms after death).

(b) culms where the leading shoots have been cut to a length of more than 1/3rd of the normal length of the culm or culms which are badly damaged or rendered unsound.

(c) twisted, bent or otherwise malformed culms.

(iii) A clump will not be considered mature for exploitation unless it contains more than 8 mature (more than 1 season old) culms.

(iv) In a mature clump the following types of culms (green and living) will be retained :—

(a) All current season's i.e., less than 1 year old culms.

(b) From the rest culms, equal in number to the current season's (less than 1 year old) culms or eight whichever is more.

The remaining culms will be considered available for exploitation.

(v) Culms to the extent available for exploitation as per rule (iv) above should be exploited in such a manner that the clump is evenly worked throughout and that the bamboos to be retained are evenly spaced out in the clump.

(vi) The culms on the periphery of the clump should not be removed except where absolutely necessary to facilitate working in the interior portion of the clump. In case of the congested clumps however following method of working may be permitted.

In order to make all portions of the clump accessible for working, clearfelling in the form of a wedge may be permitted so that opening of the wedge shall not be more than 1 m. (2½ feet) wide. The depth and width at the narrow end of the wedge should be less than 2 m. (5 feet) width all around. Working in this belt will be strictly according to the above rules.

(vii) The height at which the culms shall be cut must not be lower than 15 cm. (6") and more than 45 cm (18") from the ground level but in any case not higher than second internode and lower than first internode i.e., cutting will be in between first and second internode subject to the height limit. The cut should be just above a node.

(viii) In case of flowering clumps, exploitation should be deferred till the seeding is completed. After the seeding is completed, all the dead bamboos should be exploited.

(ix) The following acts should be strictly prohibited :—

(a) digging of rhizomes.

(b) working on the periphery of the clump except as provided under rule (vi) above.

(c) cutting of tops of bamboos for fodder or of a culm at a point higher than 45 cm (18") or below the first node from level.

(d) use of tender bamboos for bundling.

(x) Use of sharp instrument should be insisted upon during extraction.

(xi) All climbers infesting the bamboo clumps should be removed.

Section 8.—Subsidiary Cultural Operations

401. As already stated, the bamboo regeneration that has come up after the gregarious flowering and subsequent death of old bamboos, has not yet reached exploitable size. It will take at least 8 years for new regeneration to reach exploitable size but often it takes considerably more time. Exploitation of mature bamboos will not, therefore, be possible till then. In the meantime the young regeneration should be tended as under :—

(A) In areas where clump formation has not yet commenced.

(i) The area should be thoroughly gone over and 80 cm. (2 feet) diameter focii the rate of 250 per hectare (100 per acre) should be formed distributed evenly over the whole area.

(ii) All the rank growth and even bamboo seedlings around the focii formed as above and up to a distance of 1.5 m (5 feet) all round from each focus should be cleared so that the growth of the bamboo seedlings in the selected focii is not hampered.

(iii) All climbers within and around the focii upto 1.5 m (5 feet) should be completely removed.

(iv) The whole area should be strictly protected from fire and grazing.

(B) In area where clump formation has commenced but the crop is yet immature for exploitation :—

(i) The 250 focii initially established may be reduced to 125 per hectare (50 per acre) well distributed over the whole area retaining only focii containing promising switchy culms.

(ii) From the selected focii, all badly grown, twisted and otherwise damaged culms should be removed.

(iii) All climbers within and around the focii upto a distance of 1.5 m (5 feet) should be completely removed.

(iv) All the growth of inferior species overtopping or likely to overtop the bamboo clumps should be removed.

(v) The whole area should be strictly protected from fire and grazing.

Note.—The above operations should preferably be carried out annually till the bamboos reach exploitable size. Where this is not possible due to administrative reasons these operations except fire protection may be carried out on a 3 year cycle, one coupe in each felling series being taken up every year. Fire protection should be carried out every year and closure to grazing enforced till clump formation is completed.

402. Bamboo is very useful minor forest produce. It is observed that after the flowering and death of old bamboos, new regeneration has established at few places only. Future yield of bamboo will be considerably reduced if natural regeneration is not supplemented by artificial regeneration. Under-planting of bamboo has already been prescribed in the regeneration areas *under the conversion working circle* and the pulpwood plantation working circle. *In the regeneration areas of other working circles too*, bamboo may be planted at a spacing of 9 metres \times 9 metres on all suitable sites to the extent possible. A note giving the technique of raising bamboo plantation is given in Appendix No. LXXX. The technique will also apply to the raising of *katas* bamboos. It should however, be noted that *katas* bamboo requires moister conditions and hence will come up well in valleys and along the rivers etc., while on slopes, *manvel* bamboo will come up well.

CHAPTER XIV.—MISCELLANEOUS REGULATIONS

Section 1.—Exploitation and disposal of forest produce

(A) Major forest produce

403. *Demarcation of coupes, sub-coupes and unworkable areas.*—These will be demarcated one year in advance of the prescribed year of felling.

404. *Demarcation of coupes.*—(i) Annual coupes will be demarcated by cutting and clearing 3 metre wide lines and by erecting pillars or posts in the middle of the lines at suitable intervals except where the coupe boundary runs along a big nala, a fire line or a road. Coupe number and the name of felling series will be written on the pillars on the side away from the area of the coupe.

(ii) Along the entire periphery of the coupe, i.e. on the edge of the 3 metre cut line, boundary trees will be so selected as trees on either side will be visible from one another. On the boundary trees two tar bands and a red band in between will be given. The lower tar band will be at breast height and the upper one will be 15 cm. above it. Just below the lower band, serial number of the tree in Arabic numerals will be painted in tar. Before giving the bands and the numbers, the loose bark will be properly scraped. A list of the boundary trees will be prepared in the following form :—

Serial No.	Species	Girth at b. h.	Remarks
(1)	(2)	(3)	(4)

The boundary trees will not to be marked for felling.

405. *Demarcation of Sub-coupes.*—To control extraction of the felled material, each coupe will normally be divided into four sub-coupes. These sub-coupes will be demarcated as under :—

(i) By 1.5 metre wide cut and cleared lines with posts erected in the middle of the lines at suitable intervals. The posts will bear section or sub-coupe number on the side away from the area which it will denote.

(ii) Selected trees at suitable intervals on the (*outside edge of*) the cut and cleared lines will be given two tar bands. The lower band will be at breast height and the other one 15 cm. above it.

406. *Demarcation of unworkable areas.*—Selected trees on the periphery of the areas to be excluded from working will be given two red bands 15 cm. apart, the lower band being at breast height. In addition to the bands, a cross in red will be given between the bands on the side away from the unworkable areas. Just below the lower band and on the side bearing the cross, serial number of the tree in Arabic will be given. All the unworkable patches will be serially numbered in Roman numerals and this number will also be given on each boundary tree e.g. Sr. No. III/5 will denote boundary tree No. 5 of unworkable patch No. III. A list of boundary trees will be prepared in the form given in para 404 above.

407. *Marking technique.*—Following rules are laid down :—(i) All trees to be marked for felling will bear distinct marking hammer marks at breast height and at base, on a clear blaze of at least 10 cm. × 10 cm. In addition all trees of 30 cm. girth and over at breast height will bear digit serial numbers at base and breast height.

(ii) All unnumbered trees marked for felling will be enumerated in 15 cm. girth classes or as will be ordered by the Conservator of Forests.

408. *Disposal.*—All coupes except those allotted to Forest Labourers' Co-operative Societies and those to be worked departmentally will be sold by tender or as per the orders in vogue.

IMPORTANT NOTE :

Inforest cultivations.—Many small areas within the coupes have, before 25-30 years or so, have been given out for inforest cultivation, on similar conditions and annual leases, which are renewed every year as in case of 'Dalhi' lands dealt with in detail in paragraph (ii) of Chapter XI-A of Part II of the working plan. All these inforest cultivations and

'Dalhi' cultivations are not subject to the right of succession. If any occupant dies or deserts his land, the same is given for cultivation to another deserving applicant. The treegrowth of teak, *tiwas* (*Ougeinia delbergioides*), *Shisham* (*Dalbergia latifolia*) from these inforest cultivations is sold alongwith the treegrowth of adjoining coupes but the *injaili* treegrowth from these cultivations will be reserved for tahal cutting by the plot-holders. For this purpose intercoupe adjustment will have to be made but not so as to affect the sequence of coupes in any way. The whole area being reserved forest and under the control of the Forest Department such adjustments can be sanctioned by the Conservator.

(B) Minor forest produce

409. Except for bamboos, all other minor forest produce should be sold by tender as per the practice in vogue. Produce which remains unsold should be disposed of on permit rates. Bamboos should be sold on permits.

Section 2.—Irregular Exploitation

410. Irregular exploitation of timber and bamboos is prohibited except in the following cases :—

(a) Forest produce required for departmental works may be removed by the Divisional Forest Officer. These fellings should preferably be made within the coupes of the year or coupes shortly to be worked. The felling should be on silvicultural lines.

(b) The felling and disposal of forest produce on boundary lines, road alignments, paths, building sites, camping grounds etc., may be permitted by the Divisional Forest Officer.

(c) The Divisional Forest Officer may permit felling of timber and bamboos required for free grant and concessions in accordance with the provisions of the Forest Manual.

Section 3.—Roads

411. Since the formation of the 'Zilla parishad' in 1961 construction of roads has received a great impetus in the Thana district. The *Zilla Parishad* aims at achieving the target fixed by the Nagpur Plan according to which no village will be more than 8 km. from a metalled road. The forest department gives annually about Rs. 8 lakhs to *Zilla Parishad* as 30 per cent share of the revenue obtained by sale of reserved trees from malki lands, and the department has a say in fixing priorities for roads to be constructed out of the funds. The following roads should be obtained priority for construction by the *Zilla Parishad* and if necessary should be constructed departmentally and maintained as forest roads.

Serial No.	Division	Description	Approximate length
(1)	(2)	(3)	(4)
1	Dahanu	Ganjad to Dolarpada via Ambesari, Gangangaon and Dhamangaon.	45 km.
2	Dahanu	Mahagaon to Barhanpur via Kirat	30 km.
3	Dahanu	Boisar to Mahagaon	6 km.
4	Thana	Mhasa to Dhasai	35 km.
5	Shahapur	Washala to Gunda via Dolkhamb	122 km.
6	Shahapur	Mandva to Pik	15 km.
7	Shahapur	Mandva to Akhada via Mangrul	30 km.
8	Shahapur	Parali to Akhada via Pachghar	25 km.
9	Shahapur	Parali to Vajarna Dam	6 km.
10	Shahapur	Khardi to Dapur	25 km.
11	Shahapur	Mokhada to Asa via Poshera	35 km.

Section 4.—Buildings

(A) Quarters for the subordinates.

412. As will be seen from the list given in Appendix No. XVII a large number of residential buildings for the subordinates have been constructed since 1951-52, under the Five Year Plans. However, there are still no residential buildings for many subordinates. The subordinate forest staff, particularly the Foresters and Guards have to stay at remote places and it is very necessary to provide them with suitable quarters so that they can stay with their families at their headquarters and devote all their time to their duty instead of being required to leave their jurisdiction frequently to visit their families which they cannot keep with them in the absence of quarters. A list of places where quarters are required to be built is given in Appendix No. LXXXI. These should be constructed under a planned programme within a period of 5 years. Quarters for the clerical staff at Dahanu and Shahapur should also be constructed as has been done at Thana, because it has become extremely difficult at these places to get suitable residences at rents which the staff can afford.

(B) Rest Houses.

413. In most of the ranges there is either a forest rest house or a Government inspection bungalow for the use of inspecting officers. Availability of camping places facilitates adequate supervision and hence it is advisable to provide camping places where they do not exist. Though there are Government inspection bungalows at Dahanu, Thana and Shahapur, there is so much demand by officers of the other departments, that they are rarely available when required. At Dahanu, in addition to the Divisional office, there is the integrated unit. At Shahapur in addition to the Divisional Office, there is a forest school and a silvicultural research garden. Thana is the headquarter of Thana Circle and is also near Bombay. Forest Officers like, the Chief Conservator of Forests, the Conservator of Forests, Thana Circle, Thana and the Conservator of Forests, Working Plans Circle, the Silviculturist, the Forest Utilization Officer, the Forest Statistician, etc., have to visit these places frequently, but they find it difficult to do so because of non-availability of the rest houses. It is therefore proposed that forest rest houses should also be constructed at Dahanu, Thana and Shahapur. The following are the places where forest rest houses should be constructed as early as possible.

Division	Range	Proposed place for a Forest Rest House
(1)	(2)	(3)
Dahanu	.. Dahanu ..	.. Dahanu.
Dahanu	.. Bordi ..	.. Bordi.
Thana	.. Thana ..	.. Thana.
Thana	.. Badlapur ..	.. Badlapur.
Thana	.. Tokawada ..	.. Tokawada.
Thana	.. Gokhiware ..	.. Sasunavghar.
Shahapur	.. Shahapur ..	.. Shahapur.
Shahapur	.. Washala ..	.. Dolkhamb.

For the camping of Range Forest Officers and Foresters, one inspection room should be provided in all forest quarters.

Section 5.—Maintenance of Boundaries

414. The external boundaries have been demarcated by erecting 2nd class boundary marks consisting of stone cairns. Generally, the cairns are being properly maintained and the boundary lines upto a width of 25 feet, kept clean. To ensure that the boundary lines and boundary marks are kept in a proper state, a scheme for boundary maintenance on a five year cycle has been prepared vide Appendix No. LXXXII. This scheme should be scrupulously followed. The work should be done departmentally.

The Range Forest Officer will check at least 25 per cent of the annual target as per the scheme while 5 per cent verification will be done by a Gazetted Officer. The Round Officer will annually submit to the Range Forest Officer a certificate in the following form.

"I, certify that the annual length of boundary line as prescribed under the scheme given in Appendix No. LXXXII of the Working Plan for the Reserved Forests of Thana district has been verified by me and that the boundary line and marks are found to be correct as per the demarcation registers and the maps. I further certify that the next cairn on either side of a cairn is visible. They are in proper condition and bear correct serial number. There are no encroachments/encroachments as detailed below."

415. Compartments have been formed for the first time, at the time of preparation of this working plan. The compartment boundaries are mostly natural features and hence need no demarcation. Where the compartment boundary is artificial, it should be cleared to a width of 3 metres. Permanent pillars bearing compartment numbers should be erected at suitable points. This work should be completed in five years, annually the work being done in 1/5th of the total number of compartments in a Round. After the demarcation of compartment boundaries has been completed, they should be verified annually under five year cycle as prescribed in para 414 above.

416. At many places, plots have been given out for cultivation on a permanent basis. Very few of these plots have been demarcated on the ground, surveyed and shown on the maps. The result is that it is not known exactly how much area is under cultivation and it is extremely difficult to detect the illegal extension of cultivation done by almost all plot-holders. The Survey and demarcation of all such plots is an urgent necessity from the protection point of view. The Divisional Forest Officer should, therefore, get the work done as early as possible, if necessary by engaging special staff for the purpose.

Section 6.—Firewood and Charcoal Depots

417. The extent of denudation caused by the hacking and cutting of trees for firewood has been described in para 45 of Chapter II of Part I. This process of denudation is continuing at an alarming rate in the forests situated near all rail-heads e.g., Gholwad, Dahanu, Boisar, Palghar, Saphala, Virar, Bassein Road, Kalyan, Asangaon, Khardi, Kasara, Ambernath, Badlapur etc. The firewood is carried to the market places on head-loads. Firewood is taken to Kalyan and Ulhasnager in local trains from as far as Kasara and Vangani stations. Apart from tightening the checking at these places, this destruction of the forests can be minimised to some extent, if firewood and charcoal is made available to the public at these places, at reasonable rates. It is therefore, suggested that fair price fuel depots should be opened at places like Gholwad, Dahanu, Vangaon, Palghar, Saphala, Boisar, Virar, Bassein Road, Kalyan, Shahapur, Ambernath, Ulhasnager etc., and contractors or the forest labourers' co-operative societies working the coupes in the vicinity, should be required to bring the estimated quantity of firewood and charcoal to these depots and to sell them at prices to be fixed by the department. This procedure may adversely affect the revenue, but it would be advisable to adopt it all the same, in the interest of the preservation of the forests.

Section 7.—Preservation Plots

418. There are two preservation plots. One situated in compartment No. 238 (Kasa Range) containing a mixed type of forest of III quality and the other situated in compartment No. 368 (Sawa Range) consisting of a crop of *Jamba* (*Xylia xylocarpa*). It is proposed that compartment No. 436 (Jawhar range) which is an isolated patch of good quality forest, should be maintained as another preservation plot, as crop of such high quality is very rare in the Thana forest. In order to carry out ecological studies, it is suggested that the preservation plots should be wire-fenced and strictly protected from fire and grazing. Periodical study of the flora in the plots will reveal the progress of natural succession in the locality.

Section 8.—Experimental Plots

419. There are no experimental plots laid out in the Thana forests. Thana forests are one of the most important teak bearing forests in our State. There is however no data about the effect of various grades and frequency of thinnings on the growth of teak in plantations. It is, therefore, suggested that the Silviculturist should lay out a set of

thinning research plots in the existing teak plantations for the purpose. Similarly experimental plots to study whether *rab* burning has a significant effect on the rate of growth of teak in plantations and whether manuring the plantations and more frequent weedings can give the same rate of growth in plantations raised without *rab* burnings, should be laid out at suitable places by the Silviculturist. The problem assumes great importance in view of the large plantation programme envisaged under this plan. Fast growing species, particularly *Eucalyptus* species and various industrial woods will have to be paid more attention in future plans and it is, therefore, essential to study the best methods of raising their plantations and their rate of growth and for this purpose suitable sample plots will have to be laid out now.

Section 9.—Game Management

420. The present position of wild game in the Thana forests has been explained in Chapter VIII of Part I. The position is so serious that unless some drastic steps are taken there will not be any game left in the forests. It is suggested that the whole of the Thana district should be completely closed to shooting for a period of ten years, after which the position should be reviewed. In addition, measures for prevention of poaching should be intensified by providing special check posts at Bhiwandi, Kalyan and Ghodbunder. The feasibility of moving Government to require all gun licensees who have been given the licenses for crop protection to deposit their guns in the police stations as soon as the crops are harvested till the next crop season i. e., between December and June, should be explored.

421. The forest around the Tansa lake has already been declared closed to shooting. All the forest around the Tansa and the Vaitarna lakes should be constituted into a regular Game Sanctuary and provided with observation towers, etc. Because of the two lakes, there are great possibilities of developing it into a bird sanctuary too. Efforts should be made to introduce suitable species of wild animals (e. g. *sambar*, spotted deer, etc.) and birds in the sanctuary.

Section 10.—Survey and Maintenance of Maps

422. All the Thana forests are surveyed on 8" to a mile toposheets except the Ex-Jawhar state forests which are at present shown on 4" to a mile toposheets prepared by enlargement of 1" to a mile toposheets. A fresh survey of Ex-Jawhar state forests on 1:15000 scale has recently been completed by the Survey of India, but the final maps are still to be published. For the present the 4" to a mile maps will continue to be used in cases of these forests. Topographical survey of the areas included in the *Casuarina* working circle and the *babul* working circle as also of other areas recently converted into reserved forests has not been carried out. List of 8" to a mile and 4" to a mile toposheets in use is given in Appendix No. LXXXIII. One uncut and mounted set of these maps showing the stock-mapping details and one uncut and mounted set showing the management details are supplied for use in the divisional offices. In addition, two sets of cut and mounted maps showing the management details only will be supplied for use of the Range Forest Officers and Round Officers.

423. 21 toposheets on 1" to one mile scale applicable to Thana forests are:—

47/A 9, 11 and 15, 13, 14, 16.

47/E 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 15.

46/H 4, 8.

46/D 16.

A set of these maps cut and mounted showing the management details pertaining to their charges will be supplied to all the Divisional and Range Forest Officers.

424. This working plan is accompanied by a reference map on 1" to 4 miles scale showing the working circles and range boundaries and a map on 1" to 2 miles scale showing compartment boundaries, compartment numbers and working circle boundaries in addition to other details like division and range boundaries, range headquarters, roads, railways, etc. A map on 1" to 4 miles scale showing the proposed reorganisation of the existing 3 divisions into 5 divisions also accompanies this plan.

CHAPTER XV.—FIRE PROTECTION

425. The extent of direct and indirect damage caused to forests by fires has been indicated in Chapter III of Part I (Vide para. 43). Considering the extent and nature of damage caused by fire, the efforts for fire protection are very inadequate. The figures of annual expenditure on fire protection (vide para. 101 in Chapter V, Part I), show that at the prevailing rate of Rs. 40 per km. for burning fire lines not more than 467 km. of fire lines are being maintained in all the three divisions together. This is indeed a dismal picture. In the Allapalli forest which have the reputation of being one of the most rigorously fire-protected area the amount of annual expenditure on fire protection was Rs. 17.37 per sq. km. in 1945-46, whereas the average expenditure in the Thana forests which are no less valuable, is Rs. 6.86 per sq. km. This will indicate the extent to which fire protection measures have to be intensified in these forests.

426. It has already been prescribed that the exploited area under various working circles should be fire-traced for a period of 5 to 7 years. In addition, all inter-State boundaries, inter-range boundaries and demarcation lines will be cleared of bush growth and grass and fire-traced. Similarly, fire-tracing will be carried out on either side of metalled roads, cart-tracks, and rail lines passing through the forest. Inter-State and inter-range boundaries will be fire-traced to a width of 30 metres. Every Range Forest Officer will be responsible for clearing the line upto 15 metre width on his side. Burning the line should be carried out in co-ordination with the adjoining Range Forest Officer. The width of fire-line on either side of roads, cart-tracks and rail lines should be 10 metres, while along coupe and compartment boundaries it should be 3 metres. All the operations of fire tracing and burning should be over by 31st January. Fire protection should be carried out as per the rules given in Appendix No. LXXXIV.

427. For the purpose of fire protection, the areas will be classified as under :—

Class I. Complete Protection.—This class will include :—

- (i) Sample plots, experimental plots, preservation plots and all plantations up to the prescribed age.
- (ii) All forests of protection working circle and lakes catchment area working circle.
- (iii) All the regenerated coupes under various working circles for a period for which they are closed to grazing.
- (iv) All *kurans*.
- (v) Any other area of special importance as per orders of the Conservator of Forests.

Class II. General Protection.—This will include all the remaining area of reserved forest not included in Class I above.

428. In addition to fire tracing the other measures to be adopted to ensure fire protection are (i) appointment of fire watchers (ii) erection of watch towers and (iii) propaganda to enlist co-operation of local people without which fire protection can never be successful :—

(i) Fire-watchers should be appointed during the fire season i.e., from February to May. One fire-watcher should be appointed per beat. Their duty will be to patrol the forest area constantly and to extinguish with the help of local people if necessary, any fires that may be detected.

(ii) Watch-towers should be constructed at suitable places from where large tract of forest could be kept under watch. These watch towers should be provided with walki-talki sets, etc. so that information about occurrence of fire could be communicated to range headquarter which also should have one set.

(iii) At suitable places along the roads, notice-boards requesting the people to protect the forest from fires should be put up. During *Vana-mahotsava* and other suitable occasions, lectures accompanied by films should be delivered to impress on the people the importance of fire protection. Detailed rules for fire protection operations for the various classes of forests are given in Paragraph 89 of Madhya Pradesh Forest Manual, Volume I.

429. *Measures to be adopted on the outbreak of fire.*—Immediately after the outbreak of fire in the forests is noticed, the local forest subordinates shall, no matter what time of day, it is, collect sufficient number of mazdoors, proceed to the spot and extinguish the fire, either by throwing earth on it or by beating it out with branches or by counter-firing. It is most important that an attempt should be made to put out every fire that is controllable or not. The Range Forest Officer, must be informed of the occurrence of every case of fire and he will submit to the Divisional Forest Officer a report furnishing details of the area burnt and the degree of damage caused. Investigations to trace the cause of fires, and if it is due to incendiarism, to detect the offenders must be made in every case.

430. A record of (i) name and length of fire lines burnt with cost and (ii) the incidence of fire in each range shall be maintained in the divisional office. Fire maps on 1"=1 mile scale should be kept showing the location of fires, each area burnt being serially numbered in the chronological order. The dates of fires also should be shown on the maps. All fire lines burnt as well as areas specially protected shall be indicated on the maps. One set of maps shall be used for five successive years, the fires of each year being distinctly marked.

CHAPTER XVI—ESTABLISHMENT AND LABOUR

Section 1.—Staff

431. *Reorganisation of the divisions.*—The various silvicultural works like markings, plantations, tending operations etc. that are required to be supervised by the Divisional Forest Officers in the Thana forests are so numerous that as early as 1935, Starte's plan had proposed that the existing three Thana divisions should be split up into four divisions. This proposal was also repeated in Jadhav's plan of 1952. Since then the work in the divisions has increased tremendously. Under the five-Year Plan schemes, the tempo of developmental activities like special plantations and construction of buildings has greatly increased. The formation of forest labourers' co-operative societies has further increased the work to a very great extent. In addition, the problem of protection of forests from illicit cutting and cultivation is growing day-by-day. The net result of all these factors is that it has become impossible for the Divisional Forest Officer to do justice to all his multiterious activities and also to supervise the various works and to guide his subordinates. It is the administration as well the forest conservancy that ultimately suffers under such circumstances. Under this plan, the tempo of silvicultural works will increase to a still greater extent as the annual area to be planted will be 3,705 hectares as compared to less than 900 hectares planted during 1965-66 under the last plan. Also the planting will be followed by cultural operations. It is, therefore, imperative to divide the existing three divisions into five divisions. The new set up proposed is as under :—

Serial No.	Name of Division	Proposed Head-quarter of the Division	Name of Ranges included in the Division	Area of Reserved Forests		Area of Protected Forests		Total	
				Sq. km	Sq. miles	Sq. km	Sq. miles	Sq. km	Sq. miles
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	Dahanu ..	Dahanu ..	1 Bordi ..	67.157	25.93	30.173	11.65	97.330	37.58
			2 Dahanu ..	110.560	42.69	25.108	9.68	135.668	52.37
			3 Palghar ..	88.293	34.09	93.584	36.13	181.877	70.22
			4 Kasa ..	125.756	48.56	40.610	15.61	166.366	64.17
			5 Udhava ..	108.525	41.90	57.876	21.96	166.401	63.86
			Total ..	500.291	193.17	247.351	95.03	747.642	288.20
2	Jawhar ..	Jawhar ..	1 Sawa ..	119.874	46.28	10.930	4.22	130.804	50.50
			2 Jawhar ..	144.108	55.64	41.698	16.10	185.866	71.74
			3 Vikramgad	111.595	43.09	37.698	14.66	149.293	57.75
			4 Vihigaon	138.504	53.48	28.130	10.90	166.634	64.38
			Total ..	514.081	198.49	118.456	45.88	632.537	244.37
3	Wada ..	Wada ..	1 W. Wada	104.038	40.18	37.062	14.31	141.100	54.49
			2 E. Wada ..	106.194	41.00	24.086	9.30	130.280	50.30
			3 Vaitarna ..	117.928	45.53	3.108	1.20	121.036	46.73
			4 Manor ..	129.315	49.93	60.710	23.44	190.025	73.37
			5 Dahisar ..	141.091	54.47	42.371	16.36	183.468	70.83
			Total ..	598.566	231.11	167.337	64.61	765.903	295.72
4	Shahapur	Shahapur	1 Washala ..	142.429	55.00	89.458	34.54	229.887	89.54
			2 Tokawada	130.143	50.25	67.399	26.11	197.542	76.36
			3 Murbad ..	113.482	43.81	74.903	28.92	188.385	72.73
			4 Shahapur	157.040	60.62	42.993	16.60	200.033	77.22
			5 Dhasai ..	87.578	33.81	61.176	23.62	148.754	57.43
			6 Khardi ..	133.779	51.65	34.368	13.27	168.147	64.92
			Total ..	764.451	295.14	370.297	143.06	1,134.748	418.20
5	Thana ..	Thana ..	1 Thana ..	60.494	23.36	7.330	2.83	67.824	26.19
			2 Badlapur	103.304	39.89	28.152	10.87	131.456	50.76
			3 Bhiwandi	87.637	33.84	19.761	7.63	107.398	41.47
			4 Mandvi ..	110.321	42.60	17.611	6.80	127.932	49.40
			5 Padagha ..	80.223	30.97	45.143	17.43	125.366	48.40
			6 Gokhiwara	83.005	32.05	9.169	3.54	92.174	35.59
			Total ..	524.984	202.71	127.166	49.10	652.150	251.81
Grand Total ..			2,902.373	1,120.62	1,030.607	397.68	3,932.980	1,518.30	

432. The additional staff that will be required for each of the two new divisions will be as under.—

Serial No.	Designation of posts	No. of posts required	Remarks
(1)	(2)	(3)	(4)
1	D. F. O.	1	
2	Sub-D. F. O.	2	
3	Head Clerk	1	
4	Senior Accountant	1	
5	Junior Accountant	4	1 For plan scheme. 1 For establishment. 1 For Society work. 1 For pay bill.
6	Clerks	10	2 Typists. 2 Barnishi Clerks. 1 Camp Clerk. 1 Sale Clerk. 2 Miscellaneous Clerk. 2 For Sub-D. F. O.
7	Surveyors	3	
8	Peons	8	4 For D. F. O. 2 Each for Sub-D. F. O.

433. *Reorganisation of the other charges.*—The ranges need no changes except the following few minor ones which are necessary for making the range charges more compact. The proposed changes are,—

- (i) Asa round should be transferred from Vihigaon range to Jawhar range.
- (ii) Kasara round of Washala range should be transferred to Vihigaon range.
- (iii) Part of Khardi round (comptt. Nos. 659 and 656) should be transferred to Washala range.
- (iv) Part of Dengachimet round (comptt. Nos. 364 to 367) of Jawhar range should be transferred to Manor range.
- (v) Part of Ranshet round of Kasa range (comptt. No. 66) should be transferred to Dahanu, range.

The rounds and beats are also proposed to be reorganised so as to make their areas conform to the optimum prescribed for their charges. The area of a beat is given in terms of the number of compartments included in it. The details of the proposed reorganisation of the rounds and the beats are given in Appendix No. LXXXV. As per those proposals the total number of rounds in the three existing divisions will be reduced from 173 to 150 and those of the beats increased from 398 to 405.

434. *Additional staff proposed.*—In addition to the usual administrative work forest officials have to carry out other functions which can be broadly classified into four types *viz.*—(i) concerning protection of forests *i.e.* petrolling, preparing offence cases, conducting cases in Courts, recovery of compensation, fire tracing etc.; (ii) silvicultural *i.e.* mulching, planting, tending, nursery work, etc.; (iii) commercial *i.e.* sales, dealing with forest labourers' co-operative societies, exploitation, depot management etc.; and (iv) construction of roads and buildings and their repairs and maintenance. So far the principle of forest administration has been to make every official responsible for all the functions required to be carried out in his charge. The conditions have, now, so radically changed

that a time has come to revise this basic principle of administration. It is not possible nor is it fair to expect a beat guard or a round forester to attend to all the above four types of works in his charge. The work of protection has become so important, particularly in the Thana forests, that it is absolutely essential to have a special staff for this purpose at the beat guard's and forester's level. It is, therefore, proposed that every beat containing more than three compartments should have an additional beat guard specifically for protection purposes. Similarly, for every round containing more than 8 compartments, there should be a special duty forester for attending to offence cases, protection etc. Details of additional forestors and guards required are given in Appendix No. LXXXV. This way both the protection as well as the silvicultural work will be properly attended to. For sale depots there are already special duty R.F.Os. Similarly, special staff is engaged for building works. Each territorial Range Officer should have a deputy Range Forest Officer (i.e. 1st grade forester) who can assist the R.F.O. in supervising the silvicultural works. There should be at least 2 Sub-Divisional Forest Officer, in supervising the silvicultural works and in conducting sales, enquiries etc. If this proposal is accepted, following additional posts will have to be created in all the divisions together:—

	(1)	(2)
Deputy Rangers..	26
Foresters	57
Beat Guards	64

Forest prosecutor.—A large number of forest offence cases have to be taken to the Courts as the offenders are not willing to compound the offences. Most of the forest cases do not stand in the courts for want of proper conducting. It will be very helpful in successfully conducting the forest cases in the Courts, if a forest prosecutor is appointed for each division. It is, therefore, recommended that this proposal should be seriously considered.

Section 2.—Labour

435. Shortage of labour is felt during the planting and tending operations as the season clashes with agricultural works. This shortage is more acute near industrial places like Thana, Kalyan, Bhiwandi etc. Forest operations can provide adequate works all the year round since during the whole of monsoon, planting and tending operations are to be carried out; while in the fair season, marking, boundary repairs, fire tracing works are to be carried out. It will, therefore, be worth while to try to organise regular labour gangs as is done in the railways, for each felling series so that labour shortage will never be felt. The labourers could be provided with cheap quarters and other facilities. The forests labourers' co-operative societies have already taken up the exploitation work in most of the felling series. These societies can be made use of in organising the labour gangs.

CHAPTER XVII.—CONTROL AND RECORDS

Section 1.—Control Forms

436. The record of all exploitations, subsidiary cultural operations and regeneration works carried out according to the prescriptions of the plan should be maintained in the control forms given in Appendix No. LXXXVI. Separate control forms for exploitation are prescribed for different working circles; while control forms for plantations and cultural operations will be the same for all working circles. The set of control forms for each working circle should be kept in a separate control book which will have separate pages for each felling series. Two sets of control forms should be prepared. One set will be kept in the divisional office and the other set will be flying set for the use of the Divisional Forest Officer, Working Plans. The flying set will be sent annually by the Divisional Forest Officer, Working Plans to the Divisional Forest Officer concerned, who will return it to the Divisional Forest Officer, Working Plans concerned not later than 1st of August of each year, after making the necessary annual entries. All entries which show that the prescriptions have been deviated from, will be underlined in red. The Divisional Forest Officer, Working Plans should scrutinise the entire and offer his remarks to the Divisional Forest Officer. On receipt of replies from him he will submit his report to the territorial Conservator of Forests, together with consolidated remarks, not later than 1st November. The Conservator of Forests will forward the report and consolidated remarks with his remarks, to the Chief Conservator of Forests through the Conservator of Forests, Working Plans not later than February of the following year, for perusal and orders where required.

437. Control forms for fire protection works, 1/5th boundary verification and demarcation, 1/5th maintenance and verification of boundary lines will be kept in control form Nos. 6 and 7 given in Appendix No. LXXXVI. These control forms will also be maintained and scrutinised as per details given in the above para.

Section 2.—Compartment Histories

438. Sample compartment history forms Nos. 1 to 5 to be maintained are given in Appendix No. LXXXVII. Each compartment should have a separate file for its records. Form No. 1 has been written up for each compartment during the preparation of this plan and typed copies in duplicate have been supplied to the Divisional Forest Officers. Other records should be prepared immediately and maintained by them. One copy of the compartment history should be kept in the Divisional Forest Officer and the other in the Range Office. Every year, in July, the Range Forest Officer should fill in the columns in the compartment history forms and submit the same to the Divisional Forest Officer who will get them scrutinised by a Gazetted Officer, get them typed and signed them. One copy of the forms will be filed in the divisional compartment history file and another copy will be returned to the Range Forest Officer.

Section 3.—Plantation and Nursery Registers

439. Plantation registers should be maintained for all areas regenerated artificially in the Form Nos. 1 to 9, samples of which are given in Appendix No. LXXXVIII. Nursery registers should be maintained in Form Nos. 1 to 10, samples of which are given in Appendix No. LXXXIX.

CHAPTER XVIII.—FINANCIAL FORECAST AND COST OF THE PLAN

Section 1.—Financial Forecast

440. The frequent fluctuations in the market rates of forest produce like timber, firewood and charcoal make it difficult to forecast reliable figures of revenue while the constant increase in the rates of daily wages as well as in the piece-work rates for various forest operations, make it equally difficult to forecast reliable figures of expenditure. However, an approximate estimate of the total annual revenue and expenditure in all the divisions including the two additional divisions proposed, has been attempted. The details of calculations are given in Appendix No. XC-A and B. The estimated annual revenue and expenditure are as under :—

Budget head (1)	Particulars (2)	Amount (3)
REVENUE		
		Rupees
LI	I	Thinning material extracted departmentally
		55,00,000
	II (a)	Sale of timber
		1,22,80,656
	II (b)	Firewood
		3,73,524
	II (c)	Bamboos
		80,000
	II (d)	Grass
		9,00,000
	II (e)	Other M. F. P.
		60,000
	V	Miscellaneous
		1,00,000
		Total .. 1,92,94,180
EXPENDITURE		
70	B-I	Thinnings
		15,00,000
	B-II	Coupe laying, marking and cost of depot establishment.
		4,00,000
	B-III (c)	Dead stock
		50,000
	B-IV (d)	Roads
		2,00,000
	(e)	Buildings
		4,00,000
	(f)	Other works
		10,000
	B-V (a)	Boundary maintenance
		12,000
	(f)	Reproduction
		20,50,000
	(g)	Fire protection
		1,50,000
		Total of 'B' Conservancy and Works .. 47,72,000
C		Pay etc. of staff
		23,91,812
C-IV		Contingency including cost of petrol etc., for jeeps.
		1,18,000
		Total of 'C' establishment .. 25,09,812
		Total expenditure under 'B' and 'C' .. 72,81,812
		Net surplus revenue .. 1,20,12,368

Section 2.—Cost of the Plan

441. The total expenditure incurred on the preparation of this plan from 29-12-1962 to 2-12-1967 is Rs. 2,34,990.25. This works out to Rs. 0.82 per hectare (i. e. Rs. 0.33 per acre) of the area covered by the plan. This does not include the expenditure incurred on enumerations carried out under the "Forest Resources Survey Scheme".

CHAPTER XIX.—SUMMARY OF PRESCRIPTIONS.

A short summary of the important prescriptions of this plan is as under :—

Basis of Proposals

1. *Functional classification of the Forest.*—The forests have been classified into the following functional classes as recommended by the National Forest Policy of India :—

- (i) Protection forests.
- (ii) Tree forests.
- (iii) Minor forests.
- (iv) Miscellaneous forests (fodder reserves).

2. *General objects of management.*—Important objects are :—

- (i) To prevent soil erosion on steep slopes and in the catchment areas of lakes;
- (ii) To aim at creation of a normal forest;
- (iii) To raise plantations of teak, *khair* and important industrial woods species;
- (iv) To meet the local demand for forest produce to the extent possible;
- (v) To derive maximum sustained annual yield;

3. *Constitution of working circles.*—The following working circles have been constituted :—

- (i) Protection working circle.
- (ii) Selection-cum-improvement working circle.
- (iii) Lakes catchment area working circle.
- (iv) Conversion working circle.
- (v) Industrial woods plantation working circle.
- (vi) Pulpwood plantation working circle.
- (vii) Miscellaneous plantation working circle.
- (viii) Fodder reserves working circle.
- (ix) *Casuarina* working circle.
- (x) *Babul* working circle.
- (xi) Miscellaneous working circle.
- (xii) Minor forest produce (over-lapping) working circle.
- (xiii) Bamboo (over-lapping) working circle.

4. *Period of the plan.*—The period of the plan is fixed at 20 years from 1st July 1969. It may, however, be revised earlier, if necessary.

I.—The Protection Working Circle

1. *General constitution.*—This working circle contains unworkable areas not fit for exploitation on account of steep slopes or inaccessibility. Total area included in this working circle is 16,212.054 hectares.

2. *Method of treatment.*—On account of the steepness of the terrain no exploitation is possible and hence no working is prescribed.

II.—The Selection-cum-Improvement Working Circle

1. *General constitution.*—This working circle includes all workable areas (except those in the catchments of lakes) which are not fit for clear felling on account of steep slopes (more than 25°). The total area included in this working circle is 48,628·003 hectares.
2. *Felling series.*—The area has been divided into 38 felling series.
3. *Silvicultural system.*—The system prescribed is selection-cum-improvement system.
4. *Rotation.*—Rotation is tentatively fixed at 100 years on the basis of the rate of growth of teak in IV a quality area. However, under selection-cum-improvement system rotation has no significance.
5. *Exploitable size.*—Exploitable size for teak is 105 cm. in girth at b. h. and for other timber species it is 90 cm. girth at b. h.
6. *Felling cycle.*—Felling cycle is of 20 years.
7. *Yield regulation.*—Yield of teak has been calculated by Brandis' method as modified by Sagreiya and is prescribed as 33 per cent or 1 in 3 of the available trees. Yield of other species is regulated by area.
8. *Method of executing the fellings.*—A treatment map showing unworkable areas and plantable area will be prepared before marking. The total plantable area should be at least 5 per cent of the area of the coupe. All sound fruit trees and medicinally valuable trees will be reserved. In the unworkable areas only dead trees will be felled. Thinning marking will be made in congested crop.
9. *Subsidiary cultural operations.*—These will consist of—
 - (i) cutting back operations;
 - (ii) cleanings in the 6th years;
 - (iii) one thinning in the 11th year of planting in the plantations;
10. *Fire protection.*—Fire tracing around exploited coupe will be done for 5 years.
11. *Closure to grazing.*—Exploited coupe will be closed to grazing for 5 years.

III.—Lakes Catchment Area Working Circle

1. *General constitution.*—This working circle includes all workable area situated in the catchment of the Tansa, Vaitarna and Vihar lakes and the proposed Bhatsai lake which supply water to Bombay. The total area included in this working circle is 35,612·798 hectares.
2. *Felling series.*—The area has been divided into 24 felling series.
3. *Silvicultural system.*—The system prescribed is improvement fellings.
4. *Size of mature trees.*—Teak trees above 120 cm in girth at b. h. in III quality area and above 105 girth at b. h. in IV a quality area will be considered as mature. Other timber species will be considered as mature above 105 cm. girth at b. h.
5. *Felling cycle.*—The felling cycle will be of 20 years.
6. *Yield regulation.*—Yield will be regulated by area.
7. *Method of executing the felling.*—Before commencing marking, a treatment map showing unworkable area and existing plantable gaps will be prepared. In the unworkable area, only dead trees will be felled while in the rest of the area dead, dying, unsound and mature trees will be felled. Thinning marking will be done where the crop is congested. In general, no tree will be marked for felling if its removal is likely to cause soil erosion or to create gaps or to extend the existing gaps.
8. *Subsidiary cultural operations.*—These will consist of,—
 - (i) cutting back operations which will also include soil conservation measures;
 - (ii) cleanings in the 6th year;
 - (iii) one thinning in the 11th year of planting in the plantations.
9. *Other regulations.*—The exploited coupe will be fire-traced and closed to grazing for 5 years.

IV.—The Conversion Working Circle

1. *General constitution.*—The working circle includes all workable better quality areas (i.e. of III quality and above) situated on moderate slopes (less than 25°). Total area included in this working circle is 1,59,926.276 hectares.
2. *Felling series.*—The area has been divided into 84 felling series.
3. *Silvicultural system.*—The system prescribed is modified clear felling.
4. *Rotation and conversion period.*—Rotation is fixed at 80 years on the basis of the rate of growth of teak trees. Conversion period is fixed at 60 years.
5. *Periodic blocks.*—The area has been divided into 3 periodic blocks each of 20 years period. As far as possible, compartments containing area which has not been clear felled so far have been put in P. B. I.
6. *Treatment of P. B. I.*—The area of each felling series has been divided into 20 coupes. Annual area will be clear felled excepting patches which are not suitable for clear felling and patches containing advance growth of teak. Clear felled area will be planted with teak.
7. *Treatment of P. B. II.*—The area has been divided into 20 coupes. In the annual area, thinnings and climber cutting will be carried out.
8. *Treatment of P. B. III.*—The area has been divided into 20 coupes. In the annual area, silvicultural thinnings and improvement fellings will be carried out.
9. *Yield regulation.*—The yield will be regulated by area only.
10. *Method of executing the fellings in P. B. I.*—A treatment map showing unworkable areas and plantable areas will be prepared a year in advance by an officer not below in rank of Range Forest Officer. The plantable area will be clear felled except the patches containing advance growth of teak, where only overwood will be felled and the advance growth will be cut back.
11. *Treatment of areas planted since 1958-59 under Jadhav's plan.*—In these areas, cleaning in the 4th year of plantation and 1st thinning in the 7th year of plantation will be carried out irrespective of the P. B. in which the area is situated.
12. *Plantation technique.*—The plantation technique for teak and *Khair* has been given in Appendix No. LI and LII. Spacing for teak will be 2 metres × 2 metres. Stumps of teak will be planted preferably on rabbed sites. Three weedings in the first year, two in second year and one in the third year will be carried out.
13. *Subsidiary cultural operations.*—These will consist of.—
 - (i) cutting back operations in coupes of all P. Bs;
 - (ii) cleanings in the 4th year of planting in the plantation raise in P. B. I. areas;
 - (iii) thinnings in the 7th, 12th, 20th and 40th year in the plantations. First thinning may be mechanical. 'C' grade ordinary thinnings have been prescribed.
14. *Other regulations.*—The exploited coupes of periodic block I, will be fire-traced and closed to grazing for a period of 6 years. The exploited coupes of periodic block II and III will be fire-traced and closed to grazing for a period of 3 years, as a measure for periodic closure.

V.—The Industrial Woods Plantation Working Circle

1. *General constitution.*—The area included in this working circle is 5,014.838 hectares and is similar to the area included in the conversion working circle except that it is situated near the main lines of communications. The area is to be planted with industrial woods like *khair*, *hed*, *kalam*, *sawar maharukh* etc.
2. *Felling series.*—The area has been divided into 4 felling series.
3. *Silvicultural system.*—The system prescribed is clear felling, followed by artificial regeneration.
4. *Rotation.*—Rotation is tentatively fixed at 40 years.
5. *Regulation of the yield.*—Yield is regulated by area.

6. *Method of executing the fellings.*—A treatment map showing plantable and unplantable areas will be prepared. All plantable area will be clear felled and planted with suitable species. One felling series namely Kuda felling series is earmarked for raising only *khair* plantation.

7. *Subsidiary cultural operations.*—(i) Three weedings will be carried out in the first year, two in the second year and one in the third year.

(ii) Two thinnings are prescribed. First thinning will be mechanical and will be carried out in the 11th year of plantation. Second thinning will be ordinary 'C' grade thinning and will be carried out in the 20th year of the plantation.

8. *Other regulations.*—The planted area will be fire-traced and closed for grazing for a period of seven years from the year of planting.

VI.—The Pulpwood Plantation Working Circle

1. *General constitution.*—This working circle includes predominantly mixed forests in Badalapur, Mandvi, Gokhiwara and Dahisar ranges. The total area included in this working circle is 10,834·289 hectares.

2. *Felling series.*—The area has been divided into 10 felling series.

3. *Special objects of management.*—The special object of management is to raise plantations of *Eucalyptus hybrid* and bamboos sufficient to sustain 200 tonnes capacity Pulpwood factory to be located at Kalyan.

4. *Silvicultural system.*—The system prescribed is clear felling followed by artificial regeneration.

5. *Rotation.*—Rotation is tentatively fixed at 15 years.

6. *Regulation of yield.*—Yield will be regulated by area.

7. *Plantation technique.*—*Eucalyptus* will be planted at a spacing of 2 metres × 2 metres. Bamboos will be under-planted in one year old *Eucalyptus* plantations at a spacing of 6 metres × 6 metres.

8. *Subsidiary cultural operations.*—These will consist of 3 weedings in the first year, two in the second year and one in the third year. No cleanings and thinnings are necessary.

9. *Other regulations.*—The exploited coupe will be fire-traced and closed to grazing for 6 years from the year of working.

VII.—The Miscellaneous Plantation Working Circle

1. *General constitution.*—This working circle includes the hacked forests in Palghar, Thana, Bhiwandi and Padagha ranges. The total area included in this working circle is 5,340·690 hectares.

2. *Felling series.*—The area has been divided into 8 felling series.

3. *Silvicultural system.*—The system prescribed is clear felling followed by planting of firewood species like *Eucalyptus*, *Albizia fulcate*, *Acacia auriculiformis* etc.

4. *Rotation.*—Rotation is tentatively fixed at 25 years.

5. *Yield regulation.*—Yield will be regulated by area.

6. *Plantation technique.*—All the species will be transplanted. Use of chemical fertilizers has been recommended in view of the short rotation and poor site quality.

7. *Subsidiary cultural operations.*—These will consist of—

(i) three weedings in the first year, two weedings in the second year and one in the third year.

(ii) one thinning in the 15th year.

8. *Other regulations.*—The worked coupe will be fire-traced and closed to grazing for a period of six years from the year of working.

VIII.—The Fodder Reserves Working Circle

1. *General constitution.*—The working circle includes denuded and blank areas in Thana and Dahanu divisions, classed as miscellaneous forests (fodder reserves). The total area included in this working circle is 2,783.981 hectares.

2. *Series and Units.*—For the Convenience of working, the area has been divided into 5 series each of which has been further divided into 4 units.

3. *Method of treatment.*—The whole area of a series will be fenced with barbed wire. Every year one unit will be taken up for development. The selected unit will be fire-traced. A treatment map showing areas suitable for fodder development will be prepared. These areas will be ploughed with tractor, if possible. Seeds of fodder grasses will be broadcast or Tussocks will be planted in lines of 0.5 metre apart. Before planting, farm-yard manure will be mixed with soil. During monsoons a dose of ammonium sulphate will be given.

4. *Grasses to be planted.*—The recommended species of grasses are *ber*, *phool*, *mushi*, *marvel* and *shedy*.

5. *Other regulations.*—The developed area will be permanently protected from fire and closed to grazing. Harvesting of grass will be done every year after middle of October. Re-seeding the area removal of inferior grass and application of fertilizers should be done every fifth year.

6. *Sale of grass.*—Cut grass may be baled and stacked in sheds at nearest rail-heads so as to build up a reserve of fodder for use during scarcity years.

IX.—The Casuarina Working Circle

1. *General constitution.*—The working circle includes the *casuarina* plantations raised along the sea-coast in Bordi, Dahanu and Palghar ranges. The total area included in the working circle is 72.343 hectares.

2. *Felling series.*—The area constitutes only one felling series.

3. *Silvicultural system.*—The prescribed system is clear felling with artificial regeneration.

4. *Rotation.*—Rotation is kept unchanged at 15 years.

5. *Regulation of the yield.*—Yield will be regulated by area.

6. *Method of executing the fellings.*—The trees will be felled and the stumps will be uprooted.

7. *Plantation technique.*—The annual area will be fenced with barbed wire. *Casuarina* seedlings raised in bricks will be planted in pits at a spacing of 2 metres × 2 metres. No watering will be necessary.

8. *Subsidiary cultural operations.*—These will consist on one thinning in the 5th year and another in the 10th year. Both the thinnings will be mechanical.

9. *Other regulations.*—The planted area will be closed to grazing for 5 years.

X.—The Babul Working Circle

1. *General constitution.*—The working circle includes the *babul* plantations in Dahisar range. The total area is 73.045 hectares.

2. *Felling series.*—The whole area forms one felling series.

3. *Silvicultural system.*—The system prescribed is clear felling with artificial regeneration.

4. *Rotation*.—The rotation is fixed at 30 years.
5. *Regulation of the yield*.—The yield will be regulated by area.
6. *Method of executing the fellings*.—The area will be clear felled except the tad palm trees.
7. *Plantation technique*.—Treated *babul* seed will be sown in ploughed lines 2 to 3 metres apart. If possible agri-silvi will be adopted.
8. *Artificial regeneration and cultural operations*.—These will consist of :—
- (i) three to 4 weedings in the first year, two in the second year, one in the third year and one in the fourth year ;
 - (ii) cleanings will be done in the 5th year. Spacing between two plants should be 2 metres in lines ;
 - (iii) first thinning in the 10th year and second thinning in the 20th year.
9. *Other regulations*.—The annual planted area will be fire-traced and closed to grazing for a period of 5 years. 'Datan' contracts should be given for plantations which are over 10 years in age.

XI.—Miscellaneous Working Circle

General constitution.—This working circle includes an area of 5,738-944 hectares. Out of this an area of 4,848-320 hectares is to be managed as school forests for which a separate working plan will be prepared. An area of 69-969 hectares covered by three preservation plots will be dealt with as laid down in paragraph No. 418. The remaining area of 820-655 hectares is under *Dalhi* cultivation. The tree growth of injaili species from these *Dalhi* cultivations will be retained for *tahal* cutting by the plot-holders and that of teak, *tiwas* and *shisham* will be sold along with the adjoining coupes.

XII.—The Minor Forest Produce (Overlapping) Working Circle

1. *General constitution*.—This is an overlapping working circle and deals with the whole area covered by this plan.
2. *Minor forest products*.—The important minor forest products are *Apta* and *Temburni* leaves, *bel* leaves, *Kadipatta* leaves, *myrobalans*, *chilhar* bark, *ain* bark, *wavding*, *tad* leaves and fruits, *mohva* flowers and seeds, *kusari* flowers, *rankel* leaves, *honey*, *karaya* gum etc.
3. *Method of treatment*.—The minor forest products should be sold by auction or on permits. In order to increase the yield of the minor forest products, the species will be raised on suitable sites and to the extent possible in the annual regeneration areas of different working circles. *Sarpagandha* may be under-planted in teak plantations if economically profitable. Agave should be planted along boundary lines and blanks.
4. *Rules for tapping Karaya gum*.—Detailed rules for tapping gum from *kandol* trees are given.

XIII.—The Bamboo (Overlapping) Working Circle

1. *General constitution*.—This is an overlapping working circle and includes all the bamboo bearing areas. The total area included in this working circle is 2,80,270-298 hectares.
2. *Felling series*.—The area has been divided into 26 felling series.
3. *Method of treatment*.—The treatment prescribed is selection felling of mature bamboos.
4. *Felling cycle*.—The felling cycle is of 3 years and hence each felling series has been divided into 3 coupes.

5. *Method of executing the fellings.*—Following are the more important rules—

- (i) No felling will be permitted during the monsoon.
- (ii) All dead, dry damaged and malformed culms will be removed.
- (iii) A clump will be considered mature for exploitation only if it contains more than 8 mature bamboos.
- (iv) All less than one year old culms and from the rest, equal number of culms or 8 which is more will be retained and the remaining will be considered available for exploitation.
- (v) Culms will be cut not lower than 15 cm, and higher than 45 cm, from the ground level.

As the bamboos have died after flowering and as the regeneration has not yet reached the exploitable stage, actual exploitation will be started only after ascertaining that the bamboos are mature for exploitation.

6. *Subsidiary cultural operations.*—Separate prescriptions are laid down for tending the regeneration for the following two different types of areas :—

A.—*Areas where clump formation has not yet commenced.*—

- (i) 250 focii per hectare, each 80 cm. in diameter should be formed.
- (ii) Rank growth up to 1.5 metre from each focus should be cleared.
- (iii) Climbers within and around the focii should be cut.

B.—*Areas where clump formation has commenced but the crop is immature* :—

- (i) The focii will be reduced to 125 per hectare retaining those which contain promising culms.
- (ii) All malformed and damaged culms should be removed.
- (iii) Climbers in and around the focii should be cut.

As it may not be possible to carry out the operations annually all over the area, it may be done every year in one coupe of each felling series.

Miscellaneous Regulations

1. *Exploitation and disposal of forest produce :*

A.—*Demarcation of coupes*

- (i) Annual coupes will be demarcated by clearing 3 metre wide lines and by erecting pillars or posts in the lines.
- (ii) Selected trees on the periphery will be given two tar bands and one red band in between and a serial number.
- (iii) Sub-coupes will be demarcated by clearing 1.5 metre wide line and by erecting posts in the lines.
- (iv) Trees on the periphery will be given 2 tar bands and a serial number.
- (v) Unworkable areas will be demarcated by giving two geru bands and a serial number on selected trees on the periphery.

B.—*Marking technique*

- (i) All trees to be felled will bear distinct hammer marks at breast height and at base.
- (ii) Trees of valuable timber trees of 30 cm, girth and over and of all other species over 60 cm, girth will bear digit serial numbers both at breast height and at base.
- (iii) Un-numbered trees marked for felling will be enumerated in 15 cm, girth classes.

C.—Disposal

(i) All coupes except those allotted to forest labourers' co-operative societies or those to be worked departmentally, will be sold by tender.

(ii) Except bamboos, all other minor forest products will be sold by tender. Un-sold produce and bamboos will be sold on permits.

2. *Irregular exploitation.*—This will be allowed by the Divisional Forest Officer in the following cases :—

(i) to extract forest produce required for departmental works ;

(ii) to clear boundary lines, road alignments, paths, building sites, camping grounds etc. ;

(iii) to supply material at free grant rates or concessional rates.

3. *Roads.*—Eleven important roads are recommended to be constructed either departmentally or through the *Zilla Parishad*.

4. *Buildings.*—A list of places where quarters for subordinates are required to be constructed is given in Appendix No. LXXXI.

It has been recommended to construct rest houses at 8 places.

5. *Maintenance of boundaries.*—(i) A scheme for maintenance of boundaries on a five year cycle has been given in Appendix No. LXXXII. The works as per this scheme will be done departmentally. 25 per cent of the annual target will be checked by the Range Forest Officer and at least 5 per cent by Gazetted officer.

(ii) Artificial compartment boundaries should be cleared up to a width of 3 metres. The work should be completed in 5 years.

(iii) Cultivated plots situated in the forests should be surveyed and demarcated.

6. *Firewood and charcoal depots.*—In order to check the destruction of forest due to hacking and illicit cutting for fire-wood, it is suggested to open fair price fuel depots at places situated near such vulnerable areas.

7. *Preservation plots.*—In addition to the existing two preservation plots one in Sawa range and the other in Kasa range, compartment No. 436 in Jawhar range should also be constituted into a preservation plot.

8. *Experimental plots.*—It has been recommended that experimental plots to do thinning research in teak plantations and to study the technique of raising *Eucalyptus* and other industrial woods be laid out by the Silviculturist.

9. *Game management.*—It is suggested that the whole of Thana district should be closed to shooting for a period of ten years, special check posts should be set up at Bhiwandi, Kalyan and Ghodbunder.

Fire Protection

1. All inter-State boundaries and inter-range boundaries should be fire-traced to a width of 30 metres. Roads, cart-tracks and rail lines passing through forest should be fire-traced on either side up to a width of 10 metres.

2. For the purpose of fire protection the areas will be classified into class I which will get complete protection and class II which will get general protection. Class I will include plantations, forests of protection and lakes catchment area working circles, regenerated coupes and *kurans*. Class II will include rest of the areas.

3. In addition to fire-tracing, other measures recommended are : (i) appointment of fire-watchers, (ii) construction of watch-towers, provided with walki-talki sets and, (iii) propaganda.

4. Records of fire lines burnt and incidences of fire should be kept for each range, on a fire map on 1"=1 mile scale.

Establishment and Labour

1. The three existing divisions should be split up into 5 divisions viz. Dahanu, Jawhar, Vada, Shahapur and Thana.
2. *Reorganisation of other charges.*—No major reorganization of ranges is suggested. Rounds and Beats should be reorganised as proposed in Appendix No. LXXXV.
3. *Additional staff proposed.*—In view of the increase in the work-load, one Deputy Ranger should be posted in each range. Similarly, 57 important Rounds and 64 important Beats (details given in Appendix No. LXXXV), should be given additional Foresters and Guards. A Forest Prosecutor should be appointed for each division, to conduct forest offence cases in the Courts.
4. *Labour.*—It has been suggested to organise permanent labour gangs as is done in the railways, so as to overcome the labour difficulty.

Control and Records

1. *Control forms.*—Separate control forms have been prescribed for each working circle (sample forms are given in Appendix No. LXXXVI) for keeping records of all exploitations. Control forms for plantations and cultural operations will be the same for all working circles. One set of forms will be kept in the Divisional Office and the other (flying set) will be sent to the Divisional Forest Officer, Working Plans by the Divisional Forest Officer concerned annually not later than 1st August after making the necessary entries. The Divisional Forest Officer, Working Plans will scrutinise the entries, officer remarks and consider replies to the remarks and then submit his report together with his remarks to the territorial Conservator of Forest not later than 1st November. The territorial Conservator will forward the report with his remarks to the Chief Conservator of Forests, through the Working Plans Conservator, not later than February of the following year. Control forms for fire protection and boundary verification will also be maintained in the forms given.
2. *Compartment histories.*—Compartment history form Nos. 1 to 5 should be maintained in the Divisional and Range offices as per the sample forms given in Appendix No. LXXXVII.
3. *Plantation and nursery registers.*—These should be maintained in the forms given in Appendix No. LXXXVIII.

Dahanu :
Dated 4th December 1967.

N. J. JOSHI, I. F. S.,
Deputy Conservator of Forests
Divisional Forest Officer,
Working Plans, Thana.

Approved.
(Sd). N. R. RANGANATHAN, I. A. S.,
Collector, Thana.

Countersigned.
(Sd.) J. G. THOSRE, I. F. S.,
Conservator of Forests,
Working Plans Circle, Poona.

Approved.
(Sd). S. S. BUIT, I. F. S.,
Chief Conservator of Forests,
Maharashtra State, Poona.

Countersigned.
(Sd). C. S. KIRPEKAR, I. F. S.,
Conservator of Forests,
Thana Circle, Thana.